REGULATION
R2021

PRIST DEEMED TO BE UNIVERSITY
NAAC ACCREDITED
THANJAVUR- 613 403 - TAMIL NADU

INDEX

REGULATION - 2021

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School: ENGINEERINGAND TECHNOLOGY
Dept: ECE- 21 REGULATION -Mapping of cross cutting issues

ProgrammeName&Code	CourseCode	TitleoftheCourse	Cross cuttingIssues			
			Profess	Gende	Hu man	Enviro nment andSus tainabi
BTech(FT)ECE21UGECEFT	21147IP	InductionProgramme	-	-	-	-
BTech(FT)ECE21UGECEFT	21147S11	ProfessionalEnglish-I	✓	-	-	-
BTech(FT)ECE21UGECEFT	21148S12	MatricesandCalculus	-	-	-	-
BTech(FT)ECE21UGECEFT	21149S13	EngineeringPhysics	-	-	-	-
BTech(FT)ECE21UGECEFT	21149S14	EngineeringChemistry	-	-	-	-
BTech(FT)ECE21UGECEFT	21150S15	ProblemSolvingandPythonProgramming	-	-	-	-
BTech(FT)ECE21UGECEFT	21150L16	ProblemSolvingandPython	-	-	-	-
BTech(FT)ECE21UGECEFT	21149L17	ProgrammingLaboratory	-	-	-	-
BTech(FT)ECE21UGECEFT	21147L18	PhysicsandChemistryLaboratory	-	-	-	-
BTech(FT)ECE21UGECEFT	21147S21	ProfessionalEnglish–II	✓			
BTech(FT)ECE21UGECEFT	21148S22	StatisticsandNumericalMethods	-	-	-	-
BTech(FT)ECE21UGECEFT	21149S23B	PhysicsforElectronicsEngineering	-	-	-	-
BTech(FT)ECE21UGECEFT	21154S24	EngineeringGraphics	-	-	-	-
BTech(FT)ECE21UGECEFT	21153S25B	ElectricalandInstrumentationEngineering	-	-	-	-
BTech(FT)ECE21UGECEFT	21153S26A	CircuitAnalysis	-	-	-	-
BTech(FT)ECE21UGECEFT	21154L21	EngineeringPracticesLaboratory	-	-	-	-
BTech(FT)ECE21UGECEFT	21153L22A	CircuitsAnalysisLaboratory	-	-	-	-
BTech(FT)ECE21UGECEFT	21147L23	CommunicationLaboratory–II	-	-	-	-
BTech(FT)ECE21UGECEFT	21148S31B	RandomProcessesandLinearAlgebra	-	-	-	-
BTech(FT)ECE21UGECEFT	21152S32	ControlSystems	-	-	-	-
BTech(FT)ECE21UGECEFT	21152S33	CProgrammingandDataStructures	-	-	-	-
BTech(FT)ECE21UGECEFT	21152C34	DigitalSystemsDesign	-	-	-	-
BTech(FT)ECE21UGECEFT	21152C35	SignalsandSystems	-	-	-	-
BTech(FT)ECE21UGECEFT	21152C36	ElectronicDevicesandCircuits	-	-	-	-
BTech(FT)ECE21UGECEFT	21152L37	CProgrammingandDataStructuresLab	-	-	-	-
BTech(FT)ECE21UGECEFT	21152L38	ElectronicDevicesandCircuitsLab	-	-	-	-
BTech(FT)ECE21UGECEFT	21152L39	ProfessionalDevelopment	✓			
BTech(FT)ECE21UGECEFT	21152C41	ElectromagneticFields	-	-	-	-
BTech(FT)ECE21UGECEFT	21152C42	LinearIntegratedCircuits	-	-	-	-

School: ENGINEERINGAND TECHNOLOGY
Dept: ECE- 21 REGULATION -Mapping of cross cutting issues

BTech(FT)ECE21UGECEFT	21152C43	CommunicationSystems	-	-	-	-
BTech(FT)ECE21UGECEFT	21152C44	DigitalSignalProcessing	-	-	-	-
BTech(FT)ECE21UGECEFT	21152C45	NetworksandSecurity	-	-	-	-
BTech(FT)ECE21UGECEFT	21149S46	EnvironmentalSciencesand Sustainability				✓
BTech(FT)ECE21UGECEFT	21152L47	LinearIntegratedCircuitsLaboratory	-	-	-	-
BTech(FT)ECE21UGECEFT	21152L48	CommunicationSystemsLaboratory	-	-	-	-
BTech(FT)ECE21UGECEFT	21152C51	WirelessCommunication	-	-	-	-
BTech(FT)ECE21UGECEFT	21152C52	VLSIandChipDesign	-	-	-	-
BTech(FT)ECE21UGECEFT	21152C53	TransmissionLinesandRFSystems	-	-	-	-
BTech(FT)ECE21UGECEFT	21152E54A	OpticalCommunicationNetworks	-	-	-	-
BTech(FT)ECE21UGECEFT	21152E55A	SatelliteCommunication	-	-	-	-
BTech(FT)ECE21UGECEFT	21152E56A	DSPArchitectureandProgramming	-	-	-	-
BTech(FT)ECE21UGECEFT	21147MC51A	IntroductiontoWomenandGenderStudies	-	✓	-	-
BTech(FT)ECE21UGECEFT	21152L58	VLSILaboratory	-	-	-	-
BTech(FT)ECE21UGECEFT	21152OE61	DeepLearning	-	-	-	-
BTech(FT)ECE21UGECEFT	21152S62	EmbeddedSystemsandIOTDesign	-	-	-	-
BTech(FT)ECE21UGECEFT	21152S63	ArtificialIntelligenceandMachine	-	-	-	-
BTech(FT)ECE21UGECEFT		Learning	-	-	-	-
BTech(FT)ECE21UGECEFT	21152E64A	SoftwareDefinedRadio	-	-	-	-
BTech(FT)ECE21UGECEFT	21152E65A	Advanced WirelessCommunication Techniques	-	-	-	-
BTech(FT)ECE21UGECEFT	21152E66A	RemoteSensing	-	-	-	-
BTech(FT)ECE21UGECEFT		WellBeingwithTraditional	-	-	-	-
BTech(FT)ECE21UGECEFT	21147MC61A	Practices(Yoga,AyurvedaandSiddha)	-	-	✓	-
BTech(FT)ECE21UGECEFT	21147S71	HumanValuesandEthics	-	-	✓	-
BTech(FT)ECE21UGECEFT	21152OE72	RoboticsProcessAutomation	-	-	✓	-
BTech(FT)ECE21UGECEFT	21152OE73A	BiomedicalInstrumentation	-	-		-
BTech(FT)ECE21UGECEFT	21152OE74A	WearableDevices	-	-	-	-
BTech(FT)ECE21UGECEFT	21160E75A	PrinciplesofManagement	✓	-	-	-
BTech(FT)ECE21UGECEFT	21152INT76	SummerInternship	-	-	-	-
BTech(FT)ECE21UGECEFT	21152P81	ProjectWork	-	-	-	-

1.3.1 SUPPORTINGDOCUMENTS

Courses (offered in 2021-21) which address the Gender Sensitization, Human Values, Professional Ethics, Environment and sustainability.

SCHOOLOFENGINEERINGANDTECHNOLOGY

DEPARTMENTOFELECTRONICSANDCOMMUNICATION ENGINEERING

Gender Sensitization and Human Values	
Professional Ethics	
Human Values	
Environment and sustainability	
Professional Ethics & Human Values	

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SCHOOL OF ENGINEERING AND TECHNOLOGY

DEPARTMENT OF

ELECTRONICS & COMMUNICATION ENGINEERING

PROGRAM HANDBOOK

B.TECH – FULL TIME

[REGULATION 2021]

PROGRAM EDUCATIONAL OBJECTIVES (PEOs)

PEO1: To provide the students with a strong foundation in the required sciences in order to pursue studies in Electronics and Communication Engineering.

PEO2: To gain adequate knowledge to become good professional in electronic and communication engineering associated industries, higher education and research.

PEO3: To develop attitude in lifelong learning, applying and adapting new ideas and technologies as their field evolves.

PEO4: To prepare students to critically analyze existing literature in an area of specialization and ethically develop innovative and research oriented methodologies to solve the problems identified.

PEO5: To inculcate in the students a professional and ethical attitude and an ability to visualize the engineering issues in a broader social context.

PROGRAM OUTCOMES (POs)

PO1: **Engineering knowledge**: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

PO2: **Problem analysis**: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

PO3: **Design/development of solutions**: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

PO4: **Conduct investigations of complex problems**: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

PO5: **Modern tool usage**: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

PO6: **The engineer and society**: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilitiesrelevant to the professional engineering practice.

PO7: **Environment and sustainability**: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

PO8: **Ethics**: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

PO9: **Individual and team work**: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

PO10: **Communication:** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

PO11: **Project management and finance:** Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

PO12: **Life-long learning**: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

PROGRAM SPECIFIC OUTCOMES (PSOs)

PSO1: Design, develop and analyze electronic systems through application of relevant electronics, mathematics and engineering principles

PSO2: Design, develop and analyze communication systems through application of fundamentals from communication principles, signal processing, and RF System Design & Electromagnetics.

PSO3: Adapt to emerging electronics and communication technologies and develop innovative solutions for existing and newer problems

B.TECH (FULL TIME) – ECE – R-2021

I - VIII SEMESTERS CURRICULUM

SEMESTER I

Sl. No.	COURSE CODE	COURSE TITLE	L	T	P	C
THEORY						
1.	21147IP	Induction Programme	-	-	-	0
2.	21147S11	Professional English - I	3	0	0	3
3.	21148S12	Matrices and Calculus	3	1	0	4
4.	21149S13	Engineering Physics	3	0	0	3
5.	21149S14	Engineering Chemistry	3	0	0	3
6.	21150S15	Problem Solving and Python Programming	3	0	0	3
PRACTICALS						
7.	21150L16	Problem Solving and Python Programming Laboratory	0	0	4	2
8.	21149L17	Physics and Chemistry Laboratory	0	0	4	2
9.	21147L18	Communication Lab – I	0	0	2	1
		TOTAL	15	1	10	**21**

SEMESTER II

Sl. No.	COURSE CODE	COURSE TITLE	L	T	P	C
THEORY						
1.	21147S21	Professional English – II (COMMON TO CIVIL, CSE, EEE,ECE,MECH)	3	0	0	3
2.	21148S22	Statistics and Numerical Methods (COMMON TO CIVIL, CSE, EEE, ECE, MECH)	3	1	0	4
3.	21149S23B	Physics for Electronics Engineering	3	0	0	3
4.	21154S24	Engineering Graphics(COMMON TO CIVIL, CSE, EEE,ECE,MECH)	2	0	4	4
5.	21153S25B	Electrical and Instrumentation Engineering	3	0	0	3
6.	21153S26A	Circuit Analysis	3	1	0	4
PRACTICALS						
7.	21154L27	Engineering Practices Laboratory(COMMON TO ALL)	0	0	4	2
8.	21153L28A	Circuits Analysis Laboratory	0	0	4	2
9.	21147L29	Communication Lab – II	0	0	4	2
		TOTAL	17	2	16	**27**

SEMESTER III

Sl. No	COURSE CODE	COURSE TITLE	L	T	P	C
THEORY						
1.	21148S31B	Random Processes and Linear Algebra	3	1	0	4
2.	21152S32	Control Systems	3	0	0	3
3.	21152S33	C Programming and Data Structures	3	0	0	3
4.	21152C34	*Digital Systems Design*	3	0	2	4
5.	21152C35	Signals and Systems	3	1	0	4
6.	21152C36	Electronic Devices and Circuits	3	0	0	3
PRACTICALS						
7.	21152L37	C Programming and Data Structures Lab	0	0	4	2
8.	21152L38	Electronic Devices and Circuits Lab	0	0	4	2
9.	21152L39	Professional Development	0	0	2	1
		TOTAL	18	2	12	**26**

SEMESTER IV

Sl. No	COURSE CODE	COURSE TITLE	L	T	P	C
THEORY						
1.	21152C41	Electromagnetic Fields	3	0	0	3
2.	21152C42	Linear Integrated Circuits	3	0	0	3
3.	21152C43	Communication Systems	3	0	0	3
4.	21152C44	*Digital Signal Processing*	3	0	2	4
5.	21152C45	*Networks and Security*	3	0	2	4
6.	21149S46	Environmental Sciences and Sustainability	2	0	0	2
PRACTICALS						
7.	21152L47	Linear Integrated Circuits Laboratory	0	0	4	2
8.	21152L48	Communication Systems Laboratory	0	0	4	2
		TOTAL	17	0	12	**23**

SEMESTER V

Sl. No	COURSE CODE	COURSE TITLE	L	T	P	C
THEORY						
1.	21152C51	*Wireless Communication *	3	0	2	4
2.	21152C52	VLSI and Chip Design	3	0	0	3
3.	21152C53	Transmission Lines and RF Systems	3	0	0	3
4.	**21152E54_**	**Elective - I**	3	0	0	3
5.	**21152E55_**	**Elective – II**	3	0	0	3
6.	**21152E56_**	**Elective - III**	3	0	0	3
7.	**21147MC51_**	**Mandatory Course - I**	3	0	0	0
PRACTICALS						
8.	20152L58	VLSI Laboratory	0	0	4	2
		TOTAL	21	0	4	**21**

SEMESTER VI

Sl. No	COURSE CODE	COURSE TITLE	L	T	P	C
THEORY						
1.	21152S61	*Embedded Systems and IOT Design*	3	0	2	4
2.	21152S62	*Artificial Intelligence and Machine Learning*	3	0	2	4
3.	**211 OE63_**	**Open Elective - I**	3	0	0	3
4.	**21152E64_**	**Elective – IV**	3	0	0	3
5.	**21152E65_**	**Elective – V**	3	0	0	3
6.	**21152E66_**	**Elective – VI**	3	0	0	3
7.	**21147MC61_**	**Mandatory Course - II**	3	0	0	0
		TOTAL	21	0	4	**20**

SEMESTER VII

Sl. No	COURSE CODE	COURSE TITLE	L	T	P	C
THEORY						
1.	211_S71	Human Values and Ethics	2	0	0	2
2.	**21160S72_**	**Elective - VII**	3	0	0	3
3.	**211_ _OE73_**	**Open Elective – II**	3	0	0	3
4.	**211_ _OE74_**	**Open Elective – III**	3	0	0	3
5.	**211_ _OE75_**	**Open Elective – IV**	3	0	0	3
PRACTICALS						
6.	21152INT76	Summer Internship	0	0	0	2
		TOTAL	14	0	0	**16**

SEMESTER VIII

Sl. No	COURSE CODE	COURSE TITLE	L	T	P	C
PRACTICALS						
1.	21152P81	Project Work	0	0	20	10
		TOTAL	0	0	20	**10**
		TOTAL NO. OF CREDITS:				**164**

LIST OF ELECTIVES

ELECTIVE - I (SEMESTER V)

Sl. No	COURSE CODE	COURSE TITLE	L	T	P	C
1.	21152E54A	Optical Communication Networks	3	0	0	3
2.	21152E54B	4G /5G Communication Networks	3	0	0	3
3.	21152E54C	Avionics Systems	3	0	0	3

ELECTIVE – II (SEMESTER V)

Sl. No	COURSE CODE	COURSE TITLE	L	T	P	C
1.	21152E55A	Software Defined Networks	3	0	0	3
2.	21152E55B	Image Processing	3	0	0	3
3.	21152E55C	Speech Processing	3	0	0	3

ELECTIVE – III (SEMESTER V)

Sl. No	COURSE CODE	COURSE TITLE	L	T	P	C
1.	21152E56A	DSP Architecture and Programming	3	0	0	3
2.	21152E56B	Wireless Sensor Network Design	3	0	0	3
3.	21152E56C	Computer Vision	3	0	0	3

ELECTIVE – IV (SEMESTER VI)

Sl. No	COURSE CODE	COURSE TITLE	L	T	P	C
1.	21152E64A	Software Defined Radio	3	0	0	3
2.	21152E64B	Satellite Communication	3	0	0	3
3.	21152E64C	Massive MIMO Networks	3	0	0	3

ELECTIVE - V (SEMESTER VI)

Sl. No	COURSE CODE	COURSE TITLE	L	T	P	C
1.	21152E65A	Advanced Wireless Communication Techniques	3	0	0	3
2.	21152E65B	Wearable Devices	3	0	0	3
3.	21152E65C	Fundamentals of Nanoelectronics	3	0	0	3

ELECTIVE - VI (SEMESTER VI)

Sl. No	COURSE CODE	COURSE TITLE	L	T	P	C
1.	21152E66A	Remote Sensing	3	0	0	3
2.	21152E66B	Human Assist Devices	3	0	0	3
3.	21152E66C	MEMS Design	3	0	0	3

ELECTIVE - VII (SEMESTER VII)

Sl. No	COURSE CODE	COURSE TITLE	L	T	P	C
1.	21160S72A	Principles of Management	3	0	0	3
2.	21160S72B	Total Quality Management	3	0	0	3
3.	21160S72C	Human Resource Management	3	0	0	3

LIST OF OPEN ELECTIVES

OPEN ELECTIVE – I (SEMESTER VI)

Sl. No	DEPT	COURSE CODE	COURSE TITLE	L	T	P	C
1.	Civil	21155OE63	Climate Change and its Impact	3	0	0	3
2.	EEE	21153OE63	Renewable Energy System	3	0	0	3
3.	Mech	21154OE63	Introduction to Industrial Engineering	3	0	0	3
4.	CSE	21150OE63	Graph Theory	3	0	0	3
5.	ECE **	21152OE63	Deep Learning	3	0	0	3

** Applicable for other Departments

OPEN ELECTIVE – II (SEMESTER VII)

Sl. No	DEPT	COURSE CODE	COURSE TITLE	L	T	P	C
1.	Civil	21155OE73	ICT in Agriculture	3	0	0	3
2.	EEE	21153OE73	Introduction to Control Engineering	3	0	0	3
3.	Mech	21154OE73	Aviation Management	3	0	0	3

4.	CSE	21150OE73	Dev-Ops	3	0	0	3
5.	ECE **	21152OE73	Robotics Process Automation	3	0	0	3

** Applicable for other Departments

OPEN ELECTIVE – III (SEMESTER VII)

Sl. No	DEPT	COURSE CODE	COURSE TITLE	L	T	P	C
1.	Eng	21147OE74	English for Competitive Examinations	3	0	0	3
2.	Civil	21155OE74A	Remote Sensing Concepts	3	0	0	3
3.	Civil	21155OE74B	Drinking Water Supply and Treatment	3	0	0	3
4.	EEE	21153OE74A	Renewable Energy Technologies	3	0	0	3
5.	EEE	21153OE74B	Electric and Hybrid Vehicle	3	0	0	3
6.	Mech	21154OE74A	Industrial Management	3	0	0	3
7.	Mech	21154OE74B	Introduction to NonDestructive Testing	3	0	0	3
8.	ECE **	21152OE74A	Biomedical Instrumentation	3	0	0	3
9.	ECE **	21152OE74B	Fundamentals of Electronic Devices and Circuits	3	0	0	3

** Applicable for other Departments

OPEN ELECTIVE – IV (SEMESTER VII)

Sl. No	DEPT	COURSE CODE	COURSE TITLE	L	T	P	C
1.	Civil	21155OE75A	Geographical Information System	3	0	0	3
2.	Civil	21155OE75B	Basics of Integrated Water Resources Management	3	0	0	3
3.	EEE	21153OE75A	Sensors	3	0	0	3
4.	EEE	21153OE75B	Electrical, Electronic and Magnetic materials	3	0	0	3

5.	Mech	21154OE75A	Additive Manufacturing	3	0	0	3
6.	Mech	21154OE75B	Industrial Safety	3	0	0	3
7.	ECE **	21152OE75A	Wearable Devices	3	0	0	3
8.	ECE **	21152OE75B	Medical Informatics	3	0	0	3

** Applicable for other Departments

LIST OF MANDATORY COURSES

MANDATORY COURSE – I (SEMESTER V)

Sl. No	COURSE CODE	COURSE TITLE	L	T	P	C
1.	21147MC51A	Introduction to Women and Gender Studies	3	0	0	3
2.	21147MC51B	Disaster Management	3	0	0	3
3.	21147MC51C	Film Appreciation	3	0	0	3
4.	21147MC51D	Elements of Literature	3	0	0	3

MANDATORY COURSE – II (SEMESTER VI)

Sl. No	COURSE CODE	COURSE TITLE	L	T	P	C
1.	21147MC61A	Well Being with Traditional Practices (Yoga, Ayurveda and Siddha)	3	0	0	3
2.	21147MC61B	History of Science and Technology in India	3	0	0	3
3.	21147MC61C	Political and Economic Thought for a Humane Society	3	0	0	3
4.	21147MC61D	State, Nation Building and Politics in India	3	0	0	3
5.	21147MC61E	Safety in Engineering industry	3	0	0	3

B.TECH (FULL TIME) – ECE – R-2021

CREDITS DISTRIBUTION
CGPA CREDITS

Sem.	Core Courses				Elective Courses				Foundation Courses		Mandatory Courses		TOTAL CGPA Credits
	Theory Courses		Practical Courses		Dept. Elective		Open Elective						
	Nos.	Credits	Nos.	Credits	Nos.	Credits	Nos.	Credits	Nos.	Credits	Nos.	Credits	
I	01	3	03	5	-	-	-	-	04	13	-	-	21
II	02	7	03	6	-	-	-	-	04	14	-	-	27
III	05	17	03	5	-	-	-	-	01	4	-	-	26
IV	05	17	02	4	-	-	-	-	01	2	-	-	23
V	03	10	01	2	03	9	-	-	-	-	1	0	21
VI	02	8	-	-	03	9	01	3	-	-	1	0	20
VII	-	-	01	2	01	3	03	9	01	2	-	-	16
VIII	-	-	01	10	-	-	-	-	-	-	-	-	10
TOTAL CREDITS													**164**

NON CGPA CREDITS

Sem.	Non- CGPA Credits	
	No of Courses	Credits
I	01	00
II	-	-
III	-	-
IV	-	-
V	01	00
VI	01	00
VII	-	-
VIII	-	-
Total	**03**	**00**

This is a mandatory 2 week programme to be conducted as soon as the students enter the institution. Normal classes start only after the induction program is over.

The induction programme has been introduced by AICTE with the following objective:

"Engineering colleges were established to train graduates well in the branch/department of admission, have a holistic outlook, and have a desire to work for national needs and beyond. The graduating student must have knowledge and skills in the area of his/her study. However, he/she must also have a broad understanding of society and relationships. Character needs to be nurturedas an essential quality by which he/she would understand and fulfill his/her responsibility as an engineer, a citizen and a human being. Besides the above, several meta-skills and underlying values are needed."

"One will have to work closely with the newly joined students in making them feel comfortable, allow them to explore their academic interests and activities, reduce competition and make them work for excellence, promote bonding within them, build relations between teachers and students, give a broader view of life, and build character."

Hence, the purpose of this programme is to make the students feel comfortable in their new environment, open them up, set a healthy daily routine, create bonding in the batch as well as between faculty and students, develop awareness, sensitivity and understanding of the self, peoplearound them, society at large, and nature.

The following are the activities under the induction program in which the student would be fully engaged throughout the day for the entire duration of the program.

(i) Physical Activity

This would involve a daily routine of physical activity with games and sports, yoga, gardening, etc

(ii) Creative Arts

Every student would choose one skill related to the arts whether visual arts or performing arts. Examples are painting, sculpture, pottery, music, dance etc. The student would pursue it everyday for the duration of the program. These would allow for creative expression. It would develop a sense of aesthetics and
also enhance creativity which would, hopefully, grow into engineering design later.

(iii) Universal Human Values

This is the anchoring activity of the Induction Programme. It gets the student to explore oneself and allows one to experience the joy of learning, stand up to peer pressure, make decisions with courage, be aware of relationships with colleagues and supporting stay in the hostel and department, be sensitive to others, etc. A module in Universal Human Values provides the base. Methodology of teaching this content is extremely important. It must not be through do's and don'ts, but get students to explore and think by engaging them in a dialogue. It is best taught through group discussions and real life activities rather than

lecturing.
Discussions would be conducted in small groups of about 20 students with a faculty mentor each. It would be effective that the faculty mentor assigned is also the faculty advisor for the student for the full duration of the UG programme.

(iv) Literary Activity

Literary activity would encompass reading, writing and possibly, debating, enacting a play etc.

(v) Proficiency Modules

This would address some lacunas that students might have, for example, English, computer familiarity etc.

(vi) Lectures by Eminent People

Motivational lectures by eminent people from all walks of life should be arranged to give the students exposure to people who are socially active or in public life.

(vii) Visits to Local Area

A couple of visits to the landmarks of the city, or a hospital or orphanage could be organized. Thiswould familiarize them with the area as well as expose them to the underprivileged.

(viii) Familiarization to Dept./Branch & Innovations

They should be told about what getting into a branch or department means what role it plays in society, through its technology. They should also be shown the laboratories, workshops & other facilities.

(ix) Department Specific Activities

About a week can be spent in introducing activities (games, quizzes, social interactions, small experiments, design thinking etc.) that are relevant to the particular branch of Engineering / Technology / Architecture that can serve as a motivation and kindle interest in building things (become a maker) in that particular field. This can be conducted in the form of a workshop. For example, CSE and IT students may be introduced to activities that kindle computational thinking, and get them to build simple games. ECE students may be introduced to building simple circuits as an extension of their knowledge in Science, and so on. Students may be asked to build stuff using their knowledge of science.

Induction Programme is totally an activity based programme and therefore there shall be no tests / assessments during this programme.

References:
Guide to Induction program from AICTE

21147S11 **PROFESSIONAL ENGLISH - I** **L T P C3 1 0 4**

COURSE OBJECTIVES:

- To improve the communicative competence of learners
- To help learners use language effectively in academic / work contexts
- To build on students' English language skills by engaging them in listening, speaking and grammar learning activities that are relevant to authentic contexts.
- To develop learners' ability to read and write complex texts, summaries, articles, blogs, definitions, essays and user manuals.
- To use language efficiently in expressing their opinions via various media.

INTRODUCTION TO EFFECTIVE COMMUNICATION **1**

- What is effective communication? (There are many interesting activities for this.)
- Why is communication critical for excellence during study, research and work?
- What are the seven C's of effective communication?
- What are key language skills?
- What is effective listening? What does it involve?
- What is effective speaking?
- What does it mean to be an excellent reader? What should you be able to do?
- What is effective writing?
- How does one develop language and communication skills?
- What does the course focus on? How are communication and language skills going to be enhanced during this course? What do you as a learner need to do to enhance your English language and communication skills to get the best out of this course?

UNIT I INTRODUCTION TO FUNDAMENTALS OF COMMUNICATION **11**

Listening –for general information-specific details- conversation: Introduction to classmates - Audio / video (formal & informal); Telephone conversation; Listening to voicemail & messages; Listening and filling a form

Speaking - Self Introduction; Introducing a friend; Conversation - politeness strategies; Telephone conversation; Leave a voicemail; Leave a message with another person; asking for information to fill details in a form.

Reading - Reading brochures (technical context), telephone messages / social media messages relevant to technical contexts and emails.

Writing - Writing emails / letters introducing oneself

Grammar - Present Tense (simple and progressive); Question types: Wh / Yes or No/ and Tags

Vocabulary - Synonyms; One word substitution; Abbreviations & Acronyms (as used in technicalcontexts).

UNIT II NARRATION AND SUMMATION **12**

Listening - Listening to podcasts, anecdotes / stories / event narration; documentaries and interviews with celebrities.

Speaking - Narrating personal experiences / events; Interviewing a celebrity; Reporting / andsummarizing documentaries / podcasts/ interviews.

Reading - Reading biographies, travelogues, newspaper reports, Excerpts from literature, andtravel & technical blogs.

Writing - Guided writing-- Paragraph writing Short Report on an event (field trip etc.)Grammar –Past tense (simple); Subject-Verb Agreement; and Prepositions
Vocabulary - Word forms (prefixes & suffixes); Synonyms and Antonyms. Phrasal verbs.

UNIT III DESCRIPTION OF A PROCESS / PRODUCT 12

Listening - Listen to a product and process descriptions; a classroom lecture; and advertisementsabout products.

Speaking – Picture description; giving instruction to use the product; Presenting a product; andSummarizing a lecture.

Reading – Reading advertisements, gadget reviews; user manuals. Writing - Writing definitions; instructions; and Product /Process description.

Grammar - Imperatives; Adjectives; Degrees of comparison; Present & Past Perfect Tenses. Vocabulary - Compound Nouns, Homonyms; and Homophones, discourse markers (connectives &sequence words)

UNIT IV CLASSIFICATION AND RECOMMENDATIONS 12

eports –and Non Verbal Communication (tables, pie chartsetc,)

Writing – Note-making / Note-taking (*Study skills to be taught, not tested; Writing recommendations; Transferring information from non verbal (chart , graph etc, to verbal mode)
Grammar – Articles; Pronouns - Possessive & Relative pronouns.
Vocabulary - Collocations; Fixed / Semi fixed expressions.

UNIT V EXPRESSION 12

Listening – Listening to debates/ discussions; different viewpoints on an issue; and panel discussions.

Speaking –group discussions, Debates, and Expressing opinions through Simulations & Role play.Reading – Reading editorials; and Opinion Blogs;
Writing – Essay Writing (Descriptive or narrative).

Grammar – Future Tenses, Punctuation; Negation (Statements & Questions); and Simple, Compound & Complex Sentences.

Vocabulary - Cause & Effect Expressions – Content vs Function words.

TOTAL: 60 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able

- To listen and comprehend complex academic texts
- To read and infer the denotative and connotative meanings of technical texts
- To write definitions, descriptions, narrations and essays on various topics
- To speak fluently and accurately in formal and informal communicative contexts
- To express their opinions effectively in both oral and written medium of communication

TEXT BOOKS:

1. English for Engineers & Technologists Orient Blackswan Private Ltd. Department ofEnglish, Anna University, (2020 edition).
2. English for Science & Technology Cambridge University Press, 2021.
3. Authored by Dr. Veena Selvam, Dr. Sujatha Priyadarshini, Dr. Deepa Mary Francis, Dr. KN. Shoba, and Dr. Lourdes Joevani, Department of English, Anna University.

REFERENCES:

1. Technical Communication – Principles and Practices By Meenakshi Raman & Sangeeta Sharma, Oxford Univ. Press, 2016, New Delhi.
2. A Course Book on Technical English By Lakshmi Narayanan, Scitech Publications (India) Pvt. Ltd.
3. English For Technical Communication (With CD) By Aysha Viswamohan, Mcgraw Hill Education, ISBN : 0070264244.
4. Effective Communication Skill, Kulbhusan Kumar, R S Salaria, Khanna Publishing House.
5. Learning to Communicate – Dr. V. Chellammal, Allied Publishing House, New Delhi,2003

CO's-PO's & PSO's MAPPING CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	1	1	1	1	1	3	3	3	1	3	-	3	-	-	-
2	1	1	1	1	1	3	3	3	1	3	-	3	-	-	-
3	2	3	2	3	2	3	3	3	2	3	3	3	-	-	-
4	2	3	2	3	2	3	3	3	2	3	3	3	-	-	-
5	2	3	3	3	-	3	3	3	2	3	-	3	-	-	-
AVg.	**1.6**	**2.2**	**1.8**	**2.2**	**1.5**	**3**	**3**	**3**	**1.6**	**3**	**3**	**3**	**-**	**-**	**-**

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1 - low, 2 - medium, 3 - high, '-' - no correlation

21148S12 MATRICES AND CALCULUS

L	T	P	C
3	1	0	4

COURSE OBJECTIVES:

- To develop the use of matrix algebra techniques that are needed by engineers for practical applications.
- To familiarize the students with differential calculus.
- To familiarize the student with functions of several variables. This is needed in many branches of engineering.
- To make the students understand various techniques of integration.
- To acquaint the student with mathematical tools needed in evaluating multiple integrals and their applications.

UNIT I MATRICES 9 + 3

Eigenvalues and Eigenvectors of a real matrix – Characteristic equation – Properties of Eigenvalues and Eigenvectors – Cayley - Hamilton theorem – Diagonalization of matrices by orthogonal transformation – Reduction of a quadratic form to canonical form by orthogonal transformation – Nature of quadratic forms – Applications: Stretching of an elastic membrane.

UNIT II DIFFERENTIAL CALCULUS 9 + 3

Representation of functions - Limit of a function - Continuity - Derivatives - Differentiation rules (sum, product, quotient, chain rules) - Implicit differentiation - Logarithmic differentiation - Applications: Maxima and Minima of functions of one variable.

UNIT III FUNCTIONS OF SEVERAL VARIABLES 9 + 3

Partial differentiation – Homogeneous functions and Euler's theorem – Total derivative – Change of variables – Jacobians – Partial differentiation of implicit functions – Taylor's series for functions of two variables – Applications: Maxima and minima of functions of two variables and Lagrange'smethod of undetermined multipliers.

UNIT IV INTEGRAL CALCULUS 9 + 3

Definite and Indefinite integrals - Substitution rule - Techniques of Integration: Integration by parts, Trigonometric integrals, Trigonometric substitutions, Integration of rational functions by partial fraction, Integration of irrational functions - Improper integrals - Applications: Hydrostatic forceand pressure, moments and centres of mass.

UNIT V MULTIPLE INTEGRALS 9 + 3

Double integrals – Change of order of integration – Double integrals in polar coordinates – Area enclosed by plane curves – Triple integrals – Volume of solids – Change of variables in double and triple integrals – Applications: Moments and centres of mass, moment of inertia.

TOTAL: 60 PERIODS

COURSE OUTCOMES:

At the end of the course the students will be able to

- Use the matrix algebra methods for solving practical problems.
- Apply differential calculus tools in solving various application problems.
- Able to use differential calculus ideas on several variable functions.
- Apply different methods of integration in solving practical problems.
- Apply multiple integral ideas in solving areas, volumes and other practical problems.

TE KS :

1. yszig.E, vanced ineering thematics", n ey and Sons, 10th Edition, New Delhi, 2016.
2. Grewal.B.S., "Higher Engineering Mathematics", Khanna Publishers, New Delhi, 44th Edition , 2018.
3. James Stewart, " Calculus: Early Transcendentals", Cengage Learning, 8th Edition, New

Delhi, 2015. [For Units II & IV - Sections 1.1, 2.2, 2.3, 2.5, 2.7 (Tangents problems only), 2.8, 3.1 to 3.6, 3.11, 4.1, 4.3, 5.1 (Area problems only), 5.2, 5.3, 5.4 (excluding net change theorem), 5.5, 7.1 - 7.4 and 7.8].

REFERENCES:

1. Anton. H, Bivens. I and Davis. S, "Calculus", Wiley, 10th Edition, 2016
2. Bali. N., Goyal. M. and Watkins. C., “Advanced Engineering Mathematics”, Firewall Media (An imprint of Lakshmi Publications Pvt., Ltd.,), New Delhi, 7th Edition, 2009.
3. Jain . R.K. and Iyengar. S.R.K., “Advanced Engineering Mathematics”, Narosa Publications, New Delhi, 5th Edition, 2016.
4. Narayanan. S. and Manicavachagom Pillai. T. K., “Calculus" Volume I and II, S. Viswanathan Publishers Pvt. Ltd., Chennai, 2009.
5. Ramana. B.V., "Higher Engineering Mathematics", McGraw Hill Education Pvt. Ltd, New Delhi, 2016.
6. Srimantha Pal and Bhunia. S.C, “Engineering Mathematics" Oxford University Press, 2015.
7. Thomas. G. B., Hass. J, and Weir. M.D, "Thomas Calculus", 14th Edition, Pearson India, 2018.

CO's-PO's & PSO's MAPPING CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	1	1	0	0	0	0	2	0	2	3	-	-	-
C	3	3	1	1	0	0	0	0	2	0	2	3	-	-	-

O2															
CO3	3	3	1	1	0	0	0	0	2	0	2	3	-	-	-
CO4	3	3	1	1	0	0	0	0	2	0	2	3	-	-	-
CO5	3	3	1	1	0	0	0	0	2	0	2	3	-	-	-
Avg	3	3	1	1	0	0	0	0	2	0	2	3	-	-	-

1 - low, 2 - medium, 3 - high, '-' - no correlation

21149S13 ENGINEERING PHYSICS L T P C
3 0 0 3

COURSE OBJECTIVES:

- To make the students effectively achieve an understanding of mechanics.
- To enable the students to gain knowledge of electromagnetic waves and its applications.
- To introduce the basics of oscillations, optics and lasers.
- Equipping the students to successfully understand the importance of quantum physics.
- To motivate the students towards the applications of quantum mechanics.

UNIT I MECHANICS 9

Multi-particle dynamics: Center of mass (CM) – CM of continuous bodies – motion of the CM – kinetic energy of the system of particles. Rotation of rigid bodies: Rotational kinematics – rotational kinetic energy and moment of inertia - theorems of M .I –moment of inertia of continuous bodies –
of a diatomic molecule - torque – rotational dynamics of rigid bodies – conservation of angular momentum – rotational energy state of a rigid diatomic molecule - gyroscope - torsional pendulum
– double pendulum –Introduction to nonlinear oscillations.

UNIT II ELECTROMAGNETIC WAVES 9

The Maxwell's equations - wave equation; Plane electromagnetic waves in vacuum, Conditions on the wave field - properties of electromagnetic waves: speed, amplitude, phase, orientation and waves in matter - polarization - Producing electromagnetic waves - Energy and momentum in EM waves: Intensity, waves from localized sources, momentum and radiation pressure - Cell-phone reception. Reflection and transmission of electromagnetic waves from a non-conducting medium- vacuum interface for normal incidence.

UNIT III OSCILLATIONS, OPTICS AND LASERS 9

Simple harmonic motion - resonance –analogy between electrical and mechanical oscillatingsystems - waves on a string - standing waves - traveling waves - Energy transfer of a wave - sound waves - Doppler effect. Reflection and refraction of light waves - total internal reflection - interference –Michelson interferometer –Theory of air wedge and experiment. Theory of laser - characteristics - Spontaneous and stimulated emission - Einstein's coefficients - population inversion - Nd-YAG laser, CO_2 laser, semiconductor laser –Basic applications of lasers in industry.

UNIT IV BASIC QUANTUM MECHANICS 9

Photons and light waves - Electrons and matter waves –Compton effect - The Schrodinger equation (Time dependent and time independent forms) - meaning of wave function - Normalization –Free particle - particle in a infinite potential well: 1D,2D and 3D Boxes- Normalization, probabilities and the correspondence principle.

UNIT V APPLIED QUANTUM MECHANICS 9

The harmonic oscillator(qualitative)- Barrier penetration and quantum tunneling(qualitative)- Tunneling microscope - Resonant diode - Finite potential wells (qualitative)- Bloch's theorem for particles in a periodic potential –Basics of Kronig-Penney model and origin of energy bands.

TOTAL : 45 PERIODS

COURSE OUTCOMES:

After completion of this course, the students should be able to

- Understand the importance of mechanics.
- Express their knowledge in electromagnetic waves.
- Demonstrate a strong foundational knowledge in oscillations, optics and lasers.
- Understand the importance of quantum physics.
- Comprehend and apply quantum mechanical principles towards the formation of energy bands.

TEXT BOOKS:

1. D.Kleppner and R.Kolenkow. An Introduction to Mechanics. McGraw Hill Education (IndianEdition), 2017.
2. E.M.Purcell and D.J.Morin, Electricity and Magnetism, Cambridge Univ.Press, 2013.
3. Arthur Beiser, Shobhit Mahajan, S. Rai Choudhury, Concepts of Modern Physics, McGraw-Hill (Indian Edition), 2017.

REFERENCES:

1. R.Wolfson. Essential University Physics. Volume 1 & 2. Pearson Education (Indian Edition),2009.
2. Paul A. Tipler, Physic – Volume 1 & 2, CBS, (Indian Edition), 2004.
3. K.Thyagarajan and A.Ghatak. Lasers: Fundamentals and Applications, Laxmi Publications, (Indian Edition), 2019.
4. D.Halliday, R.Resnick and J.Walker. Principles of Physics, Wiley (Indian Edition), 2015.

5. N.Garcia, A.Damask and S.Schwarz. Physics for Computer Science Students. Springer-Verlag, 2012.

CO's-PO's & PSO's MAPPING CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO1	PSO2	PSO3
1	3	3	2	1	1	1	-	-	-	-	-	-	-	-	-
2	3	3	2	1	2	1	-	-	-	-	-	-	-	-	-
3	3	3	2	2	2	1	-	-	-	-	-	1	-	-	-
4	3	3	1	1	2	1	-		-	-	-	-	-	-	-
5	3	3	1	1	2	1	-	-	-	-	-	-	-	-	-
AVG	3	3	1.6	1.2	1.8	1	-	-	-	-	-	1	-	-	-

1 - low, 2 - medium, 3 - high, '-' - no correlation

21149S14 **ENGINEERING CHEMISTRY** **L T P C**
3 0 0 3

COURSE OBJECTIVES:

- To inculcate sound understanding of water quality parameters and water treatment techniques.
- To impart knowledge on the basic principles and preparatory methods of nanomaterials.
- To introduce the basic concepts and applications of phase rule and composites.
- To facilitate the understanding of different types of fuels, their preparation, properties and combustion characteristics.
- To familiarize the students with the operating principles, working processes and applications of energy conversion and storage devices.

UNIT I WATER AND ITS TREATMENT 9

Water: Sources and impurities, Water quality parameters: Definition and significance of-color, odour, turbidity, pH, hardness, alkalinity, TDS, COD and BOD, fluoride and arsenic. Municipal water treatment: primary treatment and disinfection (UV, Ozonation, break-point chlorination). Desalination of brackish water: Reverse Osmosis. Boiler troubles: Scale and sludge, Boiler corrosion, Caustic embrittlement, Priming & foaming. Treatment of boiler feed water: Internal treatment (phosphate, colloidal, sodium aluminate and calgon conditioning) and External treatment
– Ion exchange demineralization and zeolite process.

UNIT II NANOCHEMISTRY 9

Basics: Distinction between molecules, nanomaterials and bulk materials; Size-dependent properties (optical, electrical, mechanical and magnetic); Types of nanomaterials: Definition, properties and uses of – nanoparticle, nanocluster, nanorod, nanowire and nanotube. Preparation of nanomaterials: sol-gel, solvothermal, laser ablation, chemical vapour deposition, electrochemical deposition and electro spinning. Applications of nanomaterials in medicine, agriculture, energy, electronics and catalysis.

UNIT III PHASE RULE AND COMPOSITES 9

Phase rule: Introduction, definition of terms with examples. One component system - water system; Reduced phase rule; Construction of a simple eutectic phase diagram - Thermal analysis; Two component system: lead-silver system - Pattinson process.

Composites: Introduction: Definition & Need for composites; Constitution: Matrix materials (Polymer matrix, metal matrix and ceramic matrix) and Reinforcement (fiber, particulates, flakes and whiskers). Properties and applications of: Metal matrix composites (MMC), Ceramic matrix composites and Polymer matrix composites. Hybrid composites - definition and examples.

UNIT IV FUELS AND COMBUSTION 9

Fuels: Introduction: Classification of fuels; Coal and coke: Analysis of coal (proximate and ultimate), Carbonization, Manufacture of metallurgical coke (Otto Hoffmann method). Petroleum and Diesel: Manufacture of synthetic petrol (Bergius process), Knocking - octane number, diesel oil

- cetane number; Power alcohol and biodiesel.

Combustion of fuels: Introduction: Calorific value - higher and lower calorific values, Theoretical calculation of calorific value; Ignition temperature: spontaneous ignition temperature, Explosive range; Flue gas analysis - ORSAT Method. CO_2 emission and carbon footprint.

UNIT V ENERGY SOURCES AND STORAGE DEVICES 9

Stability of nucleus: mass defect (problems), binding energy; Nuclear energy: light water nuclear power plant, breeder reactor. Solar energy conversion: Principle, working and applications of solar cells; Recent developments in solar cell materials. Wind energy; Geothermal energy; Batteries: Types of batteries, Primary battery - dry cell, Secondary battery - lead acid battery and lithium-ion- battery; Electric vehicles - working principles; Fuel cells: H_2-O_2 fuel cell, microbial fuel cell; Supercapacitors: Storage principle, types and examples.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of the course, the students will be able:

- To infer the quality of water from quality parameter data and propose suitable treatment methodologies to treat water.
- To identify and apply basic concepts of nanoscience and nanotechnology in designing the synthesis of nanomaterials for engineering and technology applications.
- To apply the knowledge of phase rule and composites for material selection requirements.
- To recommend suitable fuels for engineering processes and applications.
- To recognize different forms of energy resources and apply them for suitable applications in energy sectors.

TEXT BOOKS:

1. P. C. Jain and Monica Jain, “Engineering Chemistry”, 17th Edition, Dhanpat Rai PublishingCompany (P) Ltd, New Delhi, 2018.
2. Sivasankar B., “Engineering Chemistry”, Tata McGraw-Hill Publishing Company Ltd, NewDelhi, 2008.

3. S.S. Dara, “A Text book of Engineering Chemistry”, S. Chand Publishing, 12th Edition,2018

REFERENCES:

1. B. S. Murty, P. Shankar, Baldev Raj, B. B. Rath and James Murday, “Text book of nanoscience and nanotechnology”, Universities Press-IIM Series in Metallurgy and Materials Science, 2018.
2. O.G. Palanna, “Engineering Chemistry” McGraw Hill Education (India) Private Limited, 2nd Edition, 2017.
3. Friedrich Emich, “Engineering Chemistry”, Scientific International PVT, LTD, New Delhi, 2014.
4. ShikhaAgarwal, “Engineering Chemistry-Fundamentals and Applications”, Cambridge University Press, Delhi, Second Edition, 2019.
5. O.V. Roussak and H.D. Gesser, Applied Chemistry-A Text Book for Engineers and Technologists, Springer Science Business Media, New York, 2nd Edition, 2013.

CO’s-PO’s & PSO’s MAPPING CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO1	PSO2	PSO 3
1	3	2	2	1	-	1	1	-	-	-	-	1	-	-	-
2	2	-	-	1	-	2	2	-	-	-	-	-	-	-	-
3	3	1	-	-	-	-	-	-	-	-	-	-	-	-	-
4	3	1	1	-	-	1	2	-	-	-	-	-	-	-	-
5	3	1	2	1	-	2	2	-	-	-	-	2	-	-	-
CO	**2.8**	**1.3**	**1.6**	**1**	**-**	**1.5**	**1.8**	**-**	**-**	**-**	**1.5**	**-**	**-**	**-**	

1 - low, 2 - medium, 3 - high, ‘-' - no correlation

21150S15	PROBLEM SOLVING AND PYTHON PROGRAMMING	L	C
		3	0

COURSE OBJECTIVES:

- To understand the basics of algorithmic problem solving.
- To learn to solve problems using Python conditionals and loops.
- To define Python functions and use function calls to solve problems.
- To use Python data structures - lists, tuples, dictionaries to represent complex data.
- To do input/output with files in Python.

UNIT I COMPUTATIONAL THINKING AND PROBLEM SOLVING 9

Fundamentals of Computing – Identification of Computational Problems -Algorithms, building blocks of algorithms (statements, state, control flow, functions), notation (pseudo code, flow chart, programming language), algorithmic problem solving, simple strategies for developing algorithms (iteration, recursion). Illustrative problems: find minimum in a list, insert a card in a list of sorted cards, guess an integer number in a range, Towers of Hanoi.

UNIT II DATA TYPES, EXPRESSIONS, STATEMENTS 9

Python interpreter and interactive mode,debugging; values and types: int, float, boolean, string , and list; variables, expressions, statements, tuple assignment, precedence of operators, comments; Illustrative programs: exchange the values of two variables, circulate the values of n variables, distance between two points.

UNIT III CONTROL FLOW, FUNCTIONS, STRINGS 9

Conditionals:Boolean values and operators, conditional (if), alternative (if-else),chained conditional (if-elif-else);Iteration: state, while, for, break, continue, pass; Fruitful functions: return values,parameters, local and global scope, function composition, recursion; Strings:string slices,immutability, string functions and methods, string module; Lists as arrays. Illustrative programs: square root, gcd, exponentiation, sum an array of numbers, linear search, binary search.

UNIT IV LISTS, TUPLES, DICTIONARIES 9

Lists: list operations, list slices, list methods, list loop, mutability, aliasing, cloning lists, list parameters; Tuples: tuple assignment, tuple as return value; Dictionaries: operations and methods; advanced list processing - list comprehension; Illustrative programs: simple sorting, histogram, Students marks statement, Retail bill preparation.

UNIT V FILES, MODULES, PACKAGES 9

Files and exceptions: text files, reading and writing files, format operator; command line arguments, errors and exceptions, handling exceptions, modules, packages; Illustrative programs: word count, copy file, Voter's age validation, Marks range validation (0-100).

TOTAL : 45 PERIODS

COURSE OUTCOMES:

Upon completion of the course, students will be able to

CO1: Develop algorithmic solutions to simple computational problems.

CO2: Develop and execute simple Python programs.

CO3: Write simple Python programs using conditionals and loops for solving problems.

CO4: Decompose a Python program into functions.

CO5: Represent compound data using Python lists, tuples, dictionaries etc.

CO6: Read and write data from/to files in Python programs.

TEXT BOOKS:

1. Allen B. Downey, "Think Python: How to Think like a Computer Scientist", 2nd Edition, O'Reilly Publishers, 2016.
2. Karl Beecher, "Computational Thinking: A Beginner's Guide to Problem Solving and Programming", 1st Edition, BCS Learning & Development Limited, 2017.

REFERENCES:

1. Paul Deitel and Harvey Deitel, "Python for Programmers", Pearson Education, 1st Edition, 2021.
2. G Venkatesh and Madhavan Mukund, "Computational Thinking: A Primer for Programmers and Data Scientists", 1st Edition, Notion Press, 2021.
3. John V Guttag, "Introduction to Computation and Programming Using Python: With Applications to Computational Modeling and Understanding Data", Third Edition, MIT Press, 2021
4. Eric Matthes, "Python Crash Course, A Hands - on Project Based Introduction to Programming", 2nd Edition, No Starch Press, 2019.
5. https://www.python.org/
6. Martin C. Brown, "Python: The Complete Reference", 4th Edition, Mc-Graw Hill, 2018.

CO's-PO's & PSO's MAPPING CO's	PO's												PSO's	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
1	3	3	3	3	2	-	-	-	-	-	2	2	3	3
2	3	3	3	3	2	-	-	-	-	-	2	2	3	-
3	3	3	3	3	2	-	-	-	-	-	2	-	3	-
4	2	2	-	2	2	-	-	-	-	-	1	-	3	-
5	1	2	-	-	1	-	-	-	-	-	1	-	2	-
6	2	2	-	-	2	-	-	-	-	-	1	-	2	-
AVg.	**2**	**3**	**3**	**3**	**2**	**-**	**-**	**-**	**-**	**-**	**2**	**2**	**3**	**3**

1 - low, 2 - medium, 3 - high, '-' - no correlation

21150L16 PROBLEM SOLVING AND PYTHON PROGRAMMING LABORATORY **L T P C**

0 0 4 2

COURSE OBJECTIVES:

- To understand the problem solving approaches.
- To learn the basic programming constructs in Python.
- To practice various computing strategies for Python-based solutions to real world problems.
- To use Python data structures - lists, tuples, dictionaries.

- To do input/output with files in Python.

EXPERIMENTS:

Note: The examples suggested in each experiment are only indicative. The lab instructor is expected to design other problems on similar lines. The Examination shall not be restricted to the sample experiments listed here.

1. Identification and solving of simple real life or scientific or technical problems, and developing flow charts for the same. (Electricity Billing, Retail shop billing, Sin series, weight of a motorbike, Weight of a steel bar, compute Electrical Current in Three Phase AC Circuit, etc.)
2. Python programming using simple statements and expressions (exchange the values of two variables, circulate the values of n variables, distance between two points).
3. Scientific problems using Conditionals and Iterative loops. (Number series, Number Patterns, pyramid pattern)
4. Implementing real-time/technical applications using Lists, Tuples. (Items present in a library/Components of a car/ Materials required for construction of a building –operations of list & tuples)
5. Implementing real-time/technical applications using Sets, Dictionaries. (Language, components of an automobile, Elements of a civil structure, etc.- operations of Sets & Dictionaries)
6. Implementing programs using Functions. (Factorial, largest number in a list, area of shape)
7. Implementing programs using Strings. (reverse, palindrome, character count, replacingcharacters)
8. Implementing programs using written modules and Python Standard Libraries (pandas,numpy. Matplotlib, scipy)
9. Implementing real-time/technical applications using File handling. (copy from one file toanother, word count, longest word)
10. Implementing real-time/technical applications using Exception handling. (divide by zero error,voter's age validity, student mark range validation)
11. Exploring Pygame tool.
12. Developing a game activity using Pygame like bouncing ball, car race etc.

TOTAL: 60 PERIODS

COURSE OUTCOMES:

On completion of the course, students will be able to:

CO1: Develop algorithmic solutions to simple computational problems

CO2: Develop and execute simple Python programs.

CO3: Implement programs in Python using conditionals and loops for solving problems.

CO4: Deploy functions to decompose a Python program.

CO5: Process compound data using Python data structures.

CO6: Utilize Python packages in developing software applications.

TEXT BOOKS:

1. Allen B. Downey, "Think Python: How to Think like a Computer Scientist", 2nd Edition, O'Reilly Publishers, 2016.
2. Karl Beecher, "Computational Thinking: A Beginner's Guide to Problem Solving and Programming", 1st Edition, BCS Learning & Development Limited, 2017.

REFERENCES:

1. Paul Deitel and Harvey Deitel, “Python for Programmers”, Pearson Education, 1st Edition, 2021.
2. G Venkatesh and Madhavan Mukund, “Computational Thinking: A Primer for Programmers and Data Scientists”, 1st Edition, Notion Press, 2021.
3. John V Guttag, "Introduction to Computation and Programming Using Python: With Applications to Computational Modeling and Understanding Data”, Third Edition, MIT Press, 2021.
4. Eric Matthes, “Python Crash Course, A Hands - on Project Based Introduction to Programming”, 2nd Edition, No Starch Press, 2019.
5. https://www.python.org/
6. Martin C. Brown, “Python: The Complete Reference”, 4th Edition, Mc-Graw Hill, 2018.

CO’s-PO’s & PSO’s MAPPING CO’s					PO’s								PSO’s	
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**
1	3	3	3	3	3	-	-	-	-	-	3	2	3	3
2	3	3	3	3	3	-	-	-	-	-	3	2	3	-
3	3	3	3	3	2	-	-	-	-	-	2	-	3	-
4	3	2	-	2	2	-	-	-	-	-	1	-	3	-
5	1	2	-	-	1	-	-	-	-	-	1	-	2	-
6	2	-	-	-	2	-	-	-	-	-	1	-	2	-
AVg.	**2**	**3**	**3**	**3**	**2**	**-**	**-**	**-**	**-**	**-**	**2**	**2**	**3**	**3**

1 - low, 2 - medium, 3 - high, ‘-' - no correlation

21149L17 PHYSICS AND CHEMISTRY LABORATORY L T P C 0 0 4 2

PHYSICS LABORATORY : (Any Seven Experiments)

COURSE OBJECTIVES:

- To learn the proper use of various kinds of physics laboratory equipment.
- To learn how data can be collected, presented and interpreted in a clear and concisemanner.
- To learn problem solving skills related to physics principles and interpretation ofexperimental data.
- To determine error in experimental measurements and techniques used to minimize sucherror.
- To make the student an active participant in each part of all lab exercises.

1. Torsional pendulum - Determination of rigidity modulus of wire and moment of inertia of regular and irregular objects.
2. Simple harmonic oscillations of cantilever.
3. Non-uniform bending - Determination of Young’s modulus
4. Uniform bending – Determination of Young’s modulus
5. Laser- Determination of the wavelength of the laser using grating

6. Air wedge - Determination of thickness of a thin sheet/wire
7. a) Optical fibre -Determination of Numerical Aperture and acceptance angle

   b) Compact disc- Determination of width of the groove using laser.
8. Acoustic grating- Determination of velocity of ultrasonic waves in liquids.
9. Ultrasonic interferometer – determination of the velocity of sound and compressibility ofliquids
10. Post office box -Determination of Band gap of a semiconductor.
11. Photoelectric effect
12. Michelson Interferometer.
13. Melde's string experiment
14. Experiment with lattice dynamics kit.

TOTAL: 30 PERIODS

COURSE OUTCOMES:

Upon completion of the course, the students should be able to

- Understand the functioning of various physics laboratory equipment.
- Use graphical models to analyze laboratory data.
- Use mathematical models as a medium for quantitative reasoning and describing physicalreality.
- Access, process and analyze scientific information.
- Solve problems individually and collaboratively.

CHEMISTRY LABORATORY: (Any seven experiments to be conducted)

COURSE OBJECTIVES:

- To inculcate experimental skills to test basic understanding of water quality parameters,such as, acidity, alkalinity, hardness, DO, chloride and copper.
- To induce the students to familiarize with electroanalytical techniques such as, pH metry, potentiometry and conductometry in the determination of impurities in aqueous solutions.
- To demonstrate the analysis of metals and alloys.
- To demonstrate the synthesis of nanoparticles

1. Preparation of Na_2CO_3 as a primary standard and estimation of acidity of a watersample using the primary standard
2. Determination of types and amount of alkalinity in a water sample.

\- Split the first experiment into two

3. Determination of total, temporary & permanent hardness of water by EDTA method.
4. Determination of DO content of water sample by Winkler's method.
5. Determination of chloride content of water sample by Argentometric method.
6. Estimation of copper content of the given solution by Iodometry.
7. Estimation of TDS of a water sample by gravimetry.
8. Determination of strength of given hydrochloric acid using pH meter.
9. Determination of strength of acids in a mixture of acids using conductivity meter.
10. Conductometric titration of barium chloride against sodium sulphate (precipitationtitration)
11. Estimation of iron content of the given solution using potentiometer.
12. Estimation of sodium /potassium present in water using a flame photometer.
13. Preparation of nanoparticles (TiO_2/ZnO/CuO) by Sol-Gel method.
14. Estimation of Nickel in steel
15. Proximate analysis of Coal

TOTAL : 30 PERIODS

COURSE OUTCOMES:

- To analyse the quality of water samples with respect to their acidity, alkalinity, hardnessand DO.
- To determine the amount of metal ions through volumetric and spectroscopic techniques
- To analyse and determine the composition of alloys.
- To learn simple method of synthesis of nanoparticles
- To quantitatively analyse the impurities in solution by electroanalytical techniques

TEXT BOOKS :

1. J. Mendham, R. C. Denney, J.D. Barnes, M. Thomas and B. Sivasankar, Vogel's Textbookof Quantitative Chemical Analysis (2009).

CO's-PO's & PSO's MAPPING CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2	PSO 1	PSO 2	PSO 3
1	3	2	3	1	1	-	-	-	-	-	-	-	-	-	-
2	3	3	2	1	1	-	-	-	-	-	-	-	-	-	-
3	3	2	3	1	1	-	-	-	-	-	-	-	-	-	-
4	3	3	2	1	1	-	-	-	-	-	-	-	-	-	-
5	3	2	3	1	1	-	-	-	-	-	-	-	-	-	-
AVG		3				2.4			2.6		1			1	

1 - low, 2 - medium, 3 - high, '-' - no correlation

21147S21 PROFESSIONAL ENGLISH -II L T P C
2 0 0 2

COURSE OBJECTIVES :

- To engage learners in meaningful language activities to improve their reading and writing skills
- To learn various reading strategies and apply in comprehending documents in professional context.
- To help learners understand the purpose, audience, contexts of different types of writing
- To develop analytical thinking skills for problem solving in communicative contexts
- To demonstrate an understanding of job applications and interviews for internship and placements

UNIT I MAKING COMPARISONS 6

Reading - Reading advertisements, user manuals, brochures; Writing – Professional emails, Email etiquette - Compare and Contrast Essay; Grammar – Mixed Tenses, Prepositional phrases

UNIT II EXPRESSING CAUSAL RELATIONS IN SPEAKING AND WRITING 6

Reading - Reading longer technical texts– Cause and Effect Essays, and Letters / emails of complaint, Writing - Writing responses to complaints. Grammar - Active Passive Voice transformations, Infinitive and Gerunds

UNIT III **PROBLEM SOLVING 6**

Reading - Case Studies, excerpts from literary texts, news reports etc. Writing – Letter to the Editor, Checklists, Problem solution essay / Argumentative Essay. Grammar – Error correction; If conditional sentences

UNIT IV **REPORTING OF EVENTS AND RESEARCH 6**

Reading –Newspaper articles; Writing – Recommendations, Transcoding, Accident Report, Survey Report Grammar – Reported Speech, Modals Vocabulary – Conjunctions- use of prepositions

UNIT V **THE ABILITY TO PUT IDEAS OR INFORMATION COGENTLY 6**

Reading – Company profiles, Statement of Purpose, (SOP), an excerpt of interview with professionals; Writing – Job / Internship application – Cover letter & Resume; Grammar – Numericaladjectives, Relative Clauses.

TOTAL : 30 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able

CO1:To compare and contrast products and ideas in technical texts.

CO2:To identify and report cause and effects in events, industrial processes through technical texts

CO3:To analyse problems in order to arrive at feasible solutions and communicate them in thewritten format.

CO4:To present their ideas and opinions in a planned and logical manner

CO5:To draft effective resumes in the context of job search.

TEXT BOOKS :

1. English for Engineers & Technologists (2020 edition) Orient Blackswan Private Ltd. Department of English, Anna University.
2. English for Science & Technology Cambridge University Press 2021.
3. Authored by Dr. Veena Selvam, Dr. Sujatha Priyadarshini, Dr. Deepa Mary Francis, Dr. KN.Shoba, and Dr. Lourdes Joevani, Department of English, Anna University.

REFERENCE BOOKS:

1. Raman. Meenakshi, Sharma. Sangeeta (2019). Professional English. Oxford universitypress. New Delhi.
2. Improve Your Writing ed. V.N. Arora and Laxmi Chandra, Oxford Univ. Press, 2001, NewDelhi.
3. Learning to Communicate – Dr. V. Chellammal. Allied Publishers, New Delhi, 2003
4. Business Correspondence and Report Writing by Prof. R.C. Sharma & Krishna Mohan, Tata McGraw Hill & Co. Ltd., 2001, New Delhi.
5. Developing Communication Skills by Krishna Mohan, Meera Bannerji- Macmillan India Ltd.1990, Delhi.

ASSESSMENT PATTERN

Two internal assessments and an end semester examination to test students' reading and writingskills along with their grammatical and lexical competence.

CO's-PO's & PSO's MAPPING

CO	O1	O2	O3	O4	O5	O6	O7	O8	O9	O10	O11	O12	SO1	SO2	SO3
1	3	3	3	3	3	3	3	3	2	3	3	3	-	-	-
2	3	3	3	3	3	3	3	3	2	3	3	3	-	-	-
3	3	3	3	3	3	3	3	3	2	3	3	3	-	-	-
4	3	3	3	3	2	3	3	3	2	3	3	3	-	-	-
5	-	-	-	-	-	-	-	-	3	3	3	3	-	-	-
Vg.	3	3	3	3	.75	3	3	3	.2	3	3	3	-	-	-

1-low, 2-medium, 3-high, '-"- no correlation

Note: The average value of this course to be used for program articulation matrix.

21148S22 **STATISTICS AND NUMERICAL METHODS** **L T P C**
3 1 0 4

COURSE OBJECTIVES:

- This course aims at providing the necessary basic concepts of a few statistical and numerical methods and give procedures for solving numerically different kinds of problems occurring in engineering and technology.
- To acquaint the knowledge of testing of hypothesis for small and large samples which plays an important role in real life problems.
- To introduce the basic concepts of solving algebraic and transcendental equations.
- To introduce the numerical techniques of interpolation in various intervals and numerical techniques of differentiation and integration which plays an important role in engineering and technology disciplines.
- To acquaint the knowledge of various techniques and methods of solving ordinary differential equations.

UNIT I TESTING OF HYPOTHESIS 9 + 3

Sampling distributions - Tests for single mean, proportion and difference of means (Large and small samples) – Tests for single variance and equality of variances – Chi square test for goodness of fit –Independence of attributes.

UNIT II DESIGN OF EXPERIMENTS 9 + 3

One way and two way classifications - Completely randomized design – Randomized block design –Latin square design - 2^2 factorial design.

UNIT III SOLUTION OF EQUATIONS AND EIGENVALUE PROBLEMS 9 + 3

Solution of algebraic and transcendental equations - Fixed point iteration method – Newton Raphson method- Solution of linear system of equations - Gauss elimination method – Pivoting - Gauss Jordan method – Iterative methods of Gauss Jacobi and Gauss Seidel - Eigenvalues of a matrix by Power method and Jacobi's method for symmetric matrices.

UNIT IV INTERPOLATION, NUMERICAL DIFFERENTIATION AND NUMERICAL INTEGRATION 9 +3

Lagrange's and Newton's divided difference interpolations – Newton's forward and backward difference interpolation – Approximation of derivates using interpolation polynomials – Numerical single and double integrations using Trapezoidal and Simpson's 1/3 rules.

UNIT V NUMERICAL SOLUTION OF ORDINARY DIFFERENTIAL EQUATIONS 9 +3

Single step methods: Taylor's series method - Euler's method - Modified Euler's method - Fourth order Runge-Kutta method for solving first order differential equations - Multi step methods: Milne's and Adams - Bash forth predictor corrector methods for solving first order differential equations.

TOTAL: 60 PERIODS

COURSE OUTCOMES:

Upon successful completion of the course, students will be able to:

CO1:Apply the concept of testing of hypothesis for small and large samples in real life problems. CO2:Apply the basic concepts of classifications of design of experiments in the field of agriculture. CO3:Appreciate the numerical techniques of interpolation in various intervals and apply thenumerical techniques of differentiation and integration for engineering problems.

CO4:Understand the knowledge of various techniques and methods for solving first and secondorder ordinary differential equations.

CO5:Solve the partial and ordinary differential equations with initial and boundary conditions byusing certain techniques with engineering applications.

TEXT BOOKS:

1. Grewal, B.S., and Grewal, J.S., "Numerical Methods in Engineering and Science", Khanna Publishers, 10th Edition, New Delhi, 2015.
2. Johnson, R.A., Miller, I and Freund J., "Miller and Freund's Probability and Statistics forEngineers", Pearson Education, Asia, 8th Edition, 2015.

REFERENCES:

1. Burden, R.L and Faires, J.D, "Numerical Analysis", 9th Edition, Cengage Learning, 2016.
2. Devore. J.L., "Probability and Statistics for Engineering and the Sciences", Cengage Learning, New Delhi, 8th Edition, 2014.
3. Gerald. C.F. and Wheatley. P.O. "Applied Numerical Analysis" Pearson Education, Asia, New Delhi, 7th Edition, 2007.
4. Gupta S.C. and Kapoor V. K., "Fundamentals of Mathematical Statistics", Sultan Chand & Sons, New Delhi, 12th Edition, 2020.
5. Spiegel. M.R., Schiller. J. and Srinivasan. R.A., "Schaum's Outlines on Probability and Statistics ", Tata McGraw Hill Edition, 4th Edition, 2012.
6. Walpole. R.E., Myers. R.H., Myers. S.L. and Ye. K., "Probability and Statistics for Engineers and Scientists", 9th Edition, Pearson Education, Asia, 2010.

CO's-PO's & PSO's MAPPING CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	1	1	0	0	0	0	2	0	2	3	-	-	-
CO2	3	3	1	1	0	0	0	0	2	0	2	3	-	-	-
CO3	3	3	1	1	0	0	0	0	2	0	2	3	-	-	-
CO4	3	3	1	1	0	0	0	0	2	0	2	3	-	-	-
CO5	3	3	1	1	0	0	0	0	2	0	2	3	-	-	-
Avg	3	3	1	1	0	0	0	0	2	0	2	3	-	-	-

1-low, 2-medium, 3-high, '-"- no correlation

Note: The average value of this course to be used for program articulation matrix.

21149S23B	**PHYSICS FOR ELECTRONICS ENGINEERING**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

COURSE OBJECTIVES:

- To make the students to understand the basics of crystallography and its importance in studying materials properties.
- To understand the electrical properties of materials including free electron theory, applications of quantum mechanics and magnetic materials.
- To instil knowledge on physics of semiconductors, determination of charge carriers and device applications
- To establish a sound grasp of knowledge on different optical properties of materials, optical displays and applications
- To inculcate an idea of significance of nano structures, quantum confinement and ensuing nano device applications.

UNIT I CRYSTALLOGRAPHY 9

Crystal structures: Crystal lattice – basis - unit cell and lattice parameters – crystal systems and Bravais lattices – Structure and packing fractions of SC, BCC, FCC, diamond cubic, NaCL, ZnS structures – crystal planes, directions and Miller indices – distance between successive planes – linear and planar densities – crystalline and noncrystalline materials – Example use of Miller indices: wafer surface orientation – wafer flats and notches – pattern alignment - imperfections in crystals.

UNIT II ELECTRICAL AND MAGNETIC PROPERTIES OF MATERIALS 9

Classical free electron theory - Expression for electrical conductivity – Thermal conductivity, expression - Quantum free electron theory :Tunneling – degenerate states – Fermi- Dirac statistics

– Density of energy states – Electron in periodic potential – Energy bands in solids – tight binding approximation - Electron effective mass – concept of hole. Magnetic materials: Dia, para and ferromagnetic effects – paramagnetism in the conduction electrons in metals – exchange interaction and ferromagnetism – quantum interference devices – GMR devices.

UNIT III SEMICONDUCTORS AND TRANSPORT PHYSICS 9

Intrinsic Semiconductors – Energy band diagram – direct and indirect band gap semiconductors – Carrier concentration in intrinsic semiconductors – extrinsic semiconductors - Carrier concentration in N-type & P-type semiconductors – Variation of carrier concentration with temperature – Carrier transport in Semiconductors: Drift, mobility and diffusion – Hall effect and devices – Ohmic contacts

– Schottky diode.

UNIT IV OPTICAL PROPERTIES OF MATERIALS 9

Classification of optical materials – Optical processes in semiconductors: optical absorption and emission, charge injection and recombination, optical absorption, loss and gain. Optical processes in quantum wells – Optoelectronic devices: light detectors and solar cells – light emitting diode – laser diode - optical processes in organic semiconductor devices –excitonic state – Electro-optics and nonlinear optics: Modulators and switching devices – plasmonics.

UNIT V NANO DEVICES 9

Density of states for solids - Significance between Fermi energy and volume of the material – Quantum confinement – Quantum structures – Density of states for quantum wells, wires and dots –Band gap of nanomaterials –Tunneling – Single electron phenomena – Single electron Transistor. Conductivity of metallic nanowires – Ballistic transport – Quantum resistance and conductance – Carbon nanotubes: Properties and applications - Spintronic devices and applications – Optics in quantum structures – quantum well laser.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of the course, the students should be able to

CO1:know basics of crystallography and its importance for varied materials properties

CO2:gain knowledge on the electrical and magnetic properties of materials and their applications

CO3:understand clearly of semiconductor physics and functioning of semiconductor devices

CO4:understand the optical properties of materials and working principles of various optical devices

CO5:appreciate the importance of nanotechnology and nanodevices.

TEXT BOOKS:

1. S.O. Kasap. Principles of Electronic Materials and Devices, McGraw Hill Education (IndianEdition), 2020.
2. R.F.Pierret. Semiconductor Device Fundamentals. Pearson (Indian Edition), 2006.
3. G.W.Hanson. Fundamentals of Nanoelectronics. Pearson Education (Indian Edition), 2009.

REFERENCES:

1. Laszlo Solymar, Walsh, Donald, Syms and Richard R.A., Electrical Properties ofMaterials, Oxford Univ. Press (Indian Edition) 2015.
2. Jasprit Singh, Semiconductor Optoelectronics: Physics and Technology, McGraw-Hill Education (Indian Edition), 2019.
3. Charles Kittel, Introduction to Solid State Physics, Wiley India Edition, 2019.
4. Mark Fox, Optical Properties of Solids, Oxford Univ.Press, 2001.
5. N.Gershenfeld. The Physics of Information Technology. Cambridge University Press, 2011.

CO's-PO's & PSO's MAPPING

O	O1	O2	O3	PO	O5	O6	O7	O8	O9	O10	O11	O12	SO1	SO2	SO3
1	3	-	1	-	-	-	-	-	-	-	-	-	-	-	-
2	3	2	1	2	-	2	-	-	-	-	-	-	-	-	-
3	3	2	2	-	2	-	-	-	-	-	-	-	-	-	-
4	3	-	1	-	3	2	3	-	-	-	-	1	-	-	-
5	3	-	2	1	-	2	-	-	-	-	-	1	-	-	-

G	3	2	4	1.	2.5	2	3					1			

1 - low, 2 - medium, 3 - high, '-' - no correlation

21153S25B

ELECTRICAL AND INSTRUMENTATION ENGINEERING L T P C
3 0 0 3

COURSE OBJECTIVES :

- To impart knowledge in types, construction and working of transformers
- To impart knowledge in types, construction and working of DC machines
- To impart knowledge in types, construction and working of AC rotating machines
- To introduce the functional elements and working of measuring instruments.
- To introduce the basics of power system and protection schemes

UNIT I TRANSFORMER 9

Introduction - Ideal and Practical Transformer – Phasor diagram-– Per Unit System – Equivalent circuit- Testing- Efficiency and Voltage Regulation– Three Phase Transformers – Applications- Auto Transformers, Advantages- Harmonics.

UNIT II DC MACHINES 9

Introduction – Constructional Features– Motor and Generator mode - EMF and Torque equation – Circuit Model – Methods of Excitation- Characteristics – Starting and Speed Control – Universal Motor- Stepper Motors – Brushless DC Motors- Applications

UNIT III AC ROTATING MACHINES 9

Principle of operation of three-phase induction motors – Construction –Types – Equivalent circuit, Speed Control - Single phase Induction motors -Construction– Types– starting methods. Alternator: Working principle–Equation of induced EMF – Voltage regulation, Synchronous motors- working principle-starting methods – Torque equation.

UNIT IV MEASUREMENTS AND INSTRUMENTATION 9

Functional elements of an instrument , Standards and calibration, Operating Principle , types - Moving Coil and Moving Iron meters, Measurement of three phase power, Energy Meter, InstrumentTransformers-CT and PT,DSO- Block diagram- Data acquisition.

UNIT V BASICS OF POWER SYSTEMS 9

Power system structure -Generation , Transmission and distribution , Various voltage levels, Earthing – methods of earthing, protective devices- switch fuse unit- Miniature circuit breaker- moulded case circuit breaker- earth leakage circuit breaker, safety precautions and First Aid

TOTAL: 45 PERIODS

COURSE OUTCOMES :

After completing this course, the students will be able to

CO1: Explain the working principle of electrical machines

CO2: Analyze the output characterizes of electrical machines

CO3: Choose the appropriate electrical machines for various applications **CO4:** Explain the types and operating principles of measuring instruments **CO5:** Explain the basic power system structure and protection schemes

TEXT BOOKS:

1. Kothari DP and I.J Nagrath, “Basic Electrical and Electronics Engineering”, Second Edition,McGraw Hill Education, 2020
2. S. K, Bhattacharya, “Basic Electrical and Electronics Engineering”, Second Edition, Pearson Education, 2017.
3. A.K. Sawhney, Puneet Sawhney ‘A Course in Electrical & Electronic Measurements &

Instrumentation', Dhanpat Rai and Co, New Delhi, 2015.

4. C.L.Wadhwa, "Generation, Distribution and Utilisation of Electrical Energy", New Age International pvt.ltd.,2003

REFERENCES:

1. Kothari DP and I.J Nagrath, "Basic Electrical Engineering", Fourth Edition, McGraw HillEducation, 2019
2. Mahmood Nahvi and Joseph A. Edminister, "Electric Circuits", Schaum' Outline Series,McGraw Hill, 2002.
3. H.S. Kalsi, 'Electronic Instrumentation', Tata McGraw-Hill, New Delhi, 2010

CO's-PO's & PSO's MAPPING

O	O1	O2	O3	O4	O5	O6	O7	O8	O9	O10	O11	O12	SO1	SO2	SO3
1	2	1	1	-	-	-	-	1	-	-	-	-	-	-	-
2	2	1	1	-	-	-	-	1	-	-	-	-	-	-	-
3	2	1	1	-	-	-	-	1	-	-	-	-	-	-	-
4	2	1	1	-	-	-	-	1	-	-	-	-	-	-	-
5	2	1	1	-	-	-	-	1	-	-	-	-	-	-	-
O	**2**	**1**	**1**	-	-	-	-	**1**	-	-	-	-	-	-	-

1 - low, 2 - medium, 3 - high, '-' - no correlation

21154S24 ENGINEERING GRAPHICS L T P C
2 0 4 4

COURSE OBJECTIVES:

The main learning objective of this course is to prepare the students for:

- Drawing engineering curves.
- Drawing freehand sketch of simple objects.
- Drawing orthographic projection of solids and section of solids.
- Drawing development of solids
- Drawing isometric and perspective projections of simple solids.

CONCEPTS AND CONVENTIONS (Not for Examination)

Importance of graphics in engineering applications — Use of drafting instruments — BIS conventions and specifications — Size, layout and folding of drawing sheets — Lettering and dimensioning.

UNIT I PLANE CURVES 6+12

Basic Geometrical constructions, Curves used in engineering practices: Conics — Construction of ellipse, parabola and hyperbola by eccentricity method — Construction of cycloid — construction ofinvolutes of square and circle — Drawing of tangents and normal to the above curves.

UNIT II PROJECTION OF POINTS, LINES AND PLANE SURFACE 6+12

Orthographic projection - principles - Principal planes-First angle projection-projection of points. Projection of straight lines (only First angle projections) inclined to both the principal planes - Determination of true lengths and true inclinations by rotating line method and traces. Projection of planes (polygonal and circular surfaces) inclined to both the principal planes by rotating object method.

UNIT III PROJECTION OF SOLIDS ANDFREEHAND SKETCHING 6+12

Projection of simple solids like prisms, pyramids, cylinder, cone and truncated solids when the axis is inclined to one of the principal planes and parallel to the other by rotating object method. Visualization concepts and Free Hand sketching: Visualization principles — Representation of Three Dimensional objects — Layout of views- Freehand sketching of multiple views from pictorial views of objects.

Practicing three dimensional modeling of simple objects by CAD Software (Not for examination)

UNIT IV PROJECTION OF SECTIONED SOLIDS AND DEVELOPMENT OF SURFACES 6 +12

Sectioning of above solids in simple vertical position when the cutting plane is inclined to the one of the principal planes and perpendicular to the other — obtaining true shape of section. Development of lateral surfaces of simple and sectioned solids — Prisms, pyramids cylinders and cones.

Practicing three dimensional modeling of simple objects by CAD Software (Not for examination)

UNIT V ISOMETRIC AND PERSPECTIVE PROJECTIONS 6+12

Principles of isometric projection — isometric scale —lsometric projections of simple solids and truncated solids - Prisms, pyramids, cylinders, cones- combination of two solid objects in simple vertical positions - Perspective projection of simple solids-Prisms, pyramids and cylinders by visual ray method.

Practicing three dimensional modeling of isometric projection of simple objects by CAD Software (Not for examination)

TOTAL: (L=30+P=60) 90 PERIODS

COURSE OUTCOMES:

On successful completion of this course, the student will be able to **CO1**:Use BIS conventions and specifications for engineering drawing.**CO2**:Construct the conic curves, involutes and cycloid.

CO3:Solve practical problems involving projection of lines.

CO4:Draw the orthographic, isometric and perspective projections of simple solids.

CO5:Draw the development of simple solids.

TEXT BOOKS:

1. Bhatt N.D. and Panchal V.M., “Engineering Drawing”, Charotar Publishing House, 53rd Edition, 2019.

2. Natrajan K.V., “A Text Book of Engineering Graphics”, Dhanalakshmi Publishers, Chennai,2018.
3. Parthasarathy, N. S. and Vela Murali, “Engineering Drawing”, Oxford University Press, 2015

REFERENCES:

1. Basant Agarwal and Agarwal C.M., “Engineering Drawing”, McGraw Hill, 2nd Edition, 2019.
2. Gopalakrishna K.R., “Engineering Drawing” (Vol. I&II combined), Subhas Publications, Bangalore,27th Edition, 2017.
3. Luzzader, Warren.J. and Duff,John M., “Fundamentals of Engineering Drawing with an introduction to Interactive Computer Graphics for Design and Production, Eastern Economy Edition, Prentice Hall of India Pvt. Ltd, New Delhi, 2005.
4. Parthasarathy N. S. and Vela Murali, “Engineering Graphics”, Oxford University, Press, New Delhi, 2015.
5. Shah M.B., and Rana B.C., “Engineering Drawing”, Pearson Education India, 2nd Edition, 2009.
6. Venugopal K. and Prabhu Raja V., “Engineering Graphics", New Age International (P) Limited, 2008.

Publication of Bureau of Indian Standards:

1. IS 10711 — 2001: Technical products Documentation — Size and layoutof drawing sheets.
2. IS 9609 (Parts 0 & 1) — 2001: Technical products Documentation — Lettering.
3. IS 10714 (Part 20) — 2001 & SP 46 — 2003: Lines for technical drawings.
4. IS 11669 — 1986 & SP 46 —2003: Dimensioning of Technical Drawings.
5. IS 15021 (Parts 1 to 4) — 2001: Technical drawings — Projection Methods.

Special points applicable to University Examinations on Engineering Graphics:

1. There will be five questions, each of either or type covering all units of the syllabus.
2. All questions will carry equal marks of 20 each making a total of 100.
3. The answer paper shall consist of drawing sheets of A3 size only. The students will be permitted to use appropriate scale to fit solution within A3 size.
4. The examination will be conducted in appropriate sessions on the same day

CO’s-PO’s & PSO’s MAPPING

O	O1	O2	O3	O4	O5	O6	O7	O8	O9	O10	O11	O12	SO1	SO2	SO3
1	3	1	2	-	2	-	-	-	-	3	-	2	2	2	-
2	3	1	2	-	2	-	-	-	-	3	-	2	2	2	-
3	3	1	2	-	2	-	-	-	-	3	-	2	2	2	-
4	3	1	2	-	2	-	-	-	-	3	-	2	2	2	-
5	3	1	2	-	2	-	-	-	-	3	-	2	2	2	-
O	**3**	**1**	**2**	**-**	**2**	**-**	**-**	**-**	**-**	**3**	**-**	**2**	**2**	**2**	**-**

1 - low, 2 - medium, 3 - high, ‘-' - no correlation

21153S26A

CIRCUIT ANALYSIS

L T P C

3 1 0 4

COURSE OBJECTIVES:

- To learn the basic concepts and behaviour of DC and AC circuits.
- To understand various methods of circuit/ network analysis using network theorems.
- To understand the transient and steady state response of the circuits subjected to DC excitations and AC with sinusoidal excitations.
- To learn the concept of coupling in circuits and topologies.

UNIT I DC CIRCUIT ANALYSIS 12

Basic Components of electric Circuits, Charge, current, Voltage and Power, Voltage and Current Sources, Ohms Law, Kirchoff's Current Law, Kirchoff's voltage law, The single Node – Pair Circuit, series and Parallel Connected Independent Sources, Resistors in Series and Parallel, voltage and current division, Nodal analysis, Mesh analysis.

UNIT II NETWORK THEOREM AND DUALITY 12

Useful Circuit Analysis techniques - Linearity and superposition, Thevenin and Norton Equivalent Circuits, Maximum Power Transfer, Delta-Wye Conversion. Duals, Dual circuits. Analysis using dependent current sources and voltage sources

UNIT III SINUSOIDAL STEADY STATE ANALYSIS 12

Sinusoidal Steady – State analysis , Characteristics of Sinusoids, The Complex Forcing Function, The Phasor, Phasor relationship for R, L, and C, impedance and Admittance, Nodal and Mesh Analysis, Phasor Diagrams, AC Circuit Power Analysis, Instantaneous Power, Average Power,apparent Power and Power Factor, Complex Power.

UNIT IV TRANSIENTS AND RESONANCE IN RLC CIRCUITS 12

Basic RL and RC Circuits, The Source- Free RL Circuit, The Source-Free RC Circuit, The Unit-Step Function, Driven RL Circuits, Driven RC Circuits, RLC Circuits, Frequency Response, Parallel Resonance, Series Resonance, Quality Factor.

UNIT V COUPLED CIRCUITS AND TOPOLOGY 12

Magnetically Coupled Circuits, mutual Inductance, the Linear Transformer, the Ideal Transformer, Anintroduction to Network Topology, Trees and General Nodal analysis, Links and Loop analysis.

SUGGESTED ACTIVITIES:

- Practice solving variety of problems

COURSE OUTCOMES

On successful completion of this course, the student will be able to

CO1: Apply the basic concepts of circuit analysis such as Kirchoff's laws, mesh current andnode voltage method for analysis of DC and AC circuits.

CO2: Apply suitable network theorems and analyze AC and DC circuits

CO3: Analyze steady state response of any R, L and C circuits

CO4: Analyze the transient response for any RC, RL and RLC circuits and frequency responseof parallel and series resonance circuits.

CO5: Analyze the coupled circuits and network topologies

TOTAL: 60 PERIODS

TEXT BOOKS:

1. Hayt Jack Kemmerly, Steven Durbin, "Engineering Circuit Analysis",Mc Graw Hill education,9th Edition, 2018.
2. Charles K. Alexander & Mathew N.O.Sadiku, "Fundamentals of Electric Circuits", Mc Graw-Hill, 2nd Edition, 2003.
3. Joseph Edminister and Mahmood Nahvi, ―Electric Circuits, Schaum‘s Outline Series, Tata McGraw Hill Publishing Company, New Delhi, Fifth Edition Reprint 2016.

REFERENCES:

1. Robert.L. Boylestead, "Introductory Circuit Analysis", Pearson Education India, 12th Edition, 2014. David Bell, "Fundamentals of Electric Circuits", Oxford University press, 7thEdition, 2009.
2. John O Mallay, Schaum’s Outlines "Basic Circuit Analysis", The Mc Graw Hill companies, 2nd Edition, 2011
3. Allan H.Robbins, Wilhelm C.Miller, “Circuit Analysis Theory and Practice", Cengage Learning, Fifth Edition, 1st Indian Reprint 2013

CO’s-PO’s & PSO’s MAPPING

O	O1	O2	O3	O4	O5	O6	O7	O8	O9	O10	O11	O12	SO1	SO2	SO3
1	3	2	1	1	-	-	-	1		1	-	-	-	-	-
2	3	3	2	2	-	-	-	1		1	-	-	-	-	-
3	3	3	3	3	-	-	-	1		1	-	-	-	-	-
4	3	3	3	3	-	-	-	1		1	-	-	-	-	-
5	3	3	3	2	-	-	-	1		1	-	-	-	-	-
O	**3**	**3**	**3**	**2**	**-**	**-**	**-**	**1**		**1**	**-**	**-**	**-**	**-**	**-**

1 - low, 2 - medium, 3 - high, ‘-' - no correlation

21154L21

ENGINEERING PRACTICES LABORATORY

L T P C
0 0 4 2

COURSE OBJECTIVES:

The main learning objective of this course is to provide hands on training to the students in:

- Drawing pipe line plan; laying and connecting various pipe fittings used in common household plumbing work; Sawing; planing; making joints in wood materials usedin commonhousehold wood work.
- Wiring various electrical joints in common household electrical wire work.
- Welding various joints in steel plates using arc welding work; Machining various simple processes like turning, drilling, tapping in parts; Assembling simple mechanical assembly of common household equipments; Making a tray out of

metal sheet using sheet metal work.

- Soldering and testing simple electronic circuits; Assembling and testing simple electronic components on PCB.

GROUP – A (CIVIL & ELECTRICAL)

PART I CIVIL ENGINEERING PRACTICES 15

PLUMBING WORK:

a) Connecting various basic pipe fittings like valves, taps, coupling, unions, reducers,elbows and other components which are commonly used in household.
b) Preparing plumbing line sketches.
c) Laying pipe connection to the suction side of a pump
d) Laying pipe connection to the delivery side of a pump.
e) Connecting pipes of different materials: Metal, plastic and flexiblepipes used inhousehold appliances.

WOOD WORK:

a) Sawing,
b) Planing and
c) Making joints like T-Joint, Mortise joint and Tenon joint and Dovetail joint.

Wood Work Study:

a) Studying joints in door panels and wooden furniture
b) Studying common industrial trusses using models.

PART II ELECTRICAL ENGINEERING PRACTICES 15

a) Introduction to switches, fuses, indicators and lamps - Basic switch board wiring with lamp, fan and three pin socket
b) Staircase wiring
c) Fluorescent Lamp wiring with introduction to CFL and LED types.
d) Energy meter wiring and related calculations/ calibration
e) Study of Iron Box wiring and assembly
f) Study of Fan Regulator (Resistor type and Electronic type using Diac/Triac/quadrac)
g) Study of emergency lamp wiring/Water heater

GROUP – B (MECHANICAL AND ELECTRONICS)

PART III MECHANICAL ENGINEERING PRACTICES 15

WELDING WORK:

a) Welding of Butt Joints, Lap Joints, and Tee Joints using arc welding.
b) Practicing gas welding.

BASIC MACHINING WORK:

a) (simple)Turning.
b) (simple)Drilling.
c) (simple)Tapping.

ASSEMBLY WORK:

a) Assembling a centrifugal pump.
b) Assembling a household mixer.
c) Assembling an airconditioner.

SHEET METAL WORK:

a) Making of a square tray

FOUNDRY WORK:

a) Demonstrating basic foundry operations.

PART IV ELECTRONIC ENGINEERING PRACTICES 15

SOLDERING WORK:

a) Soldering simple electronic circuits and checking continuity.

ELECTRONIC ASSEMBLY AND TESTING WORK:

a) Assembling and testing electronic components on a small PCB.

ELECTRONIC EQUIPMENT STUDY:

a) Study an elements of smart phone..
b) Assembly and dismantle of LED TV.
c) Assembly and dismantle of computer/ laptop

COURSE OUTCOMES:

Upon completion of this course, the students will be able to:TOTAL: 60 PERIODS

CO1:Draw pipe line plan; lay and connect various pipe fittings used in common household plumbingwork; Saw; plan; make joints in wood materials used in common household wood work.

CO2:Wire various electrical joints in common household electrical wire work.

CO3:Weld various joints in steel plates using arc welding work; Machine various simple processes like turning, drilling, tapping in parts; Assemble simple mechanical assembly of common household equipments; Make a tray out of metal sheet using sheet metal work.

CO4:Solder and test simple electronic circuits; Assemble and test simple electronic components on PCB.

CO's-PO's & PSO's MAPPING

O	O1	O2	O3	O4	O5	O6	O7	O8	O9	O10	O11	O12	SO1	SO2	SO3
1	3	2	-	-	1	1	1	-	-	-	-	2	2	1	1
2	3	2	-	-	1	1	1	-	-	-	-	2	2	1	1
3	3	2	-	-	1	1	1	-	-	-	-	2	2	1	1
O	3	2	-	-	1	1	1	-	-	-	-	2	2	1	1

1 - low, 2 - medium, 3 - high, '-' - no correlation

21153L22A

CIRCUIT ANALYSIS LABORATORY

L T P C
0 0 2 1

COURSE OBJECTIVES:

- To gain hands- on experience in Thevenin & Norton theorem, KVL & KCL, andSuperposition Theorems.
- To understand the working of RL,RC and RLC circuits

List of Experiments:

1. Verifications of KVL & KCL.
2. Verifications of Thevenin & Norton theorem.
3. Verification of Superposition Theorem.
4. Verification of maximum power transfer Theorem
5. Determination of Resonance Frequency of Series & Parallel RLC Circuits.
6. Transient analysis of RL and RC circuits.

TOTAL : 30 PERIODS

COURSE OUTCOMES:

At the end of the course, the student will be able to

- Design RL and RC circuits.
- Verify Thevinin & Norton theorem KVL & KCL, and Super Position Theorems.

TEXT BOOKS

1. Hayt JackKemmerly, Steven Durbin, "Engineering Circuit Analysis", McGraw Hill education,9th Edition, 2018.
2. Charles K. Alexander & Mathew N.O.Sadiku, "Fundamentals of Electric Circuits", McGraw- Hill, 2nd Edition, 2003.
3. Joseph Edminister and Mahmood Nahvi, “Electric Circuits, Schaum‘s Outline Series”, Tata McGraw Hill Publishing Company, New Delhi, Fifth Edition Reprint 2016.

REFERENCES

1. David Bell, "Fundamentals of Electric Circuits", Oxford University press, 7th Edition, 2009
2. John O Mallay, Schaum’s Outlines "Basic Circuit Analysis", The Mc Graw Hill companies, 2ndEdition, 2011.
3. A.Bruce Carlson, “Cicuits: Engineering Concepts and Analysis of Linear Electric Circuits,Cengage Learning, India Edition 2nd Indian Reprint 2009.
4. Allan H.Robbins, Wilhelm C.Miller, “Circuit Analysis Theory and Practice”, Cengage Learning, Fifth Edition, 1st Indian Reprint 2013

CO’s-PO’s & PSO’s MAPPING

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	SO1	SO2	SO3
1	3	2	1	1	-	-	-	1	-	1	-	-	-	-	-
2	3	3	2	2	-	-	-	1	-	1	-	-	-	-	-
3	3	3	3	3	-	-	-	1	-	1	-	-	-	-	-
4	3	3	3	3	-	-	-	1	-	1	-	-	-	-	-
5	3	3	3	2	-	-	-	1	-	1	-	-	-	-	-

CO	3	3	3	2	-	-	-	1	-	1	-	-	-	-	-

1 - low, 2 - medium, 3 - high, '-' - no correlation

21147L23

COMMUNICATION LABORATORY **L T P C**

0 0 4 2

COURSE OBJECTIVES:

- To identify varied group discussion skills and apply them to take part in effective discussions in a professional context.
- To analyse concepts and problems and make effective presentations explaining them clearly and precisely.
- To be able to communicate effectively through formal and informal writing.
- To be able to use appropriate language structures to write emails, reports and essays
- To give instructions and recommendations that are clear and relevant to the context

UNIT I **12**

Speaking-Role Play Exercises Based on Workplace Contexts, - talking about competition- discussing progress toward goals-talking about experiences- talking about events in life- discussing past events-Writing: writing emails (formal & semi-formal).

UNIT II **12**

Speaking: discussing news stories-talking about frequency-talking about travel problems- discussingtravel procedures- talking about travel problems- making arrangements-describing arrangements- discussing plans and decisions- discussing purposes and reasons-understanding common technology terms-Writing: - writing different types of emails.

UNIT III **12**

Speaking: discussing predictions-describing the climate-discussing forecasts and scenarios- talking about purchasing-discussing advantages and disadvantages- making comparisons- discussing likes and dislikes- discussing feelings about experiences-discussing imaginary scenarios Writing: short essays and reports-formal/semi-formal letters.

UNIT IV **12**

Speaking: discussing the natural environment-describing systems-describing position and movement- explaining rules-(example- discussing rental arrangements)- understanding technical instructions-Writing: writing instructions-writing a short article.

UNIT V **12**

Speaking: describing things relatively-describing clothing-discussing safety issues(making recommendations) talking about electrical devices-describing controlling actions-Writing:

job application(Cover letter + Curriculum vitae)-writing recommendations.

TOTAL: 60 PERIODS

LEARNING OUTCOMES

CO1:Speak effectively in group discussions held in formal/semi formal contexts.

CO2:Discuss, analyse and present concepts and problems from various perspectives to arrive atsuitable solutions

CO3:Write emails, letters and effective job applications.

CO4:Write critical reports to convey data and information with clarity and precision

CO5:Give appropriate instructions and recommendations for safe execution of tasks

Assessment Pattern

- One online / app based assessment to test speaking and writing skills
- Proficiency certification is given on successful completion of speaking and writing.

CO's-PO's & PSO's MAPPING

CO	PO	O2	O3	O4	O5	O6	O7	O8	O9	O10	O11	O12	O1	O2	O3
1	2	3	3	3	1	3	3	3	3	3	3	3	-	-	
2	2	3	3	3	1	3	3	3	3	3	3	3	-	-	
3	2	2	3	3	1	3	3	3	3	3	3	3	-	-	
4	3	3	3	3	3	3	3	3	3	3	3	3	-	-	
5	3	3	3	3	3	3	3	3	3	3	3	3	-	-	
Vg.	**2.**	**2.8**	**3**	**3**	**1.8**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**-**	**-**	

1-low, 2-medium, 3-high, '-"- no correlation

- **Note:** The average value of this course to be used for program articulation matrix.

21148S31B RANDOM PROCESSES AND LINEAR ALGEBRA L T P C

3 1 0 4

COURSE OBJECTIVES :

- To introduce the basic notions of vector spaces which will then be used to solve related problems.
- To understand the concepts of vector space, linear transformations , inner product spaces and orthogonalization..
- To provide necessary basic concepts in probability and random processes for applications such as random signals, linear systems in communication engineering.
- To provide necessary basics in probability that are relevant in applications such as random signals, linear systems in communication engineering.
- To understand the basic concepts of probability, one and two dimensional random
- variables and to introduce some standard distributions applicable to engineering which can describe real life phenomenon.

UNIT - I PROBABILITY AND RANDOM VARIABLES 9 + 3

Axioms of probability – Conditional probability – Baye's theorem - Discrete and continuous random variables – Moments – Moment generating functions – Binomial, Poisson, Geometric, Uniform, Exponential and Normal distributions - Functions of a random variable.

UNIT - II TWO - DIMENSIONAL RANDOM VARIABLES 9 + 3

Joint distributions – Marginal and conditional distributions – Covariance – Correlation and linear regression – Transformation of random variables – Central limit theorem (for independent and identically distributed random variables).

UNIT – III RANDOM PROCESSES 9 + 3

Classification – Stationary process – Markov process - Poisson process - Discrete parameter Markov chain – Chapman Kolmogorov equations (Statement only) - Limiting distributions .

UNIT - IV VECTOR SPACES 9 + 3

Vector spaces – Subspaces – Linear combinations and linear system of equations – Linear independence and linear dependence – Bases and dimensions.

UNIT - V LINEAR TRANSFORMATION AND INNER PRODUCT SPACES 9 + 3

Linear transformation - Null spaces and ranges - Dimension theorem - Matrix representation of a linear transformations - Inner product - Norms - Gram Schmidt orthogonalization process - Adjoint of linear operations - Least square approximation.

TOTAL: 60 PERIODS

COURSE OUTCOMES :

Upon successful completion of the course, students will be able to:

CO1:Explain the fundamental concepts of advanced algebra and their role in modern mathematics and applied contexts.

CO2:Demonstrate accurate and efficient use of advanced algebraic techniques.

CO3:Apply the concept of random processes in engineering disciplines.

CO4:Understand the fundamental concepts of probability with a thorough knowledge of standarddistributions that can describe certain real-life phenomenon.

CO5: Understand the basic concepts of one and two dimensional random variables and appl ythem to model engineering problems.

TEXTBOOKS :

1. Gross, D., Shortle, J.F, Thompson, J.M and Harris. C.M., “Fundamentals of Queueing Theory", Wiley Student 4th Edition, 2014.
2. Ibe, O.C., “Fundamentals of Applied Probability and Random Processes", Elsevier,1st Indian Reprint, 2007.
3. Friedberg. A.H., Insel. A.J. and Spence. L., “Linear Algebra”, Prentice Hall of India, New Delhi,4th Edition, 2004.

REFERENCES :

1. Hsu, "Schaum’s Outline of Theory and Problems of Probability, Random Variables and Random Processes", Tata McGraw Hill Edition, New Delhi, 2004.

2. Trivedi, K.S., "Probability and Statistics with Reliability, Queueing and Computer Science Applications", 2nd Edition, John Wiley and Sons, 2002.
3. Yates, R.D. and Goodman. D. J., "Probability and Stochastic Processes", 2nd Edition, WileyIndia Pvt. Ltd., Bangalore, 2012.
4. Kolman. B. Hill. D.R., "Introductory Linear Algebra", Pearson Education, New Delhi, FirstReprint, 2009.
5. Kumaresan. S., "Linear Algebra – A Geometric Approach", Prentice – Hall of India, New Delhi, Reprint, 2010.
6. Strang. G., "Linear Algebra and its applications", Thomson (Brooks/Cole), New Delhi, 2005.

CO's-PO's & PSO's MAPPING

O	O1	O2	O3	O4	O5	O6	O7	O8	O9	O10	O11	O12	SO1	SO2	SO3
O1	3	3	0	0	0	0	0	0	3	0	0	2	-	-	-
O2	3	3	0	0	0	0	0	0	3	0	0	2	-	-	-
O3	3	3	0	0	0	0	0	0	3	0	0	2	-	-	-
O4	3	3	0	0	0	0	0	0	3	0	0	2	-	-	-
O5	3	3	0	0	0	0	0	0	3	0	0	2	-	-	-
O6	3	3	0	0	0	0	0	0	3	0	0	2	-	-	-

1 - low, 2 - medium, 3 - high, '-' - no correlation

21152S33 **C PROGRAMMING AND DATA STRUCTURES** **L T**
3 0

COURSE OBJECTIVES:

- To introduce the basics of C programming language.
- To learn the concepts of advanced features of C.
- To understand the concepts of ADTs and linear data structures.
- To know the concepts of non-linear data structure and hashing.
- To familiarize the concepts of sorting and searching techniques.

UNIT I C PROGRAMMING FUNDAMENTALS (8+1 SKILL) 9

Data Types - Variables - Operations - Expressions and Statements - Conditional Statements - Functions - Recursive Functions - Arrays - Single and Multi-Dimensional Arrays.

UNIT II C PROGRAMMING - ADVANCED FEATURES (8+1 SKILL) 9

Structures – Union – Enumerated Data Types – Pointers: Pointers to Variables, Arrays and Functions – File Handling – Preprocessor Directives.

UNIT III LINEAR DATA STRUCTURES (8+1 SKILL) 9

Abstract Data Types (ADTs) - List ADT - Array-Based Implementation - Linked List - Doubly-Linked Lists - Circular Linked List - Stack ADT - Implementation of Stack - Applications - Queue ADT - Priority Queues - Queue Implementation - Applications.

UNIT IV NON-LINEAR DATA STRUCTURES (8+1 SKILL) 9

Trees - Binary Trees - Tree Traversals - Expression Trees - Binary Search Tree - Hashing - Hash Functions - Separate Chaining - Open Addressing - Linear Probing- Quadratic Probing - Double

Hashing – Rehashing.

UNIT V SORTING AND SEARCHING TECHNIQUES (8+1 SKILL) 9

Insertion Sort – Quick Sort – Heap Sort – Merge Sort -Linear Search – Binary Search.

TOTAL: 45 PERIODS

SKILL DEVELOPMENT ACTIVITIES (Group Seminar/Mini Project/Assignment/Content Preparation / Quiz/ Surprise Test / Solving GATE questions/ etc) 5

COURSE OUTCOMES:

CO1:Develop C programs for any real world/technical application.

CO2:Apply advanced features of C in solving problems.

CO3:Write functions to implement linear and non–linear data structure operations.

CO4: Suggest and use appropriate linear/non–linear data structure operations for solving a givenproblem.

CO5:Appropriately use sort and search algorithms for a given application.

CO6:Apply appropriate hash functions that result in a collision free scenario for datastorage andretrieval.

TEXT BOOKS:

1. Mark Allen Weiss, "Data Structures and Algorithm Analysis in C", Second Edition, PearsonEducation, 1997.
2. ReemaThareja, "Programming in C", Second Edition, Oxford University Press, 2016.

REFERENCES:

1. Brian W. Kernighan, Rob Pike, "The Practice of Programming", Pearson Education, 1999.
2. Paul J. Deitel, Harvey Deitel, "C How to Program", Seventh Edition, Pearson Education, 2013.
3. Alfred V. Aho, John E. Hopcroft, Jeffrey D. Ullman, "Data Structures and Algorithms", Pearson Education,1983.
4. Ellis Horowitz, SartajSahni and Susan Anderson, "Fundamentals of Data Structures", Galgotia, 2008.

List of Open Source Software/ Learning website:

https://www.coursera.org/specializations/data-structures-algorithms

https://nptel.ac.in/courses/112107243 https://nptel.ac.in/courses/112105598

CO's-PO's & PSO's MAPPING

CO	O1	O2	O3	O4	O5	O6	O7	O8	O9	O10	O11	O12	SO1	SO2	O3
1	2	3	1	2	2	1	1	-	1	2	1	3	2	1	3
2	1	2	1	2	2	-	-	-	1	1	1	2	2	2	2
3	2	3	1	2	3	-	-	-	1	1	1	2	2	1	2
4	2	1	-	1	1	-	-	-	2	1	1	2	2	3	1
5	1	2	1	2	2	1	1	-	1	2	1	3	2	2	3
CO	2	2	1	2	2	1	1	-	1	1	1	2	2	2	2

1 - low, 2 - medium, 3 - high, '-' - no correlation

21152C35 **SIGNALS AND SYSTEMS** **L T P C**

3 1 0 4

COURSE OBJECTIVES :

- To understand the basic properties of signal & systems
- To know the methods of characterization of LTI systems in time domain
- To analyze continuous time signals and system in the Fourier and Laplace domain
- To analyze discrete time signals and system in the Fourier and Z transform domain

UNIT I CLASSIFICATION OF SIGNALS AND SYSTEMS 6+6

Standard signals- Step, Ramp, Pulse, Impulse, Real and complex exponentials and Sinusoids_Classification of signals – Continuous time (CT) and Discrete Time (DT) signals, Periodic & Aperiodic signals, Deterministic & Random signals, Energy & Power signals - Classification of systems- CT systems and DT systems- – Linear & Nonlinear, Time-variant& Time-invariant,Causal & Non-causal, Stable & Unstable.

UNIT II ANALYSIS OF CONTINUOUS TIME SIGNALS 6+6

Fourier series for periodic signals - Fourier Transform – properties- Laplace Transforms andProperties

UNIT III LINEAR TIME INVARIANT CONTINUOUS TIME SYSTEMS 6+6

Impulse response - convolution integrals- Differential Equation- Fourier and Laplace transforms in Analysis of CT systems - Systems connected in series / parallel.

UNIT IV ANALYSIS OF DISCRETE TIME SIGNALS 6+6

Baseband signal Sampling–Fourier Transform of discrete time signals (DTFT)– Properties of DTFT - Z Transform & Properties

UNIT V LINEAR TIME INVARIANT-DISCRETE TIME SYSTEMS 6+6

Impulse response–Difference equations-Convolution sum- Discrete Fourier Transform and Z Transform Analysis of Recursive & Non-Recursive systems-DT systems connected in series and parallel.

TOTAL: 30+30 PERIODS

COURSE OUTCOMES:

At the end of the course, the student will be able to:

CO1:determine if a given system is linear/causal/stable

CO2: determine the frequency components present in a deterministic signal

CO3:characterize continuous LTI systems in the time domain and frequency domain

CO4:characterize discrete LTI systems in the time domain and frequency domain

CO5:compute the output of an LTI system in the time and frequency domains

TEXT BOOKS:

1. Oppenheim, Willsky and Hamid, “Signals and Systems”, 2nd Edition, Pearson Education, New Delhi, 2015.(Units I - V)
2. Simon Haykin, Barry Van Veen, “Signals and Systems”, 2nd Edition, Wiley, 2002

REFERENCES :

1. B. P. Lathi, “Principles of Linear Systems and Signals”, 2nd Edition, Oxford, 2009.
2. M. J. Roberts, “Signals and Systems Analysis using Transform methods and MATLAB”, McGraw- Hill Education, 2018.
3. John Alan Stuller, “An Introduction to Signals and Systems”, Thomson, 2007.

CO’s-PO’s & PSO’s MAPPING

CO	O1	O2	O3	O4	O5	O6	O7	O8	O9	O10	O11	O12	SO1	SO2	SO3
1	3	-	3	-	3	2	-	-	-	-	-	3	-	-	1
2	3	-	3	-	-	2	-	-	-	-	-	3	-	3	-
3	3	3	-	-	3	2	-	-	-	-	-	3	2	-	-
4	3	3	-	-	3	2	-	-	-	-	-	3	-	3	1
5	3	3	-	3	3	2	-	-	-	-	-	3	-	3	1
CO	**3**	**3**	**3**	**3**	**3**	**2**	**-**	**-**	**-**	**-**	**-**	**3**	**2**	**3**	**1**

1 - low, 2 - medium, 3 - high, ‘-' - no correlation

21152C36 ELECTRONIC DEVICES AND CIRCUITS L T P C 3 0 0 3

COURSE OBJECTIVES :

- To give a comprehensive exposure to all types of devices and circuits constructed with discrete components. This helps to develop a strong basis for building linear and digital integrated circuits
- To analyze the frequency response of small signal amplifiers
- To design and analyze single stage and multistage amplifier circuits
- To study about feedback amplifiers and oscillators principles
- To understand the analysis and design of multi vibrators

UNIT I SEMICONDUCTOR DEVICES 9

PN junction diode, Zener diode, BJT, MOSFET, UJT –structure, operation and V-I characteristics, diffusion and transition capacitance - Rectifiers – Half Wave and Full Wave Rectifier, Zener as regulator

UNIT II AMPLIFIERS 9

Load line, operating point, biasing methods for BJT and MOSFET**,** BJT small signal model – Analysis of CE, CB, CC amplifiers- Gain and frequency response –MOSFET small signal model– Analysis of CS, CG and Source follower – Gain and frequency response- High frequency analysis.

UNIT III MULTISTAGE AMPLIFIERS AND DIFFERENTIAL AMPLIFIER 9

Cascode amplifier, Differential amplifier – Common mode and Difference mode analysis –

MOSFET input stages – tuned amplifiers – Gain and frequency response – Neutralization methods.

UNIT IV FEEDBACK AMPLIFIERS AND OSCILLATORS 9

Advantages of negative feedback – Voltage / Current, Series , Shunt feedback Amplifiers –positive feedback–Condition for oscillations, phase shift – Wien bridge, Hartley, Colpitts and Crystal oscillators.

UNIT V POWER AMPLIFIERS AND DC/DC CONVERTERS 9

Power amplifiers- class A-Class B-Class AB-Class C-Power MOSFET-Temperature Effect- ClassAB Power amplifier using MOSFET –DC/DC convertors – Buck, Boost, Buck-Boost analysis and design.

TOTAL: 45 PERIODS

COURSE OUTCOMES :

At the end of the course the students will be able to

CO1: Explain the structure and working operation of basic electronic devices.

CO2: Design and analyze amplifiers.

CO3: Analyze frequency response of BJT and MOSFET amplifiers **CO4**: Design and analyze feedback amplifiers and oscillator principles.**CO5**: Design and analyze power amplifiers and supply circuits

TEXT BOOKS :

1. David A. Bell, "Electronic Devices and Circuits", Oxford Higher Education press, 5 th Edition,2010.
2. Robert L. Boylestad and Louis Nasheresky, "Electronic Devices and Circuit Theory", 10thEdition, Pearson Education / PHI, 2008.
3. Adel .S. Sedra, Kenneth C. Smith, "Micro Electronic Circuits", Oxford University Press, 7 th Edition, 2014.REFERENCES :
1. Donald.A. Neamen, "Electronic Circuit Analysis and Design", Tata McGraw Hill, 3 rd Edition, 2010.
2. D.Schilling and C.Belove, "Electronic Circuits", McGraw Hill, 3 rd Edition, 1989
3. Muhammad H.Rashid, "Power Electronics", Pearson Education / PHI , 2004.

CO's-PO's & PSO's MAPPING

CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PO12	PSO 1	PSO 2	PSO 3
1	3	3	3	3	2	1	-	-	-	-	-	1	2	1	1
2	3	2	2	3	2	2	-	-	-	-	-	1	2	1	1
3	3	3	3	2	1	2	-	-	-	-	-	1	2	1	1
4	3	3	2	3	2	2	-	-	-	-	-	1	2	1	1
5	3	2	3	2	2	1	-	-	-	-	-	1	2	1	1
CO	**3**	**3**	**3**	**3**	**2**	**2**	-	-	-	-	-	**1**	**2**	**1**	**1**

1 - low, 2 - medium, 3 - high, '-' - no correlation

221152S32 **CONTROL SYSTEMS** **L T P C**
3 0 0 3

COURSE OBJECTIVES :

- To introduce the components and their representation of control systems
- To learn various methods for analyzing the time response, frequency response and stability of the systems.
- To learn the various approach for the state variable analysis.

UNIT I SYSTEMS COMPONENTS AND THEIR REPRESENTATION 9

Control System: Terminology and Basic Structure-Feed forward and Feedback control theory- Electrical and Mechanical Transfer Function Models-Block diagram Models-Signal flow graphs models-DC and AC servo Systems-Synchronous -Multivariable control system

UNIT II TIME RESPONSE ANALYSIS 9

Transient response-steady state response-Measures of performance of the standard first order and second order system-effect on an additional zero and an additional pole-steady error constant and system- type number-PID control-Analytical design for PD, PI,PID control systems

UNIT III FREQUENCY RESPONSE AND SYSTEM ANALYSIS 9

Closed loop frequency response-Performance specification in frequency domain-Frequency response of standard second order system- Bode Plot - Polar Plot- Nyquist plots-Design of compensators using Bode plots-Cascade lead compensation-Cascade lag compensation-Cascade lag-lead compensation

UNIT IV CONCEPTS OF STABILITY ANALYSIS 9

Concept of stability-Bounded - Input Bounded - Output stability-Routh stability criterion-Relative stability-Root locus concept-Guidelines for sketching root locus-Nyquist stability criterion.

UNIT V CONTROL SYSTEM ANALYSIS USING STATE VARIABLE METHODS 9

State variable representation-Conversion of state variable models to transfer functions-Conversion of transfer functions to state variable models-Solution of state equations-Concepts of Controllability and Observability-Stability of linear systems-Equivalence between transfer function and state variable representations-State variable analysis of digital control system-Digital control design using state feedback.

TOTAL:45 PERIODS

COURSE OUTCOMES :

Upon successful completion of the course the student will be able toCO1:
Compute the transfer function of different physical systems.

CO2: Analyse the time domain specification and calculate the steady state error.

CO3: Illustrate the frequency response characteristics of open loop and closed loop system response.

CO4: Analyse the stability using Routh and root locus techniques.

CO5: Illustrate the state space model of a physical system and discuss the concepts of sampleddata control system.

TEXT BOOK:

1. M.Gopal,"Control System – Principles and Design", Tata McGraw Hill, 4th Edition, 2012.

REFERENCE:

1. J.Nagrath and M.Gopal, "Control System Engineering", New Age International Publishers, 5thEdition, 2007.
2. K.Ogata, "Modern Control Engineering", PHI, 5th Edition, 2012.
3. S.K.Bhattacharya, "Control System Engineering", Pearson, 3rd Edition, 2013.
4. Benjamin.C.Kuo, "Automatic Control Systems", Prentice Hall of India, 7th Edition,1995.

CO's-PO's & PSO's MAPPING

CO	O1	O2	O3	O4	O5	O6	O7	O8	O9	O10	O11	O12	SO1	SO2	SO3
1	3	3	3	2	2	2	-	-	-	-	2	3	3	3	3
2	3	3	3	3	2	3	-	-	-	-	2	2	3	3	3
3	3	2	3	3	2	2	-	-	-	-	2	3	3	2	3
4	3	3	3	2	2	2	-	-	-	-	2	2	3	3	3
5	2	2	3	3	2	3	-	-	-	-	2	3	2	2	3
CO	3	3	3	3	2	2	-	-	-	-	2	3	3	3	3

1 - low, 2 - medium, 3 - high, '-' - no correlation

21152C34 DIGITAL SYSTEMS DESIGN L T P C

3 0 2 4

COURSE OBJECTIVES :

- To present the fundamentals of digital circuits and simplification methods
- To practice the design of various combinational digital circuits using logic gates
- To bring out the analysis and design procedures for synchronous and asynchronous Sequential circuits
- To learn integrated circuit families.
- To introduce semiconductor memories and related technology

UNIT I BASIC CONCEPTS 9

Review of number systems-representation-conversions, Review of Boolean algebra-theorems, sum of product and product of sum simplification, canonical forms min term and max term, Simplification of Boolean expressions-Karnaugh map, completely and incompletely specified functions, Implementation of Boolean expressions using universal gates ,Tabulation methods.

UNIT II COMBINATIONAL LOGIC CIRCUITS 9

Problem formulation and design of combinational circuits - Code-Converters, Half and Full

Adders, Binary Parallel Adder – Carry look ahead Adder, BCD Adder, Magnitude Comparator, Decoder, Encoder, Priority Encoder, Mux/Demux, Case study: Digital trans-receiver / 8 bit Arithmetic and logic unit, Parity Generator/Checker, Seven Segment display decoder

UNIT III SYNCHRONOUS SEQUENTIAL CIRCUITS 9

Latches, Flip flops – SR, JK, T, D, Master/Slave FF, Triggering of FF, Analysis and design of clocked sequential circuits – Design - Moore/Mealy models, state minimization, state assignment,lock - out condition circuit implementation - Counters, Ripple Counters, Ring Counters, Shift registers, Universal Shift Register. Model Development: Designing of rolling display/real time clock

UNIT IV ASYNCHRONOUS SEQUENTIAL CIRCUITS 9

Stable and Unstable states, output specifications, cycles and races, state reduction, race free assignments, Hazards, Essential Hazards, Fundamental and Pulse mode sequential circuits, Design of Hazard free circuits.

UNIT V LOGIC FAMILIES AND PROGRAMMABLE LOGIC DEVICES 9

Logic families- Propagation Delay, Fan - In and Fan - Out - Noise Margin - RTL ,TTL,ECL, CMOS - Comparison of Logic families - Implementation of combinational logic/sequential logic design using standard ICs, PROM, PLA and PAL, basic memory, static ROM,PROM,EPROM,EEPROM EAPROM.

45 PERIODS

PRACTICAL EXERCISES : 30 PERIODS

1. Design of adders and subtractors & code converters.
2. Design of Multiplexers & Demultiplexers.
3. Design of Encoders and Decoders.
4. Design of Magnitude Comparators
5. Design and implementation of counters using flip-flops
6. Design and implementation of shift registers.

COURSE OUTCOMES :

At the end of the course the students will be able to

CO1: Use Boolean algebra and simplification procedures relevant to digital logic.
CO2: Design various combinational digital circuits using logic gates.
CO3:Analyse and design synchronous sequential circuits. **CO4**: Analyse and design asynchronous sequential circuits. .**CO5**: Build logic gates and use programmable devices

TOTAL:75 PERIODS

TEXTBOOKS :

1. M. Morris Mano and Michael D. Ciletti, ‘Digital Design’, Pearson, 5th Edition, 2013.(Unit - I -V)

REFERENCES :

1. Charles H. Roth, Jr, 'Fundamentals of Logic Design', Jaico Books, 4th Edition, 2002.
2. William I. Fletcher, "An Engineering Approach to Digital Design", Prentice- Hall of India,1980.
3. Floyd T.L., "Digital Fundamentals", Charles E. Merril publishing company,1982.
4. John. F. Wakerly, "Digital Design Principles and Practices", Pearson Education, 4 th Edition,2007.

CO's-PO's & PSO's MAPPING

	O1	O2	O3	O4	O5	O6	O7	O8	O9	O10	O11	O12	SO1	SO2	SO3
1	3	2	2	2	-	2	-	-	-	-	3	3	3	3	2
2	-	-	-	-	-	-	-	-	-	-	2	1	2	3	2
3	-	3	3	2	-	2	-	-	-	-	2	2	3	3	2
4	-	-	-	-	-	-	-	-	-	-	3	2	2	3	1
5	-	3	3	3	-	-	-	-	-	-	2	2	3	3	2
O	**3**	**.6**	**2.6**	**.3**	**-**	**2**	**-**	**-**	**-**	**-**	**2**	**2**	**3**	**3**	**2**

1 - low, 2 - medium, 3 - high, '-' - no correlation

21152L38 ELECTRONIC DEVICES AND CIRCUITS LABORATORY

L T P C
0 0 3 1.5

COURSE OBJECTIVES

- To learn the characteristics of PN Junction diode and Zener diode.
- To understand the operation of rectifiers and filters.
- To study the characteristics of amplifier.

LIST OF EXPERIMENTS

1. Characteristics of PN Junction Diode and Zener diode.
2. Full Wave Rectifier with Filters.
3. Design of Zener diode Regulator.
4. Common Emitter input-output Characteristics.
5. MOSFET Drain current and Transfer Characteristics.
6. Frequency response of CE and CS amplifiers.
7. Frequency response of CB and CC amplifiers.
8. Frequency response of Cascode Amplifier
9. CMRR measurement of Differential Amplifier
10. Class A Transformer Coupled Power Amplifier.

COURSE OUTCOMES

At the end of the laboratory course, the student will be able to understand the

CO1: Characteristics of PN Junction Diode and Zener diode.

CO2: Design and Testing of BJT and MOSFET amplifiers.

CO3: Operation of power amplifiers.

TOTAL:45 PERIODS

REFERENCE :

XYZ of Oscilloscope – Application note: Tektronix USA.

CO's-PO's & PSO's MAPPING

CO	O1	O2	PO	O4	O5	O6	O7	O8	O9	O10	O11	O12	SO1	SO2	SO3
1	2	2	3	3	2	1	-	-	-	-	-	1	2	1	1
2	2	2	3	3	2	1	-	-	-	-	-	1	2	1	1
3	2		2		1	1	-	-	-	-	-	1	2	1	1
4	-	-	-	-	3	1	-	-	-	-	-	1	2	1	1
5	-	-	-	-	2	1	-	-	-	-	-	1	2	1	1
CO	**2**	**2**	2.	**3**	**2**	**1**	-	-	-	-	-	**1**	**2**	**1**	**1**

1 - low, 2 - medium, 3 - high, '-' - no correlation

2L37 **PROGRAMMING AND DATA STRUCTURES LABORATORY** **L T P**
0 0 3 5

COURSE OBJECTIVES:

- To develop applications in C
- To implement linear and non-linear data structures
- To understand the different operations of search trees
- To get familiarized to sorting and searching algorithms

LIST OF EXPERIMENTS

1. Practice of C programming using statements, expressions, decision making and iterative statements
2. Practice of C programming using Functions and Arrays
3. Implement C programs using Pointers and Structures
4. Implement C programs using Files
5. Development of real time C applications
6. Array implementation of List ADT
7. Array implementation of Stack and Queue ADTs
8. Linked list implementation of List, Stack and Queue ADTs
9. Applications of List, Stack and Queue ADTs
10. 10.Implementation of Binary Trees and operations of Binary Trees
11. Implementation of Binary Search Trees
12. Implementation of searching techniques
13. Implementation of Sorting algorithms : Insertion Sort, Quick Sort, Merge Sort
14. Implementation of Hashing – any two collision techniques

TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of the course, the students will be able to:

CO1:Use different constructs of C and develop applications

CO2:Write functions to implement linear and non-linear data structure operations

CO3:Suggest and use the appropriate linear / non-linear data structure operations for a givenproblem

CO4:Apply appropriate hash functions that result in a collision free scenario for data storage andRetrieval

CO5:Implement Sorting and searching algorithms for a given application

CO's-PO's & PSO's MAPPING

CO	O1	O2	O3	O4	O5	O6	O7	O8	O9	O10	O11	O12	SO1	SO2	SO3
1	2	3	1	2	2	1	1	-	1	2	1	3	2	1	3
2	1	2	1	2	2	-	-	-	1	1	1	2	2	2	2
3	2	3	1	2	3	-	-	-	1	1	1	2	2	1	2
4	2	1	-	1	1	-	-	-	2	1	1	2	2	3	1
5	1	2	1	2	2	1	1	-	1	2	1	3	2	2	3
Avg	2	2	1	2	2	1	1	-	1	1	1	2	2	2	2

1 - low, 2 - medium, 3 - high, '-' - no correlation

21152L39 PROFESSIONAL DEVELOPMENT L T P C

0 0 2 1

COURSE OBJECTIVES:

To be proficient in important Microsoft Office tools: MS WORD, EXCEL, POWERPOINT.

- To be proficient in using MS WORD to create quality technical documents, by using standard templates, widely acceptable styles and formats, variety of features to enhance the presentability and overall utility value of content.
- To be proficient in using MS EXCEL for all data manipulation tasks including the common statistical, logical, mathematical etc., operations, conversion, analytics, search and explore, visualize,interlink, and utilizing many more critical features offered
- To be able to create and share quality presentations by using the features of MS PowerPoint, including: organization of content, presentability, aesthetics, using media elements and enhance the overall quality of presentations.

MS WORD: 10 Hours

Create and format a

documentWorking with

tables

Working with Bullets and Lists

Working with styles, shapes, smart art, charts

Inserting objects, charts and importing objects from other office

toolsCreating and Using document templates

Inserting equations, symbols and special characters

Working with Table of contents and References, citationsInsert and review comments

Create bookmarks, hyperlinks, endnotes

footnoteViewing document in different

modes

Working with document protection and

securityInspect document for accessibility

MS EXCEL: 10 Hours

Create worksheets, insert and format data

Work with different types of data: text, currency, date,

numeric etc.Split, validate, consolidate, Convert data

Sort and filter data

Perform calculations and use functions: (Statistical, Logical, Mathematical, date,

Time etc.,)Work with Lookup and reference formulae

Create and Work with different types of

charts Use pivot tables to summarize and

analyse data

Perform data analysis using own formulae and functions

Combine data from multiple worksheets using own formulae and built-in functions to generateresults

Export data and sheets to other file

formatsWorking with macros

Protecting data and Securing the workbook

MS POWERPOINT: 10 Hours

Select slide templates, layout and themes

Formatting slide content and using bullets and

numberingInsert and format images, smart art, tables,

charts

Using Slide master, notes and handout

masterWorking with animation and

transitions Organize and Group slides

Import or create and use media objects: audio, video, animation

Perform slideshow recording and Record narration and create presentable videos

TOTAL: 30 PERIODS

COURSE OUTCOMES:

On successful completion the students will be able to

CO1:Use MS Word to create quality documents, by structuring and organizing content for their dayto day technical and academic requirements

CO2:Use MS EXCEL to perform data operations and analytics, record, retrieve data as per requirements and visualize data for ease of understanding

CO3:Use MS PowerPoint to create high quality academic presentations by including commontables, charts, graphs, interlinking other elements, and using media objects.

21152C41	ELECTROMAGNETIC FIELDS	L T P C
		3 0 0 3

COURSE OBJECTIVES :

- To impart knowledge on the basics of static electric field and the associated laws
- To impart knowledge on the basics of static magnetic field and the associated laws
- To give insight into coupling between electric and magnetic fields through Faraday's law, displacement current and Maxwell's equations
- To gain the behaviour of the propagation of EM waves
- To study the significance of Time varying fields.

UNIT I INTRODUCTION 9

Electromagnetic model, Units and constants, Review of vector algebra, Rectangular, cylindrical andspherical coordinate systems, Line, surface and volume integrals, Gradient of a scalar field, Divergence of a vector field, Divergence theorem, Curl of a vector field, Stoke's theorem, Null identities, Helmholtz's theorem, Verify theorems for different path, surface and volume.

UNIT II ELECTROSTATICS 9

Electric field, Coulomb's law, Gauss's law and applications, Electric potential, Conductors in static electric field, Dielectrics in static electric field, Electric flux density and dielectric constant, Boundary conditions, Electrostatics boundary value problems, Capacitance, Parallel, cylindrical and spherical capacitors, Electrostatic energy, Poisson's and Laplace's equations, Uniqueness of electrostatic solutions, Current density and Ohm's law, Electromotive force and Kirchhoff's voltage law, Equation of continuity and Kirchhoff's current law

UNIT III MAGNETOSTATICS 9

Lorentz force equation, Ampere's law, Vector magnetic potential, Biot-Savart law and applications, Magnetic field intensity and idea of relative permeability, Calculation of magnetic field intensity for various current distributions Magnetic circuits, Behaviour of magnetic materials, Boundary conditions, Inductance and inductors, Magnetic energy, Magnetic forces and torques

UNIT IV TIME-VARYING FIELDS AND MAXWELL's EQUATIONS 9

Faraday's law, Displacement current and Maxwell-Ampere law, Maxwell's equations, Potential functions, Electromagnetic boundary conditions, Wave equations and solutions, Time-harmonic fields, Observing the Phenomenon of wave propagation with the aid of Maxwell's equations

UNIT V PLANE ELECTROMAGNETIC WAVES 9

Plane waves in lossless media, Plane waves in lossy media (low-loss dielectrics and good conductors), Group velocity, Electromagnetic power flow and Poynting vector, Normal incidence at a plane conducting boundary, Normal incidence at a plane dielectric boundary

COURSE OUTCOMES :

At the end of the course the students will be able to

CO1: Relate the fundamentals of vector, coordinate system to electromagnetic concepts
CO2: Analyze the characteristics of Electrostatic field
CO3: Interpret the concepts of Electric field in material space and solve the boundary conditions**CO4**: Explain the concepts and characteristics of Magneto Static field in material space and solve boundary conditions.
CO5: Determine the significance of time varying fields

TOTAL:45 PERIODS

TEXT BOOKS

1. D.K. Cheng, Field and wave electromagnetics, 2nd ed., Pearson (India), 2002
2. M.N.O.Sadiku and S.V. Kulkarni, Principles of electromagnetics, 6th ed., Oxford(Asian Edition), 2015

REFERENCES

1. Edward C. Jordan & Keith G. Balmain,Electromagnetic waves and Radiating Systems, Second Edition, Prentice-Hall Electrical Engineering Series, 2012.
2. W.H. Hayt and J.A. Buck, Engineering electromagnetics, 7th ed., McGraw-Hill (India), 2006
3. B.M. Notaros, Electromagnetics, Pearson: New Jersey, 2011

CO's-PO's & PSO's MAPPING

O	O1	O2	O3	O4	O5	O6	O7	O8	O9	O 10	O 11	12
1	2	1	1	1	-	2	1	-	-	1	-	2
2	2	2	3	3	2	2	2	-	-	1	1	2
3	2	2	3	2	2	2	1	-	-	1	1	2
4	2	2	3	2	2	2	1	-	-	1	1	2
5	2	2	2	2	2	2	1	-	-	2	2	1
CO	**2**	**2**	**2**	**2**	**2**	**2**	**1**	-	-	**1**	**1**	**2**

1 - low, 2 - medium, 3 - high, '-' - no correlation

21152C45 NETWORKS AND SECURITY L T P C

3 0 2 4

COURSE OBJECTIVES:

- To learn the Network Models and datalink layer functions.
- To understand routing in the Network Layer.
- To explore methods of communication and congestion control by the Transport Layer.
- To study the Network Security Mechanisms.
- To learn various hardware security attacks and their countermeasures**.**

UNIT I NETWORK MODELS AND DATALINK LAYER 9

Overview of Networks and its Attributes – Network Models – OSI, TCP/IP, Addressing – Introductionto Datalink Layer – Error Detection and Correction – Ethernet(802.3)- Wireless LAN – IEEE 802.11, Bluetooth – Flow and Error Control Protocols – HDLC – PPP.

UNIT II NETWORK LAYER PROTOCOLS 9

Network Layer – IPv4 Addressing – Network Layer Protocols(IP,ICMP and Mobile IP) Unicast and Multicast Routing – Intradomain and Interdomain Routing Protocols – IPv6 Addresses – IPv6 – Datagram Format **-** Transition from IPv4 to IPv6.

UNIT III TRANSPORT AND APPLICATION LAYERS 9

Transport Layer Protocols – UDP and TCP Connection and State Transition Diagram -

Congestion Control and Avoidance(DEC bit, RED)- QoS - Application Layer Paradigms – Client – Server Programming – Domain Name System – World Wide Web, HTTP, Electronic Mail.

UNIT IV NETWORK SECURITY 9

OSI Security Architecture – Attacks – Security Services and Mechanisms – Encryption – Advanced Encryption Standard – Public Key Cryptosystems – RSA Algorithm – Hash Functions – SecureHash Algorithm – Digital Signature Algorithm.

UNIT V HARDWARE SECURITY 9

Introduction to hardware security, Hardware Trojans, Side – Channel Attacks – Physical Attacks andCountermeasures – Design for Security. Introduction to Blockchain Technology.

45 PERIODS

PRACTICAL EXERCISES: 30 PERIODS

Experiments using C

1. Implement the Data Link Layer framing methods,
   i) Bit stuffing, (ii) Character stuffing
2. Implementation of Error Detection / Correction Techniques
   i) LRC, (ii) CRC, (iii) Hamming code
3. Implementation of Stop and Wait, and Sliding Window Protocols
4. Implementation of Go back-N and Selective Repeat Protocols.
5. Implementation of Distance Vector Routing algorithm (Routing Information Protocol)(Bellman-Ford).
6. Implementation of Link State Routing algorithm (Open Shortest Path First) with 5 nodes(Dijkstra's).
7. Data encryption and decryption using Data Encryption Standard algorithm.
8. Data encryption and decryption using RSA (Rivest, Shamir and Adleman) algorithm.
9. Implement Client Server model using FTP protocol.

Experiments using Tool Command Language

1. Implement and realize the Network Topology - Star, Bus and Ring using NS2.
2. Implement and perform the operation of CSMA/CD and CSMA/CA using NS2.

COURSE OUTCOMES:

Upon successful completion of the course the student will be able toCO1:
Explain the Network Models, layers and functions.

CO2: Categorize and classify the routing protocols.

CO3: List the functions of the transport and application layer.

CO4: Evaluate and choose the network security mechanisms.

CO5: Discuss the hardware security attacks and countermeasures.

TOTAL:75 PERIODS

TEXTBOOKS

1. Behrouz.A.Forouzan, Data Communication and Networking, Fifth Edition, TMH, 2017.(Unit – I,II,III)
2. William Stallings, Cryptography and Network Security, Seventh Edition, Pearson

Education,2017(Unit- IV)
3. Bhunia Swarup, Hardware Security –A Hands On Approach,Morgan Kaufmann, First edition,2018.(Unit – V).

REFERENCES

1. James.F.Kurose and Keith.W.Ross, Computer Networking – A Top – Down Approach, SixthEdition, Pearson, 2017.
2. Doughlas .E.Comer, Computer Networks and Internets with Internet Applications, Fourth Edition, Pearson Education, 2008.

21152C42 LINEAR INTEGRATED CIRCUITS L T P C

3 0 0 3

COURSE OBJECTIVES:

- To introduce the basic building blocks of linear integrated circuits
- To learn the linear and non-linear applications of operational amplifiers
- To introduce the theory and applications of analog multipliers and PLL
- To learn the theory of ADC and DAC
- To introduce the concepts of waveform generation and introduce some special function ICs

UNIT I BASICS OF OPERATIONAL AMPLIFIERS 9

Current mirror and current sources, Current sources as active loads, Voltage sources, Voltage References, BJT Differential amplifier with active loads, Basic information about op-amps – Ideal Operational Amplifier - General operational amplifier stages -and internal circuit diagrams of IC 741, DC and AC performance characteristics, slew rate, Open and closed loop configurations – MOSFET Operational Amplifiers – LF155 and TL082.

UNIT II APPLICATIONS OF OPERATIONAL AMPLIFIERS 9

Sign Changer, Scale Changer, Phase Shift Circuits, Voltage Follower, V-to-I and I-to-V converters, adder, subtractor, Instrumentation amplifier, Integrator, Differentiator, Logarithmic amplifier, Antilogarithmic amplifier, Comparators, Schmitt trigger, Precision rectifier, peak detector, clipper and clamper, Low-pass, high-pass and band-pass Butterworth filters.

UNIT III ANALOG MULTIPLIER AND PLL 9

Analog Multiplier using Emitter Coupled Transistor Pair - Gilbert Multiplier cell – Variable transconductance technique, analog multiplier ICs and their applications, Operation of the basic PLL, Closed loop analysis, Voltage controlled oscillator, Monolithic PLL IC 565, application of PLL for AM detection, FM detection, FSK modulation and demodulation and Frequency synthesizing and clock synchronization

UNIT IV ANALOG TO DIGITAL AND DIGITAL TO ANALOG CONVERTERS 9

Analog and Digital Data Conversions, D/A converter – specifications - weighted resistor type, R-2RLadder type, Voltage Mode and Current-Mode *R - 2R* Ladder types - switches for D/A converters, high speed sample-and-hold circuits, A/D Converters – specifications -

Flash type - Successive Approximation type - Single Slope type – Dual Slope type - A/D Converter using Voltage-to-Time Conversion - Over-sampling A/D Converters, Sigma – Delta converters.

UNIT V WAVEFORM GENERATORS AND SPECIAL FUNCTION ICS 9

Sine-wave generators, Multivibrators and Triangular wave generator, Saw-tooth wave generator, ICL8038 function generator, Timer IC 555, IC Voltage regulators – Three terminal fixed and adjustable voltage regulators - IC 723 general purpose regulator - Monolithic switching regulator, Low Drop – Out(LDO) Regulators - Switched capacitor filter IC MF10, Frequency to Voltage and Voltage to Frequency converters, Audio Power amplifier, Video Amplifier, Isolation Amplifier, Opto-couplers and fibre optic IC

COURSE OUTCOMES:

At the end of the course the students will be able to

CO1 : Design linear and nonlinear applications of OP – AMPS**CO2** : Design applications using analog multiplier and PLL **CO3** : Design ADC and DAC using OP – AMPS

CO4 : Generate waveforms using OP – AMP Circuits
CO5 : Analyze special function ICs

TEXT BOOK

TOTAL:45 PERIODS

1. 1.D.Roy Choudhry, Shail Jain, “Linear Integrated Circuits”, New Age International Pvt. Ltd.,2018, Fifth Edition. (Unit I – V)
2. 2.Sergio Franco, “Design with Operational Amplifiers and Analog Integrated Circuits”, 4thEdition, Tata Mc Graw-Hill, 2016 (Unit I – V)

REFERENCES

1. Ramakant A. Gayakwad, “OP-AMP and Linear ICs”, 4th Edition, Prentice Hall / PearsonEducation, 2015
2. Robert F.Coughlin, Frederick F.Driscoll, “Operational Amplifiers and Linear Integrated Circuits”, Sixth Edition, PHI, 2001.
3. S.Salivahanan & V.S. Kanchana Bhaskaran, “Linear Integrated Circuits”, TMH,2nd Edition, 4th Reprint, 2016.

CO’s-PO’s & PSO’s MAPPING

C	O	O	O	O	O	O	O	O	O	O1	O1	O1	SO	SO	SO
1	2	-	-	-	-	-	-	-	-	-	1	-	2	1	1
2	2	3	3	2	-	-	-	-	-	-	-	-	2	1	1
3	1	-	-	2	-		-	-	-	-	-	-	2	1	1
4	1	-	-	2	-	-	-	-	-	-	-	-	2	1	1
5	1	2	3	3	-	-	-	-	-	-	-	3	2	1	1
C	**.4**	**.5**	**3**	**.2**	-	-	-	-	-	-	**1**	**3**	**2**	**1**	**1**

1 - low, 2 - medium, 3 - high, ‘-' - no correlation

21152C44 **DIGITAL SIGNAL PROCESSING** **L C**
3 4

COURSE OBJECTIVES:

- To learn discrete fourier transform, properties of DFT and its application to linear filtering
- To understand the characteristics of digital filters, design digital IIR and FIR filters and applythese filters to filter undesirable signals in various frequency bands
- To understand the effects of finite precision representation on digital filters
- To understand the fundamental concepts of multi rate signal processing and its applications
- **T**o introduce the concepts of adaptive filters and its application to communication engineering

UNIT I DISCRETE FOURIER TRANSFORM 9

Sampling Theorem, concept of frequency in discrete-time signals, summary of analysis & synthesis equations for FT & DTFT, frequency domain sampling, Discrete Fourier transform (DFT) - deriving DFT from DTFT, properties of DFT - periodicity, symmetry, circular convolution. Linear filtering using DFT. Filtering long data sequences - overlap save and overlap add method. Fast computation of DFT - Radix-2 Decimation-in-time (DIT) Fast Fourier transform (FFT), Decimation-in-frequency (DIF) Fast Fourier transform (FFT). Linear filtering using FFT.

UNIT II INFINITE IMPULSE RESPONSE FILTERS 9

Characteristics of practical frequency selective filters. characteristics of commonly used analog filters - Butterworth filters, Chebyshev filters. Design of IIR filters from analog filters

(LPF, HPF, BPF, BRF) - Approximation of derivatives, Impulse invariance method, Bilinear transformation. Frequency

transformation in the analog domain. Structure of IIR filter - direct form I, direct form II, Cascade, parallel realizations.

UNIT III FINITE IMPULSE RESPONSE FILTERS 9

Design of FIR filters - symmetric and Anti-symmetric FIR filters - design of linear phase FIR filters using Fourier series method - FIR filter design using windows (Rectangular, Hamming and Hanning window), Frequency sampling method. FIR filter structures - linear phase structure, direct form realizations

UNIT IV FINITE WORD LENGTH EFFECTS 9

Fixed point and floating point number representation - ADC - quantization - truncation and rounding - quantization noise - input / output quantization - coefficient quantization error - product quantization error - overflow error - limit cycle oscillations due to product quantization and summation - scaling to prevent overflow.

UNIT V DSP APPLICATIONS 9

Multirate signal processing: Decimation, Interpolation, Sampling rate conversion by a rational factor – Adaptive Filters: Introduction, Applications of adaptive filtering to equalization-DSP Architecture-Fixed and Floating point architecture principles

45 PERIODS

PRACTICAL EXERCISES: 30 PERIODS

MATLAB / EQUIVALENT SOFTWARE PACKAGE/ DSP PROCESSOR BASEDIMPLEMENTATION

1. Generation of elementary Discrete-Time sequences
2. Linear and Circular convolutions
3. Auto correlation and Cross Correlation
4. Frequency Analysis using DFT
5. Design of FIR filters (LPF/HPF/BPF/BSF) and demonstrates the filtering operation
6. Design of Butterworth and Chebyshev IIR filters (LPF/HPF/BPF/BSF) and demonstrate the filtering operations
7. Study of architecture of Digital Signal Processor
8. Perform MAC operation using various addressing modes
9. Generation of various signals and random noise
10. Design and demonstration of FIR Filter for Low pass, High pass, Band pass and Band stop filtering
11. Design and demonstration of Butter worth and Chebyshev IIR Filters for Low pass, High pass, Band pass and Band stop filtering
12. Implement an Up-sampling and Down-sampling operation in DSP Processor

COURSE OUTCOMES:

At the end of the course students will be able to:

CO1: Apply DFT for the analysis of digital signals and systems
CO2: Design IIR and FIR filters
CO3: Characterize the effects of finite precision representation on digital filters
CO4: Design multirate filters
CO5: Apply adaptive filters appropriately in communication systems

TOTAL:75 PERIODS

TEXT BOOKS:

1. 1.John G. Proakis and Dimitris G.Manolakis, Digital Signal Processing – Principles, Algorithms and Applications, Fourth Edition, Pearson Education / Prentice Hall, 2007.
2. 2.A. V. Oppenheim, R.W. Schafer and J.R. Buck, ―Discrete-Time Signal Processing", 8th Indian Reprint, Pearson, 2004.

REFERENCES

1. Emmanuel C. Ifeachor& Barrie. W. Jervis, "Digital Signal Processing", Second Edition, Pearson Education / Prentice Hall, 2002.
2. 2.Sanjit K. Mitra, "Digital Signal Processing – A Computer Based Approach", Tata Mc GrawHill, 2007.
3. 3.Andreas Antoniou, "Digital Signal Processing", Tata Mc Graw Hill, 2006.

CO's-PO's & PSO's MAPPING

O	O1	O2	O3	O4	O5	O6	O7	O8	O9	O10	O11	O12	SO1	SO2	SO3
	3	3	3	3	2	2	-	-	-	-	1	1	3	3	2
	3	3	3	3	2	2	-	-	-	-	1	1	2	2	2
	3	3	**2**	2	2	2	-	-	-	-	1	1	1	2	2
	3	3	2	2	3	1	-	-	-	-	1	1	2	2	3
	3	2	2	2	3	2	-	-	-	-	1	1	2	2	1
O	**3**	**3**	**2**	**2**	**2**	**2**	**-**	**-**	**-**	**-**	**1**	**1**	**2**	**2**	**2**

1 - low, 2 - medium, 3 - high, '-' - no correlation

21152C43 **COMMUNICATION SYSTEMS** **L T P C**

3 0 0 3

COURSE OBJECTIVES:

- To introduce Analog Modulation Schemes
- To impart knowledge in random process
- To study various Digital techniques
- To introduce the importance of sampling & quantization
- To impart knowledge in demodulation techniques
- To enhance the class room teaching using smart connectivity instruments

UNIT I AMPLITUDE MODULATION 9

Review of signals and systems, Time and Frequency domain representation of signals, Principles of Amplitude Modulation Systems- DSB, SSB and VSB modulations. Angle Modulation, Representation of FM and PM signals, Spectral characteristics of angle modulated signals. SSB Generation – Filter and Phase Shift Methods, VSB Generation – Filter Method, Hilbert Transform, Pre-envelope & complex envelope AM techniques, Superheterodyne Receiver.

UNIT II RANDOM PROCESS & SAMPLING 9

Review of probability and random process. Gaussian and white noise characteristics, Noise in amplitude modulation systems, Noise in Frequency modulation systems. Pre-emphasis and De- emphasis, Threshold effect in angle modulation.

ow pass sampling – Aliasing- Signal Reconstruction-Quantization - Uniform & non-uniform quantization - quantization noise - Nyquist criterion- Logarithmic Companding –PAM, PPM, PWM, PCM – TDM, FDM

UNIT III DIGITAL TECHNIQUES 9

Pulse modulation Differential pulse code modulation. Delta modulation, Noise considerations in PCM,, Digital Multiplexers, Channel coding theorem - Linear Block codes - Hamming codes - Cyclic codes - Convolutional codes - Viterbi Decoder

UNIT IV DIGITAL MODULATION SCHEME 9

Geometric Representation of signals - Generation, detection, IQ representation, PSD & BER of Coherent BPSK, BFSK, & QPSK - QAM - Carrier Synchronization - Structure of Non-coherent Receivers Synchronization and Carrier Recovery for Digital modulation, Spectrum Analysis – Occupied bandwidth – Adjacent channel power, EVM, Principle of DPSK

UNIT V DEMODULATION TECHNIQUES 9

Elements of Detection Theory, Optimum detection of signals in noise, Coherent communication with waveforms- Probability of Error evaluations. Baseband Pulse Transmission- Inter symbol Interference, Optimum demodulation of digital signals over band-limited channels.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of the course students will be able to

CO1: Gain knowledge in amplitude modulation techniques

CO2: Understand the concepts of Random Process to the design of communication systems

CO3: Gain knowledge in digital techniques

CO4: Gain knowledge in sampling and quantization

CO5: Understand the importance of demodulation techniques

TEXTBOOKS :

1. Simon Haykins," Communication Systems", Wiley, 5th Edition, 2009.(Unit I - V)
2. B.P.Lathi, "Modern Digital and Analog Communication Systems", 4th Edition, Oxford University Press, 2011.

REFERENCES :

1. Wayner Tomasi, Electronic Communication System, 5th Edition, Pearson Education,2008.
2. D.Roody, J.Coolen, Electronic Communications, 4th edition PHI 2006
3. A.Papoulis, "Probability, Random variables and Stochastic Processes", McGraw Hill, 3rd edition, 1991.
4. B.Sklar, "Digital Communications Fundamentals and Applications", 2nd Edition Pearson Education 2007
5. H P Hsu, Schaum Outline Series - "Analog and Digital Communications" TMH 2006
6. Couch.L., "Modern Communication Systems", Pearson, 2001

CO's-PO's & PSO's MAPPING

CO	Pos											
	PO1	O2	O3	O4	O5	PO6	O7	O8	O9	O10	O11	O12
1	3	3	3	3	2	1	1	-	-	-	1	1
2	3	3	3	3	2	1	1	-	-	-	1	1
3	3	3	3	3	3	1	1	-	-	-	1	1
4	3	3	3	3	3	1	1	-	-	-	1	1
5	3		3	3	2	1	1	-	-			1
Avg	3		3	3	2.5	1	1	-	-			1

1 - low, 2 - medium, 3 - high, '-' - no correlation

21149S46 ENVIRONMENTAL SCIENCES AND SUSTAINABILITY L T P C

2 0 0 2

COURSE OBJECTIVES:

- To introduce the basic concepts of environment, ecosystems and biodiversity and emphasize on the biodiversity of India and its conservation.
- To impart knowledge on the causes, effects and control or prevention measures of environmental pollution and natural disasters.
- To facilitate the understanding of global and Indian scenario of renewable and nonrenewable resources, causes of their degradation and measures to preserve them.
- To familiarize the concept of sustainable development goals and appreciate the interdependence of economic and social aspects of sustainability, recognize and analyze climate changes, concept of carbon credit and the challenges of environmental management.
- To inculcate and embrace sustainability practices and develop a broader understanding on green materials, energy cycles and analyze the role of sustainable urbanization.

UNIT I ENVIRONMENT AND BIODIVERSITY 6

Definition, scope and importance of environment – need for public awareness.Eco-system and Energy flow– ecological succession. Types of biodiversity: genetic, species and ecosystem diversity– values of biodiversity, India as a mega-diversity nation – hot-spots of biodiversity – threatsto biodiversity: habitat loss, poaching of wildlife, man-wildlife conflicts – endangered and endemic species of India – conservation of biodiversity: In-situ and ex-situ.

UNIT II ENVIRONMENTALPOLLUTION 6

Causes, Effects and Preventive measures of Water, Soil, Air and Noise Pollutions. Solid, Hazardous and E-Waste management. Case studies on Occupational Health and Safety Management system (OHASMS). Environmental protection, Environmental protection acts .

UNIT III RENEWABLE SOURCES OF ENERGY 6

Energy management and conservation, New Energy Sources: Need of new sources. Different types new energy sources. Applications of- Hydrogen energy, Ocean energy resources, Tidal energy conversion. Concept, origin and power plants of geothermal energy.

UNIT IV SUSTAINABILITY AND MANAGEMENT 6

Development , GDP ,Sustainability- concept, needs and challenges-economic, social and aspects of sustainability-from unsustainability to sustainability-millennium development goals, and protocols- Sustainable Development Goals-targets, indicators and intervention areas Climate change- Global, Regional and local environmental issues and possible solutions-case studies. Concept of Carbon Credit, Carbon Footprint. Environmental management in industry-A case study.

UNIT V SUSTAINABILITY PRACTICES 6

Zero waste and R concept, Circular economy, ISO 14000 Series, Material Life cycle assessment, Environmental Impact Assessment. Sustainable habitat: Green buildings, Green materials, Energy efficiency, Sustainable transports. Sustainable energy: Non-conventional Sources, Energy Cycles- carbon cycle, emission and sequestration, Green Engineering: Sustainable urbanization- Socio- economical and technological change.

TOTAL:30 PERIODS

COURSE OUTCOMES:

CO1:To recognize and understand the functions of environment, ecosystems and biodiversity andtheir conservation.

CO2:To identify the causes, effects of environmental pollution and natural disasters and contributeto the preventive measures in the society.

CO3:To identify and apply the understanding of renewable and non-renewable resources and contribute to the sustainable measures to preserve them for future generations.

CO4:To recognize the different goals of sustainable development and apply them for suitabletechnological advancement and societal development.

CO5:To demonstrate the knowledge of sustainability practices and identify green materials, energycycles and the role of sustainable urbanization.

TEXT BOOKS :

1. Anubha Kaushik and C. P. Kaushik’s “Perspectives in Environmental Studies”, 6th Edition,New Age International Publishers ,2018.
2. Benny Joseph, ‘Environmental Science and Engineering’, Tata McGraw-Hill, New Delhi, 2016.
3. Gilbert M.Masters, ‘Introduction to Environmental Engineering and Science’, 2nd

edition,Pearson Education, 2004.

4. Allen, D. T. and Shonnard, D. R., Sustainability Engineering: Concepts, Design and Case Studies, Prentice Hall.
5. Bradley. A.S; Adebayo, A.O., Maria, P. Engineering applications in sustainable design and development, Cengage learning.
6. Environment Impact Assessment Guidelines, Notification of Government of India, 2006.
7. Mackenthun, K.M., Basic Concepts in Environmental Management, Lewis Publication, London, 1998.

REFERENCES :

1. R.K. Trivedi, 'Handbook of Environmental Laws, Rules, Guidelines, Compliances and Standards', Vol. I and II, Enviro Media. 38 . edition 2010.
2. Cunningham, W.P. Cooper, T.H. Gorhani, 'Environmental Encyclopedia', Jaico Publ., House,Mumbai, 2001.
3. Dharmendra S. Sengar, 'Environmental law', Prentice hall of India PVT. LTD, New Delhi,2007.
4. Rajagopalan, R, 'Environmental Studies-From Crisis to Cure', Oxford University Press, ThirdEdition, 2015.
5. Erach Bharucha "Textbook of Environmental Studies for Undergraduate Courses" Orient Blackswan Pvt. Ltd. 2013.

CO's-PO's & PSO's MAPPING

O	PO												PSO		
	1	2	3	4	5	6	7	8	9	1	1	l2	1	2	3
1	2	1	-	-	-	2	3	-	-	-	-	2	-	-	-
2	3	2	-	-	-	3	3	-	-	-	-	2	-	-	-
3	3	-	1	-	-	2	2	-	-	-	-	2	-	-	-
4	3	2	1	1	-	2	2	-	-	-	-	2	-	-	-
5	3	2	1	-	-	2	2	-	-	-	-	1	-	-	-
vg.	.8	.8	1	1	-	2.2	2.4	-	-	-	-	1.8	-	-	-

1 - low, 2 - medium, 3 - high, '-' - no correlation

21152L48 COMMUNICATION SYSTEMS LABORATORY L T P C

0 0 3 1.5

COURSE OBJECTIVES :

- To study the AM & FM Modulation and Demodulation.
- To learn and realize the effects of sampling and TDM.
- To understand the PCM & Digital Modulation.
- To Simulate Digital Modulation Schemes.
- To Implement Equalization Algorithms and Error Control Coding Schemes.

LIST OF EXPERIMENTS

1. AM- Modulator and Demodulator
2. FM - Modulator and Demodulator
3. Pre-Emphasis and De-Emphasis.
4. Signal sampling and TDM.
5. Pulse Code Modulation and Demodulation.

6. Pulse Amplitude Modulation and Demodulation.
7. Pulse Position Modulation and Demodulation and Pulse Width Modulation and Demodulation.
8. Digital Modulation – ASK, PSK, FSK.
9. Delta Modulation and Demodulation.
10. Simulation of ASK, FSK, and BPSK Generation and Detection Schemes.
11. Simulation of DPSK, QPSK and QAM Generation and Detection Schemes.
12. Simulation of Linear Block and Cyclic Error Control coding Schemes.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of the laboratory course, the student will be able to understand the:

CO1:Design AM, FM & Digital Modulators for specific applications.

CO2:Compute the sampling frequency for digital modulation**.**

CO3:Simulate & validate the various functional modules of Communication system.**CO4**:Demonstrate their knowledge in base band signaling schemes through implementation of digital modulation schemes.

CO5:Apply various channel coding schemes & demonstrate their capabilities towards theimprovement of the noise performance of Communication system.

CO's-PO's & PSO's MAPPING

CO	POs										
	PO1	O2	O3	O4	O5	PO 6	O7	O8	O9	O10	O11	O12
1	3	3	3	3	3	3	-	-	-	1	1	1
2	3	3	3	3	3	2	-	-	-	1	1	1
3	3	3	3	3	3	2	-	-	-	1	1	1
4	3	3	3	3	3	3	-	-	-	1	1	1
5	3	3	3	3	3	2	-	-	-	1	1	1
Avg	3	3	3	3	3	2.5	-	-	-	1	1	1

1 - low, 2 - medium, 3 - high, '-' - no correlation

21152L47 LINEAR INTEGRATED CIRCUITS LABORATORY **L T P C**

0 0 3 1.5

COURSE OBJECTIVES:

- To gain hands on experience in designing electronic circuits
- To learn simulation software used in circuit design
- To learn the fundamental principles of amplifier circuits
- To differentiate feedback amplifiers and oscillators.
- To differentiate the operation of various multivibrators

LIST OF EXPERIMENTS:

DESIGN AND ANALYSIS OF THE FOLLOWING CIRCUITS

1. Series and Shunt feedback amplifiers-Frequency response, Input and output impedance
2. RC Phase shift oscillator and Wien Bridge Oscillator
3. Hartley Oscillator and Colpitts Oscillator
4. RC Integrator and Differentiator circuits using Op-Amp

5. Clippers and Clampers
6. Instrumentation amplifier
7. Active low-pass, High pass & Band pass filters
8. PLL Characteristics and its use as frequency multiplier, clock synchronization
9. R-2R ladder type D-A converter using Op-Amp

SIMULATION USING SPICE (Using Transistor):

1. Tuned Collector Oscillator
2. Twin -T Oscillator / Wein Bridge Oscillator
3. Double and Stagger tuned Amplifiers
4. Bistable Multivibrator
5. Schmitt Trigger circuit with Predictable hysteresis
6. Analysis of power amplifier

Components and Accessories:

Transistors, Resistors, Capacitors, Inductors, diodes, Zener Diodes, Bread Boards, Transformers.SPICE Circuit Simulation Software: (any public domain or commercial software)

Note: Op-Amps uA741, LM 301, LM311, LM 324, LM317, LM723, 7805, 7812, 2N3524, 2N3525,2N3391, AD 633, LM 555, LM 565 may be used

TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of the course the students will be able to

CO1:Analyze various types of feedback amplifiers

CO2:Design oscillators, tuned amplifiers, wave-shaping circuits and multivibrators

CO3:Design and simulate feedback amplifiers,oscillators, tuned amplifiers, wave-shapingcircuits and multivibrators, filters using SPICE Tool.

CO4:Design amplifiers, oscillators, D-A converters using operational amplifiers.

CO5:Design filters using op-amp and perform an experiment on frequency response

CO's-PO's & PSO's MAPPING

CO	O1	O2	PO3	PO4	O5	O6	O7	O8	O9	O10	PO11	O12
CO 1	2	3	3	3	-	-	-	-	-	-	1	1
CO 2	2	3	3	3	-	-	-	-	-	-	1	1
CO 3	2	3	3	3	-	-	-	-	-	-	1	1
CO 4	2	3	3	3	2	-	-	-	-	-	1	1
CO5	-	-	-	-	-	-	-	-	-	-	-	-
Avg	2	3	3	3	2	-	-	-	-	-	1	1

1 - low, 2 - medium, 3 - high, '-' - no correlation

21152C51 WIRELESS COMMUNICATION L T P C

3 0 2 4

COURSE OBJECTIVES:

- To study and understand the concepts and design of a Cellular System.
- To Study And Understand Mobile Radio Propagation And Various Digital ModulationTechniques.
- To Understand The Concepts Of Multiple Access Techniques And Wireless Networks

UNIT-I THE CELLULAR CONCEPT-SYSTEM DESIGN FUNDAMENTALS 9

Introduction-Frequencyreuse-Channel Assignment Strategies-**Handoff Strategies:**Prioritizing Handoffs, Practical Handoff Considerations. **Interference And System Capacity**: Co-Channel Interference And System Capacity-Channel Planning For Wireless Systems, Adjacent Channel Interference, Power Control For Reducing Interference, Trunking And Grade Of Service. **Improving Coverage And Capacity In Cellular Systems:** Cell Splitting, Sectoring.

UNIT-II MOBILE RADIO PROPAGATION 9

Large Scale Path Loss: Introduction To Radio Wave Propagation - Free Space Propagation Model

– Three Basic Propagation Mechanism: Reflection – Brewster Angle- Diffraction- Scattering.Small Scale Fading And Multipath: Small Scale Multipath Propagation, Factors Influencing Small-Scale Fading, Doppler Shift, Coherence Bandwidth, Doppler Spread And Coherence Time. Types Of Small- Scale Fading: Fading Effects Due To Multipath Time Delay Spread, Fading Effects Due To Doppler Spread.

UNIT- III MODULATION TECHNIQUES AND EQUALIZATION AND DIVERSITY 9

Digital Modulation – An Overview: Factors That Influence The Choice Of Digital Modulation, Linear Modulation Techniques: Minimum Shift Keying (MSK), Gaussian Minimum Shift Keying(GMSK), Spread Spectrum Modulation Techniques: Pseudo- Noise (PN) Sequences, Direct Sequence Spread Spectrum (DS-SS)- Modulation Performance In Fading And Multipath Channels- Equalization, Diversity And Channel Coding: Introduction-Fundamentals Of Equalization- Diversity Techniques: Practical Space Diversity Considerations, Polarization Diversity, Frequency Diversity, Time Diversity.

UNIT- IV MULTIPLE ACCESS TECHNIQUES 9

Introduction: Introduction To Multiple Access- Frequency Division Multiple Access(FDMA)- Time Division Multiple Access(TDMA)- Spread Spectrum Multiple Access-Code Division Multiple Access(CDMA)- Space Division Multiple Access(SDMA)- Capacity Of Cellular Systems: Capacity Of Cellular CDMA, Capacity Of CDMA With Multiple Cells.

UNIT- V WIRELESS NETWORKING 9

Introduction: Difference Between Wireless And Fixed Telephone Networks, The Public Switched Telephone Network(PSTN), Development Of Wireless Networks: First Generation Wireless Networks, Second Generation Wireless Networks, Third Generation Wireless Networks, Fixed Network Transmission Hierarchy, TrafficRoutingInWireless Networks: Circuit Switching, Packet Switching- Personal Communication Services/ Networks(PCS/PCNs):Packet Vs Circuit Switching For PCN, Cellular Packet- Switched Architecture- Packet Reservation Multiple Access(PRMA)- Network Databases: Distributed Database For Mobility Management-Universal Mobile Telecommunication Systems(UMTS).

45 PERIODS

PRACTICAL EXERCISES: 30 PERIODS

1. Modeling of wireless communication systems using Matlab(Two ray channel andOkumura –Hata model)
2. Modeling and simulation of Multipath fading channel
3. Design, analyze and test Wireless standards and evaluate the performance measurements such as BER, PER, BLER, throughput, capacity, ACLR, EVM for 4G and 5G using Matlab
4. Modulation: Spread Spectrum – DSSS Modulation & Demodulation

5. Wireless Channel equalization: Zero-Forcing Equalizer (ZFE),MMSE Equalizer(MMSEE),Adaptive Equalizer (ADE),Decision Feedback Equalizer (DFE)

6. Modeling and simulation of TDMA, FDMA and CDMA for wireless communication

TOTAL:75 PERIODS

COURSE OUTCOMES :

Upon successful completion of the course the student will be able to:

CO1:Understand The Concept And Design Of A Cellular System.

CO2:Understand Mobile Radio Propagation And Various Digital Modulation Techniques.**CO3**:Understand The Concepts Of Multiple Access Techniques And Wireless Networks **CO4**:Characterize a wireless channel and evolve the system design specifications **CO5**:Design a cellular system based on resource availability and traffic demands.

TEXT BOOK :

1. Rappaport,T.S.,-Wireless communications", Pearson Education, Second Edition, 2010.

REFERENCES :

1. Wireless Communication –Andrea Goldsmith, Cambridge University Press, 2011
2. Van Nee, R. and Ramji Prasad, ―OFDM for wireless multimedia communications, ArtechHouse, 2000
3. David Tse and Pramod Viswanath, ―Fundamentals of Wireless Communication, Cambridge University Press, 2005.
4. Upena Dalal, ―Wireless Communication", Oxford University Press, 2009.
5. Andreas.F. Molisch, ―Wireless Communications", John Wiley – India, 2006.
6. Wireless Communication and Networks –William Stallings ,Pearson Education, Second Edition2002.

CO's-PO's & PSO's MAPPING

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	2	2	3	3	1	-	-	-	-	-	1	3	1	1
2	3	3	2	1	3	2	-	-	-	-	-	-	3	1	2
3	3	3	3	3	2	2	-	-	-	-	-	1	3	1	2
4	2	3	2	2	2	2	-	-	-	-	-	1	2	1	1
5	2	-	3	3	2	1	-	-	-	-	-	1	2	2	2
CO	**3**	**3**	**2**	**2**	**2**	**2**	-	-	-	-	-	**1**	**3**	**1**	**2**

1 - low, 2 - medium, 3 - high, '-' - no correlation

21152C52 **VLSI AND CHIP DESIGN** **L T P C**

3 0 0 3

COURSE OBJECTIVES:

- Understand the fundamentals of IC technology components and their characteristics.
- Understand combinational logic circuits and design principles.
- Understand sequential logic circuits and clocking strategies.

- Understand ASIC Design functioning and design.
- Understand Memory Architecture and building blocks

UNIT I MOS TRANSISTOR PRINCIPLES 9

MOS logic families (NMOS and CMOS), Ideal and Non Ideal IV Characteristics, CMOS devices. MOS(FET) Transistor Characteristic under Static and Dynamic Conditions, Technology Scaling, power consumption

UNIT II COMBINATIONAL LOGIC CIRCUITS 9

Propagation Delays, stick diagram, Layout diagrams, Examples of combinational logic design, Elmore's constant, Static Logic Gates,Dynamic Logic Gates, Pass Transistor Logic, Power Dissipation, Low Power Design principles.

UNIT III SEQUENTIAL LOGIC CIRCUITS AND CLOCKING STRATEGIES 9

Static Latches and Registers, Dynamic Latches and Registers, Pipelines, Nonbistable Sequential Circuits.Timing classification of Digital Systems, Synchronous Design, Self-Timed Circuit Design .

UNIT IV INTERCONNECT , MEMORY ARCHITECTURE AND ARITHMETIC CIRCUITS 9

Interconnect Parameters – Capacitance, Resistance, and Inductance, Electrical WireModels, Sequential digital circuits: adders, multipliers, comparators, shift registers. Logic Implementation using Programmable Devices (ROM, PLA, FPGA), Memory Architecture and Building Blocks,Memory Core and Memory Peripherals Circuitry

UNIT V ASIC DESIGN AND TESTING 9

Introduction to wafer to chip fabrication process flow. Microchip design process & issues in test and verification of complex chips, embedded cores and SOCs, Fault models, Test coding. ASIC Design Flow, Introduction to ASICs, Introduction to test benches, Writing test benches in Verilog HDL, Automatic test pattern generation, Design for testability, Scan design: Test interface and boundary scan.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

Upon successful completion of the course the student will be able toCO1: In depth knowledge of MOS technology

CO2: Understand Combinational Logic Circuits and Design Principles**CO3**: Understand Sequential Logic Circuits and Clocking Strategies **CO4**: Understand Memory architecture and building blocks

CO5: Understand the ASIC Design Process and Testing.

TEXTBOOKS

1. Jan D Rabaey, Anantha Chandrakasan, " Digital Integrated Circuits: A Design Perspective",

PHI, 2016.(Units II, III and IV).
2. Neil H E Weste, Kamran Eshranghian, " Principles of CMOS VLSI Design: A System Perspective," Addison Wesley, 2009.(Units - I, IV).
3. Michael J Smith ," Application Specific Integrated Circuits, Addison Wesley, (Unit - V)
4. Samir Palnitkar," Verilog HDL:A guide to Digital Design and Synthesis", Second Edition, Pearson Education,2003.(Unit - V)
5. Parag K.Lala," Digital Circuit Testing and Testability", Academic Press, 1997, (Unit - V)

REFERENCES

1. D.A. Hodges and H.G. Jackson, Analysis and Design of Digital Integrated Circuits, International Student Edition, McGraw Hill 1983
2. P. Rashinkar, Paterson and L. Singh, "System-on-a-Chip Verification-Methodology and Techniques", Kluwer Academic Publishers,2001
3. SamihaMourad and YervantZorian, "Principles of Testing Electronic Systems", Wiley 2000
4. M. Bushnell and V. D. Agarwal, "Essentials of Electronic Testing for Digital, Memory andMixed-Signal VLSI Circuits", Kluwer Academic Publishers,2000

CO's-PO's & PSO's MAPPING

C	O	O	O	O	O	O	O	O	O	O1	O1	O1	SO	SO	SO
1	1	1	-	-	-	-	-	-	-	-	-	-	3	3	3
2	3	2	3	2	-	-	-	-	-	-	-	1	3	3	3
3	2	3	2	3	1	1	-	-	-	-	-	2	3	2	3
4	-	-	1	1	-	-	-	-	-	-	-	3	3	3	2
5	-	-	-	-	-	2	-	-	-	-	1	-	3	2	2
C	**2**	**2**	**2**	**2**	**1**	**.5**	-	-	-	-	**1**	**2**	**3**	**3**	**3**

1 - low, 2 - medium, 3 - high, '-' - no correlation

21152C53 TRANSMISSION LINES AND RF SYSTEMS **L T P C**
3 0 0 3

COURSE OBJECTIVES:

- To introduce the various types of transmission lines and its characteristics
- To understand high frequency line, power and impedance measurements
- To impart technical knowledge in impedance matching using Smith Chart.
- To introduce passive filters and basic knowledge of active RF components
- To learn the concepts of a RF system transceiver design.

UNIT I TRANSMISSION LINE THEORY 9

General theory of Transmission lines - the transmission line - general solution - The infinite line - Wavelength, velocity of propagation - Waveform distortion - the distortion less line - Loading and different methods of loading - Line not terminated in Z 0 - Reflection coefficient - calculation of current, voltage, power delivered and efficiency of transmission - Input and transfer impedance - Open and short circuited lines - reflection factor and reflection loss.

UNIT II HIGH FREQUENCY TRANSMISSION LINES 9

Transmission line equations at radio frequencies - Line of Zero dissipation - Voltage and current on the dissipation less line, Standing Waves, Nodes, Standing Wave Ratio - Input impedance of the dissipation less line - Open and short circuited lines - Power and impedance measurement on lines -Reflection losses - Measurement of VSWR and wavelength.

UNIT III IMPEDANCE MATCHING IN HIGH FREQUENCY LINE 9

Impedance matching: Quarter wave transformer ,One Eighth wave line, Half wave line- Impedance matching by stubs- Single stub and double stub matching - Smith chart – Application of Smith chart, Solutions of problems using Smith chart - Single and double stub matching using Smith chart.

UNIT IV WAVEGUIDES 9

Waves between parallel planes of perfect conductors- Transverse Electric waves and Transverse Magnetic waves, Characteristics of TE and TM waves, Transverse Electromagnetic waves, TM and TE waves in Rectangular waveguides, TM and TE waves in Circular waveguides.

UNIT V RF SYSTEM DESIGN CONCEPTS 9

Active RF components: Semiconductor basics in RF, bipolar junction transistors, RF field effect transistors, High electron mobility transistors, Fundamentals of MMIC, Basic concepts of RF design: Filters, couplers, power dividers, Amplifier power relations, Low noise amplifiers, Power amplifiers.

COURSE OUTCOMES:

CO1: Explain the characteristics of transmission lines and its losses.

CO2: Calculate the standing wave ratio and input impedance in high frequency transmission lines.

CO3: Analyze impedance matching by stubs using Smith Charts.

CO4: Comprehend the characteristics of TE and TM waves.

CO5: Design a RF transceiver system for wireless communication

TOTAL:45 PERIODS

TEXTBOOKS

1. John D Ryder, “Networks lines and fields”,Prentice Hall of India,New Delhi,2005.(Unit I–IV)
2. Mathew M. Radmanesh, “Radio Frequency &Microwave Electronics”, Pearson Education Asia, Second Edition, 2002 (Unit – V)
3. Annapurna Das, Sisir K. Das, “Microwave Engineering”, McGraw Hill Education (India) private limited, Third edition,2000.(Unit – V)

REFERENCES

1. Reinhold Ludwig and Powel Bretchko, “RF Circuit Design” – Theory and Applications”,Pearson Education Asia, First Edition, 2001.
2. D. K. Misra, “Radio Frequency and Microwave Communication Circuits”- Analysis and Design, John Wiley & Sons, 2004.
3. Richard Chi-Hsi Li - , “RF Circuit Design” – A John Wiley & Sons, Inc, Publications

4. W.Alan Davis, Krishna Agarwal, “Radio Frequency Circuit Design”, John willy & Sons,2001

CO’s-PO’s & PSO’s MAPPING

D	O 1	O2	O3	O4	O5	O6	O7	O8	O9	O10	O11	O12	SO1	SO2	SO3
	3	3	3	3	2	1	-	-	-	1	-	1	2	1	1
	3	2	2	3	2	1	-	-	-	1	-	1	2	1	1
	3	3	3	2	1	2	-	-	-	1	-	1	2	1	1
	3	3	2	3	2	1	-	-	-	1	-	1	2	1	1
	3	2	3	2	2	1	-	-	-	1	-	1	2	1	1
D	**3**	**3**	**3**	**3**	**2**	**1**	-	-	-	**1**	-	**1**	**2**	**1**	**1**

21152L58	VLSI LABORATORY	L T P C
		0 0 4 2

COURSE OBJECTIVES:

- To learn Hardware Descriptive Language (Verilog/VHDL).
- To learn the fundamental principles of Digital System Desing using HDL and FPGA.
- To learn the fundamental principles of VLSI circuit design in digital domain
- To learn the fundamental principles of VLSI circuit design in analog domain
- To provide hands on design experience with EDA platforms.

LIST OF EXPERIMENTS:

1. Design of basic combinational and sequential (Flip-flops) circuits using HDL. Simulate it using Xilinx/Altera Software and implement by Xilinx/Altera FPGA
2. Design an Adder ; Multiplier (Min 8 Bit) using HDL. Simulate it using Xilinx/Altera Softwareand implement by Xilinx/Altera FPGA
3. Design and implement Universal Shift Register using HDL. Simulate it using Xilinx/Altera Software
4. Design Memories using HDL. Simulate it using Xilinx/Altera Software and implement by Xilinx/Altera FPGA
5. Design Finite State Machine (Moore/Mealy) using HDL. Simulate it using Xilinx/Altera Software and implement by Xilinx/Altera FPGA
6. Design 3-bit synchronous up/down counter using HDL. Simulate it using Xilinx/Altera Software and implement by Xilinx/Altera FPGA
7. Design 4-bit Asynchronous up/down counter using HDL. Simulate it using Xilinx/Altera Software and implement by Xilinx/Altera FPGA
8. Design and simulate a CMOS Basic Gates & Flip-Flops. Generate Manual/Automatic Layout .
9. Design and simulate a 4-bit synchronous counter using a Flip-Flops. Generate Manual/Automatic Layout
10. Design and Simulate a CMOS Inverting Amplifier.
11. Design and Simulate basic Common Source, Common Gate and Common Drain Amplifiers.
12. Design and simulate simple 5 transistor differential amplifier.

COURSE OUTCOMES:

On completion of the course, students will be able to:

CO1: Write HDL code for basic as well as advanced digital integrated circuit

CO2: Import the logic modules into FPGA Boards

CO3: Synthesize Place and Route the digital Ips

CO4: Design, Simulate and Extract the layouts of Digital & Analog IC Blocks using EDAtools

CO5: Test and Verification of IC design

TOTAL: 60 PERIODS

CO's-PO's & PSO's MAPPING

C	O	O	O	O	O	O	O	O	O	O1	O1	O1	SO	SO	SO
1	2	-	-	-	-	-	-	-	-	-	-	-	2	3	2
2	3	3	1	1	-	-	-	-	-	-	-	-	2	1	2
3	1	2	2	2	-	-	-	-	-	-	1	1	2	2	2
4	-	1	3	3	1	-	-	-	-	-	1	1	2	2	2
5	3	3	3	3	1	-	-	-	-	-	1	1	2	2	2
C	**.2**	**.2**	**.2**	**.2**	**1**	-	-	-	-	-	**1**	**1**	**2**	**2**	**2**

1 - low, 2 - medium, 3 - high, '-' - no correlation

21152S61 EMBEDDED SYSTEMS AND IOT DESIGN L T P C3 0 2 4

COURSE OBJECTIVES :

- Learn the architecture and features of 8051.
- Study the design process of an embedded system.
- Understand the real – time processing in an embedded system.
- Learn the architecture and design flow of IoT.
- Build an IoT based system.

UNIT I 8051 MICROCONTROLLER 9

Microcontrollers for an Embedded System – 8051 – Architecture – Addressing Modes – Instruction Set – Program and Data Memory – Stacks – Interrupts – Timers/Counters – Serial Ports – Programming.

UNIT II EMBEDDED SYSTEMS 9

Embedded System Design Process – Model Train Controller – ARM Processor – Instruction Set Preliminaries – CPU – Programming Input and Output – Supervisor Mode – Exceptions and Trap – Models for programs – Assembly, Linking and Loading – Compilation Techniques – Program Level Performance Analysis.

UNIT III PROCESSES AND OPERATING SYSTEMS 9

Structure of a real – time system – Task Assignment and Scheduling – Multiple Tasks and Multiple Processes – Multirate Systems – Pre emptive real – time Operating systems – Priority based scheduling – Interprocess Communication Mechanisms – Distributed Embedded Systems – MPSoCs and Shared Memory Multiprocessors – Design Example – Audio Player, Engine Control Unit and Video Accelerator.

UNIT IV IOT ARCHITECTURE AND PROTOCOLS 9

Internet – of – Things – Physical Design, Logical Design – IoT Enabling Technologies – Domain Specific IoTs – IoT and M2M – IoT System Management with NETCONF – YANG – IoT Platform Design – Methodology – IoT Reference Model – Domain Model – Communication Model – IoT Reference Architecture – IoT Protocols - MQTT, XMPP, Modbus, CANBUS and BACNet.

UNIT V IOT SYSTEM DESIGN 9

Basic building blocks of an IoT device – Raspberry Pi – Board – Linux on Raspberry Pi – Interfaces – Programming with Python – Case Studies: Home Automation, Smart Cities, Environment and Agriculture.

45 PERIODS

PRACTICAL EXERCISES 30 PERIODS

Experiments using 8051.

1. Programming Arithmetic and Logical Operations in 8051.
2. Generation of Square waveform using 8051.
3. Programming using On – Chip ports in 8051.
4. Programming using Serial Ports in 8051.
5. Design of a Digital Clock using Timers/Counters in 8051.Experiments using ARM
   - Interfacing ADC and DACBlinking of LEDs and LCD
   - Interfacing keyboard and Stepper Motor.Miniprojects for IoT
   - Garbage Segregator and Bin Level IndicatorColour based Product Sorting
   - Image Processing based Fire DetectionVehicle Number Plate Detection
   - Smart Lock System

COURSE OUTCOMES:

CO1: Explain the architecture and features of 8051.

CO2: Develop a model of an embedded system.

CO3: List the concepts of real time operating systems.

CO4: Learn the architecture and protocols of IoT.

CO5: Design an IoT based system for any application.

TOTAL: 60 PERIODS

TEXTBOOKS :

1. Mohammed Ali Mazidi, Janice Gillispie Mazidi, Rolin D.McKinlay, The 8051 Microcontroller and Embedded Systems Using Assembly and C, Second Edition, Pearson Education, 2008.(Unit – I)
2. 2.Marilyn Wolf, Computers as Components – Principles of Embedded Computing System Design, Third Edition, Morgan Kaufmann, 2012.(Unit – II,III)
3. Arshdeep Bahga, Vijay Madisetti, Internet – of- Things – A Hands on Approach, Universities Press, 2015.(Unit – IV,V)

REFERENCES :

1. Mayur Ramgir, Internet – of – Things, Architecture, Implementation and Security, First Edition, Pearson Education, 2020.
2. Lyla B.Das, Embedded Systems: An Integrated Approach, Pearson Education 2013.
3. Jane.W.S .Liu, Real – Time Systems, Pearson Education, 2003.

CO's-PO's & PSO's MAPPING

C	O	O	O	O	O	O	O	O	O	O1	O1	O1	SO	SO	SO
1	3	3	3	2	2	-	-	-	-	-	-	-	3	2	1
2	3	3	3	2	2	-	-	-	-	-	-	-	3	2	1
3	3	3	2	2	2	-	-	-	-	-	-	-	2	1	1
4	3	3	2	2	2	-	-	-	-	-	-	-	3	3	2
5	3	3	3	3	3	-	-	-	-	-	-	-	3	3	2
C	**3**	**3**	**.6**	**.2**	**.2**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**2.8**	**2.2**	**1.4**

1 - low, 2 - medium, 3 - high, '-' - no correlation

21152S62 ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING L T P C

3 0 2 4

COURSE OBJECTIVES:

The main objectives of this course are to:

- Study about uninformed and Heuristic search techniques.
- Learn techniques for reasoning under uncertainty
- Introduce Machine Learning and supervised learning algorithms
- Study about ensembling and unsupervised learning algorithms
- Learn the basics of deep learning using neural networks

UNIT I PROBLEM SOLVING 9

Introduction to AI - AI Applications - Problem solving agents – search algorithms – uninformed search strategies – Heuristic search strategies – Local search and optimization problems – adversarial search – constraint satisfaction problems (CSP)

UNIT II PROBABILISTIC REASONING 9

Acting under uncertainty – Bayesian inference – naïve bayes models. Probabilistic reasoning – Bayesian networks – exact inference in BN – approximate inference in BN – causal networks.

UNIT III SUPERVISED LEARNING 9

Introduction to machine learning – Linear Regression Models: Least squares, single & multiple variables, Bayesian linear regression, gradient descent, Linear Classification Models: Discriminant function – Probabilistic discriminative model - Logistic regression, Probabilistic generative model – Naive Bayes, Maximum margin classifier – Support vector machine, Decision Tree, Random forests

UNIT IV ENSEMBLE TECHNIQUES AND UNSUPERVISED LEARNING 9

Combining multiple learners: Model combination schemes, Voting, Ensemble Learning - bagging, boosting, stacking, Unsupervised learning: K-means, Instance Based Learning: KNN, Gaussian mixture models and Expectation maximization

UNIT V NEURAL NETWORKS 9

Perceptron - Multilayer perceptron, activation functions, network training – gradient descent optimization – stochastic gradient descent, error backpropagation, from shallow networks to deep networks –Unit saturation (aka the vanishing gradient problem) – ReLU, hyperparameter tuning, batch normalization, regularization, dropout.

45 PERIODS

PRACTICAL EXERCISES: 30 PERIODS

1. Implementation of Uninformed search algorithms (BFS, DFS)
2. Implementation of Informed search algorithms (A*, memory-bounded A*)
3. Implement naïve Bayes models
4. Implement Bayesian Networks
5. Build Regression models
6. Build decision trees and random forests
7. Build SVM models
8. Implement ensembling techniques

1. Implement clustering algorithms
2. Implement EM for Bayesian networks
3. Build simple NN models
4. Build deep learning NN models

OUTCOMES:

At the end of this course, the students will be able to:

CO1: Use appropriate search algorithms for problem solving

CO2: Apply reasoning under uncertainty

CO3: Build supervised learning models

CO4: Build ensembling and unsupervised models

CO5: Build deep learning neural network models

TOTAL:75 PERIODS

TEXT BOOKS:

1. Stuart Russell and Peter Norvig, “Artificial Intelligence – A Modern Approach”, FourthEdition, Pearson Education, 2021.
2. Ethem Alpaydin, “Introduction to Machine Learning”, MIT Press, Fourth Edition, 2020.

REFERENCES

1. Dan W. Patterson, “Introduction to AI and ES”, Pearson Education,2007
2. Kevin Night, Elaine Rich, and Nair B., “Artificial Intelligence”, McGraw Hill, 2008
3. Patrick H. Winston, "Artificial Intelligence", Third Edition, Pearson Education, 2006
4. Deepak Khemani, “Artificial Intelligence”, Tata McGraw Hill Education, 2013 (http://nptel.ac.in/)
5. Christopher M. Bishop, “Pattern Recognition and Machine Learning”, Springer, 2006.
6. Tom Mitchell, “Machine Learning”, McGraw Hill, 3rd Edition,1997.
7. Charu C. Aggarwal, “Data Classification Algorithms and Applications”, CRC Press, 2014
8. Mehryar Mohri, Afshin Rostamizadeh, Ameet Talwalkar, “Foundations of Machine Learning”, MIT Press, 2012.
9. Ian Goodfellow, Yoshua Bengio, Aaron Courville, “Deep Learning”, MIT Press, 2016

CO’s-PO’s & PSO’s MAPPING

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	2	2	3	1	3	2	-	-	-	-	1	3	3	
2	3	2	2	3	1	3	2	-	-	-	-	1	3	3	
3	1	2	1	3	2	3	2	-	-	-	-	1	3	3	
4	1	2	3	1	3	3	2	-	-	-	-	1	3	3	
5	2	2	2	-	3	3	2	-	-	-	-	1	3	3	
CO	2	2	2	2	2	3	2	-	-	-	-	1	3	3	

1 - low, 2 - medium, 3 - high, ‘-' - no correlation

21152INT76 **SUMMER INTERNSHIP** **L T P C0 0 0 2**

COURSE OBJECTIVES:

To enable the students to

- Get connected with industry/ laboratory/research institute
- Get practical knowledge on production process in the industry and develop skills to solve related problems
- Develop skills to carry out research in the research institutes/laboratories

The students individually undergo training in reputed firms/ research institutes / laboratories for the specified duration. After the completion of training, a detailed report should be submitted within ten days from the commencement of next semester. The students will be evaluated as per the Regulations.

No. of Weeks: 04

COURSE

OUTCOMES:

On completion of the course, the student will know about

CO1: System-level design processes, verification and validation techniques, manufacturing andproduction processes in the firm or research facilities in the laboratory/research institute

CO2: Analysis of industrial / research problems and their solutions

CO3: Documentation of system specifications, design methodologies, process parameters,testing parameters and results

CO4: Preparing of technical report and presentation

21152P81 PROJECT WORK/ INTERNSHIP L T P C0 0 20 10

COURSE OBJECTIVES:

To train the students in

- Identifying problem and developing the structured methodology to solve the identifiedproblem in the industry or research problem at research Institution or college.
- Conducting experiments, analyze and discuss the test results, and make conclusions.
- Preparing project reports and presentation

The students shall individually / or as group work on a specific topic approved by the Department. The student can select any topic which is relevant to his/her specialization of the programme. The student should continue the work on the selected topic as per the formulated methodology. At the end of the semester, after completing the work to the satisfaction of the supervisor and review committee, a detailed report which contains clear definition of the identified problem, detailed literature review related to the area of work and methodology for carrying out the work, results and discussion, conclusion and references should be prepared as per the format prescribed by the University and submitted to the Head of the department. The students will be evaluated based on the report and viva-voce examination by a panel of examiners as per the Regulations.

TOTAL: 300 PERIODS

COURSE OUTCOMES:

At the end of the project, the student will be able to

CO1: Formulate and analyze problem / create a new product/

process.CO2: Design and conduct experiments to find solution

CO3: Analyze the results and provide solution for the identified problem, prepare project report andmake presentation.

21152E54A **OPTICAL COMMUNICATION & NETWORKS** **L T P C**
3 0 0 3

COURSE OBJECTIVES:

- To Study About The Various Optical Fiber Modes, Configuration Of Optical Fibers
- To Study Transmission Characteristics Of Optical Fibers.
- To Learn About The Various Optical Sources, Detectors And Transmission Techniques.
- To Explore Various Idea About Optical Fiber Measurements And Various Coupling
- Techniques.
- To Enrich The Knowledge About Optical Communication Systems And Networks.

UNIT-I INTRODUCTION TO OPTICAL FIBER COMMUNICATION 9

Introduction - The General Systems - Advantages of Optical Fiber Communication- **Ray Theory Transmission** : Total Internal Reflection, Acceptance Angle, Numerical Aperture, Skew Rays - **Electromagnetic Mode Theory for Optical Propagation**: Modes in a Planar Guide, Phase and group velocity **- Cylindrical Fiber**: Step index fibers, Graded index fibers **- Single mode fibers**: Cutoff wavelength.

UNIT-II TRANSMISSION CHARACTERISTICS OF OPTICAL FIBERS 9

Attenuation - **Material absorption losses in silica glass fibers:** Intrinsic absorption, Extrinsic absorption - **Linear scattering losses**: Rayleigh Scattering, Mie Scattering **-Nonlinear scattering losses**: Stimulated Brillouin Scattering, Stimulated Raman Scattering – Fiber Bend Loss – Dispersion- **Chromatic dispersion**: Material dispersion, Waveguide dispersion- **Intermodal dispersion** : Multimode step index fiber, Multimode graded index fiber.

UNIT-III OPTICAL SOURCES AND OPTICAL DETECTORS 9

The laser : Introduction **- Basic concepts**: Absorption and emission of radiation, Population inversion , Optical feedback and laser oscillation, Threshold condition for laser oscillation**- Optical emission from semiconductors**: The PN junction, Spontaneous emission, Carrier recombination, Stimulated emission and lasing, Hetero junctions- **LED**: Introduction- Power and Efficiency - **LED structures**: Planar LED, Dome LED, Surface emitter LED, Edge emitter LED- LED Characteristics. **Optical Detectors:**Introduction ,Optical Detection Principles, Quantum Efficiency, Resposivity, P-N Photodiode ,P-I-N Photo Diode and Avalanche Photodiode.

UNIT-IV OPTICAL FIBER MEASUREMENTS 9

Introduction- Total Fiber Attenuation Measurement, Fiber Dispersion Measurements In Time Domain and Frequency Domain, Fiber Cut off Wavelength Measurements, Numerical Aperture Measurements. Fiber Diameter Measurements,.Reflectance And Optical Return Loss, Field Measurements

UNIT-V OPTICAL NETWORKS 9

Introduction- **Optical Network Concepts**: Optical Networking Terminology, Optical Network Node And Switching Elements, Wavelength Division Multiplexed Networks, Public Telecommunications Network Overview- **Optical Network Transmission Modes**, **Layers And Protocols**: Synchronous Networks, Asynchronous Transfer Mode, Open System Interconnection Reference Model, Optical Transport Network, Internet Protocol- **Wavelength Routing Networks**: Routing And Wavelength Assignment- **Optical Switching Networks**: Optical Circuit Switched Networks, Optical Packet Switched Networks, Multiprotocol Label Switching, Optical Burst Switching Networks- **Optical Network Deployment** : Long Haul Networks, Metropolitan area networks, Access networks, Local Area Networks- **Optical Ethernet**: Network protection, restoration and survivability.

TOTAL: 45 PERIODS

COURSE OUTCOMES

At the end of the course, the student will be able to understand the CO1:Realize Basic Elements In Optical Fibers, Different Modes And Configurations.

CO2:Analyze The Transmission Characteristics Associated With Dispersion And PolarizationTechniques.
CO3:Design Optical Sources And Detectors With Their Use In Optical Communication System.
CO4:Construct Fiber Optic Receiver Systems, Measurements And Techniques.
CO5:Design Optical Communication Systems And Its Networks.

TEXT BOOKS:

1. John M.Senior, "Optical Fiber Communication", Pearson Education, Fouth Edition.2010.

REFERENCES:

1. Gred Keiser,"Optical Fiber Communication", McGraw Hill Education (India) Private Limited. Fifth Edition, Reprint 2013.
2. Govind P. Agrawal, "Fiber-Optic Communication Systems", Third Edition, John Wiley & Sons,2004.
3. J.Gower, "Optical Communication System", Prentice Hall Of India, 2001
4. Rajiv Ramaswami, "Optical Networks " , Second Edition, Elsevier , 2004.
5. P Chakrabarti, "Optical Fiber Communication", McGraw Hill Education (India)Private Limited,2016

CO's-PO's & PSO's MAPPING

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	3	2	3	3	1	-	-	-	-	-	1	2	1	2
2	3	3	2	1	3	2	-	-	-	-	-	2	2	2	2
3	3	3	3	3	2	1	-	-	-	-	-	1	2	2	2
4	3	3	2	2	2	1	-	-	-	-	-	1	2	1	2
5	3	3	3	3	2	1	-	-	-	-	-	1	2	2	2
CO	3	3	2	3	3	1	-	-	-	-	-	1	2	1	2

1 - low, 2 - medium, 3 - high, '-' - no correlation

21152E54B **4G / 5G COMMUNICATION NETWORKS** **L T P C**
2 0 2 3

COURSE OBJECTIVES

- To learn the evolution of wireless networks.
- To get acquainted with the fundamentals of 5G networks.
- To study the processes associated with 5G architecture.
- To study spectrum sharing and spectrum trading.
- To learn the security features in 5G networks.

UNIT I EVOLUTION OF WIRELESS NETWORKS 6

Networks evolution: 2G,3G,4G, evolution of radio access networks, need for 5G. 4G versus 5G, Next Generation core(NG-core), visualized Evolved Packet core(vEPC).

UNIT II 5G CONCEPTS AND CHALLENGES 6

Fundamentals of 5G technologies, overview of 5G core network architecture,5G new radio and cloud technologies, Radio Access Technologies (RATs), EPC for 5G.

UNIT III NETWORK ARCHITECTURE AND THE PROCESSES 6

5G architecture and core, network slicing, multi access edge computing(MEC)visualization of 5G components, end-to-end system architecture, service continuity, relation to EPC, and edge computing. 5G protocols: 5G NAS,NGAP, GTP-U, IPSec and GRE.

UNIT IV DYNAMIC SPECTRUM MANAGEMENT AND MM-WAVES 6

Mobility management, Command and control, spectrum sharing and spectrum trading, cognitive radio based on 5G, millimeter waves.

UNIT V SECURITY IN 5G NETWORKS 6

Security features in 5G networks, network domain security, user domain security, flow based QoS framework,mitigating the threats in 5G.

30 PERIODS

PRACTICAL EXERCISES: **30 PERIODS**

SIMULATION USING MATLAB

1. 5G-Compliant waveform generation and testing
2. Modeling of 5G Synchronization signal blocks and bursts
3. Channel modeling in 5G networks
4. Multiband OFDM demodulation
5. Perfect Channel estimation
6. Development of 5g New Radio Polar Coding

COURSE OUTCOMES

CO1:To understand the evolution of wireless networks.
CO2:To learn the concepts of 5G networks.
CO3:To comprehend the 5G architecture and protocols.
CO4:To understand the dynamic spectrum management.
CO5:To learn the security aspects in 5G networks.

TOTAL 60 PERIODS

TEXT BOOKS

1. 5G Core networks: Powering Digitalization , Stephen Rommer, Academic Press,2019
2. An Introduction to 5G Wireless Networks : Technology, Concepts and Use cases, Saro Velrajan,First Edition, 2020.

REFERENCES

1. 5G Simplified: ABCs of Advanced Mobile Communications Jyrki. T.J.Penttinen,Copyrighted Material.
2. 5G system Design: An end to end Perspective , Wan Lee Anthony, Springer Publications,2019.

CO's-PO's & PSO's MAPPING

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	3	2	3	2	-	-	-	-	-	-	-	1	1	3
2	3	3	3	2	2	-	-	-	-	-	-	-	1	1	2
3	3	3	2	2	2	-	-	-	-	-	-		2	2	2
4	3	3	3	3	2	-	-	-	-	-	-	-	3	2	2
5	3	2	3	3	2	-	-	-	-	-	-	-	2	2	2
CO	3	2.8	2.6	2.6	2	-	-	-	-	-	-	-	1.8	1.6	2.2

1 - low, 2 - medium, 3 - high, '-' - no correlation

21152E55A **SOFTWARE DEFINED NETWORKS** **L T P C**
2 0 2 3

COURSE OBJECTIVES:

- To understand the need for SDN and its data plane operations
- To understand the functions of control plane
- To comprehend the migration of networking functions to SDN environment
- To explore various techniques of network function virtualization
- To comprehend the concepts behind network virtualization

UNIT I SDN: BACKGROUND AND DATA PLANE 6

Evolving Network Requirements – The SDN Approach – SDN and NFV-Related Standards – SDN Data Plane – OpenFlow Logical Network Device – OpenFlow Protocol.

UNIT II SDN CONTROL PLANE 6

SDN Control Plane Architecture: Southbound Interface, Northbound Interface - Control Plane Functions – ITU-T Model – OpenDaylight – REST – Cooperation and Coordination among Controllers.

UNIT III UNIT TITLE 6

SDN Application Plane Architecture – Network Services Abstraction Layer – Traffic Engineering – Measurement and Monitoring – Security – Data Center Networking -- -Mobility and Wireless – Information-centric Networking

UNIT IV NETWORK FUNCTION VIRTUALIZATION 6

NFV Concepts - Benefits and Requirements - Reference Architecture - NFV Infrastructure - Virtualized Network Functions – NFV Management and Orchestration – NFV Use cases – SDN and NFV

UNIT V NETWORK VIRTUALIZATION 6

Virtual LANs – OpenFlow VLAN Support – Virtual Private Networks – Network Virtualization – OpenDaylight's Virtual Tenant Network – CoSoftware-Defined Infrastructure

30 PERIODS

PRACTICAL EXERCISES: 30 PERIODS

1. Installing Mininet simulator
2. Creating a 1 controller, 3 node topology, POX controller
3. Ability to view, read/write Flow table rules (for different applications - say firewall, Learning switch etc.), POX, Open vSwitch
4. Building a SDN based application

COURSE OUTCOMES:

After the successful completion of this course, the student will be able to

CO1: Describe the motivation behind SDN and its data plane (K2) **CO2**: Identify the functions of control plane (K3)

CO3: Apply SDN to networking applications (K3)
CO4: Apply various operations of network function virtualization
CO5: Explain various use cases of SDN

TOTAL:60 PERIODS

TEXT BOOKS

1. William Stallings, "Foundations of Modern Networking: SDN, NFV, QoE, IoT and Cloud", Pearson Education, 1st Edition, 2015.
2. Thomas D Nadeau, Ken Gray, "SDN: Software Defined Networks", O'Reilly Media, 2013.

REFERENCES

1. Fei Hu, "Network Innovation through OpenFlow and SDN: Principles and Design", 1st Edition, CRC Press, 2014.
2. Paul Goransson, Chuck Black Timothy Culver, "Software Defined Networks: A Comprehensive Approach", 2nd Edition, Morgan Kaufmann Press, 2016.
3. Oswald Coker, Siamak Azodolmolky, "Software-Defined Networking with OpenFlow", 2nd Edition, O'Reilly Media, 2017.

CO's-PO's & PSO's MAPPING

CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2	PSO 1	PSO 2	PSO 3
1	3	3	3	3	3	2	-	-	-	-	-	3	3	3	2
2	3	3	3	2	2	2	-	-	-	-	-	3	3	2	2
3	3	3	3	3	1	2	-	-	-	-	-	3	2	3	2
4	2	3	3	2	2	1	-	-	-	-	-	2	2	1	2
5	3	3	2	2	2	1	-	-	-	-	-	2	2	2	2
CO	3	3	3	2	2	2	-	-	-	-	-	2	2	2	2

1 - low, 2 - medium, 3 - high, '-' - no correlation

21152E64C MASSIVE MIMO NETWORKS L T P C
2 0 2 3

COURSE OBJECTIVES:

- To gain knowledge about massive MIMO networks.
- To understand the massive MIMO propagation channels.
- To learn about channel estimation in single cell and multicell massive MIMO systems.
- To comprehend the concepts of massive MIMO deployment in the context of single cell and multicell deployment.

UNIT I MASSIVE MIMO NETWORKS 6

Definition of Massive MIMO, Correlated Rayleigh Fading, System Model for Uplink and Downlink, Basic Impact of Spatial Channel Correlation, Channel Hardening and Favourable Propagation, Local Scattering Spatial Correlation Model

UNIT II THE MASSIVE MIMO PROPAGATION CHANNEL 6

Favorable Propagation and Deterministic Channels-Capacity Upper Bound-Distance from Favorable Propagation-Favorable Propagation and Linear Processing-Singular Values and Favorable Propagation, Favorable Propagation and Random Channels-Independent Rayleigh Fading-Uniformly Random Line-of-Sight (UR-LoS)-Independent Rayleigh Fading versus UR-LoS - Finite-Dimensional Channels

UNIT III SINGLE-CELL SYSTEMS 6

Uplink Pilots and Channel Estimation - Orthogonal Pilots- De-Spreading of the Received Pilot Signal-MMSE Channel Estimation, Uplink Data Transmission - Zero-Forcing -Maximum-Ratio, Downlink Data Transmission-Linear Precoding-Zero-Forcing-Maximum-Ratio, Discussion-Interpretation of the Effective SINR Expressions-Implications for Power Control-Scaling Laws and Upper Bounds on the SINR - Near-Optimality of Linear Processing when M >> K - Net Spectral Efficiency - Limiting Factors: Number of Antennas and Mobility

UNIT IV MULTI-CELL SYSTEMS 6

Uplink Pilots and Channel Estimation, Uplink Data Transmission - Zero-Forcing -Maximum-Ratio, Downlink Data Transmission -Zero-Forcing - Maximum-Ratio, Discussion -Asymptotic Limits with Infinite Numbers of Base Station Antennas - The Effects of Pilot Contamination - Non-Synchronous Pilot Interference

UNIT V CASE STUDIES 6

Single-Cell Deployment Example: Fixed Broadband Access in Rural Area, Multi-Cell Deployment: Preliminaries and Algorithms, Multi-Cell Deployment Examples: Mobile Access - Dense Urban

Scenario - Suburban Scenario - Minimum Per-Terminal Throughput Performance -Additional Observations - Comparison of Power Control Policies

30 PERIODS

PRACTICAL EXERCISES: **30 PERIODS**

Implementation of (Using Matlab)

1. Massive MIMO hybrid beamforming
2. Single cell massive MIMO downlink communications
3. Multicell massive MIMO downlink communications.
4. Precoding in massive MIMO single cell and multicell downlink communications
5. Channel estimation in massive MIMO system

COURSE OUTCOMES:

CO1: Understand and explain massive MIMO networks.

CO2: Analyze massive MIMO propagation channels and their capacity bounds

CO3: Examine channel estimation techniques for single cell system.

CO4: Analyze channel estimation techniques for multi cell system.

CO5: Explain the concepts underlining the deployment of single and multicell massiveMIMO systems.

TOTAL:60 PERIODS

TEXT BOOKS

1. Thomas L. Marzetta, Erik G. Larsson, Hong Yang, Hien Quoc Ngo, "Fundamentals of Massive MIMO", Cambridge University Press 2016. (UNITS II-V)
2. Emil Björnson, Jakob Hoydis and Luca Sanguinetti (2017), "Massive MIMO Networks:Spectral, Energy, and Hardware Efficiency", Foundations and Trends, Now, 2017. (UNIT I)

REFERENCES

1. Long Zhao, Hui Zhao, Kan Zheng, "Wei Xiang Massive MIMO in 5G Networks: Selected Applications", Springer 2018.
2. Leibo Liu, Guiqiang Peng, Shaojun Wei, "Massive MIMO Detection Algorithm and VLSI Architecture", Springer 2019.
3. Shahid Mumtaz, Jonathan Rodriguez, Linglong Dai, "mmWave Massive MIMO A Paradigm for 5G", Elsevier, 2017

CO's-PO's & PSO's MAPPING

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	2	1	1	2	2	-	-	-	-	-	2	3	1	2
2	3	3	2	2	2	2	-	-	-	-	-	1	2	2	1
3	3	2	2	2	2	2	-	-	-	-	-	1	3	3	2
4	3	3	2	2	2	2	-	-	-	-	-	1	3	1	3
5	3	2	2	2	2	2	-	-	-	-	-	2	3	3	2
CO	3	2.4	1.8	1.8	2	2	-	-	-	-	-	1.4	3	2	2

1 - low, 2 - medium, 3 - high, '-' - no correlation

21152E54C **AVIONICS SYSTEMS** **L T P C**
3 0 0 3

COURSE OBJECTIVES:

- To impart knowledge on the needs for avionics for both Civil and military aircraft.
- To impart knowledge on avionics architecture and Avionics data bus.
- To impart knowledge understand the various cockpit displays and human interfaces.
- To impart knowledge on the concepts of flight control systems, FMS and their importance

- To impart knowledge on different navigation aids and need for certification

UNIT I INTRODUCTION TO AVIONICS 9

Basics of Avionics-Basics of Cockpits - Need for Avionics in civil and military aircraft and space systems – Integrated Avionics Architecture –Military and Civil system - Typical avionics System and Sub systems - Design and Technologies - Requirements and Importance of illities of Avionic Systems.

UNIT II DIGITAL AVIONICS BUS ARCHITECTURE 9

Evolution of Avionics architecture– Avionics Data buses MIL-STD-1553, MIL-STD-1773, ARINC-429, ARINC-629, AFDX/ARINC-664, ARINC-818 – Aircraft system Interface

UNIT III COCKPIT DISPLAYS AND MAN-MACHINE INTERACTION 9

Trends in display technology- CRT, LED, LCD, EL and plasma panel - Touch screen - Direct voice input (DVI) –-Civil cockpit and military cockpit: MFD, MFK, HUD, HDD, HMD, HOTAS – Glass cockpit.

UNIT IV FLIGHT CONTROL SYSTEMS 9

Introduction to Flight control systems and FMS- Longitudinal control - Lateral Control -Autopilot - Flight planning - Radar Electronic Warfare - Certification-Military and civil aircrafts.

UNIT V NAVIGATION SYSTEMS 9

Overview of navigation systems - Communication Systems - Radio navigation - Types & Principles – Fundamentals of Inertial Sensors – INS – GNSS -- GPS – Approach and Landing Aids – ILS & MLS – Hybrid Navigation

COURSE OUTCOMES: TOTAL: 45 PERIODS

Upon completion of the course, students will be able to:
CO1:Explain the different of Avionics Systems and its need for civil and military aircrafts considering the reliability and safety aspects
CO2:Select a suitable architecture and data bus based on the requirements
CO3:Compare the different display technologies used in cockpit
CO4:Explain the principles of flight control systems and the importance of FMS
CO5:Explain the communication and navigation techniques used in aircrafts

TEXT BOOK:

1. R.P.G. Collinson, “Introduction to Avionics”, Springer Publications, Third Edition, 2011.

REFERENCES:

1. Cary R .Spitzer, “The Avionics Handbook”, CRC Press, 2000.
2. Middleton, D.H. “Avionics Systems”, Longman Scientific and Technical, Longman Group UK Ltd., England, 1989.

3. Spitzer, C.R. “Digital Avionics Systems”, Prentice Hall, Englewood Cliffs, N.J., U.S.A., 1987.

4. Myron Kayton , Walter R. Fried “Avionics Navigation Systems” 2nd Edition, Wiley Publication, 2008.

5. Jim Curren, “Trend in Advanced Avionics”, IOWA State University, 1992.

CO’s-PO’s & PSO’s MAPPING

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	3	3	3	3	2	-	-	-	-	-	3	3	3	2
2	3	3	3	2	2	2	-	-	-	-	-	3	3	2	2
3	3	3	3	3	1	2	-	-	-	-	-	3	2	3	2
4	2	3	3	2	2	1	-	-	-	-	-	2	2	1	2
5	3	3	2	2	2	1	-	-	-	-	-	2	2	2	2
CO	3	3	3	2	2	2	-	-	-	-	-	2	2	2	2

1 - low, 2 - medium, 3 - high, ‘-' - no correlation

21152E64B SATELLITE COMMUNICATION L T P C
3 0 0 3

COURSE OBJECTIVES:

The student should be made to:

- Understand the basics of satellite orbits
- Understand the satellite segment and earth segment
- understand Link Power budget calculation
- Understand the various satellite access and coding technology
- Understand the applications of satellite

UNIT I SATELLITE ORBITS 9

Kepler’s Laws, Newton’s law, orbital parameters, orbital perturbations, station keeping, geo stationary and non Geo-stationary orbits – Look Angle Determination- Limits of visibility – eclipse-Sub satellite point -Sun transit outage-Launching Procedures - launch vehicles and propulsion.

UNIT II SPACE SEGMENT 9

Spacecraft Technology- Structure, Primary power, Attitude and Orbit control, Thermal control and Propulsion, communication Payload and supporting subsystems, Telemetry, Tracking and command-Transponders Antenna Subsystem.

UNIT III SATELLITE LINK DESIGN 9

Basic link analysis, Uplink and Downlink Design equation, Free space loss-Atmospheric effects, Ionospheric scintillation, Rain induced attenuation and interference, system noise temperature, Link Design with and without frequency reuse.

UNIT IV SATELLITE ACCESS AND CODINGTechniques 9

Modulation and Multiplexing: Voice, Data, Video, Analog - digital transmission system, Digital video Broadcast, multiple access: FDMA, TDMA, CDMA, PAMA and DAMA Assignment Methods, compression – encryption, Coding Schemes.

UNIT V SATELLITE APPLICATIONS 9

INTELSAT Series, INSAT, VSAT, Mobile satellite services: GSM, GPS, LEO, MEO, Satellite Navigational System. GPS-Position Location Principles, Differential GPS, Direct Broadcast satellites

(DBS/DTH).

TOTAL:45 PERIODS

COURSE OUTCOMES:

At the end of the course, the student will be able to:
CO1:Identify the satellite orbits
CO2:Analyze the satellite subsystems
CO3:Evaluate the satellite link power budget
CO4:Identify access technology for satellite
CO5:Design various satellite applications

TEXT BOOKS:

1. Dennis Roddy, “Satellite Communication”, 4th Edition, Mc Graw Hill International, 2017.
2. Timothy Pratt, Charles, W.Bostain,Jeremy E.Allnutt,"SatelliteCommunication”,3rd Edition, Wiley Publications,2021.

REFERENCES:

1. Tri T. Ha, “Digital Satellite Communications”, 2nd edition, Mc Graw Hill education, 2017.

2. Wilbur L.Pritchard, Hendri G. Suyderhoud, Robert A. Nelson, “Satellite CommunicationsSystems Engineering”, 2nd edition , Prentice Hall/Pearson , 2013.
3. M.Richharia, “Satellite Communication Systems-Design Principles”, Macmillan, 1999.
4. Brian Ackroyd, “World Satellite Communication and earth station Design”, BSP professionalBooks, 1990.
5. Bruce R. Elbert, “The Satellite Communication Applications”, Hand Book, Artech HouseBostan London, 2003.

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	3	3	3	2	3	1	1	-	1	-	1	3	3	3
2	3	2	2	3	2	3	-	-	-	-	-	1	3	3	3
3	3	3	3	2	1	3	-	-	-	-	-	1	3	3	3
4	3	3	2	3	2	3	-	-	-	-	-	1	3	3	3
5	3	2	3	2	2	1	-	-	-	-	-	1	3	3	3
CO	**3**	**3**	**3**	**3**	**2**	**3**	1	1	-	1	**-**	**1**	**3**	**3**	**3**

CO’s-PO’s & PSO’s MAPPING

1 - low, 2 - medium, 3 - high, ‘-' - no correlation

21152E55B **IMAGE PROCESSING** **L T P C**

3 0 0 3

COURSE OBJECTIVES:

- To become familiar with digital image fundamentals
- To get exposed to simple image enhancement techniques in Spatial and Frequency domain.
- To learn concepts of degradation function and restoration techniques.
- To study the image segmentation and representation techniques.
- To become familiar with image compression and recognition methods

UNIT I DIGITAL IMAGE FUNDAMENTALS 9

Steps in Digital Image Processing – Components – Elements of Visual Perception – Image Sensing and Acquisition – Image Sampling and Quantization – Relationships between pixels - Color image fundamentals - RGB, HSI models, Two-dimensional mathematical preliminaries, 2D transforms - DFT, DCT.

UNIT II IMAGE ENHANCEMENT 9

Spatial Domain: Gray level transformations – Histogram processing – Basics of Spatial Filtering– Smoothing and Sharpening Spatial Filtering, Frequency Domain: Introduction to Fourier Transform– Smoothing and Sharpening frequency domain filters – Ideal, Butterworth and Gaussian filters, Homomorphic filtering, Color image enhancement.

UNIT III IMAGE RESTORATION 9

Image Restoration - degradation model, Properties, Noise models – Mean Filters – Order Statistics – Adaptive filters – Band reject Filters – Band pass Filters – Notch Filters – Optimum Notch Filtering – Inverse Filtering – Wiener filtering

UNIT IV IMAGE SEGMENTATION 9

Edge detection, Edge linking via Hough transform – Thresholding - Region based segmentation – Region growing – Region splitting and merging – Morphological processing- erosion and dilation,Segmentation by morphological watersheds – basic concepts – Dam construction – Watershedsegmentation algorithm.

UNIT V IMAGE COMPRESSION AND RECOGNITION 9

Need for data compression, Huffman, Run Length Encoding, Shift codes, Arithmetic coding, JPEG standard, MPEG. Boundary representation, Boundary description, Fourier Descriptor, Regional Descriptors – Topological feature, Texture - Patterns and Pattern classes - Recognition based on matching.

TOTAL :45 PERIODS

COURSE OUTCOMES

At the end of the course, the students should be able to:

CO1 :Know and understand the basics and fundamentals of digital image processing, such as digitization, sampling, quantization, and 2D-transforms.

CO2: Operate on images using the techniques of smoothing, sharpening and enhancement.

CO3:Understand the restoration concepts and filtering techniques.

CO4: Learn the basics of segmentation, features extraction, compression and recognition methodsfor color models.

CO5:Comprehend image compression concepts.

TEXT BOOKS:

1. Rafael C. Gonzalez, Richard E. Woods, 'Digital Image Processing', Pearson, Third Edition,2010.
2. Anil K. Jain, 'Fundamentals of Digital Image Processing', Pearson, 2002.

REFERENCES

1. Kenneth R. Castleman, 'Digital Image Processing', Pearson, 2006.
2. Rafael C. Gonzalez, Richard E. Woods, Steven Eddins, 'Digital Image Processing using MATLAB', Pearson Education, Inc., 2011.
3. D,E. Dudgeon and RM. Mersereau, 'Multidimensional Digital Signal Processing', Prentice Hall Professional Technical Reference, 1990.
4. William K. Pratt, 'Digital Image Processing', John Wiley, New York, 2002
5. Milan Sonka et al 'Image processing, analysis and machine vision', Brookes/Cole, Vikas Publishing House, 2nd edition, 1999.

CO's-PO's & PSO's MAPPING

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	3	3	2	2	2	-	-	-	-	-	3	2	3	2
2	3	3	3	2	2	2	-	-	-	-	-	2	2	3	2
3	3	3	2	2	2	2	-	-	-	-	-	2	2	2	1
4	3	3	3	2	2	2	-	-	-	-	-	2	2	2	1
5	3	3	3	3	2	2	-	-	-	-	-	2	2	2	1
CO	3	3	3	2	2	2	-	-	-	-	-	2	2	2	2

1 - low, 2 - medium, 3 - high, '-' - no correlation

21152E55C **SPEECH PROCESSING** **L T P C**
2 0 2 3

COURSE OBJECTIVES:

- Study the fundamentals of speech signal and extracs various speech features
- Understand different speech coding techniques for speech compression applications
- Learn to build speech enhancement, text-to-speech synthesis system

UNIT I FUNDAMENTALS OF SPEECH 6

The Human speech production mechanism, Discrete-Time model of speech production, Speech perception - human auditory system, Phonetics - articulatory phonetics, acoustic phonetics, and auditory phonetics, Categorization of speech sounds, Spectrographic analysis of speech sounds, Pitch frequency, Pitch period measurement using spectral and cepstral domain, Formants, Evaluation of Formants for voiced and unvoiced speech.

UNIT II SPEECH FEATURES AND DISTORTION MEASURES 6

Significance of speech features in speech-based applications, Speech Features – Cepstral Coefficients, Mel Frequency Cepstral Coefficients (MFCCs), Perceptual Linear Prediction (PLP), Log Frequency Power Coefficients (LFPCs), Speech distortion measures–Simplified distance measure, LPC-based distance measure, Spectral distortion measure, Perceptual distortion measure.

UNIT III SPEECH CODING 6

Need for speech coding, Waveform coding of speech – PCM, Adaptive PCM, DPCM, ADPCM, Delta Modulation, Adaptive Delta Modulation, G.726 Standard for ADPCM, Parametric Speech Coding – Channel Vocoders, Linear Prediction Based Vocoders, Code Excited Linear Prediction (CELP) based Vocoders, Sinusoidal speech coding techniques, Hybrid coder, Transform domain coding of speech

UNIT IV SPEECH ENHANCEMENT 6

Classes of Speech Enhancement Algorithms, **Spectral-Subtractive Algorithms -** Multiband Spectral Subtraction, MMSE Spectral Subtraction Algorithm, Spectral Subtraction Based on Perceptual Properties, **Wiener Filtering -** Wiener Filters in the Time Domain, Wiener Filters in the Frequency Domain, Wiener Filters for Noise Reduction, Maximum-Likelihood Estimators, Bayesian Estimators, MMSE and Log-MMSE Estimator, **Subspace Algorithms.**

UNIT V SPEECH SYNTHESIS AND APPLICATION 6

A Text-to-Speech systems (TTS), Synthesizers technologies – Concatenative synthesis, Use of Formants for concatenative synthesis, Use of LPC for concatenative synthesis, HMM-based synthesis, Sinewave synthesis, Speech transformations, Watermarking for authentication of a speech, Emotion recognition from speech.

30 PERIODS

PRACTICAL EXERCISES: 30 PERIODS

1. Write a MATLAB Program to classify voiced and unvoiced segment of speech using various time-domain measures
2. Write a MATLAB Program to calculate the MFCC for a speech signal
3. Implement ITU-T G.722 Speech encoder in MATLAB
4. Write a MATLAB Program to implement Wiener Filters for Noise Reduction
5. Design a speech emotion recognition system using DCT and WPT in MATLAB

HARDWARE & SOFTWARE SUPPORT TOOLS:

- Personal Computer with MATLAB
- Microphone and Speakers

COURSE OUTCOMES:

At the end of this course, the students will be able to:

CO1: Understand the fundamentals of speech.
CO2: Extract various speech features for speech related applications
CO3: Choose an appropriate speech coder for a given application.
CO4: Build a speech enhancement system.
CO5: Build a text-to-speech synthesis system for various applications

TOTAL:60 PERIODS

TEXT BOOKS :

1. Shaila D. Apte, Speech and Audio Processing, Wiley India (P) Ltd, New Delhi, 2012
2. Philipos C. Loizou, Speech Enhancement Theory and Practice, Second Edition, CRC Press,Inc., United States, 2013

REFERENCES:

1. Rabiner L. R. and Juang B. H, Fundamentals of speech recognition, PearsonEducation, 2003
2. Thomas F. Quatieri, Discrete-time speech signal processing - Principles and practice,Pearson, 2012.

CO's-PO's & PSO's MAPPING

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	1	2	1	1	2	1	-	-	-	-	-	2	3	3	3
2	1	2	1	1	2	1	-	-	-	-	-	2	2	2	2
3	1	2	1	1	2	1	-	-	-	-	-	1	1	2	2
4	3	-	3	3	-	3	-	-	-	-	-	2	2	3	3
5	3	-	3	3	-	3	-	-	-	-	-	2	2	2	2
CO	**1.8**	**2**	**1.8**	**1.8**	**2**	**1.8**						**1.8**	**2**	**2.4**	**2.4**

1 - low, 2 - medium, 3 - high, '-' - no correlation

21152E64A SOFTWARE DEFINED RADIO

L T P C
2 0 2 3

COURSE OBJECTIVES:

- To introduce the concepts of software radios
- To know about RF implementation challenges for software defined radios
- To understand the digital generation of signals
- To learn the software and hardware requirements for software defined radios.

UNIT I INTRODUCTION TO SOFTWARE RADIO 6

The Need for Software Radios. Characteristics and Benefits of a Software Radio. Design Principles of a Software Radio.

UNIT II RF IMPLEMENTATION 6

Purpose of RF front – end, Dynamic range, RF receiver front – end topologies, Enhanced flexibilityof the RF chain with software radios, Importance of the components to overall performance, Transmitter architectures and their issues, Noise and distortion in the RF chain, Hybrid DDS – PLL systems, Applications of Direct Digital Synthesis.

UNIT III DIGITAL GENERATION OF SIGNALS 6

Comparison of direct digital synthesis with analog signal synthesis, Approaches to direct digital synthesis, Analysis of spurious signals, Performance of direct digital synthesis systems,Applications of direct digital synthesis.

UNIT IV SMART ANTENNAS 6

Benefits of smart antennas, Structures for beamforming systems, Smart antenna algorithms, Hardware implementation of smart antennas, Digital Hardware Choices-Key hardware elements.

UNIT V HARDWARE AND SOFTWARE FOR SDR & CASE STUDIES 6

DSP Processors, FPGA, ASICs. Trade-offs, Object oriented programming, Object Brokers, GNU Radio-USRP. Case Studies: SPEAK easy, JRTS, SDR-3000.

30 PERIODS

COURSE OUTCOMES:

At the end of this course, the students will be able to:

CO1: Understand the fundamentals of speech.
CO2: Extract various speech features for speech related applications
CO3: Choose an appropriate speech coder for a given application.
CO4: Build a speech enhancement system.
CO5: Build a text-to-speech synthesis system for various applications

TEXT BOOKS :

3. Shaila D. Apte, Speech and Audio Processing, Wiley India (P) Ltd, New Delhi, 2012
4. Philipos C. Loizou, Speech Enhancement Theory and Practice, Second Edition, CRC Press,Inc., United States, 2013

REFERENCES:

3. Rabiner L. R. and Juang B. H, Fundamentals of speech recognition, PearsonEducation, 2003
4. Thomas F. Quatieri, Discrete-time speech signal processing - Principles and practice,Pearson, 2012.

CO's-PO's & PSO's MAPPING

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	1	2	1	1	2	1	-	-	-	-	-	2	3	3	3
2	1	2	1	1	2	1	-	-	-	-	-	2	2	2	2
3	1	2	1	1	2	1	-	-	-	-	-	1	1	2	2
4	3	-	3	3	-	3	-	-	-	-	-	2	2	3	3
5	3	-	3	3	-	3	-	-	-	-	-	2	2	2	2
CO	**1.8**	**2**	**1.8**	**1.8**	**2**	**1.8**						**1.8**	**2**	**2.4**	**2.4**

1 - low, 2 - medium, 3 - high, '-' - no correlation

21152E65D **ADVANCED DIGITAL SIGNAL PROCESSING** **L T P C**
2 0 2 3

COURSE OBJECTIVES:

- To introduce the concepts of discrete time random signal processing
- To know about multirate signal processing and its applications
- To understand the spectrum estimation techniques
- To learn the concept of prediction theory and filtering

UNIT I MULTIRATE SIGNAL PROCESSING **6**

Review of Convolution, DFT and ZT, Multirate Signal Processing - Decimation, Interpolation, Sampling Rate Conversion by a rational factor – digital filter banks, sub band coding, Quadrature Mirror Filter.

UNIT II DISCRETE TIME RANDOM PROCESSES **6**

Stationary random processes, Autocorrelation, Rational Power Spectra, Filters for generating random Processes from white noise and inverse filter – AR, MA and ARMA processes – relationship between autocorrelation and the filter parameters.

UNIT III LINEAR PREDICTION AND FILTERING **6**

Linear Prediction – Forward and Backward - Wiener filters for filtering and prediction – FIR WienerFilter – IIR Wiener Filter – Kalman Filter.

UNIT IV ADAPTIVE FILTERING **6**

FIR adaptive filters – adaptive filters based on steepest descent method – LMS algorithm – Variants of LMS algorithm – adaptive echo cancellation – adaptive channel equalization – RLS Algorithm.

UNIT V SPECTRUM ESTIMATION **6**

Estimation of power spectra from finite duration observations of signals – Non parametric methods of spectrum estimation – the Bartlett and the Welch method – Parametric spectrum estimation – AR, MA and ARMA.

30 PERIODS

PRACTICAL EXERCISES: **30 PERIODS**

1. Study of autocorrelation and Cross Correlation of random signals
2. Design and Implementation of Multirate Systems.
3. Design and Implementation of Wiener Filter
4. Design and Implementation of FIR Linear Predictor
5. Design of adaptive filters using LMS algorithm
6. Spectrum Estimation using Bartlett and Welch Methods

COURSE OUTCOMES:

Upon successful completion of the course the student will be able to

CO1: Comprehend multirate signal processing and demonstrate its applications

CO2:Demonstrate an understanding of the power spectral density and apply to discrete randomsignals and systems

CO3: Apply linear prediction and filtering techniques to discrete random signals for signal detection and estimation.

CO4: Analyze adaptive filtering problems and demonstrate its application

CO5: Apply power spectrum estimation techniques to random signals.

TOTAL:60 PERIODS

TEXT BOOKS :

1. John G. Proakis & Dimitris G.Manolakis, ―Digital Signal Processing – Principles, Algorithms& Applications, Fourth Edition, Pearson Education / Prentice Hall, 2007.
2. P. Vaidyanathan, "Multirate systems and filter banks", Prentice Hall Inc. 1993.

REFERENCES :

1. Monson H. Hayes, "Statistical digital signal processing and modeling", John Wiley and SonsInc. New York, Indian reprint 2008.
2. Haykin, Adaptive Filter Theory, 4th Edition, Pearson Education, New Delhi, 2006.

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	3	3	2	2	2	-	-	-	-	-	1	2	3	3
2	3	3	3	2	2	2	-	-	-	-	-	2	3	2	2
3	3	3	3	2	2	2	-	-	-	-	-	2	2	2	1
4	3	3	3	2	2	2	-	-	-	-	-	2	3	2	2
5	3	3	2	2	1	1	-	-	-	-	-	1	2	3	1
CO	3	3	3	2	2	2	-	-	-	-	-	2	3	2	2

3. Sophoncles J. Orfanidis, "Optimum Signal Processing ", McGraw Hill, 2000.

CO's-PO's & PSO's MAPPING

1 - low, 2 - medium, 3 - high, '-' - no correlation

21152E64A **SOFTWARE DEFINED RADIO** **L T P C**
2 0 2 3

COURSE OBJECTIVES:

- To introduce the concepts of software radios
- To know about RF implementation challenges for software defined radios
- To understand the digital generation of signals
- To learn the software and hardware requirements for software defined radios.

UNIT I INTRODUCTION TO SOFTWARE RADIO 6

The Need for Software Radios. Characteristics and Benefits of a Software Radio. Design Principles of a Software Radio.

UNIT II RF IMPLEMENTATION 6

Purpose of RF front – end, Dynamic range, RF receiver front – end topologies, Enhanced flexibility of the RF chain with software radios, Importance of the components to overall performance, Transmitter architectures and their issues, Noise and distortion in the RF chain, Hybrid DDS – PLL systems, Applications of Direct Digital Synthesis.

UNIT III DIGITAL GENERATION OF SIGNALS 6

Comparison of direct digital synthesis with analog signal synthesis, Approaches to direct digital synthesis, Analysis of spurious signals, Performance of direct digital synthesis systems, Applications of direct digital synthesis.

UNIT IV SMART ANTENNAS 6

Benefits of smart antennas, Structures for beamforming systems, Smart antenna algorithms, Hardware implementation of smart antennas, Digital Hardware Choices-Key hardware elements.

UNIT V HARDWARE AND SOFTWARE FOR SDR & CASE STUDIES 6

DSP Processors, FPGA, ASICs. Trade-offs, Object oriented programming, Object Brokers, GNU Radio-USRP. Case Studies: SPEAK easy, JRTS, SDR-3000.

30 PERIODS

PRACTICAL EXERCISES: 30 PERIODS

1. Study of SDR hardware kit
2. Design and Implementation of digital modulation schemes using SDR
3. Implementation of synchronization techniques using SDR
4. Channel Coding Techniques using SDR
5. Study of channel estimation techniques using SDR
6. Study of MIMO concepts using SDR

COURSE OUTCOMES :

At the end of this course, the students will be able to:

CO1: Demonstrate an understanding in the evolving paradigm of Software defined radio andtechnologies for its implementation.
CO2: Analyse Radio frequency implementation issues
CO3: Implement Smart antenna techniques for software defined radio.
CO4: Compare various digital synthesis procedures.
CO5: Comprehend various hardware and software requirements for software defined radios.

TOTAL:60 PERIODS

TEXT BOOKS :

1. Jeffrey Hugh Reed, “Software Radio: A Modern Approach to Radio Engineering,” PrenticeHall Professional, 2002.
2. Tony J Rouphael, “RF and DSP for SDR,” Elsevier Newnes Press, 2008.

REFERENCES

1. P. Kenington, “RF and Baseband Techniques for Software Defined Radio,” Artech House,2005.
2. Paul Burns, “Software Defined Radio for 3G,” Artech House, 2002.
3. Behrouz. F. Bourjney“ Signal Processing for Software defined Radios”, Lulu 2008.

CO’s-PO’s & PSO’s MAPPING

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	3	2	2	2	2	-	-	-	1	-	3	3	2	2
2	3	3	3	2	2	2	-	-	-	1	-	2	3	2	2
3	3	3	3	2	2	2	-	-	-	1	-	2	3	2	3
4	3	3	3	2	2	2	-	-	-	1	-	2	2	2	2
5	3	3	3	3	2	2	-	-	-	1	-	2	2	2	2
CO	3	3	3	2	2	2	-	-	-	1	-	2	2	2	2

1 - low, 2 - medium, 3 - high, ‘-' - no correlation

21152E65A ADVANCED WIRELESS COMMUNICATION TECHNIQUES **L T P C**

3 0 0 3

COURSE OBJECTIVES

- To understand the evolving paradigm of cooperative communication
- To understand concepts related to green wireless communication
- To enable the student to understand the different power saving strategies and energy efficient signal, system and network design.
- To expose the student to the energy saving techniques adopted in existing wireless components
- To provide understanding on protocols and networks related to green future wireless communication technologies.

UNIT I COOPERATIVE COMMUNICATIONS AND GREEN CONCEPTS 9

Network architectures and research issues in cooperative cellular wireless networks ; Cooperative communications in OFDM and MIMO cellular relay networks: issues and approaches; Fundamental trade-offs on the design of green radio networks, Green modulation and coding schemes.

UNIT II COOPERATIVE TECHNIQUES 9

Cooperative techniques for energy efficiency, Cooperative base station techniques for cellular wireless networks; Turbo base stations; Antenna architectures for cooperation; Cooperative communications in 3GPP LTE-Advanced, Partial information relaying and Coordinated multi-point transmission in LTE-Advanced.

UNIT III RELAY-BASED COOPERATIVE CELLULAR NETWORKS 9

Distributed space-time block codes ; Collaborative relaying in downlink cellular systems ; Radio resource optimization; Adaptive resource allocation ; Cross-layer scheduling design for cooperative wireless two-way relay networks ; Network coding in relay-based networks.

UNIT IV GREEN RADIO NETWORKS 9

Base Station Power-Management Techniques- Opportunistic spectrum and load management, Energy-saving techniques in cellular wireless base stations , Power-management for base stations in smart grid environment, Cooperative multi cell processing techniques for energy-efficient cellular wireless communications.

UNIT V ACCESS TECHNIQUES FOR GREEN RADIO NETWORKS 9

Cross-layer design of adaptive packet scheduling for green radio networks; Energy-efficient relaying for cooperative cellular wireless networks ; Energy performance in TDD-CDMA multihop cellular networks ; Resource allocation for green communication in relay-based cellular networks ; Green Radio Test-Beds and Standardization Activities.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

CO1: The student would be able to appreciate the necessity and the design aspects of cooperative communication

CO2: The student would be able to appreciate the necessity and the design aspects of green wireless communication.

CO3: The student would be able to evolve new techniques in wireless communication

CO4: The students would be able to demonstrate the feasibility of using mathematical models using simulation tools.

CO5: The student would be able to demonstrate the impact of the green engineering solutions in aglobal, economic, environmental and societal context.

TEXT BOOKS

1. Ekram Hossain, Dong In Kim, Vijay K. Bhargava , “Cooperative Cellular Wireless Networks”,Cambridge University Press, 2011.
2. Ekram Hossain, Vijay K. Bhargava(Editor), Gerhard P. Fettweis (Editor), “Green Radio Communication Networks”, Cambridge University Press, 2012.

REFERENCES

1. F. Richard Yu, Yu, Zhang and Victor C. M. Leung “Green Communications and Networking”, CRC press, 2012.
2. Ramjee Prasad and Shingo Ohmori, Dina Simunic, “Towards Green ICT”, River Publishers,2010.
3. Jinsong Wu, Sundeep Rangan and Honggang Zhang, “Green Communications: Theoretical Fundamentals, Algorithms and Applications”, CRC Press, 2012.

CO’s-PO’s & PSO’s MAPPING

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	3	3	2	1	1	-	-	-	-	-	2	3	3	3
2	3	3	3	2	2	1	-	-	-	-	-	2	3	2	3
3	3	2	2	1	2	1	-	-	-	-	-	2	2	1	1
4	3	3	3	3	2	1	-	-	-	-	-	2	3	1	2
5	3	3	3	2	1	2	-	-	-	-	-	2	2	3	1
CO	**3**	**2.8**	**2.8**	**2**	**1.6**	**1.2**	**-**	**-**	**-**	**-**	**-**	**2**	**3**	**2**	**2**

1 - low, 2 - medium, 3 - high, ‘-' - no correlation

21160E72A PRINCIPLES OF MANAGEMENT

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

- Sketch the Evolution of Management.
- Extract the functions and principles of management.
- Learn the application of the principles in an organization.
- Study the various HR related activities.
- Analyze the position of self and company goals towards business.

UNIT I INTRODUCTION TO MANAGEMENT AND ORGANIZATIONS 9

Definition of Management – Science or Art – Manager Vs Entrepreneur- types of managers-managerial roles and skills – Evolution of Management -Scientific, human relations, system and contingency approaches- Types of Business organization- Sole proprietorship, partnership, company-public and private sector enterprises- Organization culture and Environment – Current trends and issues in Management.

UNIT II PLANNING 9

Nature and purpose of planning - Planning process - Types of planning - Objectives - Setting objectives – Policies – Planning premises – Strategic Management – Planning Tools and Techniques – Decision making steps and process.

UNIT III ORGANISING 9

Nature and purpose - Formal and informal organization - Organization chart - Organization structure – Types – Line and staff authority – Departmentalization – delegation of authority – Centralization and decentralization - Job Design - Human Resource Management - HR Planning, Recruitment, selection, Training and Development, Performance Management, Career planning and management.

UNIT IV DIRECTING 9

Foundations of individual and group behaviour- Motivation - Motivation theories - Motivational techniques - Job satisfaction - Job enrichment - Leadership - types and theories of leadership - Communication – Process of communication – Barrier in communication – Effective communication – Communication and IT.

UNIT V CONTROLLING 9

System and process of controlling - Budgetary and non - Budgetary control techniques - Use of computers and IT in Management control - Productivity problems and management - Control and performance – Direct and preventive control – Reporting.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

CO1: Upon completion of the course, students will be able to have clear understanding of managerial functions like planning, organizing, staffing, leading & controlling.
CO2: Have same basic knowledge on international aspect of management.
CO3: Ability to understand management concept of organizing.
CO4: Ability to understand management concept of directing.
CO5: Ability to understand management concept of controlling.

TEXT BOOKS:

1. Harold Koontz and Heinz Weihrich "Essentials of management" Tata McGraw Hill,1998.
2. Stephen P. Robbins and Mary Coulter, " Management", Prentice Hall (India)Pvt. Ltd., 10th Edition, 2009.

REFERENCES:

1. Robert Kreitner and MamataMohapatra, " Management", Biztantra, 2008.
2. Stephen A. Robbins and David A. Decenzo and Mary Coulter, "Fundamentals of Management" Pearson Education, 7th Edition, 2011.
3. Tripathy PC and Reddy PN, "Principles of Management", Tata Mcgraw Hill, 1999.

CO's-PO's & PSO's MAPPING

CO's	PO's												PSO's		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	3		-	-	-	1	-	-	-	-	-	-	2	1	1
2	-	1	1	-	-	-	-	-	-	-	-	-	2	1	-
3	1		-	2	-	-	1	-	2	-	1	1	-	-	2
4	-	1	1	1	2	-	-	1	2	-	-	-	1	1	1
5	1		-	-	1	1	-	-	-	3	-	1	1	-	1
AVg.	1.66	1	1	1.5	1.5	1	1	1	2	3	1	1	1.5	1	1.25

1 - low, 2 - medium, 3 - high, '-' - no correlation

21160E72B **TOTAL QUALITY MANAGEMENT** **L T P C**
3 0 0 3

COURSE OBJECTIVES:

- Teach the need for quality, its evolution, basic concepts, contribution of quality gurus, TQMframework, Barriers and Benefits of TQM.
- Explain the TQM Principles for application.
- Define the basics of Six Sigma and apply Traditional tools, New tools, Benchmarking andFMEA.
- Describe Taguchi's Quality Loss Function, Performance Measures and apply Techniqueslike QFD, TPM, COQ and BPR.
- Illustrate and apply QMS and EMS in any organization.

UNIT I INTRODUCTION 9

Introduction - Need for quality - Evolution of quality - Definition of quality - Dimensions of product and service quality -Definition of TQM-- Basic concepts of TQM - Gurus of TQM (Brief introduction) -- TQM Framework- Barriers to TQM -Benefits of TQM.

UNIT II TQM PRINCIPLES 9

Leadership - Deming Philosophy, Quality Council, Quality statements and Strategic planning- Customer Satisfaction -Customer Perception of Quality, Feedback, Customer complaints, Service Quality, Kano Model and Customer retention - Employee involvement - Motivation, Empowerment, Team and Teamwork, Recognition & Reward and Performance Appraisal-- Continuous process improvement -Juran Trilogy, PDSA cycle, 5S and Kaizen - Supplier partnership – Partnering, Supplier selection, Supplier Rating and Relationship development.

UNIT III TQM TOOLS & TECHNIQUES I 9

The seven traditional tools of quality - New management tools - Six-sigma Process Capability-Bench marking - Reasons to benchmark, Benchmarking process, What to Bench Mark, Understanding Current Performance, Planning, Studying Others, Learning from the data, Using the findings, Pitfalls and Criticisms of Benchmarking - FMEA - Intent , Documentation, Stages: Design FMEA and Process FMEA.

UNIT IV TQM TOOLS & TECHNIQUES II 9

Quality circles – Quality Function Deployment (QFD) - Taguchi quality loss function – TPM – Concepts, improvement needs – Performance measures- Cost of Quality - BPR.

UNIT V QUALITY MANAGEMENT SYSTEM 9

Introduction-Benefits of ISO Registration-ISO 9000 Series of Standards-Sector-Specific Standards - AS 9100, TS16949 and TL 9000-- ISO 9001 Requirements-Implementation-Documentation- Internal Audits-Registration-ENVIRONMENTAL MANAGEMENT SYSTEM: Introduction–ISO 14000 Series Standards–Concepts of ISO 14001–Requirements of ISO 14001-Benefits of EMS.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

CO1: Ability to apply TQM concepts in a selected enterprise.
CO2: Ability to apply TQM principles in a selected enterprise.
CO3: Ability to understand Six Sigma and apply Traditional tools, New tools, Benchmarking andFMEA.
CO4: Ability to understand Taguchi's Quality Loss Function, Performance Measures andapplyQFD, TPM, COQ and BPR.
CO5: Ability to apply QMS and EMS in any organization.

CO's- PO's & PSO's MAPPING

CO's	PO's												PSO's		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1		3										3	2		3
2						3						3		2	
3					3				3					2	3
4		2			3	2	3	2				3	3	2	
5			3			3	3	2							
AVg.		2.5	3		3	2.6	3	2	3			3	2.5	2	3

1 - low, 2 - medium, high, '-' - no correlation

TEXT BOOK:

1. Dale H.Besterfiled, Carol B.Michna,Glen H. Bester field,MaryB.Sacre, HemantUrdhwareshe and RashmiUrdhwareshe, "Total Quality Management", Pearson Education Asia, RevisedThird Edition, Indian Reprint, Sixth Impression,2013.

REFERENCES:

1. Joel.E. Ross, "Total Quality Management – Text and Cases",Routledge.,2017.
2. Kiran.D.R, "Total Quality Management: Key concepts and case studies, Butterworth – Heinemann Ltd, 2016.

3. Oakland, J.S. “TQM – Text with Cases”, Butterworth – Heinemann Ltd., Oxford, Third Edition,2003.

Suganthi,L and Anand Samuel, “Total Quality Management”, Prentice Hall (India) Pvt. Ltd.,2006 .

21154OE74A	INDUSTRIAL MANAGEMENT	L	T	P
		3	0	0

COURSE OBJECTIVES

- To study the basic concepts of management; approaches to management; contributors to management studies; various forms of business organization and trade unions function in professional organizations.
- To study the planning; organizing and staffing functions of management in professional organization.
- To study the leading; controlling and decision making functions of management in professional organization.
- To learn the organizational theory in professional organization.
- To learn the principles of productivity and modern concepts in management in professional organization.

UNIT – I INTRODUCTION TO MANAGEMENT

Management: Introduction; Definition and Functions – Approaches to the study of Management – Mintzberg’s Ten Managerial Roles – Principles of Taylor; Fayol; Weber; Parker – Forms of Organization: Sole Proprietorship; Partnership; Company (Private and Public); Cooperative – Public Sector Vs Private Sector Organization – Business Environment: Economic; Social; Political; Legal – Trade Union: Definition; Functions; Merits & Demerits.

UNIT – II FUNCTIONS OF MANAGEMENT - I

Planning: Characteristics; Nature; Importance; Steps; Limitation; Planning Premises; Strategic Planning; Vision & Mission statement in Planning- Organizing: Organizing Theory; Principles; Types; Departmentalization; Centralization and Decentralization; Authority & Responsibility – Staffing: Systems Approach; Recruiting and Selection Process; Human Resource Development (HRD) Concept and Design.

UNIT – III FUNCTIONS OF MANAGEMENT - II

Directing (Leading): Leadership Traits; Style; Morale; Managerial Grids (Blake-Mounton, Reddin) - Communication: Purpose; Model; Barriers - Controlling: Process; Types; Levels; Guidelines; Audit (External, Internal, Merits); Preventive Control - Decision Making: Elements; Characteristics; Nature; Process; Classifications.

UNIT – IV ORGANIZATION THEORY

Organizational Conflict: Positive Aspects; Individual; Role; Interpersonal; Intra Group; Inter Group; Conflict Management - Maslow’s hierarchy of needs theory; Herzberg’s motivation-hygiene theory; McClelland’s three needs motivation theory; Vroom’s valence-expectancy theory - Change Management: Concept of Change; Lewin’s Process of Change Model; Sources of Resistance; Overcoming Resistance; Guidelines to managing Conflict.

UNIT – V PRODUCTIVITY AND MODERN TOPICS

Productivity: Concept; Measurements; Affecting Factors; Methods to Improve – Modern Topics (concept, feature/characteristics, procedure, merits and demerits): Business Process Reengineering (BPR); Benchmarking; SWOT/SWOC Analysis; Total Productive Maintenance; Enterprise Resource
Planning (ERP); Management of Information Systems (MIS).

TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of the course the students would be able to

CO1 Explain basic concepts of management; approaches to management; contributors to management studies; various forms of business organization and trade unions function in professional organizations.

CO2 Discuss the planning; organizing and staffing functions of management in professional organization.

CO3 Apply the leading; controlling and decision making functions of management in professional organization.

CO4 Discuss the organizational theory in professional organization.

CO5 Apply principles of productivity and modern concepts in management in professional organization.

TEXTBOOKS:

1. M. Govindarajan and S. Natarajan, "Principles of Management", Prentice Hall of India, New Delhi, 2009.
2. Koontz. H. and Weihrich. H., "Essentials of Management: An International Perspective", 8th Edition, Tata McGrawhill, New Delhi, 2010.

REFERENCES:

1. Joseph J, Massie, "Essentials of Management", 4th Edition, Pearson Education, 1987.
2. Saxena, P. K., "Principles of Management: A Modern Approach", Global India Publications, 2009.
3. S.Chandran, "Organizational Behaviours", Vikas Publishing House Pvt. Ltd., 1994.
4. Richard L. Daft, "Organization Theory and Design", South Western College Publishing, 11th Edition, 2012.
5. S. TrevisCerto, "Modern Management Concepts and Skills", Pearson Education, 2018.

CO's-PO's & PSO's MAPPING

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	1	1	1	1	1	3	2	3	2	3	1	3	1	1	1
2	1	1	1	1	1	3	2	3	2	3	1	3	1	1	1
3	1	1	1	1	1	3	2	3	2	3	1	3	1	1	1
4	1	1	1	1	1	3	2	3	2	3	1	3	1	1	1
5	1	1	1	1	1	3	2	3	2	3	1	3	1	1	1

1 - low, 2 - medium, 3 - high, '-' - no correlation

21152E56B WIRELESS SENSOR NETWORK DESIGN L T P C
3 0 0 3

COURSE OBJECTIVES :

- To understand the fundamentals of wireless sensor network
- To gain knowledge on the MAC and Routing Protocols of WSN
- To get exposed to 6LOWPAN technology
- To acquire knowledge on the protocols required for developing real time applications using WSN and 6LOWPAN.

- To gain knowledge about operating system related to WSN and 6LOWPAN

UNIT I INTRODUCTION 9

Principle of Wireless Sensor Network -Introduction to wireless sensor networks- Challenges, Comparison with ad hoc network, Node architecture and Network architecture, design principles, Service interfaces, Gateway, Short range radio communication standards-IEEE 802.15.4, Zigbee and Bluetooth. Physical layer and transceiver design considerations.

UNIT II MAC AND ROUTING PROTOCOLS 9

MAC protocols – fundamentals, low duty cycle protocols and wakeup concepts, contention and Schedule-based protocols - SMAC, BMAC,TRAMA, Routing protocols - Requirements, Classification -SPIN, Directed Diffusion, COUGAR, ACQUIRE, LEACH, PEGASIS.

UNIT III 6LOWPAN 9

6LoWPAN Architecture - protocol stack, Adaptation Layer, Link layers - Addressing, Routing - Mesh-Under - Route-Over, Header Compression - Stateless header compression - Context- based header compression, Fragmentation and Reassembly , Mobility – types, Mobile IPv6, Proxy Home Agent, Proxy MIPv6, NEMO -Routing – MANET, ROLL, Border routing.

UNIT IV APPLICATION 9

Publish/subscribe, Web service paradigms, Common Protocols -Web service protocols, MQ telemetry transport for sensor networks (MQTT-S), ZigBee compact application protocol (CAP),Service discovery, Simple network management protocol (SNMP), Real-time transport and sessions, Industry- Specific protocols.

UNIT V TOOLS 9

TinyOS - Introduction, NesC, Interfaces, modules, configuration, Programming in TinyOS using NesC, TOSSIM, Contiki - Structure, Communication Stack, Simulation environment - Cooja simulator, Programming

TOTAL: 45 PERIODS

COURSE OUTCOMES:

CO1: To be able to design solutions for WSNs applications

CO2: To be able to develop efficient MAC and Routing Protocols

CO3: To be able to design solutions for 6LOWPAN applications

CO4: To be able to develop efficient layered protocols in 6LOWPAN

CO5: To be able to use Tiny OS and Contiki OS in WSNs and 6LOWPAN applications

REFERENCES:

1. Holger Karl , Andreas willig, “Protocol and Architecture for Wireless Sensor Networks”, John Wiley Publication, 2006.
2. Anna Forster, “Introduction to Wireless Sensor Networks”, Wiley, 2017.
3. Zach Shelby Sensinode and Carsten Bormann, “ 6LoWPAN: The Wireless Embedded Internet” John Wiley and Sons, Ltd, Publication, 2009.
4. Philip Levis, “TinyOS Programming”, 2006 -www.tinyos.net.
5. The Contiki Operating System.http://www.sics.se/contiki.

CO’s-PO’s & PSO’s MAPPING

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3

1	3	3	2	2	2	1	-	-	-	-	2	2	3	1	1
2	3	3	2	2	2	1	-	-	-	-	-	2	3	2	2
3	3	3	3	2	2	1	-	-	-	-	-	3	3	2	2
4	3	3	3	3	2	2	-	-	-	-	-	2	2	1	2
5	2	-	1	1	3	2	-	-	-	-	-	2	2	2	1
CO	**2.8**	**3**	**2.2**	**2**	**2.2**	**1.4**	**-**	**-**	**-**	**-**	**2**	**2.2**	**2.6**	**1.6**	**1.6**

1 - low, 2 - medium, 3 - high, '-' - no correlation

21152E66C **MEMS DESIGN** **L T P C**
2 0 2 3

COURSE OBJECTIVES:

- To understand the basic electrical and mechanical concepts of MEMS design
- To understand the design aspects of electrostatic sensors and actuators
- To understand the design aspects of thermal sensors and actuators
- To understand the design aspects of piezoelectric sensors and actuators
- To understand the design aspects of magnetic sensors and actuators

UNIT I ESSENTIAL ELECTRIC AND MECHANICAL CONCEPTS 6

Conductivity of semiconductors, Crystal planes and orientations, stress and strain, flexural beam bending analysis under simple loading conditions, Dynamic system, resonant frequency and quality factor

UNIT II ELECTRO STATIC SESNING AND ACTUATION 6

Parallel plate capacitor, Applications of parallel plate capacitors- inertial sensor, pressure sensor, flow sensor, tactile sensor, parallel plate actuators, interdigitated finger capacitors, applications of comb drive devices.

UNIT III THERMAL SENSING AND ACTUATION 6

Fundamentals of thermal transfer, Sensors and actuators based on thermal expansion, Themal couples, Thermal resistors, Applications- Infrared sensors, flow sensors, Inertial sensors, other sensors

UNIT IV PIEZOELECTRIC SENSING AND ACTUATION 6

Mathematical description of piezoelectric effects, Cantilever piezoelectric actuator model, properties of piezoelectric materials -Quartz, PZT,PVDF, ZnO , Applications - Acoustic sensors, Tactilesensors

UNIT V MAGNETIC SENSING AND ACTUATION 6

Concepts and principles- magnetization and nomenclatures, principles of micromagnetic actuators, fabrication of micro magnetic components- deposition, design and fabrication of magnetic coil, MEMS magnetic actuators

30 PERIODS

PRACTICAL EXERCISES: 30 PERIODS

1. Design and simulation of piezoelectric cantilever
2. Design and simulation of thermo couples
3. Design and simulation of comb drive actuators

COURSE OUTCOMES:

Upon completion of this course, the students will be able to
CO1: Understand the basics of MEMS design aspects.
CO2: Apply the knowledge in the development of electro static sensors and actuators.
CO3: Apply the knowledge in the development of thermal sensors and actuators. **CO4**: Apply the knowledge in the development of piezoelectric sensors and actuators.**CO5**: Apply the knowledge in the development of magnetic sensors and actuators.

TOTAL:60PERIODS

TEXTBOOKS

1. Chang Liu, "Foundations of MEMS", Pearson education India limited, 2006

REFERENCES

1. Murty B.S, Shankar P, Raj B, Rath, B.B, Murday J, Textbook of Nanoscience and Nanotechnology, Springer publishing, 2013.
2. Sergey Edward Lyshevski, "MEMS and NEMS: Systems, Devices, and Structures", CRCPress, 2002
3. Tai Ran Hsu, MEMS and Microsystems Design and Manufacture, Tata Mcgraw Hill, 2002
4. Vinod Kumar Khanna Nanosensors: Physical, Chemical, and Biological, CRC press,2012.

2. CO's-PO's & PSO's MAPPING

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	3	2	2	2	1	-	-	-	-	2	2	3	1	1
2	3	3	2	2	2	1	-	-	-	-	-	2	3	2	2
3	3	3	3	2	2	1	-	-	-	-	-	3	3	2	2
4	3	3	3	3	2	2	-	-	-	-	-	2	2	1	2
5	2	-	1	1	3	2	-	-	-	-	-	2	2	2	1
CO	**2.8**	**3**	**2.2**	**2**	**2.2**	**1.4**	**-**	**-**	**-**	**-**	**2**	**2.2**	**2.6**	**1.6**	**1.6**

1 - low, 2 - medium, 3 - high, '-' - no correlation

21152E65C FUNDAMENTALS OF NANOELECTRONICS **L T P C**
2 0 2 3

COURSE OBJECTIVES:

- To understand the concepts of nano electronics and quantum electronics
- To understand the concepts of nano electronic devices, transistors, tunneling devices and superconducting devices
- To understand the basics of nanotube devices

UNITI INTRODUCTION TO NANO ELECTRONICS 6

Scaling to nano - Light as a wave and particle- Electrons as waves and particles- origin of quantum mechanics - General postulates of quantum mechanics - Time independent Schrodinger wave equation- Electron confinement - Quantum dots, wires and well-Spin and angular momentum

UNIT II QUANTUM ELECTRONICS 6

Quantum electronic devices - Short channel MOS transistor - Split gate transistor - Electron wave transistor - Electron wave transistor - Electron spin transistor - Quantum cellular automata - Quantum dot array, Quantum memory.

UNIT III NANO ELECTRONIC TRANSISTORS 6

Coulomb blockade - Coulomb blockade in Nano capacitors - Coulomb blockade in tunnel junctions - Single electron transistors, Semiconductor nanowire FETs and SETs, Molecular SETs and molecular electronics - Memory cell.

UNIT IV NANO ELECTRONIC TUNNELING AND SUPER CONDUCTING DEVICES 6

Tunnel effect -Tunneling element -Tunneling diode - Resonant tunneling diode - Three terminal resonant tunneling devices- Superconducting switching devices- Cryotron- Josephson tunneling device.

UNIT V NANOTUBES AND NANOSTRUCTURE DEVICES 6

Carbon Nanotube - Fullerenes - Types of nanotubes – Formation of nanotubes -Assemblies – Purification of carbon nanotubes – Electronic properties – Synthesis of carbon nanotubes – Carbon nanotube interconnects – Carbon nanotube FETs and SETs –Nanotube for memory applications- Nano structures and nano structured devices.

30 PERIODS

PRACTICAL EXERCISES: 30 PERIODS

AD/ Any other relevant software based Simulations

1. Field Effect Transistors
2. Single Electron Transistors
3. Tunneling devices

COURSE OUTCOMES:

Upon completion of this course, the students will be able to

CO1: Understand the basics of nano electronics including quantum wires, dots and wells

CO2: Use the mechanism behind quantum electronic devices

CO3 : Analyze the key performance aspects of tunneling and superconducting nanoelectronic devices

CO4: Apply the knowledge in the development of nanotubes and nanostructure devices

TOTAL:60 PERIODS

TEXTBOOKS

1. Hanson, Fundamentals of Nanoelectronics, Pearson education, 2009.

REFERENCES

1. Jan Dienstuhl, Karl Goser, and Peter Glösekötter, Nanoelectronics and Nanosystems: From Transistors to Molecular and Quantum Devices, Springer-Verlag, 2004.
2. Mircea Dragoman and Daniela Dragoman, Nanoelectronics: Principles and Devices, Artech House, 2009.
3. Robert Puers, Livio Baldi, Marcel Van de Voorde and Sebastiaan E. Van Nooten, Nanoelectronics: Materials, Devices, Applications, Wiley, 2017.
4. Brajesh Kumar Kaushik, Nanoelectronics: Devices, Circuits and Systems, Elsevier science,

2018

CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2	PSO 1	PSO 2	PSO 3
1	3	3	2	2	2	1	-	-	-	-	-	2	2	1	1
2	3	3	3	2	2	2	-	-	-	-	-	2	3	1	1
3	3	3	3	2	2	2	-	-	-	-	-	2	3	1	1
4	3	3	2	2	2	2	-	-	-	-	-	2	3	1	1
5	3	3	3	3	3	3	-	-	-	-	-	2	3	1	2
CO	**3**	**3**	**2.6**	**2.2**	**2.2**	**2**	-	-	-	-	-	**2**	**2.8**	**1**	**1.2**

CO’s-PO’s & PSO’s MAPPING

1 - low, 2 - medium, 3 - high, ‘-' - no correlation

21155OE74A **REMOTE SENSING** **L T P C**
3 0 0 3

UNIT I REMOTE SENSING AND ELECTROMAGNETIC RADIATION 9

Definition – components of RS – History of Remote Sensing – Merits and demerits of Data Collation between conventional and remote sensing methods - Electromagnetic Spectrum - Radiation principles - Wave theory, Planck‘s law, Wien’s Displacement Law, Stefan’s Boltzmann law, Kirchoff‘s law – Radiation sources: active & passive – Radiation Quantities.

UNIT II EMR INTERACTION WITH ATMOSPHERE AND EARTH MATERIAL 9

Standard atmospheric profile - main atmospheric regions and its characteristics - interaction of radiation with atmosphere – Scattering, absorption and refraction – Atmospheric windows – Energy balance equation – Specular and diffuse reflectors – Spectral reflectance & emittance- Spectroradiometer - Spectral Signature concepts - Typical spectral reflectance curves for vegetation, soil and water – solid surface scattering in microwave region.

UNIT III ORBITS AND PLATFORMS 9

Motions of planets and satellites - Newton ‘s law of gravitation - Gravitational field and potential - Escape velocity - Kepler ‘s law of planetary motion - Orbit elements and types – Orbital perturbations and maneuvers - Types of remote sensing platforms - Ground based, Air borne platforms and Space borne platforms – Classification of satellites – Sun synchronous and Geosynchronous satellites – Legrange Orbit

UNIT IV SENSING TECHNIQUES 9

Classification of remote sensors - Resolution concept: spatial, spectral, radiometric and temporal resolutions - Scanners - Along and across track scanners - Optical-infrared sensors - Thermal sensors - microwave sensors - Calibration of sensors - High Resolution Sensors - LIDAR, UAV - Orbital and sensor characteristics of live Indian earth observation satellites.

UNIT V DATA PRODUCTS AND INTERPRETATION 9

Photographic and digital products - Types, levels and open-source satellite data products - selection and procurement of data – Visual interpretation: basic elements and interpretation keys - Digital interpretation – Concepts of Image rectification, Image enhancement and Image classification.

TOTAL:45 PERIODS

TEXTBOOKS:

1. Thomas M. Lillesand, Ralph W. Kieferand Jonathan W. Chipman, Remote Sensing and Image interpretation, John Wiley and Sons, Inc., New York, 2015.
2. George Joseph and C Jeganathan, Fundamentals of Remote Sensing, Third Edition Universities Press (India) Private limited, Hyderabad, 2018.

REFERENCES:

1. Stanley A Morain; Amelia M Budge; Michael S Renslow. Manual of Remote Sensing. Vol. I, American Society for Photogrammetry and Remote Sensing, Virginia, USA,2019, 4th edition
2. Verbyla, David, Satellite Remote Sensing of Natural Resources. CRC Press,2022 first edition.
3. Paul Curran P. J. Principles of Remote Sensing Longman, RLBS, 1996.
4. Introduction to Physics and Techniques of Remote Sensing, Charles Elachi and Jacob Van Zyl, 2021 Edition3, Wiley Publication.
5. BasudebBhatta, Remote Sensing and GIS, Oxford University Press, 2020 third edition.

COURSE OUTCOMES

CO1: To understand the principles of electromagnetic radiation.
CO2: To learn the atmospheric radiation interactions.
CO3: To study the laws of planetary motion.

CO4: To classify the different types of resolution.
CO5: To know the concepts of digital interpretation.

CO's-PO's & PSO's MAPPING

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	2	2	3	1	3	2	-	-	-	-	1	3	3	3
2	3	2	2	3	1	3	2	-	-	-	-	1	3	3	3
3	1	2	1	3	2	3	2	-	-	-	-	1	3	3	3
4	1	2	3	1	3	3	2	-	-	-	-	1	3	3	3
5	2	2	2	-	3	3	2	-	-	-	-	1	3	3	3
CO	**2**	**2**	**2**	**2**	**2**	**3**	**2**	**-**	**-**	**-**	**-**	**1**	3	3	3

1 - low, 2 - medium, 3 - high, '-' - no correlation

21152E65BC WEARABLE DEVICES L T P C
3 0 0 3

COURSE OBJECTIVES:

The student should be made to:

- To know the hardware requirement of wearable systems
- To understand the communication and security aspects in the wearable devices
- To know the applications of wearable devices in the field of medicine

UNIT I INTRODUCTION TO WEARABLE SYSTEMS AND SENSORS 9

Wearable Systems- Introduction, Need for Wearable Systems, Drawbacks of Conventional

Systems for Wearable Monitoring, Applications of Wearable Systems, Types of Wearable Systems, Components of wearable Systems. Sensors for wearable systems-Inertia movement sensors, Respiration activity sensor, Impedance plethysmography, Wearable ground reaction force sensor.

UNIT II SIGNAL PROCESSING AND ENERGY HARVESTING FOR WEARABLE DEVICES 9

Wearability issues -physical shape and placement of sensor, Technical challenges - sensor design, signal acquisition, sampling frequency for reduced energy consumption, Rejection of irrelevant information. Power Requirements- Solar cell, Vibration based, Thermal based, Human body as a heat source for power generation, Hybrid thermoelectric photovoltaic energy harvests, Thermopiles.

UNIT III WIRELESS HEALTH SYSTEMS 9

Need for wireless monitoring, Definition of Body area network, BAN and Healthcare, Technical Challenges- System security and reliability, BAN Architecture – Introduction, Wireless communication Techniques.

UNIT IV SMART TEXTILE 9

Introduction to smart textile- Passive smart textile, active smart textile. Fabrication Techniques-Conductive Fibres, Treated Conductive Fibres, Conductive Fabrics, Conductive Inks.Case study-smart fabric for monitoring biological parameters - ECG, respiration.

UNIT V APPLICATIONS OF WEARABLE SYSTEMS 9

Medical Diagnostics, Medical Monitoring-Patients with chronic disease, Hospital patients, Elderly patients, neural recording, Gait analysis, Sports Medicine.

COURSE OUTCOMES:

On successful completion of this course, the student will be able to

CO1: Describe the concepts of wearable system.
CO2: Explain the energy harvestings in wearable device.
CO3: Use the concepts of BAN in health care.
CO4: Illustrate the concept of smart textile
CO5: Compare the various wearable devices in healthcare system

TEXT BOOKS

TOTAL:45 PERIODS

1. Annalisa Bonfiglo and Danilo De Rossi, Wearable Monitoring Systems, Springer, 2011
2. Zhang and Yuan-Ting, Wearable Medical Sensors and Systems,Springer, 2013
3. Edward Sazonov and Micheal R Neuman, Wearable Sensors: Fundamentals,Implementation and Applications, Elsevier, 2014
4. Mehmet R. Yuce and JamilY.Khan, Wireless Body Area Networks Technology, Implementation applications,Pan Stanford Publishing Pte.Ltd, Singapore, 2012

REFERENCES

1. Sandeep K.S, Gupta, Tridib Mukherjee and Krishna Kumar Venkatasubramanian, BodyArea Networks Safety, Security, and Sustainability, Cambridge University Press, 2013.
2. Guang-Zhong Yang, Body Sensor Networks, Springer, 2006.

CO's- PO's & PSO's MAPPING

CO's	PO's												PSO's		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	3	2	1	1	2			1					1		1
2	3	2	1	1	2			1					1		1
3	3	2	1	1	2			1					1		1
4	3	2	1	1	2			1					1		1
5	3	2	1	1	2			1					1		1
AVg.	3	2	1	1	2			1					1		1

1 - low, 2 - medium, 3 - high, '-' - no correlation

Department of Computer Science and Engineering

Mapping of Courses to Crosscutting Issues

B.TECH

Programme Name &Code	Course Code	CourseTitle	Gender Sensitization	Professional Ethics	Environment and Sustainability	Human Values
B.Tech-21UGCSEFT	21147S11	Professional English-I	_	_	_	_
B.Tech-21UGCSEFT	21148S12	Matrices and Calculus	_	_	_	_
B.Tech-21UGCSEFT	21149S13	Engineering Physics	_	_	_	_
B.Tech-21UGCSEFT	21149S14	Engineering Chemistry	_	_	_	_
B.Tech-21UGCSEFT	21150S15	Problem Solving And Python Programming	_	_	_	_
B.Tech-21UGCSEFT	21150L16	Problem Solving And Python Programming Laboratory	_	_	_	_
B.Tech-21UGCSEFT	21149L17	Physics And Chemistry Laboratory	_	_	_	_
B.Tech-21UGCSEFT	21147L18	Communication Laboratory– I	_	_	_	_
B.Tech-21UGCSEFT	21147S21	Professional English–II	_	_	_	_
B.Tech-21UGCSEFT	21148S22	Statistics And Numerical Methods	_	_	_	_
B.Tech-21UGCSEFT	21149S23 A	Physics For Information Science	_	_	_	_
B.Tech-21UGCSEFT	21154S24	Engineering Graphics	_	_	_	_
B.Tech-21UGCSEFT	21153S25 A	Basic Electrical And Electronics Engineering	_	_	_	_
B.Tech-21UGCSEFT	21150C26	Programming in C	_	_	_	_

B.Tech-21UGCSEFT	21154L21	Engineering Practices Laboratory	_	_	_	_
B.Tech-21UGCSEFT	21150L22	Programming in C Laboratory	_	_	_	_
B.Tech-21UGCSEFT	21148S31 A	Discrete Mathematics	_	_	_	_
B.Tech-21UGCSEFT	21150C33	Data Structures	_	_	_	_
B.Tech-21UGCSEFT	21150C34	Object Oriented Programming	_	_	_	_
B.Tech-21UGCSEFT	21150C35	Foundations Of Data Science	_	_	_	_
B.Tech-21UGCSEFT	21150L36	Data Structures Laboratory	_	_	_	_
B.Tech-21UGCSEFT	21150L37	Object Oriented Programming Laboratory	_	_	_	_
B.Tech-21UGCSEFT	21150L38	Data science laboratory	_	_	_	_
B.Tech-21UGCSEFT	21150L39	Interpersonal Skills/ Listening& Speaking	_	_	_	_
B.Tech-21UGCSEFT	21150C41	Theory Of Computation	_	_	_	_
B.Tech-21UGCSEFT	21150C42	Artificial Intelligence And	_	_	_	_
B.Tech-21UGCSEFT	21150C43	Database Management Systems	_	_	_	_
B.Tech-21UGCSEFT	21150C44	Algorithms	_	_	_	_
B.Tech-21UGCSEFT	21150C45	Introduction to Operating Systems	_	_	_	_
B.Tech-21UGCSEFT	21149S46	Environmental Sciences And Sustainability	_	_	✓	_
B.Tech-21UGCSEFT	21150L47	Database Management Systems Laboratory	_	_	_	_
B.Tech-21UGCSEFT	21150L48	Operating Systems Laboratory	_	_	_	_
B.Tech-21UGCSEFT	21150C51	Compiler Design	_	_	_	_

B.Tech-21UGCSEFT	21150C53	Cryptography And Cyber Security	–	–	–	–
B.Tech-21UGCSEFT	21150C54	Distributed Computing	–	–	–	–
B.Tech-21UGCSEFT	21152S62	Embedded Systems and IoT Design	–	–	–	–
B.Tech-21UGCSEFT	21150C63	Object Oriented Software Engineering	–	–	–	–
B.Tech-21UGCSEFT	21147S71	Human Values and Ethics	–	✓	–	–
B.Tech-21UGCSEFT	21150C81	Project Work	–	–	–	–
B.Tech-21UGCSEFT	21150E55A	Exploratory Data Analysis	–	–	–	–
B.Tech-21UGCSEFT	21150E55B	Recommender Systems	–	–	–	–
B.Tech-21UGCSEFT	21150E55C	Neural Networks and Deep Learning	–	–	–	–
B.Tech-21UGCSEFT	21150E55D	Text and Speech Analysis	–	–	–	–
B.Tech-21UGCSEFT	21150E55E	Business Analytics	–	–	–	–
B.Tech-21UGCSEFT	21150E56A	Web Technologies	–	–	–	–
B.Tech-21UGCSEFT	21150E56B	App Development	–	–	–	–
B.Tech-21UGCSEFT	21150E56C	Cloud Services Management	–	–	–	–
B.Tech-21UGCSEFT	21150E56D	UI and UX Design	–	–	–	–
B.Tech-21UGCSEFT	21150E56E	Software Testing and Automation	–	–	–	–
B.Tech-21UGCSEFT	21150E56F	Web Application Security	–	–	–	–
B.Tech-21UGCSEFT	21150E56G	Dev-ops	–	–	–	–
B.Tech-21UGCSEFT	21150E56H	Principles of Programming Languages	–	–	–	–
B.Tech-21UGCSEFT	21150E64A	Cloud Computing	–	–	–	–

B.Tech-21UGCSEFT	21150E64B	Virtualization	–	–	–	–
B.Tech-21UGCSEFT	21150E64C	Cloud Services Management	–	–	–	–
B.Tech-21UGCSEFT	21150E64D	Data Warehousing	–	–	–	–
B.Tech-21UGCSEFT	21150E64E	Storage Technologies	–	–	–	–
B.Tech-21UGCSEFT	21150E64F	Software Defined Networks	–	–	–	–
B.Tech-21UGCSEFT	21150E64G	Stream Processing	–	–	–	–
B.Tech-21UGCSEFT	21150E64H	Security and Privacy in Cloud	–	–	–	–
B.Tech-21UGCSEFT	21150E65A	Ethical Hacking	–	–	–	–
B.Tech-21UGCSEFT	21150E65B	Digital and Mobile Forensics	–	–	–	–
B.Tech-21UGCSEFT	21150E65C	Social Network Security	–	–	–	–
B.Tech-21UGCSEFT	21150E65D	Modern Cryptography	–	–	–	–
B.Tech-21UGCSEFT	21150E65E	Engineering Secure Software Systems	–	–	–	–
B.Tech-21UGCSEFT	21150E65F	Crypto currency and Block chain Technologies	–	–	–	–
B.Tech-21UGCSEFT	21150E65G	Network Security	–	–	–	–
B.Tech-21UGCSEFT	21150E65H	Security and Privacy in Cloud	–	–	–	–
B.Tech-21UGCSEFT	21150E66A	Augmented Reality/Virtual Reality	–	–	–	–
B.Tech-21UGCSEFT	21150E66B	Multimedia and Animation	–	–	–	–
B.Tech-21UGCSEFT	21150E66C	Video Creation and Editing	–	–	–	–
B.Tech-21UGCSEFT	21150E66D	UI and UX Design	–	–	–	–
B.Tech-21UGCSEFT	21150E66E	Digital marketing	–	–	–	–
B.Tech-21UGCSEFT	21150E66F	Visual Effects	–	–	–	–

B.Tech-21UGCSEFT	21150E66G	Game Development	–	–	–	–
B.Tech-21UGCSEFT	21150E66H	Multimedia Data Compression and storage	–	–	–	–
B.Tech-21UGCSEFT	21150E67A	Augmented Reality/Virtual Reality	–	–	–	–
B.Tech-21UGCSEFT	21150E67B	Robotic Process Automation	–	–	–	–
B.Tech-21UGCSEFT	21150E67C	Neural Networks and Deep Learning	–	–	–	–
B.Tech-21UGCSEFT	21150E67D	Cyber security	–	–	–	–
B.Tech-21UGCSEFT	21150E67E	Quantum Computing	–	–	–	–
B.Tech-21UGCSEFT	21150E67F	Crypto currency and Block chain Technologies	–	–	–	–
B.Tech-21UGCSEFT	21150E67G	Game Development	–	–	–	–
B.Tech-21UGCSEFT	21150E67H	3D Printing and Design	–	–	–	–
B.Tech-21UGCSEFT	21160E75A	Principles of Management	–	–	–	✓
B.Tech-21UGCSEFT	21160E75B	Total Quality Management	–	–	–	✓
B.Tech-21UGCSEFT	21160E75C	Industrial Management	–	–	–	–
B.Tech-21UGCSEFT	21155OE61	Climate Change and its Impact	–	–	–	–
B.Tech-21UGCSEFT	21153OE61	Renewable Energy System	–	–	–	–
B.Tech-21UGCSEFT	21154OE61	Introduction to Industrial Engineering	–	–	–	–
B.Tech-21UGCSEFT	21150OE61	Graph Theory	–	–	–	–
B.Tech-21UGCSEFT	21152OE61	Deep Learning	–	–	–	–
B.Tech-21UGCSEFT	21155OE72	ICT in Agriculture	–	–	–	–

B.Tech-21UGCSEFT	21153OE72	Introduction to Control Engineering	–	–	–	–
B.Tech-21UGCSEFT	21154OE72	Aviation Management	–	–	–	–
B.Tech-21UGCSEFT	21150OE72	Dev-Ops	–	–	–	–
B.Tech-21UGCSEFT	21152OE72	Robotics Process Automation	–	–	–	–
B.Tech-21UGCSEFT	21147OE73A	English for Competitive Examinations	–	–	–	–
B.Tech-21UGCSEFT	21153OE73A	Renewable Energy Technologies(EEE)	–	–	–	–
B.Tech-21UGCSEFT	21153OE73B	Electric and Hybrid Vehicle(EEE)	–	–	–	–
B.Tech-21UGCSEFT	21154OE73A	Introduction to non-destructive testing (MECHANICAL ENGINEERING)	–	–	–	–
B.Tech-21UGCSEFT	21154OE73B	Industrial Management	–	–	–	–
B.Tech-21UGCSEFT	21152OE73A	Biomedical Instrumentation (ECE)	–	–	–	–
B.Tech-21UGCSEFT	21152OE73B	Fundamentals of Electronic Devices and Circuits(ECE)	–	–	–	–
B.Tech-21UGCSEFT	21154OE74A	Additive Manufacturing (MECHANICAL ENGINEERING)	–	–	–	–
B.Tech-21UGCSEFT	21154OE74B	Industrial safety(MECHANICAL ENGINEERING)	–	–	–	–
B.Tech-21UGCSEFT	21153OE74A	Sensors (EEE)	–	–	–	–
B.Tech-21UGCSEFT	21153OE74B	Electrical, Electronic and Magnetic materials (EEE)	–	–	–	–
B.Tech-21UGCSEFT	21152OE74A	Wearable devices (ECE)	–	–	–	–
B.Tech-21UGCSEFT	21152OE74B	Medical Informatics(ECE)	–	–	–	–

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SCHOOL OF ENGINEERING AND TECHNOLOGY

DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING

B.Tech – FULL TIME

Regulation 2021

B.TECH (FULL TIME) – COMPUTER SCIENCE AND ENGINEERING

Regulation - 2021

I - VIII SEMESTERS CURRICULUM

SEMESTER I

Sl. No.	COURSE CODE	COURSE TITLE	L	T	P	C
THEORY						
1.	21147IP	Induction Programme	2 Weeks			
2.	21147S11	Professional English - I	3	0	0	3
3.	21148S12	Matrices and Calculus	3	1	0	4
4.	21149S13	Engineering Physics	3	0	0	3
5.	21149S14	Engineering Chemistry	3	0	0	3
6.	21150S15	Problem Solving and Python Programming	3	0	0	3
PRACTICALS						
7.	21150L16	Problem Solving and Python Programming Laboratory	0	0	4	2
8.	21149L17	Physics and Chemistry Laboratory	0	0	4	2
9.	21147L18	Communication Laboratory – I	0	0	2	1
		TOTAL	15	1	10	**21**

SEMESTER II

Sl. No.	COURSE CODE	COURSE TITLE	L	T	P	C
THEORY						
1.	21147S21	Professional English – II	3	0	0	3
2.	21148S22	Statistics and Numerical Methods	3	1	0	4
3.	21149S23A	Physics for Information Science	3	0	0	3
4.	21154S24	Engineering Graphics	2	0	4	4
5.	21153S25A	Basic Electrical and Electronics Engineering	3	0	0	3
6.	21150C26	Programming in C	3	0	0	3
PRACTICALS						
7.	21154L21	Engineering Practices Laboratory	0	0	4	2
8.	21150L22	Programming in C Laboratory	0	0	4	2
9.	21147L23	Communication Laboratory – II	0	0	4	2
		TOTAL	17	1	16	**26**

SEMESTER III

Sl. No	COURSE CODE	COURSE TITLE	L	T	P	C
THEORY						
1.	21148S31A	Discrete Mathematics	3	1	0	4
2.	21150C32	Digital Principles and Computer Organization	3	0	2	4
3.	21150C33	Data Structures	3	0	0	3
4.	21150C34	Object Oriented Programming	3	0	0	3
5.	21150C35	Foundations of Data Science	3	0	0	3
PRACTICALS						
6.	21150L36	Data Structures Laboratory	0	0	4	2
7.	21150L37	Object Oriented Programming Laboratory	0	0	4	2
8.	21150L38	Data Science Laboratory	0	0	4	2
9.	21150L39	Professional Development	0	0	2	1
		TOTAL	15	1	16	24

SEMESTER IV

Sl. No	COURSE CODE	COURSE TITLE	L	T	P	C
THEORY						
1.	21150C41	Theory of Computation	3	0	0	3
2.	21150C42	Artificial Intelligence and Machine Learning	3	0	2	4
3.	21150C43	Database Management Systems	3	0	0	3
4.	21150C44	Algorithms	3	0	2	4
5.	21150C45	Introduction to Operating Systems	3	0	0	3
6.	21149S46	Environmental Sciences and Sustainability	3	0	0	3
PRACTICALS						
7.	21150L47	Database Management Systems Laboratory	0	0	4	2
8.	21150L48	Operating Systems Laboratory	0	0	4	2
		TOTAL	18	0	12	24

SEMESTER V

Sl. No	COURSE CODE	COURSE TITLE	L	T	P	C
THEORY						
1.	21150C51	Compiler Design	3	0	2	4
2.	21150C52	Computer Networks	3	0	2	4
3.	21150C53	Cryptography and Cyber Security	3	0	0	3
4.	21150C54	Distributed Computing	3	0	0	3
5.	21150E55_	Elective I	3	0	0	3
6.	21150E56_	Elective II	3	0	0	3
7.	21147MC51_	Mandatory Course - I	3	0	0	0
PRACTICALS						
		TOTAL	21	0	4	**20**

SEMESTER VI

Sl. No	COURSE CODE	COURSE TITLE	L	T	P	C
THEORY						
1.	211_ _OE61	Open Elective - I	3	0	0	3
2.	21152S62	Embedded Systems and IOT Design	3	0	2	4
3.	21150C63	Object Oriented Software Engineering	3	0	2	4
4.	21150E64_	Elective - III	3	0	0	3
5.	21150E65_	Elective - IV	3	0	0	3
6.	21150E66_	Elective - V	3	0	0	3
7.	21150E67_	Elective -VI	3	0	0	3
8.	21147MC61_	Mandatory Course - II	3	0	0	0
		TOTAL	24	0	4	**23**

SEMESTER VII

Sl. No	COURSE CODE	COURSE TITLE	L	T	P	C
THEORY						
1.	21147S71	Human Values and Ethics	2	0	0	2
2.	211_ _OE72	Open Elective – II	3	0	0	3
3.	211_ _OE73	Open Elective – III	3	0	0	3
4.	211_ _OE74	Open Elective – IV	3	0	0	3
5.	21160E75_	Elective – VII	3	0	0	3
PRACTICALS						
6.	21150INT76	Summer Internship	0	0	0	2
		TOTAL	14	0	0	16

SEMESTER VIII

Sl. No	COURSE CODE	COURSE TITLE	L	T	P	C
PRACTICALS						
1.	21150C81	Project Work	0	0	20	10
		TOTAL	0	0	20	**10**
		TOTAL NO. OF CREDITS:				**164**

PROFESSIONAL ELECTIVE COURSES

SEMESTER V

ELECTIVE - I

Sl. No	COURSE CODE	COURSE TITLE	L	T	P	C
1.	21150E55A	Exploratory Data Analysis	3	0	0	3
2.	21150E55B	Recommender Systems	3	0	0	3
3.	21150E55C	Neural Networks and Deep Learning	3	0	0	3
4.	21150E55D	Text and Speech Analysis	3	0	0	3
5.	21150E55E	Business Analytics	3	0	0	3
6.	21150E55F	Image and video analytics	3	0	0	3
7.	21150E55G	Computer Vision	3	0	0	3
8.	21150E55H	Big Data Analytics	3	0	0	3

SEMESTER V

ELECTIVE - II

Sl. No	COURSE CODE	COURSE TITLE	L	T	P	C
1.	21150E56A	Web Technologies	3	0	0	3
2.	21150E56B	App Development	3	0	0	3
3.	21150E56C	Cloud Services Management	3	0	0	3
4.	21150E56D	UI and UX Design	3	0	0	3
5.	21150E56E	Software Testing and Automation	3	0	0	3
6.	21150E56F	Web Application Security	3	0	0	3
7.	21150E56G	Dev-ops	3	0	0	3
8.	21150E56H	Principles of Programming Languages	3	0	0	3

SEMESTER VI

ELECTIVE - III

Sl. No	COURSE CODE	COURSE TITLE	L	T	P	C
1.	21150E64A	Cloud Computing	3	0	0	3
2.	21150E64B	Virtualization	3	0	0	3
3.	21150E64C	Cloud Services Management	3	0	0	3
4.	21150E64D	Data Warehousing	3	0	0	3
5.	21150E64E	Storage Technologies	3	0	0	3
6.	21150E64F	Software Defined Networks	3	0	0	3
7.	21150E64G	Stream Processing	3	0	0	3
8.	21150E64H	Security and Privacy in Cloud	3	0	0	3

SEMESTER VI

ELECTIVE - IV

Sl. No	COURSE CODE	COURSE TITLE	L	T	P	C
1.	21150E65A	Ethical Hacking	3	0	0	3
2.	21150E65B	Digital and Mobile Forensics	3	0	0	3
3.	21150E65C	Social Network Security	3	0	0	3
4.	21150E65D	Modern Cryptography	3	0	0	3
5.	21150E65E	Engineering Secure Software Systems	3	0	0	3
6.	21150E65F	Crypto currency and Block chain Technologies	3	0	0	3
7.	21150E65G	Network Security	3	0	0	3
8.	21150E65H	Security and Privacy in Cloud	3	0	0	3

SEMESTER VI

ELECTIVE - V

Sl. No	COURSE CODE	COURSE TITLE	L	T	P	C
1.	21150E66A	Augmented Reality/Virtual Reality	3	0	0	3
2.	21150E66B	Multimedia and Animation	3	0	0	3
3.	21150E66C	Video Creation and Editing	3	0	0	3
4.	21150E66D	UI and UX Design	3	0	0	3
5.	21150E66E	Digital marketing	3	0	0	3
6.	21150E66F	Visual Effects	3	0	0	3
7.	21150E66G	Game Development	3	0	0	3
8.	21150E66H	Multimedia Data Compression and Storage	3	0	0	3

SEMESTER VI

ELECTIVE - VI

Sl. No	COURSE CODE	COURSE TITLE	L	T	P	C
1.	21150E67A	Augmented Reality/Virtual Reality	3	0	0	3
2.	21150E67B	Robotic Process Automation	3	0	0	3
3.	21150E67C	Neural Networks and Deep Learning	3	0	0	3
4.	21150E67D	Cyber security	3	0	0	3
5.	21150E67E	Quantum Computing	3	0	0	3
6.	21150E67F	Crypto currency and Block chain Technologies	3	0	0	3
7.	21150E67G	Game Development	3	0	0	3
8.	21150E67H	3D Printing and Design	3	0	0	3

SEMESTER VII

ELECTIVE - VII

Sl. No	COURSE CODE	COURSE TITLE	L	T	P	C
1.	21160E75A	Principles of Management	3	0	0	3
2.	21160E75B	Total Quality Management	3	0	0	3
3.	21160E75C	Industrial Management	3	0	0	3

LIST OF OPEN ELECTIVES

SEMESTER VI

OPEN ELECTIVE-I

Sl. No	DEPT	COURSE CODE	COURSE TITLE	L	T	P	C
1.	Civil	21155OE61	Climate Change and its Impact	3	0	0	3
2.	EEE	21153OE61	Renewable Energy System	3	0	0	3
3.	Mech	21154OE61	Introduction to Industrial Engineering	3	0	0	3
4.	CSE	21150OE61	Graph Theory	3	0	0	3
5.	ECE	21152OE61	Deep Learning	3	0	0	3

SEMESTER VII

OPEN ELECTIVE-II

Sl. No	DEPT	COURSE CODE	COURSE TITLE	L	T	P	C
1.	Civil	21155OE72	ICT in Agriculture	3	0	0	3
2.	EEE	21153OE72	Introduction to Control Engineering	3	0	0	3
3.	Mech	21154OE72	Aviation Management	3	0	0	3
4.	CSE	21150OE72	Dev-Ops	3	0	0	3
5.	ECE	21152OE72	Robotics Process Automation	3	0	0	3

OPEN ELECTIVE-III

Sl. No	COURSE CODE	COURSE TITLE	L	T	P	C
1	21147OE73A	English for Competitive Examinations	3	0	0	3
2	21153OE73A	Renewable EnergyTechnologies(EEE)	3	0	0	3
3	21153OE73B	Electric and Hybrid Vehicle(EEE)	3	0	0	3
4	21154OE73A	Introduction to non-destructive testing (MECHANICALENGINEERING)	3	0	0	3
5	21154OE73B	Industrial Management	3	0	0	3
6	21152OE73A	Biomedical Instrumentation (ECE)	3	0	0	3
7	21152OE73B	Fundamentals of Electronic Devices and Circuits(ECE)	3	0	0	3

OPEN ELECTIVE-IV

Sl. No	COURSE CODE	COURSE TITLE	L	T	P	C
1	21154OE74A	Additive Manufacturing (MECHANICAL ENGINEERING)	3	0	0	3
2	21154OE74B	Industrial safety (MECHANICAL ENGINEERING)	3	0	0	3
3	21153OE74A	Sensors (EEE)	3	0	0	3
4	21153OE74B	Electrical, Electronic and Magnetic materials (EEE)	3	0	0	3
5	21152OE74A	Wearable devices (ECE)	3	0	0	3
6	21152OE74B	Medical Informatics(ECE)	3	0	0	3

LIST OF MANDATORY COURSES

SEMESTER V
MANDATORY COURSE – I

Sl. No	COURSE CODE	COURSE TITLE	L	T	P	C
1.	21147MC51A	Introduction to Women and Gender Studies	3	0	0	3
2.	21147MC51B	Elements of Literature	3	0	0	3
3.	21147MC51C	Film Appreciation	3	0	0	3
4.	21147MC51D	Disaster Risk Reduction and Management	3	0	0	3

SEMESTER VI

MANDATORY COURSE – II

Sl. No	COURSE CODE	COURSE TITLE	L	T	P	C
1.	21147MC61A	Well Being with Traditional Practices (Yoga, Ayurveda and Siddha)	3	0	0	3
2.	21147MC61B	History of Science and Technology in India	3	0	0	3
3.	21147MC61C	Political and Economic Thought for a Humane Society	3	0	0	3
4.	21147MC61D	State, Nation Building and Politics in India	3	0	0	3
5.	21147MC61E	Industrial Safety	3	0	0	3

Human value

Environment and sustainability

Gender Sensitization

Professional Ethics

21147IP INDUCTION PROGRAMME

This is a mandatory 2 week programme to be conducted as soon as the students enter the institution. Normal classes start only after the induction program is over.

The induction programme has been introduced by AICTE with the following objective:

"Engineering colleges were established to train graduates well in the branch/department of admission, have aholistic outlook, and have a desire to work for national needs and beyond. The graduating student must have knowledge and skills in the area of his/her study. However, he/she must also have a broad understanding of society and relationships. Character needs to be nurtured as an essential quality by which he/she would understand and fulfill his/her responsibility as an engineer, a citizen and a human being. Besides the above, several meta-skills and underlying valuesare needed."

"One will have to work closely with the newly joined students in making them feel comfortable, allowthem toexplore their academic interests and activities, reduce competition and make them work for excellence, promote bonding within them, build relations between teachers and students, give a broader view of life, and build character."

Hence, the purpose of this programme is to make the students feel comfortable in their new environment, open them up, set a healthy daily routine, create bonding in the batch as well as between faculty and students, develop awareness, sensitivity and understanding of the self, peoplearound them, society at large, and nature.

The following are the activities under the induction program in which the student would be fully engaged throughout the day for the entire duration of the program.

(i) Physical Activity

This would involve a daily routine of physical activity with games and sports, yoga, gardening, etc.

(ii) Creative Arts

Every student would choose one skill related to the arts whether visual arts or performing arts. Examples are painting, sculpture, pottery, music, dance etc. The student would pursue it everyday for the duration of the program. These would allow for creative expression. It would develop a senseof aesthetics and
also enhance creativity which would, hopefully, grow into engineering design later.

(iii) Universal Human Values

This is the anchoring activity of the Induction Programme. It gets the student to explore oneself andallows one to experience the joy of learning, stand up to peer pressure, make decisions with courage, be aware of relationships with colleagues and supporting stay in the hostel and department, be sensitive to others, etc. A module in Universal Human Values provides the base. Methodology of teaching this content is extremely important. It must not be through do's and don'ts, but get students to explore and think by engaging them in a dialogue. It is best taught through groupdiscussions and real life activities rather than lecturing.

Discussions would be conducted in small groups of about 20 students with a faculty mentor each. It would be effective that the faculty mentor assigned is also the faculty advisor for thestudent for the full duration of the UG programme.

(iv) Literary Activity

Literary activity would encompass reading, writing and possibly, debating, enacting a play etc.

(v) Proficiency Modules

This would address some lacunas that students might have, for example, English, computer familiarity etc.

(vi) Lectures by Eminent People

Motivational lectures by eminent people from all walks of life should be arranged to give the studentsexposureto people who are socially active or in public life.

(vii) Visits to Local Area

A couple of visits to the landmarks of the city, or a hospital or orphanage could be organized. This would familiarize them with the area as well as expose them to the underprivileged.

(viii) Familiarization to Dept./Branch & Innovations

They should be told about what getting into a branch or department means what role it plays in society, through its technology. They should also be shown the laboratories, workshops & other facilities.

(ix) Department Specific Activities

About a week can be spent in introducing activities (games, quizzes, social interactions, small experiments, design thinking etc.) that are relevant to the particular branch of Engineering / Technology / Architecture that can serve as a motivation and kindle interest in building things (become a maker) in that particular field. This can be conducted in the form of a workshop. For example, CSE and IT students may be introduced to activities that kindle computational thinking, and get them to build simple games. ECE students may be introduced to building simple circuits asan extension of their knowledge in Science, and so on. Students maybe asked to build stuff using their knowledge of science.

Induction Programme is totally an activity based programme and therefore there shall be no tests / assessments during this programme.

References:

Guide to Induction program from AICTE

21147S11 PROFESSIONAL ENGLISH I L T P C

3 0 0 3

COURSE OBJECTIVES:

- To improve the communicative competence of learners
- To learn to use basic grammatic structures in suitable contexts
- To acquire lexical competence and use them appropriately in a sentence and understandtheir meaning in a text
- To help learners use language effectively in professional contexts
- To develop learners' ability to read and write complex texts, summaries, articles, blogs, definitions, essays and user manuals.

UNIT I INTRODUCTION TO EFFECTIVE COMMUNICATION 1

What is effective communication? (Explain using activities) Why is communication critical for excellence during study, research and work? What are the seven C's of effective communication? What are key language skills? What is effective listening? What does it involve? What is effective speaking? What does it mean to be an excellent reader? What should you be able to do? What is effective writing? How does one develop language and communication skills? What does the coursefocus on? How are communication and language skills going to be enhanced during this course? What do you as a learner need to do to enhance your English language and communication skillsto get the best out of this course?

INTRODUCTION TO FUNDAMENTALS OF COMMUNICATION 8

Reading - Reading brochures (technical context), telephone messages / social media messages relevant to technical contexts and emails. Writing - Writing emails / letters introducing oneself. Grammar - Present Tense (simple and progressive); Question types: Wh/ Yes or No/ and Tags. Vocabulary - Synonyms; One word substitution; Abbreviations & Acronyms (as used in technical contexts).

UNIT II NARRATION AND SUMMATION 9

Reading - Reading biographies, travelogues, newspaper reports, Excerpts from literature, and travel & technical blogs. Writing - Guided writing-- Paragraph writing Short Report on an event (field trip etc.) Grammar –Past tense (simple); Subject-Verb Agreement; and Prepositions. Vocabulary - Word forms (prefixes& suffixes); Synonyms and Antonyms. Phrasal verbs.

UNIT III DESCRIPTION OF A PROCESS / PRODUCT 9

Reading – Reading advertisements, gadget reviews; user manuals. Writing - Writing definitions; instructions; and Product /Process description. Grammar - Imperatives; Adjectives; Degrees of comparison; Present & Past Perfect Tenses. Vocabulary - Compound Nouns, Homonyms; and Homophones, discourse markers (connectives & sequence words).

UNIT IV CLASSIFICATION AND RECOMMENDATIONS 9

Reading – Newspaper articles; Journal reports –and Non Verbal Communcation (tables, pie chartsetc,.). Writing – Note-making / Note-taking (*Study skills to be taught, not tested); Writing recommendations; Transferring information from non verbal (chart , graph etc, to verbal mode) Grammar – Articles; Pronouns

- Possessive & Relative pronouns. Vocabulary - Collocations; Fixed

/ Semi fixed expressions.

UNIT V EXPRESSION 9

Reading – Reading editorials; and Opinion Blogs; Writing – Essay Writing (Descriptive or narrative). Grammar – Future Tenses, Punctuation; Negation (Statements & Questions); and Simple,

Compound & Complex Sentences. Vocabulary - Cause & Effect Expressions – Content vs Functionwords.

TOTAL : 45 PERIODS

COURSE OUTCOMES :

At the end of the course, learners will be able

CO1: To use appropriate words in a professional context

CO2: To gain understanding of basic grammatic structures and use them in right context.**CO3:**To read and infer the denotative and connotative meanings of technical texts **CO4:**To write definitions, descriptions, narrations and essays on various topics

TEXT BOOKS :

1. English for Engineers & Technologists Orient Blackswan Private Ltd. Department of English, Anna University, (2020 edition)
2. English for Science & Technology Cambridge University Press, 2021.

Authored by Dr. Veena Selvam, Dr. Sujatha Priyadarshini, Dr. Deepa Mary Francis, Dr. KN.Shoba, and Dr. Lourdes Joevani, Department of English, Anna University.

REFERENCES:

1. Technical Communication – Principles And Practices By Meenakshi Raman & Sangeeta Sharma, Oxford Univ. Press, 2016, New Delhi.
2. A Course Book On Technical English By Lakshminarayanan, Scitech Publications (India)Pvt. Ltd.
3. English For Technical Communication (With CD) By Aysha Viswamohan, Mcgraw Hill Education, ISBN : 0070264244.
4. Effective Communication Skill, Kulbhusan Kumar, RS Salaria, Khanna Publishing House.
5. Learning to Communicate – Dr. V. Chellammal, Allied Publishing House, New Delhi,2003.

ASSESSMENT PATTERN

Two internal assessments and an end semester examination to test students' reading and writingskills along with their grammatical and lexical competence.

CO's-PO's & PSO's MAPPING

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	1	1	1	1	1	3	3	3	1	3	-	3	-	-	-
2	1	1	1	1	1	3	3	3	1	3	-	3	-	-	-
3	2	3	2	3	2	3	3	3	2	3	3	3	-	-	-
4	2	3	2	3	2	3	3	3	2	3	3	3	-	-	-
5	2	3	3	3	-	3	3	3	2	3	-	3	-	-	-
Vg.	**1.6**	**2.2**	**1.8**	**2.2**	**1.5**	**3**	**3**	**3**	**1.6**	**3**	**3**	**3**	**-**	**-**	**-**

1 - low, 2 - medium, 3 - high, '-' - no correlation

21148S12 **MATRICES AND CALCULUS** **L T P C**
3 1 0 4

COURSE OBJECTIVES:

- To develop the use of matrix algebra techniques that are needed by engineers for practical applications.
- To familiarize the students with differential calculus.
- To familiarize the student with functions of several variables. This is needed in many branches of engineering.
- To make the students understand various techniques of integration.
- To acquaint the student with mathematical tools needed in evaluating multiple integrals andtheir applications.

UNIT I MATRICES 9 + 3

Eigenvalues and Eigenvectors of a real matrix – Characteristic equation – Properties of Eigenvalues and Eigenvectors – Cayley - Hamilton theorem – Diagonalization of matrices by orthogonal transformation
– Reduction of a quadratic form to canonical form by orthogonal transformation – Nature of quadratic forms – Applications: Stretching of an elastic membrane.

UNIT II DIFFERENTIAL CALCULUS 9 + 3

Representation of functions - Limit of a function - Continuity - Derivatives - Differentiation rules (sum, product, quotient, chain rules) - Implicit differentiation - Logarithmic differentiation - Applications: Maximaand Minima of functions of one variable.

UNIT III FUNCTIONS OF SEVERAL VARIABLES 9 + 3

Partial differentiation – Homogeneous functions and Euler's theorem – Total derivative – Change of variables – Jacobians – Partial differentiation of implicit functions – Taylor's series for functions oftwo variables – Applications: Maxima and minima of functions of two variables and Lagrange's method of undetermined multipliers.

UNIT IV INTEGRAL CALCULUS 9 + 3

Definite and Indefinite integrals - Substitution rule - Techniques of Integration: Integration by parts, Trigonometric integrals, Trigonometric substitutions, Integration of rational functions by partial fraction, Integration of irrational functions - Improper integrals - Applications: Hydrostatic force and pressure, moments and centres of mass.

UNIT V MULTIPLE INTEGRALS 9 + 3

Double integrals – Change of order of integration – Double integrals in polar coordinates – Area enclosed by plane curves – Triple integrals – Volume of solids – Change of variables in double and triple integrals – Applications: Moments and centres of mass, moment of inertia.

TOTAL: 60 PERIODS

COURSE OUTCOMES:

At the end of the course the students will be able to

CO1:Use the matrix algebra methods for solving practical problems. CO2:Apply differential calculus tools in solving various application problems.CO3:Able to use differential calculus ideas on several variable functions.

CO4:Apply different methods of integration in solving practical problems.

CO5:Apply multiple integral ideas in solving areas, volumes and other practical problems.

TEXT BOOKS :

1. Kreyszig.E, "Advanced Engineering Mathematics", John Wiley and Sons, **10th Edition, New Delhi, 2016.**
2. Grewal.B.S., "Higher Engineering Mathematics", Khanna Publishers, New Delhi, 44th Edition , 2018.
3. James Stewart, " Calculus: Early Transcendentals", Cengage Learning, 8th Edition, New Delhi, 2015. [For Units II & IV - Sections 1.1, 2.2, 2.3, 2.5, 2.7 (Tangents problems only), 2.8, 3.1 to 3.6, 3.11, 4.1, 4.3, 5.1 (Area problems only), 5.2, 5.3, 5.4 (excluding net change theorem), 5.5, 7.1 - 7.4 and 7.8].

REFERENCES:

1. Anton. H, Bivens. I and Davis. S, "Calculus", Wiley, 10th Edition, 2016
2. Bali. N., Goyal. M. and Watkins. C., "Advanced Engineering Mathematics", FirewallMedia (An imprint of Lakshmi Publications Pvt., Ltd.,), New Delhi, 7th Edition, 2009.
3. Jain . R.K. and Iyengar. S.R.K., "Advanced Engineering Mathematics", Narosa Publications, New Delhi, 5th Edition, 2016.
4. Narayanan. S. and Manicavachagom Pillai. T. K., "Calculus" Volume I and II, **S. Viswanathan Publishers Pvt. Ltd., Chennai, 2009.**
5. Ramana. B.V., "Higher Engineering Mathematics", McGraw Hill Education Pvt. Ltd,New Delhi, 2016.
6. Srimantha Pal and Bhunia. S.C, "Engineering Mathematics" Oxford University Press, 2015.
7. Thomas. G. B., Hass. J, and Weir. M.D, "Thomas Calculus", 14th Edition, Pearson India,2018.

CO's-PO's & PSO's MAPPING

CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PO12	PSO 1	PSO 2	PSO 3
CO 1	3	3	1	1	0	0	0	0	2	0	2	3	-	-	-
CO 2	3	3	1	1	0	0	0	0	2	0	2	3	-	-	-
CO 3	3	3	1	1	0	0	0	0	2	0	2	3	-	-	-
CO 4	3	3	1	1	0	0	0	0	2	0	2	3	-	-	-
CO 5	3	3	1	1	0	0	0	0	2	0	2	3	-	-	-
Avg	3	3	1	1	0	0	0	0	2	0	2	3	-	-	-

1 - low, 2 - medium, 3 - high, '-' - no correlation

21149S13 **ENGINEERING PHYSICS** **L T P C**

3 0 0 3

COURSE OBJECTIVES:

- To make the students effectively achieve an understanding of mechanics.
- To enable the students to gain knowledge of electromagnetic waves and its applications.
- To introduce the basics of oscillations, optics and lasers.
- Equipping the students to successfully understand the importance of quantum physics.
- To motivate the students towards the applications of quantum mechanics.

UNIT I MECHANICS 9

Multi-particle dynamics: Center of mass (CM) – CM of continuous bodies – motion of the CM – kinetic energy of the system of particles. Rotation of rigid bodies: Rotational kinematics – rotational kinetic energy and moment of inertia - theorems of M .I –moment of inertia of continuous bodies –

of a diatomic molecule - torque – rotational dynamics of rigid bodies – conservation of angularmomentum – rotational energy state of a rigid diatomic molecule - gyroscope - torsional pendulum

- double pendulum –Introduction to nonlinear oscillations.

UNIT II ELECTROMAGNETIC WAVES 9

The Maxwell's equations - wave equation; Plane electromagnetic waves in vacuum, Conditions on the wave field - properties of electromagnetic waves: speed, amplitude, phase, orientation and waves in matter - polarization - Producing electromagnetic waves - Energy and momentum in EM waves: Intensity, waves from localized sources, momentum and radiation pressure - Cell-phone reception. Reflection and transmission of electromagnetic waves from a non-conducting medium- vacuum interface for normal incidence.

UNIT III OSCILLATIONS, OPTICS AND LASERS 9

Simple harmonic motion - resonance –analogy between electrical and mechanical oscillating systems - waves on a string - standing waves - traveling waves - Energy transfer of a wave - soundwaves - Doppler effect. Reflection and refraction of light waves - total internal reflection - interference –Michelson interferometer –Theory of air wedge and experiment. Theory of laser - characteristics - Spontaneous and stimulated emission - Einstein's coefficients - population inversion - Nd-YAG laser, CO2 laser, semiconductor laser –Basic applications of lasers in industry.

UNIT IV BASIC QUANTUM MECHANICS 9

Photons and light waves - Electrons and matter waves –Compton effect - The Schrodinger equation(Time dependent and time independent forms) - meaning of wave function - Normalization – Free particle - particle in a infinite potential well: 1D,2D and 3D Boxes- Normalization, probabilities and the correspondence principle.

UNIT V APPLIED QUANTUM MECHANICS 9

The harmonic oscillator(qualitative)- Barrier penetration and quantum tunneling(qualitative)- Tunneling microscope - Resonant diode - Finite potential wells (qualitative)- Bloch's theorem for particles in a periodicpotential –Basics of Kronig-Penney model and origin of energy bands.

TOTAL : 45 PERIODS

COURSE OUTCOMES:

After completion of this course, the students should be able to

CO1:Understand the importance of mechanics.

CO2:Express their knowledge in electromagnetic waves.

CO3:Demonstrate a strong foundational knowledge in oscillations, optics and lasers.

CO4:Understand the importance of quantum physics.

CO5:Comprehend and apply quantum mechanical principles towards the formation of energy bands.

TEXT BOOKS:

1. D.Kleppner and R.Kolenkow. An Introduction to Mechanics. McGraw Hill Education (Indian Edition), 2017.
2. E.M.Purcell and D.J.Morin, Electricity and Magnetism, Cambridge Univ.Press, 2013.
3. Arthur Beiser, Shobhit Mahajan, S. Rai Choudhury, Concepts of Modern Physics, McGraw-Hill (Indian Edition), 2017.

REFERENCES:

1. R.Wolfson. Essential University Physics. Volume 1 & 2. Pearson Education (Indian Edition),2009.
2. Paul A. Tipler, Physic – Volume 1 & 2, CBS, (Indian Edition), 2004.
3. K.Thyagarajan and A.Ghatak. Lasers: Fundamentals and Applications, Laxmi Publications,(Indian Edition), 2019.
4. D.Halliday, R.Resnick and J.Walker. Principles of Physics, Wiley (Indian Edition), 2015.
5. N.Garcia, A.Damask and S.Schwarz. Physics for Computer Science Students. Springer-Verlag, 2012.

CO's-PO's & PSO's MAPPING

CO	PO	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	3	2	1	1	1	-	-	-	-	-	-	-	-	-
2	3	3	2	1	2	1	-	-	-	-	-	-	-	-	-
3	3	3	2	2	2	1	-	-	-	-	-	1	-	-	-
4	3	3	1	1	2	1	-	-	-	-	-	-	-	-	
5	3	3	1	1	2	1	-	-	-	-	-	-	-	-	-
AV	3	3	1.6	1.2	1.8	1	-	-	-	-	-	1	-	-	-

1 - low, 2 - medium, 3 - high, '-' - no correlation

21149S14 **ENGINEERING CHEMISTRY** **L T P C**

3 0 0 3

COURSE OBJECTIVES:

- To inculcate sound understanding of water quality parameters and water treatment techniques.
- To impart knowledge on the basic principles and preparatory methods of nanomaterials.
- To introduce the basic concepts and applications of phase rule and composites.
- To facilitate the understanding of different types of fuels, their preparation, properties and combustion characteristics.
- To familiarize the students with the operating principles, working processes and applicationsof energy conversion and storage devices.

UNIT I WATER AND ITS TREATMENT 9

Water: Sources and impurities, Water quality parameters: Definition and significance of-color, odour,turbidity,pH, hardness, alkalinity, TDS, COD and BOD, fluoride and arsenic. Municipal water treatment: primary treatment and disinfection (UV, Ozonation, break-point chlorination). Desalination of brackish water: Reverse Osmosis. Boiler troubles: Scale and sludge, Boiler corrosion, Caustic embrittlement, Priming & foaming. Treatment of boiler feed water: Internal treatment (phosphate, colloidal, sodium aluminate and calgon conditioning) and External treatment
- Ion exchange demineralization and zeolite process.

UNIT II NANOCHEMISTRY 9

Basics: Distinction between molecules, nanomaterials and bulk materials; Size-dependent properties (optical,electrical, mechanical and magnetic); Types of nanomaterials: Definition, properties and uses of – nanoparticle, nanocluster, nanorod, nanowire and nanotube. Preparation of nanomaterials: sol-gel, solvothermal, laser ablation, chemical vapour deposition, electrochemical deposition and electro spinning. Applications of nanomaterials in medicine, agriculture, energy, electronics and catalysis.

UNIT III PHASE RULE AND COMPOSITES 9

Phase rule: Introduction, definition of terms with examples. One component system - water system;Reduced phase rule; Construction of a simple eutectic phase diagram - Thermal analysis; Two

component system: lead-silver system - Pattinson process.

Composites: Introduction: Definition & Need for composites; Constitution: Matrix materials (Polymermatrix,metal matrix and ceramic matrix) and Reinforcement (fiber, particulates, flakes and whiskers). Properties and applications of: Metal matrix composites (MMC), Ceramic matrix composites and Polymer matrix composites. Hybrid composites - definition and examples.

UNIT IV FUELS AND COMBUSTION 9

Fuels: Introduction: Classification of fuels; Coal and coke: Analysis of coal (proximate and ultimate), Carbonization, Manufacture of metallurgical coke (Otto Hoffmann method). Petroleum and Diesel: Manufacture of synthetic petrol (Bergius process), Knocking - octane number, diesel oil - cetane number; Power alcohol and biodiesel.

Combustion of fuels: Introduction: Calorific value - higher and lower calorific values, Theoretical calculation of calorific value; Ignition temperature: spontaneous ignition temperature, Explosive range; Flue gas analysis - ORSAT Method. CO_2 emission and carbon footprint.

UNIT V ENERGY SOURCES AND STORAGE DEVICES 9

Stability of nucleus: mass defect (problems), binding energy; Nuclear energy: light water nuclear power plant, breeder reactor. Solar energy conversion: Principle, working and applications of solar cells; Recent developments in solar cell materials. Wind energy; Geothermal energy; Batteries: Types of batteries, Primary battery - dry cell, Secondary battery - lead acid battery and lithium-ion- battery; Electric vehicles - working principles; Fuel cells: H2-O2 fuel cell, microbial fuel cell; Supercapacitors: Storage principle, types and examples.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of the course, the students will be able:

CO1:To infer the quality of water from quality parameter data and propose suitable treatmentmethodologies totreat water.

CO2:To identify and apply basic concepts of nanoscience and nanotechnology in designing thesynthesisof nanomaterials for engineering and technology applications.

CO3:To apply the knowledge of phase rule and composites for material selection requirements.

CO4:To recommend suitable fuels for engineering processes and applications.

CO5:To recognize different forms of energy resources and apply them for suitable applications inenergysectors.

TEXT BOOKS:

1. P. C. Jain and Monica Jain, "Engineering Chemistry", 17th Edition, Dhanpat Rai Publishing Company (P) Ltd, New Delhi, 2018.
2. Sivasankar B., "Engineering Chemistry", Tata McGraw-Hill Publishing Company Ltd, NewDelhi, 2008.
3. S.S. Dara, "A Text book of Engineering Chemistry", S. Chand Publishing, 12th Edition,2018

REFERENCES:

1. B. S. Murty, P. Shankar, Baldev Raj, B. B. Rath and James Murday, "Text book of nanoscience and nanotechnology", Universities Press-IIM Series in Metallurgy and MaterialsScience, 2018.
2. O.G. Palanna, "Engineering Chemistry" McGraw Hill Education (India) Private Limited, 2nd Edition, 2017.
3. Friedrich Emich, "Engineering Chemistry", Scientific International PVT, LTD, New Delhi, 2014.
4. ShikhaAgarwal, "Engineering Chemistry-Fundamentals and Applications", Cambridge University Press, Delhi, Second Edition, 2019.
5. O.V. Roussak and H.D. Gesser, Applied Chemistry-A Text Book for Engineers and Technologists, Springer Science Business Media, New York, 2nd Edition, 2013.

CO's-PO's & PSO's MAPPING

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	2	2	1	-	1	1	-	-	-	-	1	-	-	-
2	2	-	-	1	-	2	2	-	-	-	-	-	-	-	-
3	3	1	-	-	-	-	-	-	-	-	-	-	-	-	-
4	3	1	1	-	-	1	2	-	-	-	-	-	-	-	-
5	3	1	2	1	-	2	2	-	-	-	-	2	-	-	-
CO	**2.8**	**1.3**	**1.6**	**1**	**-**	**1.5**	**1.8**	**-**		**-**	**-**	**1.5**	**-**	**-**	**-**

1 - low, 2 - medium, 3 - high, '-' - no correlation

21150S15 **PROBLEM SOLVING AND PYTHON PROGRAMMING**

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

- To understand the basics of algorithmic problem solving.
- To learn to solve problems using Python conditionals and loops.
- To define Python functions and use function calls to solve problems.
- To use Python data structures - lists, tuples, dictionaries to represent complex data.
- To do input/output with files in Python.

UNIT I COMPUTATIONAL THINKING AND PROBLEM SOLVING 9

Fundamentals of Computing – Identification of Computational Problems -Algorithms, building blocks of algorithms (statements, state, control flow, functions), notation (pseudo code, flow chart, programming language), algorithmic problem solving, simple strategies for developing algorithms (iteration, recursion). Illustrative problems: find minimum in a list, insert a cardin a list of sorted cards, guess an integernumber in a range, Towers of Hanoi.

UNIT II DATA TYPES, EXPRESSIONS, STATEMENTS 9

Python interpreter and interactive mode,debugging; values and types: int, float, boolean, string , and list; variables, expressions, statements, tuple assignment, precedence of operators, comments; Illustrative programs: exchange the values of two variables, circulate the values of n variables, distance between two points.

UNIT III CONTROL FLOW, FUNCTIONS, STRINGS 9

Conditionals:Boolean values and operators, conditional (if), alternative (if-else),chained conditional (if-elif- else);Iteration: state, while, for, break, continue, pass; Fruitful functions: return values,parameters, localand global scope, function composition, recursion; Strings: string slices,immutability, string functions and methods, string module; Lists as arrays. Illustrative programs: square root, gcd, exponentiation, sum an array of numbers, linear search, binary search.

UNIT IV LISTS, TUPLES, DICTIONARIES 9

Lists: list operations, list slices, list methods, list loop, mutability, aliasing, cloning lists, list parameters; Tuples: tuple assignment, tuple as return value; Dictionaries: operations and methods; advanced list processing - list comprehension; Illustrative programs: simple sorting, histogram, Students marks statement, Retail bill preparation.

UNIT V FILES, MODULES, PACKAGES 9

Files and exceptions: text files, reading and writing files, format operator; command line arguments, errors and exceptions, handling exceptions, modules, packages; Illustrative programs: word count, copy file, Voter's age validation, Marks range validation (0-100).

TOTAL : 45 PERIODS

COURSE OUTCOMES:

Upon completion of the course, students will be able to

CO1: Develop algorithmic solutions to simple computational problems.
CO2: Develop and execute simple Python programs.
CO3: Write simple Python programs using conditionals and loops for solving problems.
CO4: Decompose a Python program into functions.

CO5: Represent compound data using Python lists, tuples, dictionaries etc.
CO6: Read and write data from/to files in Python programs.

TEXT BOOKS:

1. Allen B. Downey, "Think Python: How to Think like a Computer Scientist", 2nd Edition, O'Reilly Publishers, 2016.
2. Karl Beecher, "Computational Thinking: A Beginner's Guide to Problem Solving and Programming", 1st Edition, BCS Learning & Development Limited, 2017.

REFERENCES:

1. Paul Deitel and Harvey Deitel, "Python for Programmers", Pearson Education, 1st Edition, 2021.
2. G Venkatesh and Madhavan Mukund, "Computational Thinking: A Primer for Programmers and Data Scientists", 1st Edition, Notion Press, 2021.
3. John V Guttag, "Introduction to Computation and Programming Using Python: With Applications to Computational Modeling and Understanding Data", Third Edition, MIT Press,2021
4. Eric Matthes, "Python Crash Course, A Hands - on Project Based Introduction to Programming", 2nd Edition, No Starch Press, 2019.
5. https://www.python.org/
6. Martin C. Brown, "Python: The Complete Reference", 4th Edition, Mc-Graw Hill, 2018.

CO's-PO's & PSO's MAPPING

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	3	3	3	2	-	-	-	-	-	2	2	3	3	-
2	3	3	3	3	2	-	-	-	-	-	2	2	3	-	-
3	3	3	3	3	2	-	-	-	-	-	2	-	3	-	-
4	2	2	-	2	2	-	-	-	-	-	1	-	3	-	-
5	1	2	-	-	1	-	-	-	-	-	1	-	2	-	-
6	2	2	-	-	2	-	-	-	-	-	1	-	2	-	
AVg.	**2**	**3**	**3**	**3**	**2**	-	-	-	-	-	**2**	**2**	**3**	**3**	-

1 - low, 2 - medium, 3 - high, '-' - no correlation

21150L16 PROBLEM SOLVING AND PYTHON PROGRAMMING LABORATORY L T P C

0 0 4 2

COURSE OBJECTIVES:

- To understand the problem solving approaches.
- To learn the basic programming constructs in Python.
- To practice various computing strategies for Python-based solutions to real world problems.
- To use Python data structures - lists, tuples, dictionaries.
- To do input/output with files in Python.

EXPERIMENTS:

Note: The examples suggested in each experiment are only indicative. The lab instructor isexpected to design other problems on similar lines. The Examination shall not be restricted to the sample experiments listed here.

1. Identification and solving of simple real life or scientific or technical problems, and developingflow charts for the same. (Electricity Billing, Retail shop billing, Sin series, weight of a motorbike, Weight of a steel bar, compute Electrical Current in Three Phase AC Circuit, etc.)
2. Python programming using simple statements and expressions (exchange the values of twovariables, circulate the values of n variables, distance between two points).
3. Scientific problems using Conditionals and Iterative loops. (Number series, Number Patterns,pyramid pattern)
4. Implementing real-time/technical applications using Lists, Tuples. (Items present in a library/Components of a car/ Materials required for construction of a building –operations of list & tuples)
5. Implementing real-time/technical applications using Sets, Dictionaries. (Language, components of an automobile, Elements of a civil structure, etc.- operations of Sets & Dictionaries)
6. Implementing programs using Functions. (Factorial, largest number in a list, area of shape)
7. Implementing programs using Strings. (reverse, palindrome, character count, replacingcharacters)
8. Implementing programs using written modules and Python Standard Libraries (pandas,numpy. Matplotlib, scipy)
9. Implementing real-time/technical applications using File handling. (copy from one file to another, word count, longest word)
10. Implementing real-time/technical applications using Exception handling. (divide by zeroerror, voter's age validity, student mark range validation)
11. Exploring Pygame tool.
12. Developing a game activity using Pygame like bouncing ball, car race etc.

TOTAL: 60 PERIODS

COURSE OUTCOMES:

On completion of the course, students will be able to:

CO1: Develop algorithmic solutions to simple computational problems

CO2: Develop and execute simple Python programs.

CO3: Implement programs in Python using conditionals and loops for solving problems.

CO4: Deploy functions to decompose a Python program.

CO5: Process compound data using Python data structures.

CO6: Utilize Python packages in developing software applications.

TEXT BOOKS:

1. Allen B. Downey, “Think Python: How to Think like a Computer Scientist”, 2nd Edition, O’Reilly Publishers, 2016.
2. Karl Beecher, “Computational Thinking: A Beginner's Guide to Problem Solving and Programming”, 1st Edition, BCS Learning & Development Limited, 2017.

REFERENCES:

1. Paul Deitel and Harvey Deitel, “Python for Programmers”, Pearson Education, 1st Edition, 2021.
2. G Venkatesh and Madhavan Mukund, “Computational Thinking: A Primer for Programmers and Data Scientists”, 1st Edition, Notion Press, 2021.
3. John V Guttag, "Introduction to Computation and Programming Using Python: With Applications to Computational Modeling and Understanding Data”, Third Edition, MIT Press,2021.
4. Eric Matthes, “Python Crash Course, A Hands - on Project Based Introduction to Programming”, 2nd Edition, No Starch Press, 2019.
5. https://www.python.org/
6. Martin C. Brown, “Python: The Complete Reference”, 4th Edition, Mc-Graw Hill, 2018.

CO’s-PO’s & PSO’s MAPPING

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	3	3	3	2	-	-	-	-	-	2	2	3	3	-
2	3	3	3	3	2	-	-	-	-	-	2	2	3	-	-
3	3	3	3	3	2	-	-	-	-	-	2	-	3	-	-
4	2	2	-	2	2	-	-	-	-	-	1	-	3	-	-
5	1	2	-	-	1	-	-	-	-	-	1	-	2	-	-
6	2	2	-	-	2	-	-	-	-	-	1	-	2	-	
AVg.	**2**	**3**	**3**	**3**	**2**	-	-	-	-	-	**2**	**2**	**3**	**3**	-

1 - low, 2 - medium, 3 - high, ‘-' - no correlation

21149L17 PHYSICS AND CHEMISTRY LABORATORY L T P C
0 0 4 2

PHYSICS LABORATORY : (Any Seven Experiments)

COURSE OBJECTIVES:

- To learn the proper use of various kinds of physics laboratory equipment.
- To learn how data can be collected, presented and interpreted in a clear and concise manner.
- To learn problem solving skills related to physics principles and interpretation of experimentaldata.
- To determine error in experimental measurements and techniques used to minimize sucherror.
- To make the student an active participant in each part of all lab exercises.

1. Torsional pendulum - Determination of rigidity modulus of wire and moment of inertia of

regular and irregular objects.

2. Simple harmonic oscillations of cantilever.
3. Non-uniform bending - Determination of Young's modulus
4. Uniform bending – Determination of Young's modulus
5. Laser- Determination of the wavelength of the laser using grating
6. Air wedge - Determination of thickness of a thin sheet/wire
7. a) Optical fibre -Determination of Numerical Aperture and acceptance angle
   b) Compact disc- Determination of width of the groove using laser.
8. Acoustic grating- Determination of velocity of ultrasonic waves in liquids.
9. Ultrasonic interferometer – determination of the velocity of sound and compressibility of liquids
10. Post office box -Determination of Band gap of a semiconductor.
11. Photoelectric effect
12. Michelson Interferometer.
13. Melde's string experiment
14. Experiment with lattice dynamics kit.

TOTAL: 30 PERIODS

COURSE OUTCOMES:

Upon completion of the course, the students should be able to
CO1:Understandthe functioning of various physics laboratory equipment.CO2:Use graphical models to analyze laboratory data.
CO3:Use mathematical models as a medium for quantitative reasoning and describing physicalreality.
CO4:Access, process and analyze scientific information.
CO5:Solve problems individually and collaboratively.

CO's-PO's & PSO's MAPPING

CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PO12	PSO 1	PSO 2	PSO 3
1	3	2	3	1	1	-	-	-	-	-	-	-	-	-	-
2	3	3	2	1	1	-	-	-	-	-	-	-	-	-	-
3	3	2	3	1	1	-	-	-	-	-	-	-	-	-	-
4	3	3	2	1	1	-	-	-	-	-	-	-	-	-	-
5	3	2	3	1	1	-	-	-	-	-	-	-	-	-	-
AVG	3	2.4	2.6	1	1	-	-	-	-	-	-	-	-	-	-

1 - low, 2 - medium, 3 - high, '-' - no correlation

CHEMISTRY LABORATORY: (Any seven experiments to be conducted)

COURSE OBJECTIVES:

- To inculcate experimental skills to test basic understanding of water quality parameters,such as, acidity, alkalinity, hardness, DO, chloride and copper.
- To induce the students to familiarize with electroanalytical techniques such as, pH metry, potentiometry and conductometry in the determination of impurities in aqueous solutions.
- To demonstrate the analysis of metals and alloys.
- To demonstrate the synthesis of nanoparticles

1. Preparation of Na2CO3 as a primary standard and estimation of acidity of a water sample

using the primary standard

2. Determination of types and amount of alkalinity in a water sample.

- **Split the first experiment into two**

3. Determination of total, temporary & permanent hardness of water by EDTA method.
4. Determination of DO content of water sample by Winkler's method.
5. Determination of chloride content of water sample by Argentometric method.
6. Estimation of copper content of the given solution by Iodometry.
7. Estimation of TDS of a water sample by gravimetry.
8. Determination of strength of given hydrochloric acid using pH meter.
9. Determination of strength of acids in a mixture of acids using conductivity meter.
10. Conductometric titration of barium chloride against sodium sulphate (precipitation titration)
11. Estimation of iron content of the given solution using potentiometer.
12. Estimation of sodium /potassium present in water using a flame photometer.
13. Preparation of nanoparticles (TiO2/ZnO/CuO) by Sol-Gel method.
14. Estimation of Nickel in steel
15. Proximate analysis of Coal

TOTAL : 30 PERIODS

COURSE OUTCOMES:

CO1:To analyse the quality of water samples with respect to their acidity, alkalinity, hardness andDO.CO2:To determine the amount of metal ions through volumetric and spectroscopic techniques CO3:To analyse and determine the composition of alloys.

CO4:To learn simple method of synthesis of nanoparticles

CO5:To quantitatively analyse the impurities in solution by electroanalytical techniques

TEXT BOOKS :

1. **J. Mendham, R. C. Denney, J.D. Barnes, M. Thomas and B. Sivasankar, Vogel's Textbookof Quantitative Chemical Analysis (2009).**

CO's-PO's & PSO's MAPPING

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	-	1	-	-	2	2	-	-	-	-	2	-	-	-
2	3	1	2	-	-	1	2	-	-	-	-	1	-	-	-
3	3	2	1	1	-	-	1	-	-	-	-	-	-	-	-
4	2	1	2	-	-	2	2	-	-	-	-	-	-	-	-
5	2	1	2	-	1	2	2	-	-	-	-	1	-	-	-
Avg.	**2.6**	**1.3**	**1.6**	**1**	**1**	**1.4**	**1.8**	**-**	**-**	**-**	**-**	**1.3**	**-**	**-**	**-**

1 - low, 2 - medium, 3 - high, '-' - no correlation

21147L18 **Communication Laboratory – I** **L T P C**

0 0 2 1

COURSE OBJECTIVES:

- To improve the communicative competence of learners
- To help learners use language effectively in academic /work contexts
- To develop various listening strategies to comprehend various types of audio materialslike lectures, discussions, videos etc.
- To build on students' English language skills by engaging them in listening, speaking and grammar learning activities that are relevant to authentic contexts.
- To use language efficiently in expressing their opinions via various media.

UNIT I INTRODUCTION TO FUNDAMENTALS OF COMMUNICATION 6

Listening for general information-specific details- conversation: Introduction to classmates - Audio / video (formal & informal); Telephone conversation; Listening to voicemail & messages; Listening and filling a form. Speaking - making telephone calls-Self Introduction; Introducing a friend; - politeness strategies- making polite requests, making polite offers, replying to polite requests and offers- understanding basic instructions(filling out a bank application for example).

UNIT II NARRATION AND SUMMATION 6

Listening - Listening to podcasts, anecdotes / stories / event narration; documentaries and interviews with celebrities. Speaking - Narrating personal experiences / events-Talking about current and temporary situations & permanent and regular situations* - describing experiences and feelings- engaging in small talk- describing requirements and abilities.

UNIT III DESCRIPTION OF A PROCESS / PRODUCT 6

Listening - Listen to product and process descriptions; a classroom lecture; and advertisements about products. Speaking – Picture description- describing locations in workplaces- Giving instruction to use the product- explaining uses and purposes- Presenting a product- describing shapes and sizes and weights- talking about quantities(large & small)-talking about precautions.

UNIT IV CLASSIFICATION AND RECOMMENDATIONS 6

Listening – Listening to TED Talks; Listening to lectures - and educational videos. Speaking – SmallTalk; discussing and making plans-talking about tasks-talking about progress- talking about positions and directions of movement-talking about travel preparations- talking about transportation-

UNIT V EXPRESSION 6

Listening – Listening to debates/ discussions; different viewpoints on an issue; and panel discussions. Speaking –making predictions- talking about a given topic-giving opinions- understanding a website- describing processes

TOTAL : 30 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able

CO1:To listen to and comprehend general as well as complex academic information

CO2:To listen to and understand different points of view in a discussion

CO3:To speak fluently and accurately in formal and informal communicative contexts

CO4:Todescribe products and processes and explain their uses and purposes clearly andaccurately

CO5:To express their opinions effectively in both formal and informal discussions

CO's-PO's & PSO's MAPPING

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	3	3	3	3	1	3	3	3	3	3	3	3	-	-	-
2	3	3	3	3	1	3	3	3	3	3	3	3	-	-	-
3	3	3	3	3	1	3	3	3	3	3	3	3	-	-	-
4	3	3	3	3	1	3	3	3	3	3	3	3	-	-	-
5	3	3	3	3	1	3	3	3	3	3	3	3	-	-	-
AVg.	**3**	**3**	**3**	**3**	**1**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**-**	**-**	**-**

1 - low, 2 - medium, 3 - high, '-' - no correlation

Note: The average value of this course to be used for program articulation matrix.

ASSESSMENT PATTERN

- **One online / app based assessment to test listening /speaking**
- **End Semester ONLY listening and speaking will be conducted online.**
- **Proficiency certification is given on successful completion of listening and speaking internaltest andend semester exam.**

21147S21 PROFESSIONAL ENGLISH - II L T P C
2 0 0 2

COURSE OBJECTIVES :

- To engage learners in meaningful language activities to improve their reading and writingskills
- To learn various reading strategies and apply in comprehending documents in professionalcontext.
- To help learners understand the purpose, audience, contexts of different types of writing
- To develop analytical thinking skills for problem solving in communicative contexts
- To demonstrate an understanding of job applications and interviews for internship and placements

UNIT I MAKING COMPARISONS 6

Reading - Reading advertisements, user manuals, brochures; Writing – Professional emails, Email etiquette -Compare and Contrast Essay; Grammar – Mixed Tenses, Prepositional phrases

UNIT II EXPRESSING CAUSAL RELATIONS IN SPEAKING AND WRITING 6

Reading - Reading longer technical texts– Cause and Effect Essays, and Letters / emails of complaint, Writing - Writing responses to complaints. Grammar - Active Passive Voice transformations, Infinitive and Gerunds

UNIT III PROBLEM SOLVING 6

Reading - Case Studies, excerpts from literary texts, news reports etc. Writing – Letter to the Editor, Checklists, Problem solution essay / Argumentative Essay. Grammar – Error correction; If conditional sentences

UNIT IV REPORTING OF EVENTS AND RESEARCH 6

Reading –Newspaper articles; Writing – Recommendations, Transcoding, Accident Report, Survey

Report Grammar – Reported Speech, Modals Vocabulary – Conjunctions- use of prepositions

UNIT V THE ABILITY TO PUT IDEAS OR INFORMATION COGENTLY 6

Reading – Company profiles, Statement of Purpose, (SOP), an excerpt of interview with professionals; Writing – Job / Internship application – Cover letter & Resume; Grammar – Numerical adjectives, Relative Clauses.

TOTAL : 30 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able

CO1:To compare and contrast products and ideas in technical texts.

CO2:To identify and report cause and effects in events, industrial processes through technical textsCO3:Toanalyse problems in order to arrive at feasible solutions and communicate them in the written format.

CO4:To present their ideas and opinions in a planned and logical manner

CO5:To draft effective resumes in the context of job search.

TEXT BOOKS :

1. English for Engineers & Technologists (2020 edition) Orient Blackswan Private Ltd. Department of English, Anna University.
2. English for Science & Technology Cambridge University Press 2021.
3. Authored by Dr. Veena Selvam, Dr. Sujatha Priyadarshini, Dr. Deepa Mary Francis, Dr. KN.Shoba, and Dr. Lourdes Joevani, Department of English, Anna University.

REFERENCES:

1. Raman. Meenakshi, Sharma. Sangeeta (2019). Professional English. Oxford university press.New Delhi.
2. Improve Your Writing ed. V.N. Arora and Laxmi Chandra, Oxford Univ. Press, 2001, NewDelhi.
3. Learning to Communicate – Dr. V. Chellammal. Allied Publishers, New Delhi, 2003
4. Business Correspondence and Report Writing by Prof. R.C. Sharma & Krishna Mohan, TataMcGraw Hill & Co. Ltd., 2001, New Delhi.
5. Developing Communication Skills by Krishna Mohan, Meera Bannerji- Macmillan India Ltd.1990, Delhi.

ASSESSMENT PATTERN

Two internal assessments and an end semester examination to test students' reading and writing skills alongwith their grammatical and lexical competence.

CO's-PO's & PSO's MAPPING

CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PO12	PSO 1	PSO 2	PSO 3
1	3	3	3	3	3	3	3	3	2	3	3	3	-	-	-
2	3	3	3	3	3	3	3	3	2	3	3	3	-	-	-
3	3	3	3	3	3	3	3	3	2	3	3	3	-	-	-
4	3	3	3	3	2	3	3	3	2	3	3	3	-	-	-
5	-	-	-	-	-	-	-	-	3	3	3	3	-	-	-
AVg.	3	3	3	3	2.75	3	3	3	2.2	3	3	3	-	-	-

1 - low, 2 - medium, 3 - high, '-' - no correlation

Note: The average value of this course to be used for program articulation matrix.

21148S22 **STATISTICS AND NUMERICAL METHODS** **L T P C**
3 1 0 4

COURSE OBJECTIVES:

- This course aims at providing the necessary basic concepts of a few statistical and numerical methods and give procedures for solving numerically different kinds of problems occurring in engineering and technology.
- To acquaint the knowledge of testing of hypothesis for small and large samples which plays an important role in real life problems.
- To introduce the basic concepts of solving algebraic and transcendental equations.
- To introduce the numerical techniques of interpolation in various intervals and numerical techniques of differentiation and integration which plays an important role in engineering and technology disciplines.
- To acquaint the knowledge of various techniques and methods of solving ordinary differential equations.

UNIT I TESTING OF HYPOTHESIS 9 + 3

Sampling distributions - Tests for single mean, proportion and difference of means (Large and smallsamples) – Tests for single variance and equality of variances – Chi square test for goodness of fit – Independence of attributes.

UNIT II DESIGN OF EXPERIMENTS 9 + 3

One way and two way classifications - Completely randomized design – Randomized block design - Latin square design - 2^2 factorial design.

UNIT III SOLUTION OF EQUATIONS AND EIGENVALUE PROBLEMS 9 + 3

Solution of algebraic and transcendental equations - Fixed point iteration method – Newton Raphsonmethod-Solution of linear system of equations - Gauss elimination method – Pivoting - Gauss Jordan method – Iterative methods of Gauss Jacobi and Gauss Seidel - Eigenvalues of a matrix by Power method and Jacobi's method for symmetric matrices.

UNIT IV INTERPOLATION, NUMERICAL DIFFERENTIATION AND NUMERICAL INTEGRATION 9 +3

Lagrange's and Newton's divided difference interpolations – Newton's forward and backward difference interpolation – Approximation of derivates using interpolation polynomials – Numericalsingle and double integrations using Trapezoidal and Simpson's 1/3 rules.

UNIT V NUMERICAL SOLUTION OF ORDINARY DIFFERENTIAL EQUATIONS9 +3

Single step methods: Taylor's series method - Euler's method - Modified Euler's method - Fourth order Runge-Kutta method for solving first order differential equations - Multi step methods: Milne'sand Adams - Bash forth predictor corrector methods for solving first order differential equations.

TOTAL: 60 PERIODS

COURSE OUTCOMES:

Upon successful completion of the course, students will be able to:

CO1:Apply the concept of testing of hypothesis for small and large samples in real life problems.

CO2:Apply the basic concepts of classifications of design of experiments in the field of agriculture.

CO3:Appreciate the numerical techniques of interpolation in various intervals and apply the numericaltechniques of differentiation and integration for engineering problems.

CO4:Understand the knowledge of various techniques and methods for solving first and secondorderordinary differential equations.

CO5:Solve the partial and ordinary differential equations with initial and boundary conditions byusingcertain techniques with engineering applications.

TEXT BOOKS:

1. Grewal, B.S., and Grewal, J.S., "Numerical Methods in Engineering and Science", Khanna Publishers, 10th Edition, New Delhi, 2015.
2. Johnson, R.A., Miller, I and Freund J., “Miller and Freund’s Probability and Statistics for Engineers", Pearson Education, Asia, 8th Edition, 2015.

REFERENCES:

1. Burden, R.L and Faires, J.D, "Numerical Analysis”, 9th Edition, Cengage Learning, 2016.
2. Devore. J.L., "Probability and Statistics for Engineering and the Sciences”, Cengage Learning, New Delhi, 8th Edition, 2014.
3. Gerald. C.F. and Wheatley. P.O. "Applied Numerical Analysis” Pearson Education, Asia,New Delhi, 7th Edition, 2007.
4. Gupta S.C. and Kapoor V. K., “Fundamentals of Mathematical Statistics”, Sultan Chand &Sons, New Delhi, 12th Edition, 2020.
5. Spiegel. M.R., Schiller. J. and Srinivasan. R.A., "Schaum’s Outlines on Probability and Statistics ", Tata McGraw Hill Edition, 4th Edition, 2012.
6. Walpole. R.E., Myers. R.H., Myers. S.L. and Ye. K., “Probability and Statistics for Engineersand Scientists", 9th Edition, Pearson Education, Asia, 2010.

CO’s-PO’s & PSO’s MAPPING

CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PO12	PSO 1	PSO 2	PSO 3
CO 1	3	3	1	1	1	0	0	0	2	0	2	3	-	-	-
CO 2	3	3	1	1	1	0	0	0	2	0	2	3	-	-	-
CO 3	3	3	1	1	1	0	0	0	2	0	2	3	-	-	-
CO 4	3	3	1	1	1	0	0	0	2	0	2	3	-	-	-
CO 5	3	3	1	1	1	0	0	0	2	0	2	3	-	-	-
Avg	3	3	1	1	1	0	0	0	2	0	2	3	-	-	-

1 - low, 2 - medium, 3 - high, ‘-' - no correlation

21149S23A	**PHYSICS FOR INFORMATION SCIENCE**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

COURSE OBJECTIVES:

- To make the students understand the importance in studying electrical properties of materials.
- To enable the students to gain knowledge in semiconductor physics
- To instill knowledge on magnetic properties of materials.
- To establish a sound grasp of knowledge on different optical properties of materials, opticaldisplays and applications
- To inculcate an idea of significance of nano structures, quantum confinement, ensuing nanodevice applications and quantum computing.

UNIT I ELECTRICAL PROPERTIES OF MATERIALS 9

Classical free electron theory - Expression for electrical conductivity – Thermal conductivity, expression - Wiedemann-Franz law – Success and failures - electrons in metals – Particle in a three dimensional box – degenerate states – Fermi- Dirac statistics – Density of energy states – Electron in periodic potential – Energy bands in solids – tight binding approximation - Electron effective mass – concept of hole.

UNIT II SEMICONDUCTOR PHYSICS 9

Intrinsic Semiconductors – Energy band diagram – direct and indirect band gap semiconductors – Carrier concentration in intrinsic semiconductors – extrinsic semiconductors - Carrier concentration in N-type & P- type semiconductors – Variation of carrier concentration with temperature – variation of Fermi level with temperature and impurity concentration – Carrier transport in Semiconductor: random motion, drift, mobility and diffusion – Hall effect and devices – Ohmic contacts – Schottky diode.

UNIT III MAGNETIC PROPERTIES OF MATERIALS 9

Magnetic dipole moment – atomic magnetic moments- magnetic permeability and susceptibility - Magnetic material classification: diamagnetism – paramagnetism – ferromagnetism – antiferromagnetism – ferrimagnetism – Ferromagnetism: origin and exchange interaction- saturation magnetization and Curie temperature – Domain Theory- M versus H behaviour – Hard and soft magnetic materials – examples and uses-– Magnetic principle in computer data storage – Magnetic harddisc (GMR sensor).

UNIT IV OPTICAL PROPERTIES OF MATERIALS 9

Classification of optical materials – carrier generation and recombination processes - Absorptionemission and scattering of light in metals, insulators and semiconductors (concepts only) - photocurrent in a P-N diode – solar cell - LED – Organic LED – Laser diodes – Optical data storagetechniques.

UNIT V NANODEVICES AND QUANTUM COMPUTING 9

Introduction - quantum confinement – quantum structures: quantum wells, wires and dots — bandgap of nanomaterials. Tunneling – Single electron phenomena: Coulomb blockade - resonant- tunneling diode
– single electron transistor – quantum cellular automata - Quantum system for information processing - quantum states – classical bits – quantum bits or qubits –CNOT gate - multiple qubits – Bloch sphere – quantum gates – advantage of quantum computing over classicalcomputing.

TOTAL :45 PERIODS

COURSE OUTCOMES:

At the end of the course, the students should be able to

CO1:gain knowledge on classical and quantum electron theories, and energy band structures
CO2:acquire knowledge on basics of semiconductor physics and its applications in various devicesCO3:get knowledge onmagnetic properties of materials and their applications in data storage,
CO4:have the necessary understanding on the functioning of optical materials for optoelectronics
CO5:understand the basics of quantum structures and their applications and basics of quantumcomputing

TEXT BOOKS:

1. Jasprit Singh, "Semiconductor Devices: Basic Principles", Wiley (Indian Edition), 2007.
2. S.O. Kasap. Principles of Electronic Materials and Devices, McGraw-Hill Education (Indian Edition), 2020.

3. Parag K. Lala, Quantum Computing: A Beginner's Introduction, McGraw-Hill Education (Indian Edition), 2020.

REFERENCES:

1. Charles Kittel, Introduction to Solid State Physics, Wiley India Edition, 2019.
2. Y.B.Band and Y.Avishai, Quantum Mechanics with Applications to Nanotechnology and
3. Information Science, Academic Press, 2013.
4. V.V.Mitin, V.A. Kochelap and M.A.Stroscio, Introduction to Nanoelectronics, Cambridge Univ.Press, 2008.
5. G.W. Hanson, Fundamentals of Nanoelectronics, Pearson Education (Indian Edition) 2009.
6. B.Rogers, J.Adams and S.Pennathur, Nanotechnology: Understanding Small Systems, CRCPress, 2014.

CO's-PO's & PSO's MAPPING

CO's	PO's												PSO's		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	3	1	-	-	-	-	-	-	-	-	-	-	-	-	-
2	3	1	2	-	-	-	-	-	-	-	-	-	-	-	-
3	3	-	-	1	2	1	1	-	-	-	-	-	-	-	-
4	3	-	2	1	3	-	1	-	-	-	-	-	-	-	-
5	3	2	2	2	2	1	2	-	-	-	-	2	-	-	-
AVG	3	1.3	2	1.3	2.3	1	1.3	-	-	-	-	2	-	-	-

1-Low,2-Medium,3-High,"-"-no correlation

Note: the average value of this course to be used for program articulation matrix.

21153S25A **BASIC ELECTRICAL AND ELECTRONICS ENGINEERING** **L T P C**
3 0 0 3

COURSE OBJECTIVES:

- To introduce the basics of electric circuits and analysis
- To impart knowledge in the basics of working principles and application of electrical machines
- To introduce analog devices and their characteristics
- To educate on the fundamental concepts of digital electronics
- To introduce the functional elements and working of measuring instruments

UNIT I ELECTRICAL CIRCUITS 9

DC Circuits: Circuit Components: Conductor, Resistor, Inductor, Capacitor – Ohm's Law - Kirchhoff'sLaws – Independent and Dependent Sources – Simple problems- Nodal Analysis, Mesh analysis with Independent sources only (Steady state)

Introduction to AC Circuits and Parameters: Waveforms, Average value, RMS Value, Instantaneouspower, real power, reactive power and apparent power, power factor – Steady state analysis of RLCcircuits (Simple problems only)

UNIT II ELECTRICAL MACHINES 9

Construction and Working principle- DC Separately and Self excited Generators, EMF equation, Types and Applications. Working Principle of DC motors, Torque Equation, Types and Applications. Construction, Working principle and Applications of Transformer, Three phase Alternator,

Synchronous motor and Three Phase Induction Motor.

UNIT III ANALOG ELECTRONICS 9

Resistor, Inductor and Capacitor in Electronic Circuits- Semiconductor Materials: Silicon &Germanium – PN Junction Diodes, Zener Diode –Characteristics Applications – Bipolar Junction Transistor-Biasing, JFET, SCR, MOSFET,IGBT – Types, I-V Characteristics and Applications, Rectifier and Inverters

UNIT IV DIGITAL ELECTRONICS 9

Review of number systems, binary codes, error detection and correction codes, Combinational logic - representation of logic functions-SOP and POS forms, K-map representations - minimization usingK maps (Simple Problems only).

UNIT V MEASUREMENTS AND INSTRUMENTATION 9

Functional elements of an instrument, Standards and calibration, Operating Principle, types - MovingCoil andMoving Iron meters, Measurement of three phase power, Energy Meter, Instrument Transformers-CT and PT, DSO- Block diagram- Data acquisition.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

After completing this course, the students will be able to

CO1: Compute the electric circuit parameters for simple problems

CO2: Explain the working principle and applications of electrical machines

CO3: Analyze the characteristics of analog electronic devices

CO4: Explain the basic concepts of digital electronics

CO5: Explain the operating principles of measuring instruments

TEXT BOOKS:

1. Kothari DP and I.J Nagrath, "Basic Electrical and Electronics Engineering", Second Edition, McGraw Hill Education, 2020
2. S.K.Bhattacharya "Basic Electrical and Electronics Engineering", Pearson Education, SecondEdition, 2017.
3. Sedha R.S., "A textbook book of Applied Electronics", S. Chand & Co., 2008
4. James A .Svoboda, Richard C. Dorf, "Dorf's Introduction to Electric Circuits", Wiley, 2018.
5. A.K. Sawhney, Puneet Sawhney 'A Course in Electrical & Electronic Measurements & Instrumentation', Dhanpat Rai and Co, 2015.

REFERENCES:

1. Kothari DP and I.J Nagrath, "Basic Electrical Engineering", Fourth Edition, McGraw Hill
2. Education, 2019.
3. Thomas L. Floyd, 'Digital Fundamentals', 11th Edition, Pearson Education, 2017.
4. 4. Albert Malvino, David Bates, 'Electronic Principles, McGraw Hill Education; 7th edition,2017.
5. Mahmood Nahvi and Joseph A. Edminister, "Electric Circuits", Schaum' Outline Series, McGrawHill, 2002.
6. H.S. Kalsi, 'Electronic Instrumentation', Tata McGraw-Hill, New Delhi, 2010

CO's-PO's & PSO's MAPPING

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	2	2	1	-	-	-	-	1	-	-	-	2	-	-	1
2	2	2	1	-	-	-	-	1	-	-	-	2	-	-	1
3	2	1	1	-	-	-	-	1	-	-	-	2	-	-	1
4	2	2	1	-	-	-	-	1	-	-	-	2	-	-	1
5	2	2	1	-	-	-	-	1	-	-	-	2	-	-	1
CO	2	1.8	1	-	-	-	-	1	-	-	-	2	-	-	1

1 - low, 2 - medium, 3 - high, '-' - no correlation

		L	T	P	C
21154S24	**ENGINEERING GRAPHICS**	**2**	**0**	**4**	**4**

COURSE OBJECTIVES:

The main learning objective of this course is to prepare the students for:

- Drawing engineering curves.
- Drawing a freehand sketch of simple objects.
- Drawing orthographic projection of solids and section of solids.
- Drawing development of solids
- Drawing isometric and perspective projections of simple solids.

CONCEPTS AND CONVENTIONS (Not for Examination)

Importance of graphics in engineering applications — Use of drafting instruments — BIS conventions and specifications — Size, layout and folding of drawing sheets — Lettering and dimensioning.

UNIT I PLANE CURVES 6+12

Basic Geometrical constructions, Curves used in engineering practices: Conics — Construction of ellipse, parabola and hyperbola by eccentricity method — Construction of cycloid — construction of involutes of square and circle — Drawing of tangents and normal to the above curves.

UNIT II PROJECTION OF POINTS, LINES AND PLANE SURFACE 6+12

Orthographic projection- principles-Principal planes-First angle projection-projection of points. Projection of straight lines (only First angle projections) inclined to both the principal planes - Determination of true lengths and true inclinations by rotating line method and traces. Projection of planes (polygonal and circular surfaces) inclined to both the principal planes by rotating object method.

UNIT III PROJECTION OF SOLIDS AND FREEHAND SKETCHING 6+12

Projection of simple solids like prisms, pyramids, cylinder, cone and truncated solids when the axis is inclined to one of the principal planes and parallel to the other by rotating object method. Visualization concepts and Free Hand sketching: Visualization principles —Representation of ThreeDimensional objects
— Layout of views- Freehand sketching of multiple views from pictorial views of objects.
Practicing three dimensional modeling of simple objects by CAD Software (Not for examination)

UNIT IV PROJECTION OF SECTIONED SOLIDS AND DEVELOPMENT OF SURFACES 6 +12

Sectioning of above solids in simple vertical position when the cutting plane is inclined to one of the principal planes and perpendicular to the other — obtaining true shape of section. Development of lateral surfaces of simple and sectioned solids — Prisms, pyramids cylinders and cones.
Practicing three dimensional modeling of simple objects by CAD Software (Not for examination)

UNIT V ISOMETRIC AND PERSPECTIVE PROJECTIONS 6+12

Principles of isometric projection — isometric scale — isometric projections of simple solids and truncated solids - Prisms, pyramids, cylinders, cones- combination of two solid objects in simplevertical positions - Perspective projection of simple solids - Prisms, pyramids and cylinders by visualray method.

Practicing three dimensional modeling of isometric projection of simple objects by CAD Software (Not for examination)

TOTAL: (L=30+P=60) 90 PERIODS

COURSE OUTCOMES:
On successful completion of this course, the student will be able to
CO1:UseBIS conventions and specifications for engineering drawing.CO2:Construct the conic curves, involutes and cycloid.
CO3:Solve practical problems involving projection of lines.
CO4:Draw the orthographic, isometric and perspective projections of simple solids.
CO5:Draw the development of simple solids.

TEXT BOOK:

1. Bhatt N.D. and Panchal V.M., "Engineering Drawing", Charotar Publishing House, 53rd Edition, 2019.
2. Natarajan K.V., "A Text Book of Engineering Graphics", Dhanalakshmi Publishers, Chennai,2018.
3. Parthasarathy, N. S. and Vela Murali, "Engineering Drawing", Oxford University Press, 2015

REFERENCES:

1. Basant Agarwal and Agarwal C.M., "Engineering Drawing", McGraw Hill, 2nd Edition, 2019.
2. Gopalakrishna K.R., "Engineering Drawing" (Vol. I&II combined), Subhas Publications, Bangalore, 27th Edition, 2017.
3. Luzzader, Warren.J. and Duff,John M., "Fundamentals of Engineering Drawing with an introduction to Interactive Computer Graphics for Design and Production, Eastern Economy Edition, Prentice Hall of India Pvt. Ltd, New Delhi, 2005.
4. Parthasarathy N. S. and Vela Murali, "Engineering Graphics", Oxford University, Press, NewDelhi, 2015.
5. Shah M.B., and Rana B.C., "Engineering Drawing", Pearson Education India, 2nd Edition, 2009.
6. Venugopal K. and Prabhu Raja V., "Engineering Graphics", New Age International (P) Limited, 2008.

Publication of Bureau of Indian Standards:

1. IS 10711 — 2001: Technical products Documentation — Size and layout of drawing sheets.
2. IS 9609 (Parts 0 & 1) — 2001: Technical products Documentation — Lettering.
3. IS 10714 (Part 20) — 2001 & SP 46 — 2003: Lines for technical drawings.
4. IS 11669 — 1986 & SP 46 —2003: Dimensioning of Technical Drawings.
5. IS 15021 (Parts 1 to 4) — 2001: Technical drawings — Projection Methods.

Special points applicable to University Examinations on Engineering Graphics:

1. There will be five questions, each of either or type covering all units of the syllabus.
2. All questions will carry equal marks of 20 each making a total of 100.
3. The answer paper shall consist of drawing sheets of A3 size only. The students will be permitted to use appropriate scale to fit a solution within A3 size.
4. The examination will be conducted in appropriate sessions on the same day

CO's-PO's & PSO's MAPPING

CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PO12	PSO 1	PSO 2	PSO 3
1	3	1	2	-	2	-	-	-	-	3	-	2	2	2	-
2	3	1	2	-	2	-	-	-	-	3	-	2	2	2	-
3	3	1	2	-	2	-	-	-	-	3	-	2	2	2	-
4	3	1	2	-	2	-	-	-	-	3	-	2	2	2	-
5	3	1	2	-	2	-	-	-	-	3	-	2	2	2	-
CO	3	1	2	-	2	-	-	-	-	3	-	2	2	2	-

1 - low, 2 - medium, 3 - high, '-' - no correlation

21150C26	PROGRAMMING IN C	L T P C
		3 0 0 3

COURSE OBJECTIVES:

- To understand the constructs of C Language.
- To develop C Programs using basic programming constructs
- To develop C programs using arrays and strings
- To develop modular applications in C using functions
- To develop applications in C using pointers and structures
- To do input/output and file handling in C

UNIT I BASICS OF C PROGRAMMING 9

Introduction to programming paradigms – Applications of C Language - Structure of C program - C programming: Data Types - Constants – Enumeration Constants - Keywords – Operators: Precedence and Associativity - Expressions - Input/Output statements, Assignment statements – Decision making statements - Switch statement - Looping statements – Preprocessor directives - Compilation process

UNIT II ARRAYS AND STRINGS 9

Introduction to Arrays: Declaration, Initialization – One dimensional array –Two dimensional arrays - String operations: length, compare, concatenate, copy – Selection sort, linear and binarysearch.

UNIT III FUNCTIONS AND POINTERS 9

Modular programming - Function prototype, function definition, function call, Built-in functions (string functions, math functions) – Recursion, Binary Search using recursive functions –Pointers – Pointer operators – Pointer arithmetic – Arrays and pointers – Array of pointers – Parameter passing: Pass by value, Pass by reference.

UNIT IV STRUCTURES AND UNION 9

Structure - Nested structures – Pointer and Structures – Array of structures – Self referential

structures – Dynamic memory allocation - Singly linked list – typedef – Union - Storage classes and Visibility.

UNIT V FILE PROCESSING 9

Files – Types of file processing: Sequential access, Random access – Sequential access file - Randomaccess file - Command line arguments.

COURSE OUTCOMES:

Upon completion of the course, the students will be able to

CO1:Demonstrate knowledge on C Programming constructs

CO2: Develop simple applications in C using basic constructs

CO3: Design and implement applications using arrays and strings

CO4: Develop and implement modular applications in C using functions.

CO5: Develop applications in C using structures and pointers.

CO6: Design applications using sequential and random access file processing.

TOTAL : 45 PERIODS

TEXT BOOKS:

1. ReemaThareja, "Programming in C", Oxford University Press, Second Edition, 2016.
2. Kernighan, B.W and Ritchie,D.M, "The C Programming language", Second Edition, Pearson Education, 2015.

REFERENCES:

1. Paul Deitel and Harvey Deitel, "C How to Program with an Introduction to C++", Eighth edition, Pearson Education, 2018.
2. Yashwant Kanetkar, Let us C, 17th Edition, BPB Publications, 2020.
3. Byron S. Gottfried, "Schaum's Outline of Theory and Problems of Programming with C", McGraw-Hill Education, 1996.
4. Pradip Dey, Manas Ghosh, "Computer Fundamentals and Programming in C", Second
5. Edition, Oxford University Press, 2013.
6. Anita Goel and Ajay Mittal, "Computer Fundamentals and Programming in C", 1st Edition, Pearson Education, 2013.

CO's-PO's & PSO's MAPPING

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	1	2	2	1	2	1	1	1	2	-	3	2	1	2	-
2	2	2	2	1	2	1	1	1	2	-	3	3	2	2	-
3	2	3	2	1	2	1	1	1	2	-	3	2	2	2	-
4	3	2	2	1	3	1	1	1	2	-	3	3	2	2	-
5	2	3	3	1	2	1	2	1	2	-	3	2	2	3	-
6	2	2	3	2	1	2	-	-	2	1	2	2	2	2	
CO	**2**	**2**	**2**	**1**	**2**	**1**	**1**	**1**	**2**	**-**	**3**	**2**	**2**	**2**	**-**

1 - low, 2 - medium, 3 - high, '-' - no correlation

21154L21 ENGINEERING PRACTICES LABORATORY **L T P C**
0 0 4 2

COURSE OBJECTIVES:

The main learning objective of this course is to provide hands on training to thestudents in:

1. Drawing pipe line plan; laying and connecting various pipe fittings used in common household plumbing work; Sawing; planing; making joints in wood materials used in commonhousehold wood work.
2. Wiring various electrical joints in common household electrical wire work.
3. Welding various joints in steel plates using arc welding work; Machining various simple processes like turning, drilling, tapping in parts; Assembling simple mechanicalassembly of common household equipments; Making a tray out of metal sheet usingsheet metal work.
4. Soldering and testing simple electronic circuits; Assembling and testing simple electronic components on PCB.

GROUP – A (CIVIL & ELECTRICAL)

PART I CIVIL ENGINEERING PRACTICES 15

PLUMBING WORK:

a) Connecting various basic pipe fittings like valves, taps, coupling, unions, reducers,elbows and other components which are commonly used in household.
b) Preparing plumbing line sketches.
c) Laying pipe connection to the suction side of a pump
d) Laying pipe connection to the delivery side of a pump.
e) Connecting pipes of different materials: Metal, plastic and flexible pipesused inhousehold appliances.

WOOD WORK:

a) Sawing,
b) Planing and
c) Making joints like T-Joint, Mortise joint and Tenon joint and Dovetail joint.

Wood Work Study:

a) Studying joints in door panels and wooden furniture
b) Studying common industrial trusses using models.

PART II ELECTRICAL ENGINEERING PRACTICES 15

a) Introduction to switches, fuses, indicators and lamps - Basic switch boardwiring with lamp, fan and three pin socket
b) Staircase wiring
c) Fluorescent Lamp wiring with introduction to CFL and LED types.
d) Energy meter wiring and related calculations/ calibration
e) Study of Iron Box wiring and assembly
f) Study of Fan Regulator (Resistor type and Electronic type using Diac/Triac/quadrac)
g) Study of emergency lamp wiring/Water heater

GROUP – B (MECHANICAL AND ELECTRONICS)

PART III MECHANICAL ENGINEERING PRACTICES 15

WELDING WORK:

a) Welding of Butt Joints, Lap Joints, and Tee Joints using arc welding.
b) Practicing gas welding.

BASIC MACHINING WORK:

a) (simple)Turning.
b) (simple)Drilling.
c) (simple)Tapping.

ASSEMBLY WORK:

a) Assembling a centrifugal pump.
b) Assembling a household mixer.
c) Assembling an airconditioner.

SHEET METAL WORK:

a) Making of a square tray

FOUNDRY WORK:

a) Demonstrating basic foundry operations.

PART IV ELECTRONIC ENGINEERING PRACTICES 15

SOLDERING WORK:

a) Soldering simple electronic circuits and checking continuity.

ELECTRONIC ASSEMBLY AND TESTING WORK:

a) Assembling and testing electronic components on a small PCB.

ELECTRONIC EQUIPMENT STUDY:

a) Study an elements of smart phone..

b) Assembly and dismantle of LED TV.

c) Assembly and dismantle of computer/ laptop

TOTAL : 60 PERIODS

COURSE OUTCOMES:

Upon completion of this course, the students will be able to:

CO1:Draw pipe line plan; lay and connect various pipe fittings used in common household plumbingwork; Saw; plan; make joints in wood materials used in common household wood work.
CO2:Wire various electrical joints in common household electrical wire work.
CO3:Weld various joints in steel plates using arc welding work; Machine various simple processes like turning, drilling, tapping in parts; Assemble simple mechanical assembly of common householdequipments; Make a tray out of metal sheet using sheet metal work.
CO4:Solder and test simple electronic circuits; Assemble and test simple electronic components onPCB.

CO's-PO's & PSO's MAPPING

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	2	-	-	1	1	1	-	-	-	-	2	2	1	1
2	3	2	-	-	1	1	1	-	-	-	-	2	2	1	1
3	3	2	-	-	1	1	1	-	-	-	-	2	2	1	1
CO	3	2	-	-	1	1	1	-	-	-	-	2	2	1	1

1 - low, 2 - medium, 3 - high, '-' - no correlation

21150L22 PROGRAMMING IN C LABORATORY L T P C
0 0 4 2

COURSE OBJECTIVES:

- To familiarise with C programming constructs.
- To develop programs in C using basic constructs.
- To develop programs in C using arrays.
- To develop applications in C using strings, pointers, functions.
- To develop applications in C using structures.
- To develop applications in C using file processing.

LIST OF EXPERIMENTS:

Note: The lab instructor is expected to design problems based on the topics listed. TheExamination shall not be restricted to the sample experiments designed.

1. I/O statements, operators, expressions
2. decision-making constructs: if-else, goto, switch-case, break-continue
3. Loops: for, while, do-while
4. Arrays: 1D and 2D, Multi-dimensional arrays, traversal
5. Strings: operations
6. Functions: call, return, passing parameters by (value, reference), passing arrays to function.
7. Recursion
8. Pointers: Pointers to functions, Arrays,Strings, Pointers to Pointers, Array of Pointers
9. Structures: Nested Structures, Pointers to Structures, Arrays of Structures and Unions.
10. Files: reading and writing, File pointers, file operations, random access, processor directives.

TOTAL: 60 PERIODS

COURSE OUTCOMES:

Upon completion of the course, the students will be able to CO1:
Demonstrate knowledge on C programming constructs.**CO2:**
Develop programs in C using basic constructs.

CO3: Develop programs in C using arrays.
CO4: Develop applications in C using strings, pointers, functions.
CO5: Develop applications in C using structures.
CO6: Develop applications in C using file processing.

TEXT BOOKS:

1. ReemaThareja, “Programming in C”, Oxford University Press, Second Edition, 2016.
2. Kernighan, B.W and Ritchie,D.M, “The C Programming language”, Second Edition, Pearson Education, 2015.

REFERENCES:

1. Paul Deitel and Harvey Deitel, “C How to Program with an Introduction to C++”, Eighth edition, Pearson Education, 2018.
2. Yashwant Kanetkar, Let us C, 17th Edition, BPB Publications, 2020.
3. Byron S. Gottfried, "Schaum's Outline of Theory and Problems of Programming with C", McGraw-Hill Education, 1996.
4. Pradip Dey, Manas Ghosh, “Computer Fundamentals and Programming in C”, Second
5. Edition, Oxford University Press, 2013.
6. Anita Goel and Ajay Mittal, “Computer Fundamentals and Programming in C”, 1st Edition, Pearson Education, 2013.

CO’s-PO’s & PSO’s MAPPING

CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2	PSO 1	PSO 2	PSO3
1	1	3	3	1	1	1	-	-	2	1	2	2	2	2	
2	2	3	3	2	1	1	-	-	2	1	2	2	2	3	
3	2	2	2	1	1	2	-	-	2	-	2	2	2	2	
4	2	2	2	2	1	2	-	-	3	-	3	3	3	2	
5	2	2	3	2	3	2	-	-	3	-	3	3	3	3	
6	2	2	3	2	1	2	-	-	2	1	2	2	2	2	
Avg	2	2	3	2	1	2	-	-	2	1	2	2	2	2	

1 - low, 2 - medium, 3 - high, ‘-' - no correlation

21147L23 COMMUNICATION LABORATORY L T P C
0 0 4 2

COURSE OBJECTIVES

- **To identify varied group discussion skills and apply them to take part in effective discussionsin aprofessional context.**
- **To analyse concepts and problems and make effective presentations explaining them clearlyand precisely.**
- **To be able to communicate effectively through formal and informal writing.**
- **To be able to use appropriate language structures to write emails, reports and**
- **essaysTo give instructions and recommendations that are clear and relevant to the context**

UNIT I 12

Speaking-Role Play Exercises Based on Workplace Contexts, - talking about competition- discussing progress toward goals-talking about experiences- talking about events in life- discussingpast events- Writing: writing emails (formal & semi-formal).

UNIT II 12

Speaking: discussing news stories-talking about frequency-talking about travel problems- discussing travel procedures- talking about travel problems- making arrangements-describing

arrangements-discussing plans and decisions- discussing purposes and reasons- understanding common technology terms-Writing: - writing different types of emails.

UNIT III **12**

Speaking: discussing predictions-describing the climate-discussing forecasts and scenarios- talking about purchasing-discussing advantages and disadvantages- making comparisons- discussing likes and dislikes- discussing feelings about experiences-discussing imaginary scenarios Writing: short essays and reports- formal/semi-formal letters.

UNIT IV **12**

Speaking: discussing the natural environment-describing systems-describing position and movement-explaining rules-(example- discussing rental arrangements)- understanding technical instructions-Writing: writing instructions-writing a short article.

UNIT V **12**

Speaking: describing things relatively-describing clothing-discussing safety issues (making recommendations) talking about electrical devices-describing controlling actions- Writing:
job application(Cover letter + Curriculum vitae)-writing recommendations.

TOTAL: 60 PERIODS

COURSE OUTCOMES

CO1:Speak effectively in group discussions held in ~~a~~ formal/semi formal contexts.

CO2:Discuss, analyse and present concepts and problems from various perspectives to arrive atsuitablesolutions

CO3:Write emails, letters and effective job applications.

CO4:Write critical reports to convey data and information with clarity and precision

CO5:Give appropriate instructions and recommendations for safe execution of tasks

Assessment Pattern

- **One online / app based assessment to test speaking and writing skills**
- **Proficiency certification is given on successful completion of speaking and writing.**

CO's-PO's & PSO's MAPPING

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	2	3	3	3	1	3	3	3	3	3	3	3	-	-	-
2	2	3	3	3	1	3	3	3	3	3	3	3	-	-	-
3	2	2	3	3	1	3	3	3	3	3	3	3	-	-	-
4	3	3	3	3	3	3	3	3	3	3	3	3	-	-	-
5	3	3	3	3	3	3	3	3	3	3	3	3	-	-	-
AVg.	**2.4**	**2.8**	**3**	**3**	**1.8**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**-**	**-**	**-**

1 - low, 2 - medium, 3 - high, '-' - no correlation

Note: The average value of this course to be used for program articulation matrix.

21148S31A **DISCRETE MATHEMATICS** **L T P C**
3 1 0 4

COURSE OBJECTIVES:

- To extend student's logical and mathematical maturity and ability to deal with abstraction.
- To introduce most of the basic terminologies used in computer science courses and application of ideas to solve practical problems.
- To understand the basic concepts of combinatorics and graph theory.
- To familiarize the applications of algebraic structures.
- To understand the concepts and significance of lattices and boolean algebra which are

widely used in computer science and engineering.

UNIT I LOGIC AND PROOFS 9+3

Propositional logic – Propositional equivalences - Predicates and quantifiers – Nested quantifiers – Rules of inference - Introduction to proofs – Proof methods and strategy.

UNIT II COMBINATORICS 9+3

Mathematical induction – Strong induction and well ordering – The basics of counting – The pigeonhole principle – Permutations and combinations – Recurrence relations – Solving linear recurrence relations – Generating functions – Inclusion and exclusion principle and its applications.

UNIT III GRAPHS 9+3

Graphs and graph models – Graph terminology and special types of graphs – Matrix representation of graphs and graph isomorphism – Connectivity – Euler and Hamilton paths.

UNIT IV ALGEBRAIC STRUCTURES 9+3

Algebraic systems – Semi groups and monoids - Groups – Subgroups – Homomorphism's – Normal subgroup and cosets – Lagrange's theorem – Definitions and examples of Rings and Fields.

UNIT V LATTICES AND BOOLEAN ALGEBRA 9+3

Partial ordering – Posets – Lattices as posets – Properties of lattices - Lattices as algebraic systems – Sub lattices – Direct product and homomorphism – Some special lattices – Boolean algebra – Sub Boolean Algebra – Boolean Homomorphism.

TOTAL: 60 PERIODS

COURSE OUTCOMES:

At the end of the course, students would :

CO1:Have knowledge of the concepts needed to test the logic of a program.

CO2:Have an understanding in identifying structures on many levels.

CO3:Be aware of a class of functions which transform a finite set into another finite set whichrelatesto input and output functions in computer science.

CO4:Be aware of the counting principles.

CO5:Be exposed to concepts and properties of algebraic structures such as groups, rings andfields.

TEXT BOOKS:

1. Rosen. K.H., "Discrete Mathematics and its Applications", 7th Edition, Tata McGrawHill Pub. Co. Ltd., New Delhi, Special Indian Edition, 2017.
2. Tremblay. J.P. and Manohar. R, "Discrete Mathematical Structures with Applications to Computer Science", Tata McGraw Hill Pub. Co. Ltd, New Delhi, 30th Reprint, 2011.

REFERENCES:

1. Grimaldi. R.P. "Discrete and Combinatorial Mathematics: An Applied Introduction", 5thEdition, Pearson Education Asia, Delhi, 2013.
2. Koshy. T. "Discrete Mathematics with Applications", Elsevier Publications, 2006.
3. Lipschutz. S. and Mark Lipson., "Discrete Mathematics", Schaum's Outlines, Tata McGrawHill Pub. Co. Ltd., New Delhi, 3rd Edition, 2010.

CO's-PO's & PSO's MAPPING

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	3	2	-	-	-	-	-	-	-	-	2	-	-	-
2	3	3	-	-	-	-	-	-	-	-	-	-	-	-	-
3	-	3	2	-	-	2	-	-	-	3	-	-	-	-	-
4	-	2	2	2	-	-	-	-	-	-	-	-	-	-	-
5	-	2	2	2	-	-	-	-	-	2	-	-	-	-	-
AVg.	**1**	**3**	**2**	**1**	**-**	**-**	**-**	**-**	**-**	**1**	**-**	**-**	**-**	**-**	**-**

1 - low, 2 - medium, 3 - high, '-' - no correlation

21150C32 DIGITAL PRINCIPLES AND COMPUTER ORGANIZATION

L T P C
3 0 2 4

COURSE OBJECTIVES:

- To analyze and design combinational circuits.
- To analyze and design sequential circuits
- To understand the basic structure and operation of a digital computer.
- To study the design of data path unit, control unit for processor and to familiarize with the hazards.
- To understand the concept of various memories and I/O interfacing.

UNIT I COMBINATIONAL LOGIC 9

Combinational Circuits – Karnaugh Map - Analysis and Design Procedures – Binary Adder – Subtractor – Decimal Adder - Magnitude Comparator – Decoder – Encoder – Multiplexers - Demultiplexers

UNIT II SYNCHRONOUS SEQUENTIAL LOGIC 9

Introduction to Sequential Circuits – Flip-Flops – operation and excitation tables, Triggering of FF, Analysis and design of clocked sequential circuits – Design – Moore/Mealy models, state minimization, state assignment, circuit implementation - Registers – Counters.

UNIT III COMPUTER FUNDAMENTALS 9

Functional Units of a Digital Computer: Von Neumann Architecture – Operation and Operands of Computer Hardware Instruction – Instruction Set Architecture (ISA): Memory Location, Address and Operation – Instruction and Instruction Sequencing – Addressing Modes, Encoding of MachineInstruction
– Interaction between Assembly and High Level Language.

UNIT IV PROCESSOR 9

Instruction Execution – Building a Data Path – Designing a Control Unit – Hardwired Control, Microprogrammed Control – Pipelining – Data Hazard – Control Hazards.

UNIT V MEMORY AND I/O 9

Memory Concepts and Hierarchy – Memory Management – Cache Memories: Mapping and Replacement Techniques – Virtual Memory – DMA – I/O – Accessing I/O: Parallel and Serial Interface – Interrupt I/O – Interconnection Standards: USB, SATA

45 PERIODS

PRACTICAL EXERCISES: 30 PERIODS

1. Verification of Boolean theorems using logic gates.
2. Design and implementation of combinational circuits using gates for arbitrary functions.
3. Implementation of 4-bit binary adder/subtractor circuits.

4. Implementation of code converters.
5. Implementation of BCD adder, encoder and decoder circuits
6. Implementation of functions using Multiplexers.
7. Implementation of the synchronous counters
8. Implementation of a Universal Shift register.
9. Simulator based study of Computer Architecture

COURSE OUTCOMES:

At the end of this course, the students will be able to:

CO1 : Design various combinational digital circuits using logic gates

CO2 : Design sequential circuits and analyze the design procedures

CO3 : State the fundamentals of computer systems and analyze the execution of an instruction

CO4 : Analyze different types of control design and identify hazards

CO5 : Identify the characteristics of various memory systems and I/O communication

TOTAL: 75 PERIODS

TEXT BOOKS:

1. M. Morris Mano, Michael D. Ciletti, "Digital Design : With an Introduction to the Verilog HDL, VHDL, and System Verilog", Sixth Edition, Pearson Education, 2018.
2. David A. Patterson, John L. Hennessy, "Computer Organization and Design, The Hardware/Software Interface", Sixth Edition, Morgan Kaufmann/Elsevier, 2020.

REFERENCES:

1. Carl Hamacher, Zvonko Vranesic, Safwat Zaky, Naraig Manjikian, "Computer Organization and Embedded Systems", Sixth Edition, Tata McGraw-Hill, 2012.
2. William Stallings, "Computer Organization and Architecture – Designing for Performance",Tenth Edition, Pearson Education, 2016.
3. M. Morris Mano, "Digital Logic and Computer Design", Pearson Education, 2016.

CO's-PO's & PSO's MAPPING

CO's	PO's												PSO's		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	3	3	3	3	3	2	1	1	1	1	2	3	2	3	3
2	3	3	3	3	2	1	1	1	1	1	2	3	1	2	2
3	3	3	3	3	2	2	1	1	1	1	2	3	2	3	1
4	3	3	3	3	1	1	1	1	1	1	1	2	1	3	1
5	3	3	3	3	1	2	1	1	1	1	1	2	1	2	1
AVg.	3	3	3	3	1.8	1.6	1	1	1	1	1.6	2.6	1.4	2.6	1.6

1 - low, 2 - medium, 3 - high, '-"- no correlation

21150C35 **FOUNDATIONS OF DATA SCIENCE** **L T P C**

3 0 0 3

COURSE OBJECTIVES:

- To understand the data science fundamentals and process.
- To learn to describe the data for the data science process.
- To learn to describe the relationship between data.
- To utilize the Python libraries for Data Wrangling.
- To present and interpret data using visualization libraries in Python

UNIT I INTRODUCTION 9

Data Science: Benefits and uses – facets of data - Data Science Process: Overview – Definingresearch goals – Retrieving data – Data preparation - Exploratory Data analysis – build the model– presenting findings and building applications - Data Mining - Data Warehousing – Basic Statistical descriptions of Data

UNIT II DESCRIBING DATA 9

Types of Data - Types of Variables -Describing Data with Tables and Graphs –Describing Data with Averages - Describing Variability - Normal Distributions and Standard (z) Scores

UNIT III DESCRIBING RELATIONSHIPS 9

Correlation –Scatter plots –correlation coefficient for quantitative data –computational formula for correlation coefficient – Regression –regression line –least squares regression line – Standard error of estimate – interpretation of r2 –multiple regression equations –regression towards the mean

UNIT IV PYTHON LIBRARIES FOR DATA WRANGLING 9

Basics of Numpy arrays –aggregations –computations on arrays –comparisons, masks, booleanlogic – fancy indexing – structured arrays – Data manipulation with Pandas – data indexing and selection – operating on data – missing data – Hierarchical indexing – combining datasets –aggregation and grouping – pivot tables

UNIT V DATA VISUALIZATION 9

Importing Matplotlib – Line plots – Scatter plots – visualizing errors – density and contour plots – Histograms – legends – colors – subplots – text and annotation – customization – three dimensional plotting - Geographic Data with Basemap - Visualization with Seaborn.

COURSE OUTCOMES:

At the end of this course, the students will be able to:CO1:
Define the data science process
CO2: Understand different types of data description for data science process
CO3: Gain knowledge on relationships between data
CO4: Use the Python Libraries for Data Wrangling
CO5: Apply visualization Libraries in Python to interpret and explore data

TOTAL:45 PERIODS

TEXT BOOKS

1. David Cielen, Arno D. B. Meysman, and Mohamed Ali, “Introducing Data Science”, Manning Publications, 2016. (Unit I)
2. Robert S. Witte and John S. Witte, “Statistics”, Eleventh Edition, Wiley Publications, 2017.(Units II and III)

3. Jake VanderPlas, “Python Data Science Handbook”, O’Reilly, 2016. (Units IV and V)

REFERENCES:

1. **Allen B. Downey, “Think Stats: Exploratory Data Analysis in Python”, Green Tea Press,2014.**

CO’s-PO’s & PSO’s MAPPING

CO’s	PO’s												PSO’s		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	2	2	1	2	2	-	-	-	1	1	1	2	2	2	2
2	2	1	-	1	1	-	-	-	2	1	1	2	2	3	1
3	2	2	1	2	2	1	1	-	1	2	1	3	2	2	3
4	3	2	2	1	2	-	-	-	1	1	2	2	3	3	2
5	2	2	1	2	2	-	-	-	1	1	1	2	2	2	2
AVg.	2	2	1	2	2	1	1	-	1	1	1	2	2	2	2

1 - low, 2 - medium, 3 - high, ‘-“- no correlation

21150C33 DATA STRUCTURES L T P C
3 0 0 3

COURSE OBJECTIVES:

- To understand the concepts of ADTs.
- To Learn linear data structures – lists, stacks, and queues.
- To understand non-linear data structures – trees and graphs.
- To understand sorting, searching and hashing algorithms.
- To apply Tree and Graph structures.

UNIT I LISTS 9

Abstract Data Types (ADTs) – List ADT – Array-based implementation – Linked list implementation – Singly linked lists – Circularly linked lists – Doubly-linked lists – Applications of lists – Polynomial ADT – Radix Sort – Multilists.

UNIT II STACKS AND QUEUES 9

Stack ADT – Operations – Applications – Balancing Symbols – Evaluating arithmetic expressions- Infix to Postfix conversion – Function Calls – Queue ADT – Operations – Circular Queue – DeQueue – Applications of Queues.

UNIT III TREES 9

Tree ADT – Tree Traversals - Binary Tree ADT – Expression trees – Binary Search Tree ADT – AVL Trees – Priority Queue (Heaps) – Binary Heap.

UNIT IV MULTIWAY SEARCH TREES AND GRAPHS 9

B-Tree – B+ Tree – Graph Definition – Representation of Graphs – Types of Graph - Breadth-first traversal – Depth-first traversal — Bi-connectivity – Euler circuits – Topological Sort – Dijkstra's algorithm – Minimum Spanning Tree – Prim's algorithm – Kruskal's algorithm

UNIT V SEARCHING, SORTING AND HASHING TECHNIQUES 9

Searching – Linear Search – Binary Search. Sorting – Bubble sort – Selection sort – Insertionsort –Shell sort –. Merge Sort – Hashing – Hash Functions – Separate Chaining – Open Addressing – Rehashing – Extendible Hashing.

COURSE OUTCOMES:

At the end of this course, the students will be able to:

CO1: Define linear and non-linear data structures.

CO2: Implement linear and non–linear data structure operations.

CO3: Use appropriate linear/non–linear data structure operations for solving a given problem.

CO4: Apply appropriate graph algorithms for graph applications.

CO5: Analyze the various searching and sorting algorithms.

TOTAL:45 PERIODS

TEXT BOOKS

1. Mark Allen Weiss, Data Structures and Algorithm Analysis in C, 2nd Edition, Pearson Education, 2005.
2. Kamthane, Introduction to Data Structures in C, 1st Edition, Pearson Education, 2007

REFERENCES

1. Langsam, Augenstein and Tanenbaum, Data Structures Using C and C++, 2nd Edition,Pearson Education, 2015.
2. Thomas H. Cormen, Charles E. Leiserson, Ronald L.Rivest, Clifford Stein, Introduction to Algorithms", Fourth Edition, Mcgraw Hill/ MIT Press, 2022.
3. Alfred V. Aho, Jeffrey D. Ullman,John E. Hopcroft ,Data Structures and Algorithms, 1st edition, Pearson, 2002.
4. Kruse, Data Structures and Program Design in C, 2nd Edition, Pearson Education, 2006.

CO's-PO's & PSO's MAPPING

CO's	PO's												PSO's		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	2	3	1	2	2	1	1	-	1	2	1	3	2	1	3
2	1	2	1	2	2	-	-	-	1	1	1	2	2	2	2
3	2	3	1	2	3	-	-	-	1	1	1	2	2	1	2
4	2	1	-	1	1	-	-	-	2	1	1	2	2	3	1
5	1	2	1	2	2	1	1	-	1	2	1	3	2	2	3
AVg.	2	2	1	2	2	1	1	-	1	1	1	2	2	2	2

1 - low, 2 - medium, 3 - high, '-"- no correlation

21150C34 OBJECT ORIENTED PROGRAMMING L T P C
3 0 0 3

COURSE OBJECTIVES:

- To understand Object Oriented Programming concepts and basics of Java programminglanguage
- To know the principles of packages, inheritance and interfaces
- To develop a java application with threads and generics classes
- To define exceptions and use I/O streams
- To design and build Graphical User Interface Application using JAVAFX

UNIT I INTRODUCTION TO OOP AND JAVA 9

Overview of OOP – Object oriented programming paradigms – Features of Object Oriented Programming – Java Buzzwords – Overview of Java – Data Types, Variables and Arrays – Operators – Control Statements – Programming Structures in Java – Defining classes in Java – Constructors-Methods -Access specifiers - Static members- Java Doc comments

UNIT II INHERITANCE, PACKAGES AND INTERFACES 9

Overloading Methods – Objects as Parameters – Returning Objects –Static, Nested and Inner Classes. Inheritance: Basics– Types of Inheritance -Super keyword -Method Overriding – Dynamic Method Dispatch
–Abstract Classes – final with Inheritance. Packages and Interfaces: Packages – Packages and Member Access –Importing Packages – Interfaces.

UNIT III EXCEPTION HANDLING AND MULTITHREADING 9

Exception Handling basics – Multiple catch Clauses – Nested try Statements – Java's Built-in Exceptions – User defined Exception. Multithreaded Programming: Java Thread Model–Creating a Thread and Multiple Threads – Priorities – Synchronization – Inter Thread Communication-Suspending – Resuming, and Stopping Threads –Multithreading. Wrappers – Auto boxing.

UNIT IV I/O, GENERICS, STRING HANDLING 9

I/O Basics – Reading and Writing Console I/O – Reading and Writing Files. Generics: Generic Programming – Generic classes – Generic Methods – Bounded Types – Restrictions and Limitations. Strings: Basic String class, methods and String Buffer Class.

UNIT V JAVAFX EVENT HANDLING, CONTROLS AND COMPONENTS 9

JAVAFX Events and Controls: Event Basics – Handling Key and Mouse Events. Controls: Checkbox, ToggleButton – RadioButtons – ListView – ComboBox – ChoiceBox – Text Controls – ScrollPane. Layouts – FlowPane – HBox and VBox – BorderPane – StackPane – GridPane. Menus – Basics – Menu – Menu bars – MenuItem.

COURSE OUTCOMES:

On completion of this course, the students will be able to
CO1:Apply the concepts of classes and objects to solve simple problems
CO2:Develop programs using inheritance, packages and interfaces
CO3:Make use of exception handling mechanisms and multithreaded model to solve real worldproblemsCO4:Build Java applications with I/O packages, string classes, Collections and generics concepts CO5:Integrate the concepts of event handling and JavaFX components and controls for developingGUI based applications

TOTAL:45 PERIODS

TEXT BOOKS:

1. Herbert Schildt, "Java: The Complete Reference", 11 th Edition, McGraw Hill Education, NewDelhi, 2019
2. Herbert Schildt, "Introducing JavaFX 8 Programming", 1 st Edition, McGraw Hill Education, NewDelhi, 2015

REFERENCE:

1. Cay S. Horstmann, "Core Java Fundamentals", Volume 1, 11 th Edition, Prentice Hall,2018.

CO's-PO's & PSO's MAPPING

CO's	PO's												PSO's		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	1	1	3	1	3	-	-	-	3	2	2	2	3	1	2
2	2	1	3	2	1	-	-	-	2	1	1	3	3	3	2
3	3	3	1	2	2	-	-	-	3	2	1	2	3	1	3
4	3	1	2	2	2	-	-	-	1	2	1	3	3	1	1
5	1	1	2	3	2	-	-	-	3	2	1	2	3	3	3
AVg.	2	1	2	2	2	-	-	-	2	2	1	2	3	2	2

1 - low, 2 - medium, 3 - high, '-"- no correlation

21150L36 DATA STRUCTURES LABORATORY L T P C
0 0 3 1.5

COURSE OBJECTIVES:

- To demonstrate array implementation of linear data structure algorithms.
- To implement the applications using Stack.
- To implement the applications using Linked list
- To implement Binary search tree and AVL tree algorithms.
- To implement the Heap algorithm.
- To implement Dijkstra's algorithm.
- To implement Prim's algorithm
- To implement Sorting, Searching and Hashing algorithms.

LIST OF EXERCISES:

1. Array implementation of Stack, Queue and Circular Queue ADTs
2. Implementation of Singly Linked List
3. Linked list implementation of Stack and Linear Queue ADTs
4. Implementation of Polynomial Manipulation using Linked list
5. Implementation of Evaluating Postfix Expressions, Infix to Postfix conversion
6. Implementation of Binary Search Trees
7. Implementation of AVL Trees
8. Implementation of Heaps using Priority Queues
9. Implementation of Dijkstra's Algorithm
10. Implementation of Prim's Algorithm
11. Implementation of Linear Search and Binary Search
12. Implementation of Insertion Sort and Selection Sort
13. Implementation of Merge Sort
14. Implementation of Open Addressing (Linear Probing and Quadratic Probing)

TOTAL:45 PERIODS

COURSE OUTCOMES:

At the end of this course, the students will be able to:

CO1: Implement Linear data structure algorithms.
CO2: Implement applications using Stacks and Linked lists
CO3:Implement Binary Search tree and AVL tree operations.CO4: Implement graph algorithms.
CO5: Analyze the various searching and sorting algorithms.

CO's-PO's & PSO's MAPPING

CO's	PO's												PSO's		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	1	2	2	1	-	-	-	-	2	1	2	2	2	2	3
2	3	3	1	1	-	-	-	-	1	1	1	3	1	2	2
3	2	1	3	1	-	-	-	-	1	1	2	3	3	3	3
4	3	1	3	3	-	-	-	-	1	2	3	3	2	1	2
5	3	2	1	1	2	-	-	-	3	3	3	1	3	1	3
AVg.	2	2	2	1	2	-	-	-	2	2	2	2	2	2	3

1 - low, 2 - medium, 3 - high, '-"- no correlation

21150L37 OBJECT ORIENTED PROGRAMMING LABORATORY

L T P C
0 0 3 1.5

COURSE OBJECTIVES:

- To build software development skills using java programming for real-world applications.
- To understand and apply the concepts of classes, packages, interfaces, inheritance,exception handling and file processing.
- To develop applications using generic programming and event handling

LIST OF EXPERIMENTS:

1. Solve problems by using sequential search, binary search, and quadratic sorting algorithms (selection, insertion)
2. Develop stack and queue data structures using classes and objects.
3. Develop a java application with an Employee class with Emp_name, Emp_id, Address, Mail_id, Mobile_no as members. Inherit the classes, Programmer, Assistant Professor, Associate Professor and Professor from employee class. Add Basic Pay (BP) as the member of all the inherited classes with 97% of BP as DA, 10 % of BP as HRA, 12% of

   BP as PF, 0.1% of BP for staff club funds. Generate pay slips for the employees with their gross and net salary.
4. Write a Java Program to create an abstract class named Shape that contains two integers and an empty method named printArea(). Provide three classes named Rectangle, Triangleand Circle such that each one of the classes extends the class Shape. Each one of the classes contains only the method printArea( ) that prints the area of the given shape.
5. Solve the above problem using an interface.
6. Implement exception handling and creation of user defined exceptions.
7. Write a java program that implements a multi-threaded application that has three threads. First thread generates a random integer every 1 second and if the value is even, the second thread computes the square of the number and prints. If the value is odd, the third thread will print the valueof the cube of the number.
8. Write a program to perform file operations.
9. Develop applications to demonstrate the features of generics classes.
10. Develop applications using JavaFX controls, layouts and menus.
11. Develop a mini project for any application using Java concepts.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

On completion of this course, the students will be able to

CO1 : Design and develop java programs using object oriented programming concepts

CO2 : Develop simple applications using object oriented concepts such as package, exceptions

CO3: Implement multithreading, and generics concepts

CO4 : Create GUIs and event driven programming applications for real world problems

CO5: Implement and deploy web applications using Java

CO's-PO's & PSO's MAPPING

CO's	PO's												PSO's		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	2	1	2	1	-	-	-	-	1	2	2	2	1	2	3
2	2	1	3	1	-	-	-	-	2	3	3	2	1	3	1
3	2	2	1	2	1	-	-	-	1	2	1	3	2	3	2
4	2	2	1	3	-	-	-	-	3	1	1	1	2	1	2
5	1	3	3	1	3	-	-	-	1	1	1	1	2	1	2
AVg.	2	2	2	2	2	-	-	-	2	2	2	2	2	2	2

1 - low, 2 - medium, 3 - high, '-"- no correlation

21150L38 DATA SCIENCE LABORATORY L T P C

0 0 4 2

COURSE OBJECTIVES:

- To understand the python libraries for data science
- To understand the basic Statistical and Probability measures for data science.
- To learn descriptive analytics on the benchmark data sets.
- To apply correlation and regression analytics on standard data sets.
- To present and interpret data using visualization packages in Python.

LIST OF EXPERIMENTS:

1. Download, install and explore the features of NumPy, SciPy, Jupyter, Statsmodels andPandas packages.
2. Working with Numpy arrays
3. Working with Pandas data frames
4. Reading data from text files, Excel and the web and exploring various commands for doing descriptive analytics on the Iris data set.
5. Use the diabetes data set from UCI and Pima Indians Diabetes data set for performing the following:
    a. Univariate analysis: Frequency, Mean, Median, Mode, Variance, Standard Deviation, Skewness and Kurtosis.
    b. Bivariate analysis: Linear and logistic regression modeling
    c. Multiple Regression analysis
    d. Also compare the results of the above analysis for the two data sets.
6. Apply and explore various plotting functions on UCI data sets.
    a. Normal curves
    b. Density and contour plots
    c. Correlation and scatter plots
    d. Histograms
    e. Three dimensional plotting
7. Visualizing Geographic Data with Basemap

TOTAL: 60 PERIODS

COURSE OUTCOMES:

At the end of this course, the students will be able to: CO1: Make use of the python libraries for data science

CO2: Make use of the basic Statistical and Probability measures for data science.

CO3: Perform descriptive analytics on the benchmark data sets.

CO4: Perform correlation and regression analytics on standard data sets

CO5: Present and interpret data using visualization packages in Python.

CO's-PO's & PSO's MAPPING

CO's	PO's												PSO's		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	3	2	1	1	-	-	-	-	1	3	3	3	1	3	2
2	3	2	2	3	1	-	-	-	3	1	3	2	1	3	3
3	3	2	1	3	1	-	-	-	2	1	1	1	3	2	3
4	2	3	1	3	-	-	-	-	2	3	2	3	3	3	1
5	1	2	3	1	1	-	-	-	2	1	3	1	1	3	3
AVg.	2	2	2	2	1	-	-	-	2	2	2	2	2	3	2

1 - low, 2 - medium, 3 - high, '-"- no correlation

21150L39 PROFESSIONAL DEVELOPMENT L T P C
0 0 2 1

COURSE OBJECTIVES:

To be proficient in important Microsoft Office tools: MS WORD, EXCEL, POWERPOINT.

- To be proficient in using MS WORD to create quality technical documents, by using standard templates, widely acceptable styles and formats, variety of features to enhance the presentability and overall utility value of content.
- To be proficient in using MS EXCEL for all data manipulation tasks including the common statistical, logical, mathematical etc., operations, conversion, analytics, search and explore, visualize,interlink, and utilizing many more critical features offered
- To be able to create and share quality presentations by using the features of MS PowerPoint,including: organization of content, presentability, aesthetics, using media elements and enhance the overall quality of presentations.

MS WORD: 10 Hours

Create and format a

documentWorking with

tables

Working with Bullets and Lists

Working with styles, shapes, smart art, charts

Inserting objects, charts and importing objects from other office

toolsCreating and Using document templates

Inserting equations, symbols and special characters

Working with Table of contents and References, citations

Insert and review comments

Create bookmarks, hyperlinks, endnotes

footnoteViewing document in different modes

Working with document protection and

securityInspect document for accessibility

MS EXCEL: 10 Hours

Create worksheets, insert and format data

Work with different types of data: text, currency, date, numeric etc.Split,

validate, consolidate, Convert data

Sort and filter data

Perform calculations and use functions: (Statistical, Logical, Mathematical, date, Time

etc.,)Workwith Lookup and reference formulae

Create and Work with different types of charts

Usepivot tables to summarize and analyse data

Perform data analysis using own formulae and functions

Combine data from multiple worksheets using own formulae and built-in functions to

generateresultsExport data and sheets to other file formats

Working with macros

Protecting data and Securing the workbook

MS POWERPOINT: 10 Hours

Select slide templates, layout and themes

Formatting slide content and using bullets and

numberingInsertand format images, smart art, tables,

charts

Using Slide master, notes and handout master

Working with animation and transitions

Organizeand Group slides

Import or create and use media objects: audio, video, animation

Perform slideshow recording and Record narration and create presentable videos

TOTAL: 30 PERIODS

COURSE OUTCOMES:

On successful completion the students will be able to

CO1:Use MS Word to create quality documents, by structuring and organizing content for their dayto daytechnical and academic requirements
CO2:Use MS EXCEL to perform data operations and analytics, record, retrieve data as perrequirements and visualize data for ease of understanding
CO3:Use MS PowerPoint to create high quality academic presentations by including commontables, charts, graphs, interlinking other elements, and using media objects.

21150C41	THEORY OF COMPUTATION	L T P C
		3 0 0 3

COURSE OBJECTIVES:

- To understand foundations of computation including automata theory
- To construct models of regular expressions and languages.
- To design context free grammar and push down automata
- To understand Turing machines and their capability
- To understand Undecidability and NP class problems

UNIT I AUTOMATA AND REGULAR EXPRESSIONS 9

Need for automata theory - Introduction to formal proof – Finite Automata (FA) – Deterministic Finite Automata (DFA) – Non-deterministic Finite Automata (NFA) – Equivalence between NFA and DFA – Finite Automata with Epsilon transitions – Equivalence of NFA and DFA- Equivalence of NFAs with and without ε-moves- Conversion of NFA into DFA — Minimization of DFAs.

UNIT II REGULAR EXPRESSIONS AND LANGUAGES 9

Regular expression – Regular Languages- Equivalence of Finite Automata and regular expressions - Proving languages to be not regular (Pumping Lemma) – Closure properties of regular languages.

UNIT III CONTEXT FREE GRAMMAR AND PUSH DOWN AUTOMATA 9

Types of Grammar - Chomsky‘s hierarchy of languages -Context-Free Grammar (CFG) and Languages – Derivations and Parse trees – Ambiguity in grammars and languages – Push Down Automata (PDA): Definition – Moves - Instantaneous descriptions -Languages of pushdown automata – Equivalence of pushdown automata and CFG-CFG to PDA-PDA to CFG – Deterministic Pushdown Automata.

UNIT IV NORMAL FORMS AND TURING MACHINES 9

Normal forms for CFG – Simplification of CFG- Chomsky Normal Form (CNF) and Greibach NormalForm (GNF) – Pumping lemma for CFL – Closure properties of Context Free Languages – Turing Machine : Basic model – definition and representation – Instantaneous Description – Language acceptance by TM
– TM as Computer of Integer functions – Programming techniques for Turingmachines (subroutines).

UNIT V UNDECIDABILITY 9

Unsolvable Problems and Computable Functions –PCP-MPCP- Recursive and recursively enumerable languages – Properties - Universal Turing machine -Tractable and Intractable problems

- P and NP completeness – Kruskal's algorithm – Travelling Salesman Problem- 3-CNF SATproblems.

COURSE OUTCOMES:

At the end of this course, the students will be able to:

CO1: Construct automata theory using Finite Automata

CO2: Write regular expressions for any pattern

CO3: Design context free grammar and Pushdown Automata

CO4: Design Turing machine for computational functions

CO5: Differentiate between decidable and undecidable problems

TOTAL:45 PERIODS

TEXT BOOKS:

1. Hopcroft J.E., Motwani R. & Ullman J.D., "Introduction to Automata Theory, Languages and Computations", 3rd Edition, Pearson Education, 2008.
2. John C Martin , "Introduction to Languages and the Theory of Computation", 4th Edition,Tata McGraw Hill, 2011.

REFERENCES:

1. Harry R Lewis and Christos H Papadimitriou , "Elements of the Theory of Computation", 2nd Edition, Prentice Hall of India, 2015.
2. Peter Linz, "An Introduction to Formal Language and Automata", 6th Edition, Jones & Bartlett,2016.
3. K.L.P.Mishra and N.Chandrasekaran, "Theory of Computer Science: Automata Languages and Computation", 3rd Edition, Prentice Hall of India, 2006.

CO's-PO's & PSO's MAPPING

CO's	PO's												PSO's		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	1	3	2	3	-	-	-	-	1	1	2	3	1	3	2
2	2	2	3	2	1	-	-	-	3	3	2	3	3	1	2
3	2	2	3	2	1	-	-	-	1	3	1	2	1	2	2
4	2	2	2	1	-	-	-	-	1	3	3	2	1	3	2
5	2	2	2	1	1	-	-	-	1	1	3	2	3	1	3
AVg.	2	2	2	2	1	-	-	-	1	2	2	2	2	2	2

1 - low, 2 - medium, 3 - high, '-"- no correlation

21150C42 ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING L T P C
3 0 2 4

COURSE OBJECTIVES:

The main objectives of this course are to:

- Study about uninformed and Heuristic search techniques.
- Learn techniques for reasoning under uncertainty
- Introduce Machine Learning and supervised learning algorithms
- Study about ensembling and unsupervised learning algorithms
- Learn the basics of deep learning using neural networks

UNIT I PROBLEM SOLVING 9

Introduction to AI - AI Applications - Problem solving agents – search algorithms – uninformed search strategies – Heuristic search strategies – Local search and optimization problems – adversarial search – constraint satisfaction problems (CSP)

UNIT II PROBABILISTIC REASONING 9

Acting under uncertainty – Bayesian inference – naïve bayes models. Probabilistic reasoning – Bayesian networks – exact inference in BN – approximate inference in BN – causal networks.

UNIT III SUPERVISED LEARNING 9

Introduction to machine learning – Linear Regression Models: Least squares, single & multiple variables, Bayesian linear regression, gradient descent, Linear Classification Models: Discriminant function

– Probabilistic discriminative model - Logistic regression, Probabilistic generative model – Naive Bayes, Maximum margin classifier – Support vector machine, Decision Tree, Random forests

UNIT IV ENSEMBLE TECHNIQUES AND UNSUPERVISED LEARNING 9

Combining multiple learners: Model combination schemes, Voting, Ensemble Learning - bagging, boosting, stacking, Unsupervised learning: K-means, Instance Based Learning: KNN, Gaussian mixture models and Expectation maximization

UNIT V NEURAL NETWORKS 9

Perceptron - Multilayer perceptron, activation functions, network training – gradient descent optimization – stochastic gradient descent, error backpropagation, from shallow networks to deep networks

–Unit saturation (aka the vanishing gradient problem) – ReLU, hyperparameter tuning, batch normalization, regularization, dropout.

45 PERIODS

PRACTICAL EXERCISES: 30 PERIODS

1. Implementation of Uninformed search algorithms (BFS, DFS)
2. Implementation of Informed search algorithms (A*, memory-bounded A*)
3. Implement naïve Bayes models
4. Implement Bayesian Networks
5. Build Regression models
6. Build decision trees and random forests
7. Build SVM models
8. Implement ensembling techniques
9. Implement clustering algorithms
10. Implement EM for Bayesian networks
11. Build simple NN models
12. Build deep learning NN models

COURSE OUTCOMES:

At the end of this course, the students will be able to:

CO1: Use appropriate search algorithms for problem solving

CO2: Apply reasoning under uncertainty

CO3: Build supervised learning models

CO4: Build ensembling and unsupervised models

CO5: Build deep learning neural network models

TOTAL:75 PERIODS

TEXT BOOKS:

1. Stuart Russell and Peter Norvig, “Artificial Intelligence – A Modern Approach”, Fourth Edition, Pearson Education, 2021.
2. Ethem Alpaydin, “Introduction to Machine Learning”, MIT Press, Fourth Edition, 2020.

REFERENCES:

1. Dan W. Patterson, “Introduction to Artificial Intelligence and Expert Systems”, Pearson Education,2007
2. Kevin Night, Elaine Rich, and Nair B., “Artificial Intelligence”, McGraw Hill, 2008
3. Patrick H. Winston, "Artificial Intelligence", Third Edition, Pearson Education, 2006
4. Deepak Khemani, “Artificial Intelligence”, Tata McGraw Hill Education, 2013 (http://nptel.ac.in/)
5. Christopher M. Bishop, “Pattern Recognition and Machine Learning”, Springer, 2006.
6. Tom Mitchell, “Machine Learning”, McGraw Hill, 3rd Edition,1997.
7. Charu C. Aggarwal, “Data Classification Algorithms and Applications”, CRC Press, 2014
8. Mehryar Mohri, Afshin Rostamizadeh, Ameet Talwalkar, “Foundations of Machine Learning”, MIT Press, 2012.
9. Ian Goodfellow, Yoshua Bengio, Aaron Courville, “Deep Learning”, MIT Press, 2016

CO’s-PO’s & PSO’s MAPPING

CO’s	**PO’s**												**PSO’s**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	3	2	3	3	-	-	-	-	1	3	3	3	1	2	2
2	1	1	1	3	1	-	-	-	1	2	1	3	2	3	2
3	2	1	2	1	1	-	-	-	2	1	1	3	1	1	1
4	3	1	3	1	-	-	-	-	2	1	2	1	2	2	2
5	3	1	1	2	2	-	-	-	3	1	2	3	2	1	2
AVg.	2	1	2	2	1	-	-	-	2	2	2	3	2	2	2

1 - low, 2 - medium, 3 - high, ‘-“- no correlation

21150C43 DATABASE MANAGEMENT SYSTEMS L T P C

3 0 0 3

COURSE OBJECTIVES:

- To learn the fundamentals of data models, relational algebra and SQL
- To represent a database system using ER diagrams and to learn normalization techniques
- To understand the fundamental concepts of transaction, concurrency and recovery processing
- To understand the internal storage structures using different file and indexing techniqueswhich will help in physical DB design
- To have an introductory knowledge about the Distributed databases, NOSQL and databasesecurity

UNIT I RELATIONAL DATABASES 10

Purpose of Database System – Views of data – Data Models – Database System Architecture – Introduction to relational databases – Relational Model – Keys – Relational Algebra – SQL fundamentals – Advanced SQL features – Embedded SQL– Dynamic SQL

UNIT II DATABASE DESIGN 8

Entity-Relationship model – E-R Diagrams – Enhanced-ER Model – ER-to-Relational Mapping – Functional Dependencies – Non-loss Decomposition – First, Second, Third Normal Forms, Dependency Preservation – Boyce/Codd Normal Form – Multi-valued Dependencies and FourthNormal Form – Join Dependencies and Fifth Normal Form

UNIT III TRANSACTIONS 9

Transaction Concepts – ACID Properties – Schedules – Serializability – Transaction support in SQL – Need for Concurrency – Concurrency control –Two Phase Locking- Timestamp – Multiversion – Validation and Snapshot isolation– Multiple Granularity locking – Deadlock Handling – Recovery Concepts – Recovery based on deferred and immediate update – Shadow paging – ARIES Algorithm

UNIT IV IMPLEMENTATION TECHNIQUES 9

RAID – File Organization – Organization of Records in Files – Data dictionary Storage – Column Oriented Storage– Indexing and Hashing –Ordered Indices – B+ tree Index Files – B tree Index Files – Static Hashing – Dynamic Hashing – Query Processing Overview – Algorithms for Selection, Sorting and join operations – Query optimization using Heuristics - Cost Estimation.

UNIT V ADVANCED TOPICS 9

Distributed Databases: Architecture, Data Storage, Transaction Processing, Query processing and optimization – NOSQL Databases: Introduction – CAP Theorem – Document Based systems – Key value Stores – Column Based Systems – Graph Databases. Database Security: Security issues –Access control based on privileges – Role Based access control – SQL Injection – Statistical Database security – Flow control – Encryption and Public Key infrastructures – Challenges

COURSE OUTCOMES:

Upon completion of this course, the students will be able toCO1:
Construct SQL Queries using relational algebra
CO2: Design database using ER model and normalize the database
CO3: Construct queries to handle transaction processing and maintain consistency of thedatabase
CO4: Compare and contrast various indexing strategies and apply the knowledge to tune theperformance of the database
CO5: Appraise how advanced databases differ from Relational Databases and find a suitabledatabasefor the given requirement.

TOTAL:45 PERIODS

TEXT BOOKS:

1. Abraham Silberschatz, Henry F. Korth, S. Sudharshan, "Database System Concepts", SeventhEdition, McGraw Hill, 2020.
2. Ramez Elmasri, Shamkant B. Navathe, "Fundamentals of Database Systems", SeventhEdition, Pearson Education, 2017

REFERENCES:

1. C.J.Date, A.Kannan, S.Swamynathan, "An Introduction to Database Systems", Eighth Edition,PearsonEducation, 2006.

CO's-PO's & PSO's MAPPING

CO's	PO's												PSO's		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	2	2	3	2	1	-	-	-	2	1	1	1	2	1	3
2	3	1	1	1	1	-	-	-	2	3	3	3	3	1	2
3	3	2	3	2	1	-	-	-	2	1	1	2	2	3	3
4	1	2	3	2	-	-	-	-	3	2	3	3	1	2	3
5	1	1	3	3	2	-	-	-	1	3	3	1	2	2	2
AVg.	2	2	3	2	1	-	-	-	2	2	2	2	2	2	3

1 - low, 2 - medium, 3 - high, '-"- no correlation

21150C44 ALGORITHMS L T P C
3 0 2 4

COURSE OBJECTIVES:

- To understand and apply the algorithm analysis techniques on searching and sortingalgorithms
- To critically analyze the efficiency of graph algorithms
- To understand different algorithm design techniques
- To solve programming problems using state space tree
- To understand the concepts behind NP Completeness, Approximation algorithms and randomized algorithms.

UNIT I INTRODUCTION 9

Algorithm analysis: Time and space complexity - Asymptotic Notations and its properties Best case, Worst case and average case analysis – Recurrence relation: substitution method - Lower bounds – searching: linear search, binary search and Interpolation Search, Pattern search: The naïve string-matching algorithm - Rabin-Karp algorithm - Knuth-Morris-Pratt algorithm. Sorting: Insertion sort – heap sort

UNIT II GRAPH ALGORITHMS 9

Graph algorithms: Representations of graphs - Graph traversal: DFS – BFS - applications - Connectivity, strong connectivity, bi-connectivity - Minimum spanning tree: Kruskal's and Prim's algorithm- Shortest path: Bellman-Ford algorithm - Dijkstra's algorithm - Floyd-Warshall algorithm Network flow: Flow networks - Ford-Fulkerson method – Matching: Maximum bipartite matching

UNIT III ALGORITHM DESIGN TECHNIQUES 9

Divide and Conquer methodology: Finding maximum and minimum - Merge sort - Quick sort **Dynamic programming:** Elements of dynamic programming — Matrix-chain multiplication - Multi stage graph — Optimal Binary Search Trees. **Greedy Technique**: Elements of the greedy strategy
- Activity-selection problem –- Optimal Merge pattern — Huffman Trees.

UNIT IV STATE SPACE SEARCH ALGORITHMS 9

Backtracking: n-Queens problem - Hamiltonian Circuit Problem - Subset Sum Problem – Graph colouring problem Branch and Bound: Solving 15-Puzzle problem - Assignment problem - Knapsack Problem - Travelling Salesman Problem

UNIT V NP-COMPLETE AND APPROXIMATION ALGORITHM 9

Tractable and intractable problems: Polynomial time algorithms – Venn diagram representation - NP-algorithms - NP-hardness and NP-completeness – Bin Packing problem - Problem reduction:TSP – 3-CNF problem. Approximation Algorithms: TSP - Randomized Algorithms: concept andapplication - primality testing - randomized quick sort - Finding k^{th} smallest number

45 PERIODS

PRACTICAL EXERCISES: 30 PERIODS

Searching and Sorting Algorithms

1. Implement Linear Search. Determine the time required to search for an element. Repeat the experiment for different values of *n*, the number of elements in the list to be searched and plot a graph of the time taken versus *n*.
2. Implement recursive Binary Search. Determine the time required to search an element. Repeat the experiment for different values of *n*, the number of elements in the list to be searched and plot a graph of the time taken versus *n*.
3. Given a text txt [0...n-1] and a pattern pat [0...m-1], write a function search (char pat [ ], chartxt [ ]) that prints all occurrences of pat [ ] in txt [ ]. You may assume that n > m.
4. Sort a given set of elements using the Insertion sort and Heap sort methods and determine the time required to sort the elements. Repeat the experiment for different values of *n*, the number of elements in the list to be sorted and plot a graph of the time taken versus *n*.

Graph Algorithms

1. Develop a program to implement graph traversal using Breadth First Search
2. Develop a program to implement graph traversal using Depth First Search
3. From a given vertex in a weighted connected graph, develop a program to find the shortestpaths to other vertices using Dijkstra's algorithm.
4. Find the minimum cost spanning tree of a given undirected graph using Prim's algorithm.
5. Implement Floyd's algorithm for the All-Pairs- Shortest-Paths problem.
6. Compute the transitive closure of a given directed graph using Warshall's algorithm.

Algorithm Design Techniques

1. Develop a program to find out the maximum and minimum numbers in a given list of *n* **numbers using the divide and conquer technique.**
2. Implement Merge sort and Quick sort methods to sort an array of elements and determine the time required to sort. Repeat the experiment for different values of *n*, the number of elements in the list to be sorted and plot a graph of the time taken versus *n*.

State Space Search Algorithms

1. Implement N Queens problem using Backtracking.

Approximation Algorithms Randomized Algorithms

1. Implement any scheme to find the optimal solution for the Traveling Salesperson problem and then solve the same problem instance using any approximation algorithm and determinethe error in the approximation.
2. Implement randomized algorithms for finding the k^{th} smallest number. The programs can be implemented in C/C++/JAVA/ Python.

TOTAL:75 PERIODS

COURSE OUTCOMES:

At the end of this course, the students will be able to:

CO1: Analyze the efficiency of algorithms using various frameworks

CO2: Apply graph algorithms to solve problems and analyze their efficiency.
CO3: Make use of algorithm design techniques like divide and conquer, dynamic programmingand greedytechniques to solve problems
CO4: Use the state space tree method for solving problems.
CO5: Solve problems using approximation algorithms and randomized algorithms

TEXT BOOKS:

1. Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest and Clifford Stein, "Introduction to Algorithms", 3rd Edition, Prentice Hall of India, 2009.
2. Ellis Horowitz, Sartaj Sahni, Sanguthevar Rajasekaran "Computer Algorithms/C++" Orient Blackswan, 2nd Edition, 2019.

REFERENCES:

1. Anany Levitin, "Introduction to the Design and Analysis of Algorithms", 3rd Edition, Pearson Education, 2012.
2. Alfred V. Aho, John E. Hopcroft and Jeffrey D. Ullman, "Data Structures and Algorithms", Reprint Edition, Pearson Education, 2006.
3. S. Sridhar, "Design and Analysis of Algorithms", Oxford university press, 2014.

CO's-PO's & PSO's MAPPING

CO's	PO's												PSO's		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	3	2	-	-	-		1	-	-	-	-	1	-	1	-
2	2	3	-	-	-	-	1	-	-	-	-	1	-	1	-
3	1	2	3	1	-	-	2	-	-	-	-	-	-	1	1
4	1	1	-	-	-	-	-	-	-	-	-	-	-	-	-
5	1	1	-	-	-	-	-	-	-	-	-	-	-	-	-
AVg.	2.67	1.8	3	1	-	-	1.33	-	-	-	-	1	-	1	1

1 - low, 2 - medium, 3 - high, '-"- no correlation

21150C45 INTRODUCTION TO OPERATING SYSTEMS L T P C
3 0 0 3

COURSE OBJECTIVES:

- To understand the basics and functions of operating systems.
- To understand processes and threads
- To analyze scheduling algorithms and process synchronization.
- To understand the concept of deadlocks.
- To analyze various memory management schemes.
- To be familiar with I/O management and file systems.
- To be familiar with the basics of virtual machines and Mobile OS like iOS and Android.

UNIT I INTRODUCTION 7

Computer System - Elements and organization; Operating System Overview - Objectives and Functions - Evolution of Operating System; Operating System Structures – Operating System Services - User Operating System Interface - System Calls – System Programs - Design and Implementation - Structuring methods.

UNIT II PROCESS MANAGEMENT 11

Processes - Process Concept - Process Scheduling - Operations on Processes - Inter-process Communication; CPU Scheduling - Scheduling criteria - Scheduling algorithms: Threads - Multithread Models – Threading issues; Process Synchronization - The Critical-Section problem - Synchronization hardware – Semaphores – Mutex - Classical problems of synchronization - Monitors; Deadlock - Methods for handling deadlocks, Deadlock prevention, Deadlock avoidance, Deadlock detection, Recovery from deadlock.

UNIT III MEMORY MANAGEMENT 10

Main Memory - Swapping - Contiguous Memory Allocation – Paging - Structure of the Page Table - Segmentation, Segmentation with paging; Virtual Memory - Demand Paging – Copy on Write - Page Replacement - Allocation of Frames –Thrashing.

UNIT IV STORAGE MANAGEMENT 10

Mass Storage system – Disk Structure - Disk Scheduling and Management; File-System Interface - File concept - Access methods - Directory Structure - Directory organization - File system mounting - File Sharing and Protection; File System Implementation - File System Structure - Directory implementation - Allocation Methods - Free Space Management; I/O Systems – I/O Hardware, Application I/O interface, Kernel I/O subsystem.

UNIT V VIRTUAL MACHINES AND MOBILE OS 7

Virtual Machines – History, Benefits and Features, Building Blocks, Types of Virtual Machines and their Implementations, Virtualization and Operating-System Components; Mobile OS - iOS and Android.

TOTAL:45 PERIODS

COURSE OUTCOMES:

At the end of this course, the students will be able to:

CO1 : Analyze various scheduling algorithms and process synchronization.
CO2 : Explain deadlock prevention and avoidance algorithms.
CO3 : Compare and contrast various memory management schemes.
CO4 : Explain the functionality of file systems, I/O systems, and Virtualization
CO5 : Compare iOS and Android Operating Systems.

TEXT BOOKS:

1. Abraham Silberschatz, Peter Baer Galvin and Greg Gagne, "Operating System Concepts"‖,10th Edition, John Wiley and Sons Inc., 2018.
2. Andrew S Tanenbaum, "Modern Operating Systems", Pearson, 5th Edition, 2022 New Delhi.

REFERENCES:

1. Ramaz Elmasri, A. Gil Carrick, David Levine, " Operating Systems – A Spiral Approach",Tata McGraw Hill Edition, 2010.
2. William Stallings, "Operating Systems: Internals and Design Principles", 7th Edition, Prentice Hall, 2018.
3. Achyut S.Godbole, Atul Kahate, "Operating Systems", McGraw Hill Education, 2016.

CO's-PO's & PSO's MAPPING

CO's	PO's												PSO's		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	3	1	2	2	-	-	-	-	3	2	3	1	1	2	2
2	2	2	3	1	1	-	-	-	2	1	1	2	2	1	2
3	1	3	2	2	1	-	-	-	2	2	1	1	1	2	2
4	1	3	3	3	-	-	-	-	1	2	1	2	1	3	2
5	3	1	2	1	1	-	-	-	3	2	3	2	2	2	1
AVg.	2	2	2	2	1	-	-	-	2	2	2	2	1	2	**2**

1 - low, 2 - medium, 3 - high, '-"- no correlation

21149S46 ENVIRONMENTAL SCIENCES AND SUSTAINABILITY L T P C
2 0 0 2

COURSE OBJECTIVES:

- To introduce the basic concepts of environment, ecosystems and biodiversity and emphasize on the biodiversity of India and its conservation.
- To impart knowledge on the causes, effects and control or prevention measures of environmental pollution and natural disasters.
- To facilitate the understanding of global and Indian scenario of renewable and nonrenewable resources, causes of their degradation and measures to preserve them.
- To familiarize the concept of sustainable development goals and appreciate the interdependence of economic and social aspects of sustainability, recognize and analyze climate changes, concept of carbon credit and the challenges of environmental management.
- To inculcate and embrace sustainability practices and develop a broader understanding on green materials, energy cycles and analyze the role of sustainable urbanization.

UNIT I ENVIRONMENT AND BIODIVERSITY 6

Definition, scope and importance of environment – need for public awareness. Eco-system and Energy flow– ecological succession. Types of biodiversity: genetic, species and ecosystem diversity– values of biodiversity, India as a mega-diversity nation – hot-spots of biodiversity – threats to biodiversity: habitatloss, poaching of wildlife, man-wildlife conflicts – endangered and endemic species of India – conservation of biodiversity: In-situ and ex-situ.

UNIT II ENVIRONMENTAL POLLUTION 9

Causes, Effects and Preventive measures of Water, Soil, Air and Noise Pollutions. Solid, **Hazardous and E-Waste management. Case studies on Occupational Health and Safety Management system (OHASMS). Environmental protection, Environmental protection acts .**

UNIT III RENEWABLE SOURCES OF ENERGY 6

Energy management and conservation, New Energy Sources: Need of new sources. Different types new energy sources. Applications of- Hydrogen energy, Ocean energy resources, Tidal energy conversion. Concept, origin and power plants of geothermal energy.

UNIT IV SUSTAINABILITY AND MANAGEMENT 6

Development , GDP ,Sustainability- concept, needs and challenges-economic, social and aspects of sustainability-from unsustainability to sustainability-millennium development goals, and protocols-

Sustainable Development Goals-targets, indicators and intervention areas Climate change-Global,Regional and local environmental issues and possible solutions-case studies. Concept of Carbon Credit, Carbon Footprint. Environmental management in industry-A case study.

UNIT V SUSTAINABILITY PRACTICES 6

Zero waste and R concept, Circular economy, ISO 14000 Series, Material Life cycle assessment, Environmental Impact Assessment. Sustainable habitat: Green buildings, Green materials, Energy efficiency, Sustainable transports. Sustainable energy: Non-conventional Sources, Energy Cycles-carbon cycle, emission and sequestration, Green Engineering: Sustainable urbanization- Socio-economical and technological change.

TOTAL: 30 PERIODS

COURSE OUTCOMES:

CO1:To recognize and understand the functions of environment, ecosystems and biodiversity andtheirconservation.

CO2:To identify the causes, effects of environmental pollution and natural disasters and contributeto thepreventive measures in the society.

CO3:To identify and apply the understanding of renewable and non-renewable resources andcontributeto the sustainable measures to preserve them for future generations.

CO4:To recognize the different goals of sustainable development and apply them for suitabletechnological advancement and societal development.

CO5:To demonstrate the knowledge of sustainability practices and identify green materials, energycyclesand the role of sustainable urbanization.

TEXT BOOKS:

1. Anubha Kaushik and C. P. Kaushik's "Perspectives in Environmental Studies", 6th Edition,New Age International Publishers ,2018.
2. Benny Joseph, 'Environmental Science and Engineering', Tata McGraw-Hill, New Delhi,2016.
3. Gilbert M.Masters, 'Introduction to Environmental Engineering and Science', 2nd edition, Pearson Education, 2004.
4. Allen, D. T. and Shonnard, D. R., Sustainability Engineering: Concepts, Design and CaseStudies, Prentice Hall.
5. Bradley. A.S; Adebayo, A.O., Maria, P. Engineering applications in sustainable design and development, Cengage learning.
6. Environment Impact Assessment Guidelines, Notification of Government of India, 2006.
7. Mackenthun, K.M., Basic Concepts in Environmental Management, Lewis Publication, London, 1998.

REFERENCES :

1. R.K. Trivedi, 'Handbook of Environmental Laws, Rules, Guidelines, Compliances and Standards', Vol. I and II, Enviro Media. 38 . edition 2010.
2. Cunningham, W.P. Cooper, T.H. Gorhani, 'Environmental Encyclopedia', Jaico Publ., House, Mumbai, 2001.
3. Dharmendra S. Sengar, 'Environmental law', Prentice hall of India PVT. LTD, New Delhi, 2007.
4. Rajagopalan, R, 'Environmental Studies-From Crisis to Cure', Oxford University Press, ThirdEdition, 2015.
5. Erach Bharucha "Textbook of Environmental Studies for Undergraduate Courses" Orient Blackswan Pvt. Ltd. 2013.

CO's-PO's & PSO's MAPPING

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	2	1	2	3
1	2	1	-	-	-	2	3	-	-	-	-	2	-	-	-
2	3	2	-	-	-	3	3	-	-	-	-	2	-	-	-
3	3	-	1	-	-	2	2	-	-	-	-	2	-	-	-
4	3	2	1	1	-	2	2	-	-	-	-	2	-	-	-
5	3	2	1	-	-	2	2	-	-	-	-	1	-	-	-
Avg.	**2.8**	**1.8**	**1**	**1**	**-**	**2.2**	**2.4**	**-**	**-**	**-**	**-**	**1.8**	-	-	

1 - low, 2 - medium, 3 - high, '-' - no correlation

21150L48 OPERATING SYSTEMS LABORATORY

L	T	P	C
0	0	3	1.5

COURSE OBJECTIVES:

- **To install windows operating systems.**
- **To understand the basics of Unix command and shell**
- **programming.To implement various CPU scheduling**
- **algorithms.**
- **To implement Deadlock Avoidance and Deadlock Detection**
- **AlgorithmsTo implement Page Replacement Algorithms**
- **To implement various memory allocation methods.**

To be familiar with File Organization and File Allocation Strategies.

LIST OF EXPERIMENTS:

1. Installation of windows operating system
2. Illustrate UNIX commands and Shell Programming
3. Process Management using System Calls : Fork, Exit, Getpid, Wait, Close
4. Write C programs to implement the various CPU Scheduling Algorithms
5. Illustrate the inter process communication strategy
6. Implement mutual exclusion by Semaphore
7. Write C programs to avoid Deadlock using Banker's Algorithm
8. Write a C program to Implement Deadlock Detection Algorithm
9. Write C program to implement Threading
10. Implement the paging Technique using C program
11. Write C programs to implement the following Memory Allocation Methods

    a. First Fit b. Worst Fit c. Best Fit
12. Write C programs to implement the various Page Replacement Algorithms
13. Write C programs to Implement the various File Organization Techniques
14. Implement the following File Allocation Strategies using C programs

    a. Sequential b. Indexed c. Linked
15. Write C programs for the implementation of various disk scheduling algorithms

16. Install any guest operating system like Linux using VMware.

TOTAL:45 PERIODS

COURSE OUTCOMES:

At th end of this course, the students will be able to:CO1 :
Define and implement UNIX Commands.
CO2 : Compare the performance of various CPU Scheduling Algorithms.
CO3 : Compare and contrast various Memory Allocation Methods.
CO4 :Define File Organization and File Allocation Strategies.
CO5 : Implement various Disk Scheduling Algorithms.

CO's-PO's & PSO's MAPPING

CO's	PO's												PSO's		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	3	1	3	1	1	-	-	-	1	3	3	3	2	1	3
2	3	1	1	2	2	-	-	-	3	2	1	1	3	1	2
3	3	3	2	1	2	-	-	-	3	3	1	2	2	2	2
4	1	2	2	3	2	-	-	-	3	1	3	1	1	2	1
5	2	2	1	1	3	-	-	-	1	2	2	3	1	3	3
AVg.	2	2	2	2	2	-	-	-	2	2	2	2	2	2	**2**

1 - low, 2 - medium, 3 - high, '-"- no correlation

21150L47 DATABASE MANAGEMENT SYSTEMS LABORATORY **L T P C**
0 0 3 1.5

COURSE OBJECTIVES:

- **To learn and implement important commands in**
- **SQL.To learn the usage of nested and joint queries.**
- **To understand functions, procedures and procedural extensions of**
- **databases.To understand design and implementation of typical database**
- **applications.**
  To be familiar with the use of a front end tool for GUI based application development.

LIST OF EXPERIMENTS:

1. Create a database table, add constraints (primary key, unique, check, Not null), insert rows,update and delete rows using SQL DDL and DML commands.
2. Create a set of tables, add foreign key constraints and incorporate referential integrity.
3. Query the database tables using different 'where' clause conditions and also implement aggregate functions.
4. Query the database tables and explore sub queries and simple join operations.
5. Query the database tables and explore natural, equi and outer joins.
6. Write user defined functions and stored procedures in SQL.
7. Execute complex transactions and realize DCL and TCL commands.
8. Write SQL Triggers for insert, delete, and update operations in a database table.
9. Create View and index for database tables with a large number of records.
10. Create an XML database and validate it using XML schema.
11. Create Document, column and graph based data using NOSQL database tools.
12. Develop a simple GUI based database application and incorporate all the above-mentioned features
13. Case Study using any of the real life database applications from the following list

a) Inventory Management for a EMart Grocery Shop
b) Society Financial Management
c) Cop Friendly App – Eseva
d) Property Management – eMall
e) Star Small and Medium Banking and Finance
   - Build Entity Model diagram. The diagram should align with the business and functionalgoals stated in the application.
   - Apply Normalization rules in designing the tables in scope.
   - Prepared applicable views, triggers (for auditing purposes), functions for enabling enterprise grade features.
   - Build PL SQL / Stored Procedures for Complex Functionalities, ex EOD Batch Processing for calculating the EMI for Gold Loan for each eligible Customer.
- Ability to showcase ACID Properties with sample queries with appropriate settings

TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of this course, the students will be able to:

CO1: Create databases with different types of key constraints.
CO2: Construct simple and complex SQL queries using DML and DCL commands.
CO3: Use advanced features such as stored procedures and triggers and incorporate in GUI basedapplicationdevelopment.
CO4: Create an XML database and validate with meta-data (XML schema).
CO5: Create and manipulate data using NOSQL database.

CO's-PO's & PSO's MAPPING

CO's	PO's												PSO's		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	3	3	3	3	-	-	-	-	3	1	3	2	2	3	2
2	2	2	3	2	2	-	-	-	1	2	3	3	2	1	2
3	3	3	2	1	1	-	-	-	1	1	1	3	2	3	3
4	1	3	3	3	1	-	-	-	1	1	3	2	3	1	3
5	3	2	1	1	1	-	-	-	2	2	3	1	3	1	2
AVg.	2	3	2	2	1	-	-	-	2	1	3	2	2	2	2

1 - low, 2 - medium, 3 - high, '-"- no correlation

21150C52 **COMPUTER NETWORKS** **L T P C**
3 0 2 4

COURSE OBJECTIVES:

- To understand the concept of layering in networks.
- To know the functions of protocols of each layer of TCP/IP protocol suite.
- To visualize the end-to-end flow of information.
- To learn the functions of network layer and the various routing protocols
- To familiarize the functions and protocols of the Transport layer

UNIT I INTRODUCTION AND APPLICATION LAYER 10

Data Communication - Networks – Network Types – Protocol Layering – TCP/IP Protocol suite – OSI Model – Introduction to Sockets - Application Layer protocols: HTTP – FTP – Email protocols(SMTP - POP3 - IMAP - MIME) – DNS – SNMP

UNIT II TRANSPORT LAYER 9

Introduction - Transport-Layer Protocols: UDP – TCP: Connection Management – Flow control - Congestion Control - Congestion avoidance (DECbit, RED) – SCTP – Quality of Service

UNIT III NETWORK LAYER 7

Switching : Packet Switching - Internet protocol - IPV4 – IP Addressing – Subnetting - IPV6, ARP, RARP, ICMP, DHCP

UNIT IV ROUTING 7

Routing and protocols: Unicast routing - Distance Vector Routing - RIP - Link State Routing – OSPF - Path-vector routing - BGP - Multicast Routing: DVMRP – PIM.

UNIT V DATA LINK AND PHYSICAL LAYERS 12

Data Link Layer – Framing – Flow control – Error control – Data-Link Layer Protocols – HDLC – PPP -Media Access Control – Ethernet Basics – CSMA/CD – Virtual LAN – Wireless LAN (802.11) - Physical Layer: Data and Signals - Performance – Transmission media- Switching – Circuit Switching.

45 PERIODS

PRACTICAL EXERCISES: 30 PERIODS

1. Learn to use commands like tcpdump, netstat, ifconfig, nslookup and traceroute. Captureping and trace route PDUs using a network protocol analyzer and examine.
2. Write a HTTP web client program to download a web page using TCP sockets.
3. Applications using TCP sockets like: a) Echo client and echo server b) Chat
4. Simulation of DNS using UDP sockets.
5. Use a tool like Wireshark to capture packets and examine the packets
6. Write a code simulating ARP /RARP protocols.
7. Study of Network simulator (NS) and Simulation of Congestion Control Algorithms using NS.
8. Study of TCP/UDP performance using Simulation tool.
9. Simulation of Distance Vector/ Link State Routing algorithm.
10. Simulation of an error correction code (like CRC)

COURSE OUTCOMES:

At the end of this course, the students will be able to:
CO 1: Explain the basic layers and its functions in computer networks.
CO 2:Understand the basics of how data flows from one node to another.CO 3: Analyze routing algorithms.
CO 4: Describe protocols for various functions in the network.
CO 5: Analyze the working of various application layer protocols.

TOTAL:75 PERIODS

TEXT BOOKS

1. James F. Kurose, Keith W. Ross, Computer Networking, A Top-Down Approach Featuring theInternet, Eighth Edition, Pearson Education, 2021.
2. Behrouz A. Forouzan, Data Communications and Networking with TCP/IP Protocol Suite, SixthEdition TMH, 2022

REFERENCES

1. Larry L. Peterson, Bruce S. Davie, Computer Networks: A Systems Approach, Fifth Edition, Morgan Kaufmann Publishers Inc., 2012.
2. William Stallings, Data and Computer Communications, Tenth Edition, Pearson Education,2013.
3. Nader F. Mir, Computer and Communication Networks, Second Edition, Prentice Hall, 2014.
4. Ying-Dar Lin, Ren-Hung Hwang, Fred Baker, “Computer Networks: An Open Source Approach”, McGraw Hill, 2012.

0CO’s-PO’s & PSO’s MAPPING

CO’s	PO’s												PSO’s		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	-	2	-	-		-	-	-	-	-	-	-	3	-	-
2	-	1	-	-	2	-	-	-	-	-	-	2	-	2	-
3	-	2	-	-	3	-	-	-	-	-	-	-	-	3	-
4	-		-	1	2	-	-	-	-	3	-	-	-	-	-
5	-	3	2	-	-	-	-	-	-	-	-	-	-	-	3
AVg.	-	1	-	-	1	-	-	-	-	1	-	-	-	1	1

1 - low, 2 - medium, 3 - high, ‘-“- no correlation

21150C51 COMPILER DESIGN L T P C

3 0 2 4

COURSE OBJECTIVES:

- To learn the various phases of compiler.
- To learn the various parsing techniques.
- To understand intermediate code generation and run-time environment.
- To learn to implement the front-end of the compiler.
- To learn to implement code generator.
- To learn to implement code optimization.

UNIT I INTRODUCTION TO COMPILERS & LEXICAL ANALYSIS 8

Introduction- Translators- Compilation and Interpretation- Language processors -The Phases of Compiler – Lexical Analysis – Role of Lexical Analyzer – Input Buffering – Specification of Tokens – Recognition of Tokens – Finite Automata – Regular Expressions to Automata NFA, DFA – Minimizing DFA - Language for Specifying Lexical Analyzers – Lex tool.

UNIT II SYNTAX ANALYSIS 11

Role of Parser – Grammars – Context-free grammars – Writing a grammar Top Down Parsing - General Strategies - Recursive Descent Parser Predictive Parser-LL(1) - Parser-Shift Reduce Parser-LR Parser- LR (0)Item Construction of SLR Parsing Table - Introduction to LALR Parser - Error Handling and Recovery in Syntax Analyzer-YACC tool - Design of a syntax Analyzer for aSample Language

UNIT III SYNTAX DIRECTED TRANSLATION & INTERMEDIATE CODE GENERATION 9

Syntax directed Definitions-Construction of Syntax Tree-Bottom-up Evaluation of S-Attribute Definitions- Design of predictive translator - Type Systems-Specification of a simple type Checker- Equivalence of Type Expressions-Type Conversions. Intermediate Languages: Syntax Tree, Three Address Code, Types and Declarations, Translation of Expressions, Type Checking, Back patching.

UNIT IV RUN-TIME ENVIRONMENT AND CODE GENERATION 9

Runtime Environments – source language issues – Storage organization – Storage Allocation Strategies: Static, Stack and Heap allocation - Parameter Passing-Symbol Tables - Dynamic Storage Allocation - Issues in the Design of a code generator – Basic Blocks and Flow graphs - Design of a simple Code Generator - Optimal Code Generation for Expressions– Dynamic Programming Code Generation.

UNIT V CODE OPTIMIZATION 8

Principal Sources of Optimization – Peep-hole optimization - DAG- Optimization of Basic Blocks - GlobalData Flow Analysis - Efficient Data Flow Algorithm – Recent trends in Compiler Design.

45 PERIODS

LIST OF EXPERIMENTS:

1. Using the LEX tool, Develop a lexical analyzer to recognize a few patterns in C. (Ex. identifiers, constants, comments, operators etc.). Create a symbol table, while recognizing identifiers.
2. Implement a Lexical Analyzer using LEX Tool
3. Generate YACC specification for a few syntactic categories.

    a. Program to recognize a valid arithmetic expression that uses operator +, -, * and /.
    b. Program to recognize a valid variable which starts with a letter followed by any number of letters or digits.
    c. Program to recognize a valid control structures syntax of C language (For loop,while loop, if-else, if-else-if, switch-case, etc.).
    d. Implementation of calculator using LEX and YACC

4. Generate three address code for a simple program using LEX and YACC.
5. Implement type checking using Lex and Yacc.
6. Implement simple code optimization techniques (Constant folding, Strength reduction and Algebraic transformation)
7. Implement back-end of the compiler for which the three address code is given as input andthe 8086 assembly language code is produced as output.

30 PERIODS
TOTAL: 75 PERIODS

COURSE OUTCOMES:

On Completion of the course, the students should be able to:

CO1:Understand the techniques in different phases of a compiler.

CO2:Design a lexical analyser for a sample language and learn to use the LEX tool.

CO3:Apply different parsing algorithms to develop a parser and learn to use YACC tool

CO4:Understand semantics rules (SDT), intermediate code generation and run-time environment.

CO5:Implement code generation and apply code optimization techniques.

TEXT BOOK:

1. Alfred V. Aho, Monica S. Lam, Ravi Sethi, Jeffrey D. Ullman, “Compilers: Principles, Techniques and Tools”, Second Edition, Pearson Education, 2009.

REFERENCES

1. Randy Allen, Ken Kennedy, Optimizing Compilers for Modern Architectures: A Dependencebased Approach, Morgan Kaufmann Publishers, 2002.
2. Steven S. Muchnick, Advanced Compiler Design and Implementation‖, Morgan Kaufmann Publishers - Elsevier Science, India, Indian Reprint 2003.
3. Keith D Cooper and Linda Torczon, Engineering a Compiler‖, Morgan Kaufmann PublishersElsevier Science, 2004.
4. V. Raghavan, Principles of Compiler Design‖, Tata McGraw Hill Education Publishers, 2010.
5. Allen I. Holub, Compiler Design in C‖, Prentice-Hall Software Series, 1993.

CO’s-PO’s & PSO’s MAPPING

CO’s	PO’s												PSO’s		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	3	3	3	3	-	-	-	-	3	3	1	3	2	3	2
2	3	3	3	3	3	-	-	-	3	2	3	2	2	1	2
3	3	3	2	2	3	-	-	-	3	1	1	1	2	2	3
4	3	2	2	1	1	-	-	-	2	3	2	3	1	2	1
5	3	3	3	2	1	-	-	-	2	1	1	3	2	1	2
AVg.	**3.00**	**2.80**	**2.60**	**2.20**	**2.00**	-	-	-	**2.60**	**2.00**	**1.60**	**2.40**	**1.80**	**1.80**	**2.00**

1 - low, 2 - medium, 3 - high, ‘-“- no correlation

21150C53 CRYPTOGRAPHY AND CYBER SECURITY L T P C
3 0 0 3

COURSE OBJECTIVES:

- Learn to analyze the security of in-built cryptosystems.
- Know the fundamental mathematical concepts related to security.
- Develop cryptographic algorithms for information security.
- Comprehend the various types of data integrity and authentication schemes
- Understand cyber crimes and cyber security.

UNIT I INTRODUCTION TO SECURITY 9

Computer Security Concepts – The OSI Security Architecture – Security Attacks – Security Services and Mechanisms – A Model for Network Security – Classical encryption techniques: Substitutiontechniques, Transposition techniques, Steganography – Foundations of modern cryptography: Perfect security – Information Theory – Product Cryptosystem – Cryptanalysis.

UNIT II SYMMETRIC CIPHERS 9

Number theory – Algebraic Structures – Modular Arithmetic - Euclid‘s algorithm – Congruence and matrices – Group, Rings, Fields, Finite Fields

SYMMETRIC KEY CIPHERS: SDES – Block Ciphers – DES, Strength of DES – Differential and linear cryptanalysis – Block cipher design principles – Block cipher mode of operation – Evaluation criteria for AES – Pseudorandom Number Generators – RC4 – Key distribution.

UNIT III ASYMMETRIC CRYPTOGRAPHY 9

MATHEMATICS OF ASYMMETRIC KEY CRYPTOGRAPHY: Primes – Primality Testing – Factorization – Euler's totient function, Fermat's and Euler's Theorem – Chinese Remainder Theorem – Exponentiation and logarithm

ASYMMETRIC KEY CIPHERS: RSA cryptosystem – Key distribution – Key management – Diffie Hellman key exchange -– Elliptic curve arithmetic – Elliptic curve cryptography.

UNIT IV INTEGRITY AND AUTHENTICATION ALGORITHMS 9

Authentication requirement – Authentication function – MAC – Hash function – Security of hash function: HMAC, CMAC – SHA – Digital signature and authentication protocols – DSS – Schnorr Digital Signature Scheme – ElGamal cryptosystem – Entity Authentication: Biometrics, Passwords, Challenge Response protocols – Authentication applications – Kerberos

MUTUAL TRUST: Key management and distribution – Symmetric key distribution using symmetric and asymmetric encryption – Distribution of public keys – X.509 Certificates.

UNIT V CYBER CRIMES AND CYBER SECURITY 9

Cyber Crime and Information Security – classifications of Cyber Crimes – Tools and Methods – Password Cracking, Keyloggers, Spywares, SQL Injection – Network Access Control – Cloud Security – Web Security – Wireless Security

TOTAL:45 PERIODS

COURSE OUTCOMES:

CO1: Understand the fundamentals of networks security, security architecture, threats andvulnerabilities

CO2: Apply the different cryptographic operations of symmetric cryptographic algorithmsCO3: Apply the different cryptographic operations of public key cryptography CO4: Apply the various Authentication schemes to simulate different applications.CO5: Understand various cyber crimes and cyber security.

TEXT BOOKS

1. William Stallings, "Cryptography and Network Security - Principles and Practice", Seventh Edition, Pearson Education, 2017.
2. Nina Godbole, Sunit Belapure, "Cyber Security: Understanding Cyber crimes, ComputerForensics and Legal Perspectives", First Edition, Wiley India, 2011.

REFERENCES

1. Behrouz A. Ferouzan, Debdeep Mukhopadhyay, "Cryptography and Network Security", 3rdEdition, Tata Mc Graw Hill, 2015.
2. Charles Pfleeger, Shari Pfleeger, Jonathan Margulies, "Security in Computing", Fifth Edition,Prentice Hall, New Delhi, 2015.

CO’s-PO’s & PSO’s MAPPING

CO’s	PO’s												PSO’s		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	3	2	1	2	2	-	-	-	1	-	-	1	2	3	3
2	3	3	3	3	3	-	-	-	2	-	-	1	3	3	3
3	3	3	3	3	3	-	-	-	2	-	-	1	3	3	3
4	3	3	3	3	3	-	-	-	2	-	-	1	3	3	3
5	3	2	3	2	3	-	-	-	3	-	-	2	3	2	3
AVg.	3	2.6	2.6	2.6	2.8	-	-	-	2	-	-	1.2	2.8	2.8	3

1 - low, 2 - medium, 3 - high, ‘-“- no correlation

21150C54 DISTRIBUTED COMPUTING L T P C
3 0 0 3

COURSE OBJECTIVES:

- To introduce the computation and communication models of distributed systems
- To illustrate the issues of synchronization and collection of information in distributed systems
- To describe distributed mutual exclusion and distributed deadlock detection techniques
- To elucidate agreement protocols and fault tolerance mechanisms in distributed systems
- To explain the cloud computing models and the underlying concepts

UNIT I INTRODUCTION 8

Introduction: Definition-Relation to Computer System Components – Motivation – Message -Passing Systems versus Shared Memory Systems – Primitives for Distributed Communication – Synchronous versus Asynchronous Executions – Design Issues and Challenges; A Model of Distributed Computations: A Distributed Program – A Model of Distributed Executions – Models ofCommunication Networks – Global State of a Distributed System.

UNIT II LOGICAL TIME AND GLOBAL STATE 10

Logical Time: Physical Clock Synchronization: NTP – A Framework for a System of Logical Clocks – Scalar Time – Vector Time; Message Ordering and Group Communication: Message Ordering Paradigms **–** Asynchronous Execution with Synchronous Communication – Synchronous Program Order on Asynchronous System – Group Communication – Causal Order – Total Order; Global State and Snapshot Recording Algorithms: Introduction – System Model and Definitions – Snapshot Algorithms for FIFO Channels.

UNIT III DISTRIBUTED MUTEX AND DEADLOCK 10

Distributed Mutual exclusion Algorithms: Introduction – Preliminaries – Lamport’s algorithm – Ricart-Agrawala’s Algorithm –– Token-Based Algorithms – Suzuki-Kasami’s Broadcast Algorithm; Deadlock Detection in Distributed Systems: Introduction – System Model – Preliminaries – Modelsof Deadlocks – Chandy-Misra-Haas Algorithm for the AND model and OR Model.

UNIT IV CONSENSUS AND RECOVERY 10

Consensus and Agreement Algorithms: Problem Definition – Overview of Results – Agreement in a Failure- Free System(Synchronous and Asynchronous) – Agreement in Synchronous Systems with Failures; Checkpointing and Rollback Recovery: Introduction – Background and Definitions – Issues in Failure Recovery – Checkpoint-based Recovery – Coordinated Checkpointing Algorithm -
- Algorithm for Asynchronous Checkpointing and Recovery

UNIT V CLOUD COMPUTING 7

Definition of Cloud Computing – Characteristics of Cloud – Cloud Deployment Models – Cloud Service Models – Driving Factors and Challenges of Cloud – Virtualization – Load Balancing – Scalability and Elasticity – Replication – Monitoring – Cloud Services and Platforms: Compute Services – Storage Services – Application Services

COURSE OUTCOMES:

Upon the completion of this course, the student will be able toCO1:
Explain the foundations of distributed systems (K2)
CO2: Solve synchronization and state consistency problems (K3)
CO3 Use resource sharing techniques in distributed systems (K3)
CO4: Apply working model of consensus and reliability of distributed systems (K3)
CO5: Explain the fundamentals of cloud computing (K2) **TOTAL:45 PERIODS**

TEXT BOOKS

1. Kshemkalyani Ajay D, Mukesh Singhal, “Distributed Computing: Principles, Algorithms and Systems”, Cambridge Press, 2011.
2. Mukesh Singhal, Niranjan G Shivaratri, “Advanced Concepts in Operating systems”, Mc-Graw Hill Publishers, 1994.

REFERENCES

1. George Coulouris, Jean Dollimore, Time Kindberg, “Distributed Systems Concepts and Design”, Fifth Edition, Pearson Education, 2012.
2. Pradeep L Sinha, “Distributed Operating Systems: Concepts and Design”, Prentice Hall ofIndia, 2007.
3. Tanenbaum A S, Van Steen M, “Distributed Systems: Principles and Paradigms”, Pearson Education, 2007.
4. Liu M L, “Distributed Computing: Principles and Applications”, Pearson Education, 2004.
5. Nancy A Lynch, “Distributed Algorithms”, Morgan Kaufman Publishers, 2003.
6. Arshdeep Bagga, Vijay Madisetti, “ Cloud Computing: A Hands-On Approach”, UniversitiesPress, 2014.

CO’s-PO’s & PSO’s MAPPING

CO’s	PO’s												PSO’s		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	2	2	3	3	1	-	-	-	2	1	3	3	2	1	1
2	1	3	2	1	2	-	-	-	2	2	2	2	1	3	2
3	2	2	1	3	3	-	-	-	3	2	1	1	1	2	1
4	1	2	2	3	1	-	-	-	3	3	2	1	3	1	1
5	3	3	1	2	3	-	-	-	3	3	3	1	3	2	3
AVg.	1.8	2.4	1.8	2.4	2	-	-	-	2.6	2.2	2.2	1.6	2	1.8	1.6

1 - low, 2 - medium, 3 - high, ‘-“- no correlation

21150C63 **OBJECT ORIENTED SOFTWARE ENGINEERING** **L T P C**

3 0 2 4

COURSE OBJECTIVES:

- To understand Software Engineering Lifecycle Models
- To Perform software requirements analysis
- To gain knowledge of the System Analysis and Design concepts using UML.
- To understand software testing and maintenance approaches
- To work on project management scheduling using DevOps

UNIT I SOFTWARE PROCESS AND AGILE DEVELOPMENT 9

Introduction to Software Engineering, Software Process, Perspective and Specialized Process Models – Introduction to Agility-Agile process-Extreme programming-XP Process-Case Study.

UNIT II REQUIREMENTS ANALYSIS AND SPECIFICATION 9

Requirement analysis and specification – Requirements gathering and analysis – Software Requirement Specification – Formal system specification – Finite State Machines – Petrinets – Object modelling using UML – Use case Model – Class diagrams – Interaction diagrams – Activitydiagrams – State chart diagrams – Functional modelling – Data Flow Diagram- CASE TOOLS.

UNIT III SOFTWARE DESIGN 9

Software design – Design process – Design concepts – Coupling – Cohesion – Functional independence – Design patterns – Model-view-controller – Publish-subscribe – Adapter – Command – Strategy – Observer – Proxy – Facade – Architectural styles – Layered - Client Server - Tiered - Pipeand filter- User interface design-Case Study.

UNIT IV SOFTWARE TESTING AND MAINTENANCE 9

Testing – Unit testing – Black box testing– White box testing – Integration and System testing– Regression testing – Debugging - Program analysis – Symbolic execution – Model Checking-Case Study

UNIT V PROJECT MANAGEMENT 9

Software Project Management- Software Configuration Management - Project Scheduling- DevOps: Motivation-Cloud as a platform-Operations- Deployment Pipeline:Overall Architecture Building and Testing-Deployment- Tools- Case Study

COURSE OUTCOMES:

CO1: Compare various Software Development Lifecycle Models
CO2: Evaluate project management approaches as well as cost and schedule estimationstrategies.
CO3: Perform formal analysis on specifications.
CO4: Use UML diagrams for analysis and design.
CO5: Architect and design using architectural styles and design patterns, and test the system

45 PERIODS

PRACTICAL EXERCISES: **30 PERIODS**

LIST OF EXPERIMENTS:

1. Identify a software system that needs to be developed.
2. Document the Software Requirements Specification (SRS) for the identified system.
3. Identify use cases and develop the Use Case model.

4. Identify the conceptual classes and develop a Domain Model and also derive a ClassDiagram from that.
5. Using the identified scenarios, find the interaction between objects and represent them usingUML Sequence and Collaboration Diagrams
6. Draw relevant State Chart and Activity Diagrams for the same system.
7. Implement the system as per the detailed design
8. Test the software system for all the scenarios identified as per the usecase diagram
9. Improve the reusability and maintainability of the software system by applying appropriatedesign patterns.
10. Implement the modified system and test it for various scenarios.

SUGGESTED DOMAINS FOR MINI-PROJECT:

1. Passport automation system.
2. Book bank
3. Exam registration
4. Stock maintenance system.
5. Online course reservation system
6. Airline/Railway reservation system
7. Software personnel management system
8. Credit card processing
9. e-book management system
10. Recruitment system
11. Foreign trading system
12. Conference management system
13. BPO management system
14. Library management system
15. Student information system

TOTAL:75 PERIODS

TEXT BOOKS

1. Bernd Bruegge and Allen H. Dutoit, “Object-Oriented Software Engineering: Using UML, Patterns and Java”, Third Edition, Pearson Education, 2009.
2. Roger S. Pressman, Object-Oriented Software Engineering: An Agile Unified Methodology,First Edition, Mc Graw-Hill International Edition, 2014.

REFERENCES

1. Carlo Ghezzi, Mehdi Jazayeri, Dino Mandrioli, Fundamentals of Software Engineering, 2ndedition, PHI Learning Pvt. Ltd., 2010.
2. Craig Larman, Applying UML and Patterns, 3rd ed, Pearson Education, 2005.
3. Len Bass, Ingo Weber and Liming Zhu, “DevOps: A Software Architect‘s Perspective”, Pearson Education, 2016
4. Rajib Mall, Fundamentals of Software Engineering, 3rd edition, PHI Learning Pvt. Ltd., 2009.
5. Stephen Schach, Object-Oriented and Classical Software Engineering, 8th ed, McGraw-Hill,2010.

CO's-PO's & PSO's MAPPING

CO's	PO's												PSO's		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	2	2	1	2	2	-	-	-	-	1	1	2	2	2	**1**
2	2	3	2	3	2	-	-	-	2	2	3	2	3	2	**1**
3	2	3	2	1	1	-	-	-	2	2	3	2	2	3	**1**
4	2	3	2	2	3	-	-	-	2	2	3	2	2	3	**1**
5	2	3	1	2	2	-	-	-	-	-	-	1	3	2	**2**
AVg.	**2**	**2**	**1**	**2**	**2**	**-**	**-**	**-**	**-**	**1**	**1**	**2**	**2**	**2**	**1**

1 - low, 2 - medium, 3 - high, '-' - no correlation

21152S62 EMBEDDED SYSTEMS AND IOT L T P C
3 0 2 4

COURSE OBJECTIVES:

- To learn the internal architecture and programming of an embedded processor.
- To introduce interfacing I/O devices to the processor.
- To introduce the evolution of the Internet of Things (IoT).
- To build a small low-cost embedded and IoT system using Arduino/Raspberry Pi/ open platform.
- To apply the concept of Internet of Things in real world scenario.

UNIT I 8-BIT EMBEDDED PROCESSOR 9

8-Bit Microcontroller – Architecture – Instruction Set and Programming – Programming Parallel Ports - Timers and Serial Port – Interrupt Handling.

UNIT II EMBEDDED C PROGRAMMING 9

Memory And I/O Devices Interfacing – Programming Embedded Systems in C – Need For RTOS – MultipleTasks and Processes – Context Switching – Priority Based Scheduling Policies.

UNIT III IOT AND ARDUINO PROGRAMMING 9

Introduction to the Concept of IoT Devices – IoT Devices Versus Computers – IoT Configurations – Basic Components – Introduction to Arduino – Types of Arduino – Arduino Toolchain – Arduino Programming Structure – Sketches – Pins – Input/Output From PinsUsing Sketches – Introduction to Arduino Shields – Integration of Sensors and Actuators with Arduino.

UNIT IV IOT COMMUNICATION AND OPEN PLATFORMS 9

IoT Communication Models and APIs – IoT Communication Protocols – Bluetooth – WiFi – ZigBee – GPS – GSM modules – Open Platform (like Raspberry Pi) – Architecture – Programming – Interfacing – Accessing GPIO Pins – Sending and Receiving Signals Using GPIO Pins – Connecting to the Cloud.

UNIT V APPLICATIONS DEVELOPMENT 9

Complete Design of Embedded Systems – Development of IoT Applications – Home Automation –Smart Agriculture – Smart Cities – Smart Healthcare.

45 PERIODS

PRACTICAL EXERCISES: **30 PERIODS**

1. Write 8051 Assembly Language experiments using simulator.
2. Test data transfer between registers and memory.
3. Perform ALU operations.
4. Write Basic and arithmetic Programs Using Embedded C.
5. Introduction to Arduino platform and programming
6. Explore different communication methods with IoT devices (Zigbee, GSM, Bluetooth)
7. Introduction to Raspberry PI platform and python programming
8. Interfacing sensors with Raspberry PI
9. Communicate between Arduino and Raspberry PI using any wireless medium
10. Setup a cloud platform to log the data
11. Log Data using Raspberry PI and upload to the cloud platform
12. Design an IOT based system

COURSE OUTCOMES:

CO1: Explain the architecture of embedded processors.

CO2: Write embedded C programs.

CO3: Design simple embedded applications.

CO4: Compare the communication models in IOT

CO5: Design IoT applications using Arduino/Raspberry Pi /open platform.

TOTAL :75 PERIODS

TEXTBOOKS

1. Muhammed Ali Mazidi, Janice Gillispie Mazidi, Rolin D. McKinlay, "The 8051 Microcontrollerand Embedded Systems", Pearson Education, Second Edition, 2014
2. Robert Barton, Patrick Grossetete, David Hanes, Jerome Henry, Gonzalo Salgueiro, "IoT Fundamentals: Networking Technologies, Protocols, and Use Cases for the Internet of Things", CISCO Press, 2017.

REFERENCES

1. Michael J. Pont, "Embedded C", Pearson Education, 2007.
2. Wayne Wolf, "Computers as Components: Principles of Embedded Computer System Design", Elsevier, 2006.
3. Andrew N Sloss, D. Symes, C. Wright, "Arm System Developer's Guide", Morgan Kauffman/ Elsevier, 2006.
4. Arshdeep Bahga, Vijay Madisetti, "Internet of Things – A hands-on approach", UniversitiesPress, 2015

CO's-PO's & PSO's MAPPING

CO's	PO's												PSO's		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	3	3	3	3	-	-	-	-	1	2	3	3	2	1	3
2	2	1	3	2	2	-	-	-	1	2	2	3	3	1	3
3	3	1	3	3	1	-	-	-	1	2	1	1	1	3	3
4	3	2	3	2	1	-	-	-	1	2	2	3	2	2	1
5	2	3	3	2	2	-	-	-	1	3	3	2	3	1	3
AVg.	2.6	2	3	2.4	1.5	-	-	-	1	2.2	2.2	2.4	2.2	1.6	2.6

1 - low, 2 - medium, 3 - high, '-"- no correlation

21147S71 **HUMAN VALUES AND ETHICS** **L T P C**

2 0 0 2

COURSE DESCRIPTION

This course aims to provide a broad understanding about the modern values and ethical principles that have evolved and are enshrined in the Constitution of India with regard to the democratic, secular and scientific aspects. The course is designed for undergraduate students so that they could study, understand and apply these values in their day to day life.

COURSE OBJECTIVES:

- To create awareness about values and ethics enshrined in the Constitution of India
- To sensitize students about the democratic values to be upheld in the modern society.
- To inculcate respect for all people irrespective of their religion or other affiliations.
- To instill the scientific temper in the students' minds and develop their critical thinking.
- To promote sense of responsibility and understanding of the duties of citizen.

UNIT I DEMOCRATIC VALUES 6

Understanding Democratic values: Equality, Liberty, Fraternity, Freedom, Justice, Pluralism, Tolerance, Respect for All, Freedom of Expression, Citizen Participation in Governance – World Democracies: French Revolution, American Independence, Indian Freedom Movement.

Reading Text: Excerpts from John Stuart Mills' *On Liberty*

UNIT II SECULAR VALUES 6

Understanding Secular values – Interpretation of secularism in Indian context - Disassociation of state from religion – Acceptance of all faiths – Encouraging non-discriminatory practices.

Reading Text: Excerpt from *Secularism in India: Concept and Practice* by Ram Puniyani

UNIT III SCIENTIFIC VALUES 6

Scientific thinking and method: Inductive and Deductive thinking, Proposing and testing Hypothesis, Validating facts using evidence based approach – Skepticism and Empiricism – Rationalism and Scientific Temper.

Reading Text: Excerpt from *The Scientific Temper* by Antony Michaelis R

UNIT IV SOCIAL ETHICS 6

Application of ethical reasoning to social problems – Gender bias and issues – Gender violence – Social discrimination – Constitutional protection and policies – Inclusive practices.

Reading Text: Excerpt from *21 Lessons for the 21st Century* by Yuval Noah Harari

UNIT V SCIENTIFIC ETHICS 6

Transparency and Fairness in scientific pursuits – Scientific inventions for the betterment of society - Unfair application of scientific inventions – Role and Responsibility of Scientist in the modern society.

Reading Text: Excerpt from *American Prometheus: The Triumph and Tragedy of J.Robert Oppenheimer* by Kai Bird and Martin J. Sherwin.

TOTAL: 30 PERIODS

REFERENCES:

1. The Nonreligious: Understanding Secular People and Societies, Luke W. Galen Oxford University Press, 2016.
2. Secularism: A Dictionary of Atheism, Bullivant, Stephen; Lee, Lois, Oxford University Press, 2016.
3. The Oxford Handbook of Secularism, John R. Shook, Oxford University Press, 2017.

4. The Civic Culture: Political Attitudes and Democracy in Five Nations by Gabriel A. Almond and Sidney Verba, Princeton University Press,
5. Research Methodology for Natural Sciences by Soumitro Banerjee, IISc Press, January 2022

COURSE OUTCOMES

Students will be able to

CO1 : Identify the importance of democratic, secular and scientific values in harmonious functioning of social life

CO2 : Practice democratic and scientific values in both their personal and professional life. CO3 : Find rational solutions to social problems.

CO4 : Behave in an ethical manner in society

CO5 : Practice critical thinking and the pursuit of truth.

1150INT76 **SUMMER INTERNSHIP** **L T P C**

0 0 0 2

COURSE OBJECTIVES:

To enable the students to

- **Get connected with reputed industry/ laboratory/academia / research institute**
- **Get practical knowledge on Product Development / Services and operations / Software Design and Development / Testing / Analytics/ research/ startups/ professionalism / business processes and insights / domain knowledge/ Industry Practices/ and other related aspects and develop skills to solve related problems**
- **Develop technical, soft, team skills to cater to the needs of the industry / academia / businesses / research / organizations in the core aspects of Automation, Digitalization**

The students individually undergo training in reputed firms/ research institutes / laboratories for the specifiedduration. After the completion of training, a detailed report should be submitted within ten days from the commencement of next semester. The students will be evaluated as per the Regulations.

No. of Weeks: 04

COURSE OUTCOMES:

On completion of the course, the student will know about

CO1: Industry Practices, Processes,Techniques, technology, automation and other coreaspects ofsoftware industry

CO2: Analyze, Design solutions to complex business problemsCO3: Build and deploy solutions for target platform

CO4: Preparation of Technical reports and presentation.

21150C81 **PROJECT WORK/ INTERNSHIP#** **L T P C**

0 0 20 10

COURSE OBJECTIVES:

To train the students

- **For gaining domain knowledge, and technical skills to solve potential business / researchproblems**
- **Gather requirements and Design suitable software solutions and evaluate**
- **alternatives**
- **To work in small teams and understand the processes and practices in the**
- **'industry.Implement, Test and deploy solutions for target platforms**
- **Preparing project reports and presentation**

The students shall individually / or as group work on business/research domains and related problems approved by the Department / organization that offered the internship / project.

The student can select any topic which is relevant to his/her specialization of the programme. Thestudent should continue the work on the selected topic as per the formulated methodology. At the end of the semester, after completing the work to the satisfaction of the supervisor and review

committee, a detailed report which contains clear definition of the identified problem, detailed literature review related to the area of work and methodology for carrying out the work, results and discussion, conclusion and references should be prepared as per the format prescribed by the University and submitted to the Head of the department. The students will be evaluated based on the report and viva-voce examination by a panel of examiners as per the Regulations.

TOTAL: 300 PERIODS

COURSE OUTCOMES:

At the end of the project, the student will be able to

CO1: Gain Domain knowledge and technical skill set required for solving industry /researchproblems

CO2: Provide solution architecture, module level designs, algorithmsCO3: Implement, test and deploy the solution for the target platform

CO4: Prepare detailed technical report, demonstrate and present the work

VERTICAL S ELECTIVE - I

21150E55A **EXPLORATORY DATA ANALYSIS** **L T P C**

2 0 2 3

COURSE OBJECTIVES:

- To outline an overview of exploratory data
- analysis.To implement data visualization using
- Matplotlib. To perform univariate data
- exploration and analysis.To apply bivariate data
- exploration and analysis.

To use Data exploration and visualization techniques for multivariate and time series data.

UNIT I EXPLORATORY DATA ANALYSIS 6

EDA fundamentals – Understanding data science – Significance of EDA – Making sense of data – Comparing EDA with classical and Bayesian analysis – Software tools for EDA - Visual Aids forEDA- Data transformation techniques-merging database, reshaping and pivoting, Transformation techniques.

UNIT II EDA USING PYTHON 6

Data Manipulation using Pandas – Pandas Objects – Data Indexing and Selection – Operating onData – Handling Missing Data – Hierarchical Indexing – Combining datasets – Concat, Append, Merge and Join – Aggregation and grouping – Pivot Tables – Vectorized String Operations.

UNIT III UNIVARIATE ANALYSIS 6

Introduction to Single variable: Distribution Variables - Numerical Summaries of Level and Spread - Scaling and Standardizing – Inequality.

UNIT IV BIVARIATE ANALYSIS 6

Relationships between Two Variables - Percentage Tables - Analysing Contingency Tables - Handling Several Batches - Scatterplots and Resistant Lines.

UNIT V MULTIVARIATE AND TIME SERIES ANALYSIS 6

Introducing a Third Variable - Causal Explanations - Three-Variable Contingency Tables and Beyond – Fundamentals of TSA – Characteristics of time series data – Data Cleaning – Time-based indexing – Visualizing – Grouping – Resampling.

30 PERIODS

PRACTICAL EXERCISES: 30 PERIODS

1. Install the data Analysis and Visualization tool: R/ Python /Tableau Public/ Power BI.
2. Perform exploratory data analysis (EDA) with datasets like email data set. Export all your emails as a dataset, import them inside a pandas data frame, visualize them and get differentinsights from the data.
3. Working with Numpy arrays, Pandas data frames , Basic plots using Matplotlib.
4. Explore various variable and row filters in R for cleaning data. Apply various plot features in R on sample data sets and visualize.
5. Perform Time Series Analysis and apply the various visualization techniques.
6. Perform Data Analysis and representation on a Map using various Map data sets with MouseRollover effect, user interaction, etc.Build cartographic visualization for multiple datasets involving various countries of the world;states and districts in India etc.
7. Perform EDA on Wine Quality Data Set.
8. Use a case study on a data set and apply the various EDA and visualization techniques andpresent an analysis report.

COURSE OUTCOMES:

At the end of this course, the students will be able to:

CO1: Understand the fundamentals of exploratory data analysis.

CO2: Implement the data visualization using Matplotlib.

CO3: Perform univariate data exploration and analysis.

CO4: Apply bivariate data exploration and analysis.

CO5: Use Data exploration and visualization techniques for multivariate and time series data.

TOTAL: 60 PERIODS

TEXT BOOKS:

1. Suresh Kumar Mukhiya, Usman Ahmed, “Hands-On Exploratory Data Analysis with Python”,Packt Publishing, 2020. (Unit 1)
2. Jake Vander Plas, "Python Data Science Handbook: Essential Tools for Working with Data",First Edition, O Reilly, 2017. (Unit 2)
3. Catherine Marsh, Jane Elliott, “Exploring Data: An Introduction to Data Analysis for Social Scientists”, Wiley Publications, 2nd Edition, 2008. (Unit 3,4,5)

REFERENCES:

1. Eric Pimpler, Data Visualization and Exploration with R, GeoSpatial Training service, 2017.
2. Claus O. Wilke, “Fundamentals of Data Visualization”, O’reilly publications, 2019.
3. Matthew O. Ward, Georges Grinstein, Daniel Keim, “Interactive Data Visualization: Foundations, Techniques, and Applications”, 2nd Edition, CRC press, 2015.

CO’s-PO’s & PSO’s MAPPING

CO’s	PO’s												PSO’s		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	3	2	3	3	3	-	-	-	2	2	3	2	3	3	2
2	2	2	2	3	3	-	-	-	3	2	2	2	1	2	3
3	2	3	2	2	3	-	-	-	2	2	2	1	2	3	1
4	2	2	2	2	3	-	-	-	3	2	2	1	2	2	2
5	2	2	3	2	1	-	-	-	1	2	2	1	2	2	3
AVg.	2.2	2.2	2.4	2.4	2.6	-	-	-	2.2	2	2.2	1.4	2	2.4	2.2

1 - low, 2 - medium, 3 - high, ‘-' - no correlation

21150E55B RECOMMENDER SYSTEMS L T P C
2 0 2 3

COURSE OBJECTIVES:

- To understand the foundations of the recommender system.
- To learn the significance of machine learning and data mining algorithms for Recommender systems
- To learn about collaborative filtering
- To make students design and implement a recommender system.
- To learn collaborative filtering.

UNIT I INTRODUCTION 6

Introduction and basic taxonomy of recommender systems - Traditional and non-personalized Recommender Systems - Overview of data mining methods for recommender systems- similarity measures- Dimensionality reduction – Singular Value Decomposition (SVD)

Suggested Activities:

- Practical learning – Implement Data similarity measures.
- External Learning – Singular Value Decomposition (SVD) applications

Suggested Evaluation Methods:

- Quiz on Recommender systems.
- Quiz of python tools available for implementing Recommender systems

UNIT II CONTENT-BASED RECOMMENDATION SYSTEMS 6

High-level architecture of content-based systems - Item profiles, Representing item profiles, Methods for learning user profiles, Similarity-based retrieval, and Classification algorithms.

Suggested Activities:

- Assignment on content-based recommendation systems
- Assignment of learning user profiles

Suggested Evaluation Methods:

- Quiz on similarity-based retrieval.

- Quiz of content-based filtering

UNIT III COLLABORATIVE FILTERING 6

A systematic approach, Nearest-neighbor collaborative filtering (CF), user-based and item-based CF, components of neighborhood methods (rating normalization, similarity weight computation, and neighborhood selection

Suggested Activities:

- Practical learning – Implement collaborative filtering concepts
- Assignment of security aspects of recommender systems

Suggested Evaluation Methods:

- Quiz on collaborative filtering
- Seminar on security measures of recommender systems

UNIT IV ATTACK-RESISTANT RECOMMENDER SYSTEMS 6

Introduction – Types of Attacks – Detecting attacks on recommender systems – Individual attack – Group attack – Strategies for robust recommender design - Robust recommendation algorithms.

Suggested Activities:

- Group Discussion on attacks and their mitigation
- Study of the impact of group attacks
- External Learning – Use of CAPTCHAs

Suggested Evaluation Methods:

- Quiz on attacks on recommender systems
- Seminar on preventing attacks using the CAPTCHAs

UNIT V EVALUATING RECOMMENDER SYSTEMS 6

Evaluating Paradigms – User Studies – Online and Offline evaluation – Goals of evaluation design – Design Issues – Accuracy metrics – Limitations of Evaluation measures

Suggested Activities:

- Group Discussion on goals of evaluation design
- Study of accuracy metrics

Suggested Evaluation Methods:

- Quiz on evaluation design
- Problems on accuracy measures **30 PERIODS**

PRACTICAL EXERCISES 30 PERIODS

1. Implement Data similarity measures using Python
2. Implement dimension reduction techniques for recommender systems
3. Implement user profile learning
4. Implement content-based recommendation systems
5. Implement collaborative filter techniques
6. Create an attack for tampering with recommender systems
7. Implement accuracy metrics like Receiver Operated Characteristic curves

TOTAL: 60 PERIODS

COURSE OUTCOMES:

On completion of the course, the students will be able to:

CO1:Understand the basic concepts of recommender systems.

CO2:Implement machine-learning and data-mining algorithms in recommender systems data sets.

CO3:Implementation of Collaborative Filtering in carrying out performance evaluation of recommendersystems based on various metrics.

CO4:Design and implement a simple recommender system.

CO5:Learn about advanced topics of recommender systems.

CO6:Learn about advanced topics of recommender systems applications

TEXTBOOKS:

1. Charu C. Aggarwal, Recommender Systems: The Textbook, Springer, 2016.
2. Dietmar Jannach , Markus Zanker , Alexander Felfernig and Gerhard Friedrich , Recommender Systems: An Introduction, Cambridge University Press (2011), 1st ed.
3. Francesco Ricci , Lior Rokach , Bracha Shapira , Recommender Sytems Handbook, 1st ed,Springer (2011),
4. Jure Leskovec, Anand Rajaraman, Jeffrey David Ullman, Mining of massive datasets, 3rdedition, Cambridge University Press, 2020.

CO's-PO's & PSO's MAPPING

CO's	PO's												PSO's		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	2	2	1	2	1	-	-	-	1	-	-	1	-	-	-
2	1	2	-	-	1	-	-	-	-	-	-	1	-	-	-
3	2	3	1	-	1	-	-	-	2	-	-	-	-	-	-
4	3	2	2	2	1	-	-	-	2	-	-	2	-	-	-
5	1	1	-	2	1	-	-	-	-	-	-	1	-	-	-
6	2	2	1	1	1	-	-	-	-	-	-	1	-	-	-
AVg	1.83	2	0.83	1.16	1	-	-	-	0.83	-	-	1	-	-	-

1 - low, 2 - medium, 3 - high, '-' - no correlation

21150E55C NEURAL NETWORKS AND DEEP LEARNING L T P C
2 0 2 3

COURSE OBJECTIVES:

- To understand the basics in deep neural networks
- To understand the basics of associative memory and unsupervised learning networks
- To apply CNN architectures of deep neural networks
- To analyze the key computations underlying deep learning, then use them to build and traindeep neural networks for various tasks.
- To apply autoencoders and generative models for suitable applications.

UNIT I INTRODUCTION 6

Neural Networks-Application Scope of Neural Networks-Artificial Neural Network: An Introduction-Evolution of Neural Networks-Basic Models of Artificial Neural Network- Important Terminologies of ANNs-Supervised Learning Network.

UNIT II ASSOCIATIVE MEMORY AND UNSUPERVISED LEARNING NETWORKS6

Training Algorithms for Pattern Association-Autoassociative Memory Network-Heteroassociative

Memory Network-Bidirectional Associative Memory (BAM)-Hopfield Networks-Iterative Autoassociative Memory Networks-Temporal Associative Memory Network-Fixed Weight Competitive Nets-Kohonen Self- Organizing Feature Maps-Learning Vector Quantization-Counter propagation Networks-Adaptive Resonance Theory Network.

UNIT III THIRD-GENERATION NEURAL NETWORKS 6

Spiking Neural Networks-Convolutional Neural Networks-Deep Learning Neural Networks-Extreme Learning Machine Model-Convolutional Neural Networks: The Convolution Operation – Motivation – Pooling – Variants of the basic Convolution Function – Structured Outputs – Data Types – Efficient Convolution Algorithms – Neuroscientific Basis – Applications: Computer Vision, Image Generation, Image Compression.

UNIT IV DEEP FEEDFORWARD NETWORKS 6

History of Deep Learning- A Probabilistic Theory of Deep Learning- Gradient Learning – Chain Rule and Backpropagation - Regularization: Dataset Augmentation – Noise Robustness -Early Stopping, Bagging and Dropout - batch normalization- VC Dimension and Neural Nets.

UNIT V RECURRENT NEURAL NETWORKS 6

Recurrent Neural Networks: Introduction – Recursive Neural Networks – Bidirectional RNNs – Deep Recurrent Networks – Applications: Image Generation, Image Compression, Natural Language
Processing. Complete Auto encoder, Regularized Autoencoder, Stochastic Encoders and Decoders, Contractive Encoders.

30 PERIODS

LAB EXPERIMENTS: 30 PERIODS

1. Implement simple vector addition in TensorFlow.
2. Implement a regression model in Keras.
3. Implement a perceptron in TensorFlow/Keras Environment.
4. Implement a Feed-Forward Network in TensorFlow/Keras.
5. Implement an Image Classifier using CNN in TensorFlow/Keras.
6. Improve the Deep learning model by fine tuning hyper parameters.
7. Implement a Transfer Learning concept in Image Classification.
8. Using a pre trained model on Keras for Transfer Learning
9. Perform Sentiment Analysis using RNN
10. Implement an LSTM based Autoencoder in TensorFlow/Keras.
11. Image generation using GAN

Additional Experiments:

12. Train a Deep learning model to classify a given image using pre trained model
13. Recommendation system from sales data using Deep Learning
14. Implement Object Detection using CNN
15. Implement any simple Reinforcement Algorithm for an NLP problem

TOTAL: 60 PERIODS

COURSE OUTCOMES:

At the end of this course, the students will be able to: CO1:
Apply Convolution Neural Network for image processing.

CO2: Understand the basics of associative memory and unsupervised learning networks.

CO3: Apply CNN and its variants for suitable applications.

CO4: Analyze the key computations underlying deep learning and use them to build and train deepneuralnetworks for various tasks.

CO5: Apply autoencoders and generative models for suitable applications.

TEXT BOOKS:

1. Ian Goodfellow, Yoshua Bengio, Aaron Courville, “Deep Learning”, MIT Press, 2016.
2. Francois Chollet, “Deep Learning with Python”, Second Edition, Manning Publications,2021.

REFERENCES:

1. Aurélien Géron, “Hands-On Machine Learning with Scikit-Learn and TensorFlow”, Oreilly,2018.
2. Josh Patterson, Adam Gibson, “Deep Learning: A Practitioner’s Approach”, O’Reilly Media,2017.
3. Charu C. Aggarwal, “Neural Networks and Deep Learning: A Textbook”, Springer International Publishing, 1st Edition, 2018.
4. Learn Keras for Deep Neural Networks, Jojo Moolayil, Apress,2018
5. Deep Learning Projects Using TensorFlow 2, Vinita Silaparasetty, Apress, 2020
6. Deep Learning with Python, FRANÇOIS CHOLLET, MANNING SHELTER ISLAND,2017.
7. S Rajasekaran, G A Vijayalakshmi Pai, “Neural Networks, FuzzyLogic and Genetic Algorithm, Synthesis and Applications”, PHI Learning, 2017.
8. Pro Deep Learning with TensorFlow, Santanu Pattanayak, Apress,2017
9. James A Freeman, David M S Kapura, “Neural Networks Algorithms, Applications, and Programming Techniques”, Addison Wesley, 2003.

CO’s-PO’s & PSO’s MAPPING

CO’s	PO’s												PSO’s		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	3	2	3	2	3	1	-	-	2	1	-	-	2	2	1
2	3	1	2	1	-	-	-	-	-	1	2	2	-	1	-
3	3	3	3	3	3	1	-	-	2	1	-	-	2	2	1
4	3	3	3	3	3	-	-	-	2	-	2	3	2	2	2
5	1	1	3	2	3	-	-	-	2	-	-	-	1	1	-
AVg.	2.6	2	2.8	2.2	2.4	0.4	0	0	1.6	0.6	0.8	1	1.4	1.6	0.8

1 - low, 2 - medium, 3 - high, ‘-' - no correlation

21150E55D TEXT AND SPEECH ANALYSIS L T P C
2 0 2 3

COURSE OBJECTIVES:

- Understand natural language processing basics
- Apply classification algorithms to text documents
- Build question-answering and dialogue systems
- Develop a speech recognition system
- Develop a speech synthesizer

UNIT I NATURAL LANGUAGE BASICS 6

Foundations of natural language processing – Language Syntax and Structure- Text Preprocessing and Wrangling – Text tokenization – Stemming – Lemmatization – Removing stop-words – Feature Engineering for Text representation – Bag of Words model- Bag of N-Grams model – TF-IDF model

Suggested Activities

- Flipped classroom on NLP
- Implementation of Text Preprocessing using NLTK
- Implementation of TF-IDF models

Suggested Evaluation Methods

- Quiz on NLP Basics
- Demonstration of Programs

UNIT II TEXT CLASSIFICATION **6**

Vector Semantics and Embeddings -Word Embeddings - Word2Vec model – Glove model – FastText model – Overview of Deep Learning models – RNN – Transformers – Overview of Text summarization and Topic Models

Suggested Activities

- Flipped classroom on Feature extraction of documents
- Implementation of SVM models for text classification
- External learning: Text summarization and Topic models

Suggested Evaluation Methods

- Assignment on above topics
- Quiz on RNN, Transformers
- Implementing NLP with RNN and Transformers

UNIT III QUESTION ANSWERING AND DIALOGUE SYSTEMS **9**

Information retrieval – IR-based question answering – knowledge-based question answering – language models for QA – classic QA models – chatbots – Design of dialogue systems -– evaluating dialogue systems

Suggested Activities:

- Flipped classroom on language models for QA
- Developing a knowledge-based question-answering system
- Classic QA model development

Suggested Evaluation Methods

- Assignment on the above topics
- Quiz on knowledge-based question answering system
- Development of simple chatbots

UNIT IV TEXT-TO-SPEECH SYNTHESIS **6**

Overview. Text normalization. Letter-to-sound. Prosody, Evaluation. Signal processing - Concatenative and parametric approaches, WaveNet and other deep learning-based TTS systems

Suggested Activities:

- Flipped classroom on Speech signal processing
- Exploring Text normalization
- Data collection

- Implementation of TTS systems

Suggested Evaluation Methods

- Assignment on the above topics
- Quiz on wavenet, deep learning-based TTS systems
- Finding accuracy with different TTS systems

UNIT V AUTOMATIC SPEECH RECOGNITION 6

Speech recognition: Acoustic modelling – Feature Extraction - HMM, HMM-DNN systems

Suggested Activities:

- Flipped classroom on Speech recognition.
- Exploring Feature extraction

Suggested Evaluation Methods

- Assignment on the above topics
- Quiz on acoustic modelling

30 PERIODS

PRACTICAL EXERCISES 30 PERIODS

1. Create Regular expressions in Python for detecting word patterns and tokenizing text
2. Getting started with Python and NLTK - Searching Text, Counting Vocabulary, Frequency Distribution, Collocations, Bigrams
3. Accessing Text Corpora using NLTK in Python
4. Write a function that finds the 50 most frequently occurring words of a text that are not stopwords.
5. Implement the Word2Vec model
6. Use a transformer for implementing classification
7. Design a chatbot with a simple dialog system
8. Convert text to speech and find accuracy
9. Design a speech recognition system and find the error rate

TOTAL: 60 PERIODS

COURSE OUTCOMES:

On completion of the course, the students will be able to

CO1:Explain existing and emerging deep learning architectures for text and speech processing CO2:Apply deep learning techniques for NLP tasks, language modelling and machine translationCO3:Explain coreference and coherence for text processing

CO4:Build question-answering systems, chatbots and dialogue systems

CO5:Apply deep learning models for building speech recognition and text-to-speech systems

TEXTBOOK

1. Daniel Jurafsky and James H. Martin, "Speech and Language Processing: An Introductionto NaturalLanguage Processing, Computational Linguistics, and Speech Recognition", Third Edition, 2022.

REFERENCES:

1. Dipanjan Sarkar, "Text Analytics with Python: A Practical Real-World approach to Gaining Actionable insights from your data", APress,2018.
2. Tanveer Siddiqui, Tiwary U S, "Natural Language Processing and Information Retrieval",Oxford University Press, 2008.
3. Lawrence Rabiner, Biing-Hwang Juang, B. Yegnanarayana, "Fundamentals of Speech Recognition" 1st Edition, Pearson, 2009.

4. Steven Bird, Ewan Klein, and Edward Loper, “Natural language processing with Python”, O’REILLY.

CO’s-PO’s & PSO’s MAPPING

CO’s	PO’s												PSO’s		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	3	2	3	1	3	-	-	-	1	2	1	2	1	1	1
2	3	1	2	1	3	-	-	-	2	2	1	3	3	2	1
3	2	2	1	3	1	-	-	-	3	3	1	2	3	3	1
4	2	1	1	1	2	-	-	-	2	1	2	2	3	1	1
5	1	3	2	2	1	-	-	-	3	2	1	1	2	3	1
AVg.	2.2	1.8	1.8	1.6	2	-	-	-	2.2	2	1.2	2	2.4	2	1

1 - low, 2 - medium, 3 - high, ‘-' - no correlation

21150E55E BUSINESS ANALYTICS L T P C
2 0 2 3

COURSE OBJECTIVES:

- To understand the Analytics Life Cycle.
- To comprehend the process of acquiring Business Intelligence
- To understand various types of analytics for Business Forecasting
- To model the supply chain management for Analytics.
- To apply analytics for different functions of a business

UNIT I INTRODUCTION TO BUSINESS ANALYTICS 6

Analytics and Data Science – Analytics Life Cycle – Types of Analytics – Business Problem Definition – Data Collection – Data Preparation – Hypothesis Generation – Modeling – Validation and Evaluation – Interpretation – Deployment and Iteration

UNIT II BUSINESS INTELLIGENCE 6

Data Warehouses and Data Mart - Knowledge Management –Types of Decisions - Decision MakingProcess - Decision Support Systems – Business Intelligence –OLAP – Analytic functions

UNIT III BUSINESS FORECASTING 6

Introduction to Business Forecasting and Predictive analytics - Logic and Data Driven Models – DataMining and Predictive Analysis Modelling –Machine Learning for Predictive analytics.

UNIT IV HR & SUPPLY CHAIN ANALYTICS 6

Human Resources – Planning and Recruitment – Training and Development - Supply chain network
- Planning Demand, Inventory and Supply – Logistics – Analytics applications in HR & Supply Chain
- Applying HR Analytics to make a prediction of the demand for hourly employees for a year.

UNIT V MARKETING & SALES ANALYTICS 6

Marketing Strategy, Marketing Mix, Customer Behaviour –selling Process – Sales Planning – Analytics applications in Marketing and Sales - predictive analytics for customers' behaviour in marketing and sales.

30 PERIODS

LIST OF EXPERIMENTS:

Use MS-Excel and Power-BI to perform the following experiments using a Business data set, and

make presentations.
Students may be encouraged to bring their own real-time socially relevant data set.

I Cycle – MS Excel

1. Explore the features of Ms-Excel.
2. (i) Get the input from user and perform numerical operations (MAX, MIN, AVG, SUM, SQRT, ROUND)
   ii) Perform data import/export operations for different file formats.
3. Perform statistical operations - Mean, Median, Mode and Standard deviation, Variance, Skewness, Kurtosis
4. Perform Z-test, T-test & ANOVA
5. Perform data pre-processing operations i) Handling Missing data ii) Normalization
6. Perform dimensionality reduction operation using PCA, KPCA & SVD
7. Perform bivariate and multivariate analysis on the dataset.
8. Apply and explore various plotting functions on the data set.

II Cycle – Power BI Desktop

9. Explore the features of Power BI Desktop
10. Prepare & Load data
11. Develop the data model
12. Perform DAX calculations
13. Design a report
14. Create a dashboard and perform data analysis
15. Presentation of a case study

30 PERIODS

COURSE OUTCOMES:

CO1: Explain the real world business problems and model with analytical solutions.
CO2: Identify the business processes for extracting Business Intelligence
CO3 : Apply predictive analytics for business fore-casting
CO4: Apply analytics for supply chain and logistics management
CO5: Use analytics for marketing and sales.

TOTAL :60 PERIODS

TEXT BOOKS

1. R. Evans James, Business Analytics, 2nd Edition, Pearson, 2017

2. R N Prasad, Seema Acharya, Fundamentals of Business Analytics, 2nd Edition, Wiley,2016
3. Philip Kotler and Kevin Keller, Marketing Management, 15th edition, PHI, 2016
4. VSP RAO, Human Resource Management, 3rd Edition, Excel Books, 2010.
5. Mahadevan B, "Operations Management -Theory and Practice",3rd Edition,
Pearson Education,2018.

CO's-PO's & PSO's MAPPING

CO's	PO's												PSO's		
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1	2	2	3	1	1	-	-	-	1	2	1	1	3	2	1
2	3	3	3	2	3	-	-	-	1	2	2	2	3	1	2
3	2	2	3	3	2	-	-	-	3	1	1	3	3	1	2
4	2	1	1	2	2	-	-	-	3	3	2	1	1	3	1
5	2	3	2	3	2	-	-	-	3	3	1	3	3	1	1
AVg.	2.2	2.2	2.4	2.2	2	-	-	-	2.2	2.2	1.4	2	2.6	1.6	1.4

1 - low, 2 - medium, 3 - high, '-' - no correlation

21150E55F IMAGE AND VIDEO ANALYTICS L T P C

2 0 2 3

COURSE OBJECTIVES:

- To understand the basics of image processing techniques for computer vision.
- To learn the techniques used for image pre-processing.
- To discuss the various object detection techniques.
- To understand the various Object recognition mechanisms.
- To elaborate on the video analytics techniques.

UNIT I INTRODUCTION 6

Computer Vision – Image representation and image analysis tasks - Image representations – digitization – properties – color images – Data structures for Image Analysis - Levels of image datarepresentation - Traditional and Hierarchical image data structures.

UNIT II IMAGE PRE-PROCESSING 6

Local pre-processing - Image smoothing - Edge detectors - Zero-crossings of the second derivative - Scale in image processing - Canny edge detection - Parametric edge models - Edges in multi- speralct images - Local pre-processing in the frequency domain - Line detection by local pre- processing operators - Image restoration.

UNIT III OBJECT DETECTION USING MACHINE LEARNING 6

Object detection– Object detection methods – Deep Learning framework for Object detection– bounding box approach-Intersection over Union (IoU) –Deep Learning Architectures-R-CNN-Faster R-CNN-You Only Look Once(YOLO)-Salient features-Loss Functions-YOLO architectures

UNIT IV FACE RECOGNITION AND GESTURE RECOGNITION 6

Face Recognition-Introduction-Applications of Face Recognition-Process of Face Recognition- DeepFace solution by Facebook-FaceNet for Face Recognition- Implementation using FaceNet- Gesture Recognition.

UNIT V VIDEO ANALYTICS 6

Video Processing – use cases of video analytics-Vanishing Gradient and exploding gradient problem-

RestNet architecture-RestNet and skip connections-Inception Network-GoogleNet architecture-Improvement in Inception v2-Video analytics-RestNet and Inception v3.

30 PERIODS

LIST OF EXERCISES **30 PERIODS**

1. Write a program that computes the T-pyramid of an image.
2. Write a program that derives the quad tree representation of an image using the homogeneitycriterion of equal intensity
3. Develop programs for the following geometric transforms: (a) Rotation (b) Change of scale **(c) Skewing (d) Affine transform calculated from three pairs of corresponding points (e)Bilinear transform calculated from four pairs of corresponding points.**
4. Develop a program to implement Object Detection and Recognition
5. Develop a program for motion analysis using moving edges, and apply it to your image sequences.
6. Develop a program for Facial Detection and Recognition
7. Write a program for event detection in video surveillance system

TOTAL: 60 PERIODS

COURSE OUTCOMES:

At the end of this course, the students will be able to:

CO1: Understand the basics of image processing techniques for computer vision and video analysis.

CO2: Explain the techniques used for image pre-processing.

CO3: Develop various object detection techniques.

CO4: Understand the various face recognition mechanisms.

CO5: Elaborate on deep learning-based video analytics.

TEXT BOOK:

1. Milan Sonka, Vaclav Hlavac, Roger Boyle, “Image Processing, Analysis, and Machine Vision”, 4nd edition, Thomson Learning, 2013.
2. Vaibhav Verdhan,(2021, Computer Vision Using Deep Learning Neural Network Architectures with Python and Keras,Apress 2021(UNIT-III,IV and V)

REFERENCES

1. Richard Szeliski, “Computer Vision: Algorithms and Applications”, Springer Verlag London
2. Limited,2011.
3. Caifeng Shan, FatihPorikli, Tao Xiang, Shaogang Gong, “Video Analytics for Business Intelligence”, Springer, 2012.
4. D. A. Forsyth, J. Ponce, “Computer Vision: A Modern Approach”, Pearson Education, 2003.
5. E. R. Davies, (2012), “Computer & Machine Vision”, Fourth Edition, Academic Press.

CO’s-PO’s & PSO’s MAPPING

CO’s	PO’s												PSO’s		
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1	3	1	2	2	2	-	-	-	3	3	2	1	2	1	3
2	2	2	3	3	3	-	-	-	3	2	1	1	2	2	1
3	1	2	2	2	3	-	-	-	1	2	1	2	1	1	3
4	1	2	3	2	3	-	-	-	2	2	2	3	2	2	2
5	3	2	1	3	2	-	-	-	2	1	1	3	3	2	1
AVg.	2	1.8	2.2	2.4	2.6	-	-	-	2.2	2	1.4	2	2	1.6	2

1 - low, 2 - medium, 3 - high, '-' - no correlation

21150E55G COMPUTER VISION L T P C

2 0 2 3

COURSE OBJECTIVES:

- To understand the fundamental concepts related to Image formation and processing.
- To learn feature detection, matching and detection
- To become familiar with feature based alignment and motion estimation
- To develop skills on 3D reconstruction
- To understand image based rendering and recognition

UNIT I INTRODUCTION TO IMAGE FORMATION AND PROCESSING 6

Computer Vision - Geometric primitives and transformations - Photometric image formation - The digital camera - Point operators - Linear filtering - More neighborhood operators - Fourier transforms - Pyramids and wavelets - Geometric transformations - Global optimization.

UNIT II FEATURE DETECTION, MATCHING AND SEGMENTATION 6

Points and patches - Edges - Lines - Segmentation - Active contours - Split and merge - Mean shiftand mode finding - Normalized cuts - Graph cuts and energy-based methods.

UNIT III FEATURE-BASED ALIGNMENT & MOTION ESTIMATION 6

2D and 3D feature-based alignment - Pose estimation - Geometric intrinsic calibration - Triangulation - Two-frame structure from motion - Factorization - Bundle adjustment - Constrained structure and motion - Translational alignment - Parametric motion - Spline-based motion - Optical flow - Layeredmotion.

UNIT IV 3D RECONSTRUCTION 6

Shape from X - Active rangefinding - Surface representations - Point-based representations- Volumetric representations - Model-based reconstruction - Recovering texture maps and albedosos.

UNIT V IMAGE-BASED RENDERING AND RECOGNITION 6

View interpolation Layered depth images - Light fields and Lumigraphs - Environment mattes - Video-basedrendering-Object detection - Face recognition - Instance recognition - Category recognition - Context and scene understanding- Recognition databases and test sets.

30 PERIODS

PRACTICAL EXERCISES: 30 PERIODS

LABORATORY EXPERIMENTS:

Software needed:

OpenCV computer vision Library for OpenCV in Python / PyCharm or C++ / Visual Studio or or equivalent

- OpenCV Installation and working with Python
- Basic Image Processing - loading images, Cropping, Resizing, Thresholding, Contour analysis, Bolb detection
- Image Annotation – Drawing lines, text circle, rectangle, ellipse on images
- Image Enhancement - Understanding Color spaces, color space conversion, Histogram equialization, Convolution, Image smoothing, Gradients, Edge Detection
- Image Features and Image Alignment – Image transforms – Fourier, Hough, Extract ORBImage features, Feature matching, cloning, Feature matching based image alignment
- Image segmentation using Graphcut / Grabcut

- Camera Calibration with circular grid
- Pose Estimation
- 3D Reconstruction – Creating Depth map from stereo images
- Object Detection and Tracking using Kalman Filter, Camshift

1. docs.opencv.org
2. https://opencv.org/opencv-free-course/

TOTAL : 60 PERIODS

OURSE OUTCOMES:

At the end of this course, the students will be able to:

CO1:To understand basic knowledge, theories and methods in image processing and computervision.

CO2:To implement basic and some advanced image processing techniques in OpenCV.

CO3:To apply 2D a feature-based based image alignment, segmentation and motion estimations.CO4:To apply 3D image reconstruction techniques

CO5:To design and develop innovative image processing and computer vision applications.

TEXT BOOKS:

1. Richard Szeliski, "Computer Vision: Algorithms and Applications", Springer- Texts in Computer Science, Second Edition, 2022.
2. Computer Vision: A Modern Approach, D. A. Forsyth, J. Ponce, Pearson Education, SecondEdition, 2015.

REFERENCES:

1. Richard Hartley and Andrew Zisserman, Multiple View Geometry in Computer Vision, Second Edition, Cambridge University Press, March 2004.
2. Christopher M. Bishop; Pattern Recognition and Machine Learning, Springer, 2006
3. E. R. Davies, Computer and Machine Vision, Fourth Edition, Academic Press, 2012.

CO's-PO's & PSO's MAPPING

CO's	PO's												PSO's		
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3	3	3	2	2	3	-	-	-	1	1	2	2	3	2	2
4	2	3	3	2	3	-	-	-	2	1	2	3	2	2	3
5	2	3	3	2	2	2	-	-	3	1	2	3	3	3	3
AVg.	2.6	2.6	2.4	1.8	2.4	0.4	0.25	0	2	1	2.2	2.4	2.6	1.8	2.2

1 - low, 2 - medium, 3 - high, '-' - no correlation

21150E55H BIG DATA ANALYTICS L T P C
2 0 2 3

COURSE OBJECTIVES:

- To understand big data.
- To learn and use NoSQL big data management.
- To learn mapreduce analytics using Hadoop and related tools.
- To work with map reduce applications
- To understand the usage of Hadoop related tools for Big Data Analytics

UNIT I UNDERSTANDING BIG DATA 5

Introduction to big data – convergence of key trends – unstructured data – industry examples of bigdata –web analytics – big data applications– big data technologies – introduction to Hadoop – opensource technologies – cloud and big data – mobile business intelligence – Crowd sourcing analytics– inter and trans firewall analytics.

UNIT II NOSQL DATA MANAGEMENT 7

Introduction to NoSQL – aggregate data models – key-value and document data models – relationships –graph databases – schemaless databases – materialized views – distribution models – master-slave replication – consistency - Cassandra – Cassandra data model – Cassandraexamples – Cassandra clients

UNIT III MAP REDUCE APPLICATIONS 6

MapReduce workflows – unit tests with MRUnit – test data and local tests – anatomy of MapReducejob run – classic Map-reduce – YARN – failures in classic Map-reduce and YARN – job scheduling – shuffle and sort – task execution – MapReduce types – input formats – output formats.

UNIT IV BASICS OF HADOOP 6

Data format – analyzing data with Hadoop – scaling out – Hadoop streaming – Hadoop pipes – designof Hadoop distributed file system (HDFS) – HDFS concepts – Java interface – data flow – Hadoop I/O – data integrity – compression – serialization – Avro – file-based data structures - Cassandra – Hadoop integration.

UNIT V HADOOP RELATED TOOLS 6

Hbase – data model and implementations – Hbase clients – Hbase examples – praxis.Pig – Grunt – pig data model – Pig Latin – developing and testing Pig Latin scripts.
Hive – data types and file formats – HiveQL data definition – HiveQL data manipulation – HiveQL queries.

30 PERIODS

COURSE OUTCOMES:

After the completion of this course, students will be able to: CO1:Describe big data and use cases from selected business domains.**CO2:**Explain NoSQL big data management.

CO3:Install, configure, and run Hadoop and HDFS.
CO4:Perform map-reduce analytics using Hadoop.
CO5:Use Hadoop-related tools such as HBase, Cassandra, Pig, and Hive for big data analytics.

LIST OF EXPERIMENTS: 30 PERIODS

1. Downloading and installing Hadoop; Understanding different Hadoop modes. Startup scripts, Configuration files.
2. Hadoop Implementation of file management tasks, such as Adding files and directories, **retrieving files and Deleting files**
3. Implement of Matrix Multiplication with Hadoop Map Reduce
4. Run a basic Word Count Map Reduce program to understand Map Reduce Paradigm.
5. Installation of Hive along with practice examples.
7. Installation of HBase, Installing thrift along with Practice examples
8. Practice importing and exporting data from various databases.

Software Requirements:

Cassandra, Hadoop, Java, Pig, Hive and HBase.

TOTAL:60 PERIODSXT BOOKS:

1. Michael Minelli, Michelle Chambers, and AmbigaDhiraj, "Big Data, Big Analytics: Emerging Business Intelligence and Analytic Trends for Today's Businesses", Wiley, 2013.
2. Eric Sammer, "Hadoop Operations", O'Reilley, 2012.
3. Sadalage, Pramod J. "NoSQL distilled", 2013

REFERENCES:

1. E. Capriolo, D. Wampler, and J. Rutherglen, "Programming Hive", O'Reilley, 2012.
2. Lars George, "HBase: The Definitive Guide", O'Reilley, 2011.
3. Eben Hewitt, "Cassandra: The Definitive Guide", O'Reilley, 2010.
4. Alan Gates, "Programming Pig", O'Reilley, 2011.

CO's-PO's & PSO's MAPPING

CO's	PO's												PSO's		
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3	3	3	3	2	3	-	-	-	2	2	1	2	2	3	3
4	2	3	3	3	3	-	-	-	2	2	3	2	3	3	2
5	3	3	3	3	3	-	-	-	3	1	3	2	3	2	3
AVg.	2.8	3	2.8	2.8	2.8	-	-	-	2.2	1.8	2.6	2	2.2	2.8	2.6

1 - low, 2 - medium, 3 - high, '-' - no correlation

ELECTIVE - II

21150E56A **WEB TECHNOLOGIES** **L T P C**
2 0 2 3

COURSE OBJECTIVES:

- To understand different Internet Technologies
- To learn java-specific web services architecture
- To Develop web applications using frameworks

UNIT I WEBSITE BASICS, HTML 5, CSS 3, WEB 2.0 7

Web Essentials: Clients, Servers and Communication – The Internet – World wide web – HTTP Request Message – HTTP Response Message – Web Clients – Web Servers – HTML5 – Tables –Lists – Image – HTML5 control elements – Drag and Drop – Audio – Video controls - CSS3 – Inline,embedded and external style sheets – Rule cascading – Inheritance – Backgrounds – Border Images – Colors – Shadows – Text – Transformations – Transitions – Animations. Bootstrap

Framework

UNIT II CLIENT SIDE PROGRAMMING 6

Java Script: An introduction to JavaScript–JavaScript DOM Model-Exception Handling-Validation-Built-inobjects-Event Handling- DHTML with JavaScript- JSON introduction – Syntax – FunctionFiles.

UNIT III SERVER SIDE PROGRAMMING 5

Servlets: Java Servlet Architecture- Servlet Life Cycle- Form GET and POST actions- Session Handling- Understanding Cookies- DATABASE CONNECTIVITY: JDBC.

UNIT IV PHP and XML 6

An introduction to PHP: PHP- Using PHP- Variables- Program control- Built-in functions- Form Validation. XML: Basic XML- Document Type Definition- XML Schema, XML Parsers and Validation,XSL ,

UNIT V INTRODUCTION TO ANGULAR and WEB APPLICATIONS FRAMEWORKS 6

Introduction to AngularJS, MVC Architecture, Understanding ng attributes, Expressions and data binding, Conditional Directives, Style Directives, Controllers, Filters, Forms, Routers, Modules, Services; Web Applications Frameworks and Tools – Firebase- Docker- Node JS- React- Django- UI & UX.

COURSE OUTCOMES:

CO1: Construct a basic website using HTML and Cascading Style Sheets

CO2: Build dynamic web page with validation using Java Script objects and by applying differenteventhandling mechanisms.

CO3: Develop server side programs using Servlets and JSP.

CO4: Construct simple web pages in PHP and to represent data in XML format.

CO5: Develop interactive web applications.

30 PERIODS

PRACTICAL EXERCISES: 30 PERIODS

List Of Experiments:

1. Create a web page with the following using HTML.
   - To embed an image map in a web page.
   - To fix the hot spots.
   - Show all the related information when the hot spots are clicked.
2. Create a web page with all types of Cascading style sheets.
3. Client Side Scripts for Validating Web Form Controls using DHTML.
4. Installation of Apache Tomcat web server.
5. Write programs in Java using Servlets:
   - To invoke servlets from HTML forms.
   - Session Tracking.
6. Write programs in Java to create three-tier applications using JSP and Databases
   - For conducting on-line examination.
   - For displaying student mark list. Assume that student information is available in a databasewhich has been stored in a database server.
7. Programs using XML – Schema – XSLT/XSL.

TOTAL:60 PERIODS

TEXTBOOKS

1. **Deitel and Deitel and Nieto, Internet and World Wide Web - How to Program, Prentice Hall, 5th**

Edition, 2011.

2. Jeffrey C and Jackson, Web Technologies A Computer Science Perspective, PearsonEducation, 2011.
3. Angular 6 for Enterprise-Ready Web Applications, Doguhan Uluca, 1st edition, Packt Publishing

REFERENCES:

1. Stephen Wynkoop and John Burke "Running a Perfect Website", QUE, 2nd Edition,1999.
2. Chris Bates, Web Programming – Building Intranet Applications, 3rd Edition, Wiley Publications, 2009.
3. Gopalan N.P. and Akilandeswari J., "Web Technology", Prentice Hall of India, 2011.
4. UttamK.Roy, "Web Technologies", Oxford University Press, 2011.
5. Angular: Up and Running: Learning Angular, Step by Step, Shyam Seshadri, 1st edition,OReilly

CO's-PO's & PSO's MAPPING

CO's	PO's												PSO's		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	3	2	3	3	3	-	-	-	1	3	3	1	3	2	3
2	2	2	2	1	2	-	-	-	2	2	1	3	2	2	2
3	1	1	3	2	3	-	-	-	1	2	1	1	1	2	1
4	2	3	3	1	2	-	-	-	3	1	2	2	2	2	2
5	1	2	3	2	2	-	-	-	2	1	3	1	1	1	2
AVg.	1.8	2	2.8	1.8	2.4	-	-	-	1.8	1.8	2	1.6	1.8	1.8	2

1 - low, 2 - medium, 3 - high, '-' - no correlation

21150E56B APP DEVELOPMENT L T P C

2 0 2 3

COURSE OBJECTIVES:

- To learn development of native applications with basic GUI Components
- To develop cross-platform applications with event handling
- To develop applications with location and data storage capabilities
- To develop web applications with database access

UNIT I FUNDAMENTALS OF MOBILE & WEB APPLICATION DEVELOPMENT 6

Basics of Web and Mobile application development, Native App, Hybrid App, Cross-platform App, What is Progressive Web App, Responsive Web design,

UNIT II NATIVE APP DEVELOPMENT USING JAVA 6

Native Web App, Benefits of Native App, Scenarios to create Native App, Tools for creating Native App, Cons of Native App, Popular Native App Dev elopment Frameworks, Java & Kotlin for Android, Swift & Objective-C for iOS, Basics of React Native, Native Components, JSX, State, Props

UNIT III HYBRID APP DEVELOPMENT 6

Hybrid Web App, Benefits of Hybrid App, Criteria for creating Native App, Tools for creating HybridApp, Cons of Hybrid App, Popular Hybrid App Development Frameworks, Ionic, Apache Cordova,

UNIT IV CROSS-PLATFORM APP DEVELOPMENT USING REACT-NATIVE 6

What is Cross-platform App, Benefits of Cross-platform App, Criteria for creating Cross-platform App, Tools for creating Cross-platform App, Cons of Cross-platform App, Popular Cross-platform App Development Frameworks, Flutter, Xamarin, React-Native, Basics of React Native, Native Components, JSX, State, Props

UNIT V NON-FUNCTIONAL CHARACTERISTICS OF APP FRAMEWORKS 6

Comparison of different App frameworks, Build Performance, App Performance, Debugging capabilities, Time to Market, Maintainability, Ease of Development, UI/UX, Reusability

OURSE OUTCOMES:

CO1:Develop Native applications with GUI Components.

CO2:Develop hybrid applications with basic event handling.

CO3: Implement cross-platform applications with location and data storage capabilities.

CO4: Implement cross platform applications with basic GUI and event handling.

CO5:Develop web applications with cloud database access.

30 PERIODS

PRACTICAL EXERCISES: 30 PERIODS

1. Using react native, build a cross platform application for a BMI calculator.
2. Build a cross platform application for a simple expense manager which allows entering expenses and income on each day and displays category wise weekly income and expense.
3. Develop a cross platform application to convert units from imperial system to metric system (km to miles, kg to pounds etc.,)
4. Design and develop a cross platform application for day to day task (to-do) management.
5. Design an android application using Cordova for a user login screen with username, password, reset button and a submit button. Also, include header image and a label. Use layout managers.
6. Design and develop an android application using Apache Cordova to find and display the current location of the user.
7. Write programs using Java to create Android application having Databases
   - For a simple library application.
   - For displaying books available, books lend, book reservation. Assume that student information is available in a database which has been stored in a database server.

TOTAL:60 PERIODS

TEXT BOOKS

1. Head First Android Development, Dawn Griffiths, O'Reilly, 1st edition
2. Apache Cordova in Action, Raymond K. Camden, Manning. 2015
3. Full Stack React Native: Create beautiful mobile apps with JavaScript and React Native, Anthony Accomazzo, Houssein Djirdeh, Sophia Shoemaker, Devin Abbott, FullStack publishing

REFERENCES

1. Android Programming for Beginners, John Horton, Packt Publishing, 2nd Edition
2. Native Mobile Development by Shaun Lewis, Mike Dunn
3. Building Cross-Platform Mobile and Web Apps for Engineers and Scientists: An Active Learning Approach, Pawan Lingras, Matt Triff, Rucha Lingras
4. Apache Cordova 4 Programming, John M Wargo, 2015
5. React Native Cookbook, Daniel Ward, Packt Publishing, 2nd Edition

CO's-PO's & PSO's MAPPING

CO's	PO's												PSO's		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	2	2	1	2	3	-	-	-	1	1	2	1	2	3	3
2	2	1	3	2	2	-	-	-	3	2	2	3	3	2	1
3	2	2	2	1	2	-	-	-	1	1	1	1	1	1	2
4	1	3	1	1	3	-	-	-	1	1	3	2	1	3	1
5	1	1	3	1	3	-	-	-	1	1	2	1	3	2	1
AVg.	1.6	1.8	2	1.4	2.6	-	-	-	1.4	1.2	2	1.6	2	2.2	1.6

1 - low, 2 - medium, 3 - high, '-' - no correlation

21150E56C **CLOUD SERVICES MANAGEMENT** **L T P C**
2 0 2 3

COURSE OBJECTIVES:

- Introduce Cloud Service Management terminology, definition & concepts
- Compare and contrast cloud service management with traditional IT service management
- Identify strategies to reduce risk and eliminate issues associated with adoption of cloudservices
- Select appropriate structures for designing, deploying and running cloud-based services ina business environment
- Illustrate the benefits and drive the adoption of cloud-based services to solve real world problems

UNIT I CLOUD SERVICE MANAGEMENT FUNDAMENTALS 6

Cloud Ecosystem, The Essential Characteristics, Basics of Information Technology Service Management and Cloud Service Management, Service Perspectives, Cloud Service Models, Cloud Service Deployment Models

UNIT II CLOUD SERVICES STRATEGY 6

Cloud Strategy Fundamentals, Cloud Strategy Management Framework, Cloud Policy, Key Driver for Adoption, Risk Management, IT Capacity and Utilization, Demand and Capacity matching, Demand Queueing, Change Management, Cloud Service Architecture

UNIT III CLOUD SERVICE MANAGEMENT 6

Cloud Service Reference Model, Cloud Service LifeCycle, Basics of Cloud Service Design, Dealing with Legacy Systems and Services, Benchmarking of Cloud Services, Cloud Service Capacity Planning, Cloud Service Deployment and Migration, Cloud Marketplace, Cloud Service Operations Management

UNIT IV CLOUD SERVICE ECONOMICS 6

Pricing models for Cloud Services, Freemium, Pay Per Reservation, Pay per User, Subscription based Charging, Procurement of Cloud-based Services, Capex vs Opex Shift, Cloud service Charging, Cloud Cost Models

UNIT V CLOUD SERVICE GOVERNANCE & VALUE 6

IT Governance Definition, Cloud Governance Definition, Cloud Governance Framework, Cloud Governance Structure, Cloud Governance Considerations, Cloud Service Model Risk Matrix, Understanding Value of Cloud Services, Measuring the value of Cloud Services, Balanced Scorecard, Total Cost of Ownership

COURSE OUTCOMES:

CO1:Exhibit cloud-design skills to build and automate business solutions using cloud technologies. CO2: Possess Strong theoretical foundation leading to excellence and excitement towards adoption of cloud-based services

CO3: Solve the real world problems using Cloud services and technologies

30 PERIODS

PRACTICAL EXERCISES: **30 PERIODS**

1. Create a Cloud Organization in AWS/Google Cloud/or any equivalent Open Source cloudsoftwares like Openstack, Eucalyptus, OpenNebula with Role-based access control
2. Create a Cost-model for a web application using various services and do Cost-benefitanalysis
3. Create alerts for usage of Cloud resources
4. Create Billing alerts for your Cloud Organization
5. Compare Cloud cost for a simple web application across AWS, Azure and GCP and suggestthe best one

TOTAL:60 PERIODS

TEXT BOOKS

1. Cloud Service Management and Governance: Smart Service Management in Cloud Era byEnamul Haque, Enel Publications
2. Cloud Computing: Concepts, Technology & Architecture by Thomas Erl, Ricardo Puttini, Zaigham Mohammad 2013
3. Cloud Computing Design Patterns by Thomas Erl, Robert Cope, Amin Naserpour

REFERENCES

1. Economics of Cloud Computing by Praveen Ayyappa, LAP Lambert Academic Publishing
2. Mastering Cloud Computing Foundations and Applications Programming Rajkumar Buyya, Christian Vechhiola, S. Thamarai Selvi

CO's-PO's & PSO's MAPPING

CO's	PO's												PSO's		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	3	3	1	1	1	-	-	-	2	1	3	2	2	1	3
2	3	1	2	3	2	-	-	-	1	2	3	1	2	2	2
3	1	1	3	1	3	-	-	-	3	3	1	1	3	2	1
4	1	1	1	2	3	-	-	-	2	3	3	1	1	1	1
5	1	3	3	2	2	-	-	-	1	3	1	2	1	3	2
AVg.	1.8	1.8	2	1.8	2.2	-	-	-	1.8	2.4	2.2	1.4	1.8	1.8	1.8

1 - low, 2 - medium, 3 - high, '-' - no correlation

21150E56D **UI A UX DESIGN** **L T P C**
2 0 2 3

COURSE OBJECTIVES:

- To provide a sound knowledge in UI & UX
- To understand the need for UI and UX
- To understand the various Research Methods used in Design
- To explore the various Tools used in UI & UX
- Creating a wireframe and prototype

UNIT I FOUNDATIONS OF DESIGN 6

UI vs. UX Design - Core Stages of Design Thinking - Divergent and Convergent Thinking - Brainstorming and Game storming - Observational Empathy

UNIT II FOUNDATIONS OF UI DESIGN 6

Visual and UI Principles - UI Elements and Patterns - Interaction Behaviors and Principles – Branding - Style Guides

UNIT III FOUNDATIONS OF UX DESIGN 6

Introduction to User Experience - Why You Should Care about User Experience - Understanding User Experience - Defining the UX Design Process and its Methodology - Research in User Experience Design - Tools and Method used for Research - User Needs and its Goals - Know aboutBusiness Goals

UNIT IV WIREFRAMING, PROTOTYPING AND TESTING 6

Sketching Principles - Sketching Red Routes - Responsive Design – Wireframing - Creating Wireflows - Building a Prototype - Building High-Fidelity Mockups - Designing Efficiently with Tools - Interaction Patterns - Conducting Usability Tests - Other Evaluative User Research Methods - SynthesizingTest Findings - Prototype Iteration

UNIT V RESEARCH, DESIGNING, IDEATING, & INFORMATION ARCHITECTURE6

Identifying and Writing Problem Statements - Identifying Appropriate Research Methods - Creating Personas - Solution Ideation - Creating User Stories - Creating Scenarios - Flow Diagrams - Flow Mapping - Information Architecture

30 PERIODS

LIST OF EXPERIMENTS 30 PERIODS

1. Designing a Responsive layout for an societal application
2. Exploring various UI Interaction Patterns
3. Developing an interface with proper UI Style Guides
4. Developing Wireflow diagram for application using open source software
5. Exploring various open source collaborative interface Platform
6. Hands on Design Thinking Process for a new product
7. Brainstorming feature for proposed product
8. Defining the Look and Feel of the new Project
9. Create a Sample Pattern Library for that product (Mood board, Fonts, Colors based onUI principles)
10. Identify a customer problem to solve
11. Conduct end-to-end user research - User research, creating personas, Ideationprocess (User stories, Scenarios), Flow diagrams, Flow Mapping
12. Sketch, design with popular tool and build a prototype and perform usability testing andidentify improvements

TOTAL: 60 PERIODS

COURSE OUTCOMES:

On completion of the course, the students will be able to:

CO1:Build UI for user Applications

CO2:Evaluate UX design of any product or applicationCO3:Demonstrate UX Skills in product development CO4:Implement Sketching principles

CO5:Create Wireframe and Prototype

TEXT BOOKS

1. Joel Marsh, "UX for Beginners", O'Reilly , 2022
2. Jon Yablonski, "Laws of UX using Psychology to Design Better Product & Services" O'Reilly2021

REFERENCES

1. Jenifer Tidwell, Charles Brewer, Aynne Valencia, "Designing Interface" 3 rd Edition , O'Reilly2020
2. Steve Schoger, Adam Wathan "Refactoring UI", 2018
3. Steve Krug, "Don't Make Me Think, Revisited: A Commonsense Approach to Web & Mobile", Third Edition, 2015
4. https://www.nngroup.com/articles/
5. https://www.interaction-design.org/literature.

CO's-PO's & PSO's MAPPING

CO's	PO's												PSO's		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	3	1	1	3	1	-	-	-	3	3	2	1	3	3	1
2	2	3	1	3	2	-	-	-	1	2	2	2	1	2	2
3	1	3	3	2	2	-	-	-	2	3	1	2	1	3	3
4	1	2	3	3	1	-	-	-	3	2	1	3	3	3	3
5	1	2	3	2	1	-	-	-	2	1	1	1	3	2	2
AVg.	1.6	2.2	2.2	2.6	1.4	-	-	-	2.2	2.2	1.4	1.8	2.2	2.6	2.2

1 - low, 2 - medium, 3 - high, '-' - no correlation

21150E56E **SOFTWARE TESTING AND AUTOMATION** **L T P C**
2 0 2 3

COURSE OBJECTIVES:

- To understand the basics of software testing
- To learn how to do the testing and planning effectively
- To build test cases and execute them
- To focus on wide aspects of testing and understanding multiple facets of testing
- To get an insight about test automation and the tools used for test automation

UNIT I FOUNDATIONS OF SOFTWARE TESTING 6

Why do we test Software?, Black-Box Testing and White-Box Testing, Software Testing Life Cycle, V-model of Software Testing, Program Correctness and Verification, Reliability versus Safety, Failures, Errors and Faults (Defects), Software Testing Principles, Program Inspections, Stages of Testing: Unit Testing, Integration Testing, System Testing

UNIT II TEST PLANNING 6

The Goal of Test Planning, High Level Expectations,Intergroup Responsibilities, Test Phases, Test Strategy, Resource Requirements, Tester Assignments, Test Schedule, Test Cases, Bug Reporting, Metrics and Statistics.

UNIT III TEST DESIGN AND EXECUTION 6

Test Objective Identification, Test Design Factors, Requirement identification, Testable Requirements, Modeling a Test Design Process, Modeling Test Results, Boundary Value Testing, Equivalence Class Testing, Path Testing, Data Flow Testing, Test Design Preparedness Metrics, Test Case Design Effectiveness, Model-Driven Test Design, Test Procedures, Test Case

Organization and Tracking, Bug Reporting, Bug Life Cycle.

UNIT IV ADVANCED TESTING CONCEPTS 6

Performance Testing: Load Testing, Stress Testing, Volume Testing, Fail-Over Testing, Recovery Testing, Configuration Testing, Compatibility Testing, Usability Testing, Testing the Documentation,Security testing, Testing in the Agile Environment, Testing Web and Mobile Applications.

UNIT V TEST AUTOMATION AND TOOLS 6

Automated Software Testing, Automate Testing of Web Applications, Selenium: Introducing Web Driver and Web Elements, Locating Web Elements, Actions on Web Elements, Different Web Drivers, Understanding Web Driver Events, Testing: Understanding Testing.xml, Adding Classes, Packages, Methods to Test, Test Reports.

30 PERIODS

PRACTICAL EXERCISES: 30 PERIODS

1. Develop the test plan for testing an e-commerce web/mobile application (www.amazon.in).
2. Design the test cases for testing the e-commerce application
3. Test the e-commerce application and report the defects in it.
4. Develop the test plan and design the test cases for an inventory control system.
5. Execute the test cases against a client server or desktop application and identify the defects.
6. Test the performance of the e-commerce application.
7. Automate the testing of e-commerce applications using Selenium.
8. Integrate TestNG with the above test automation.
9. Mini Project:
   a) Build a data-driven framework using Selenium and TestNG
   b) Build Page object Model using Selenium and TestNG
   c) Build BDD framework with Selenium, TestNG and Cucumber

COURSE OUTCOMES:

CO1: Understand the basic concepts of software testing and the need for software testing

CO2: Design Test planning and different activities involved in test planning

CO3: Design effective test cases that can uncover critical defects in the applicationCO4: Carry out advanced types of testing

CO5:-Automate the software testing using Selenium and TestNG

TOTAL:60 PERIODS

TEXTBOOKS

1. Yogesh Singh, “Software Testing”, Cambridge University Press, 2012
2. Unmesh Gundecha, Satya Avasarala, "Selenium WebDriver 3 Practical Guide" - SecondEdition 2018

REFERENCES

1. Glenford J. Myers, Corey Sandler, Tom Badgett, The Art of Software Testing, 3rd Edition,2012, John Wiley & Sons, Inc.
2. Ron Patton, Software testing, 2nd Edition, 2006, Sams Publishing
3. Paul C. Jorgensen, Software Testing: A Craftsman’s Approach, Fourth Edition, 2014, Taylor& Francis Group.
4. Carl Cocchiaro, Selenium Framework Design in Data-Driven Testing, 2018, Packt Publishing.
5. Elfriede Dustin, Thom Garrett, Bernie Gaurf, Implementing Automated Software Testing,2009, Pearson Education, Inc.
6. Satya Avasarala, Selenium WebDriver Practical Guide, 2014, Packt Publishing.

7. **Varun Menon, TestNg Beginner's Guide, 2013, Packt Publishing.**

CO's-PO's & PSO's MAPPING

CO's	PO's												PSO's		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	3	3	2	1	2	-	-	-	1	1	3	2	3	2	3
2	2	3	1	1	1	-	-	-	2	2	1	2	1	2	3
3	2	2	1	3	1	-	-	-	1	3	1	2	2	3	2
4	2	1	3	2	1	-	-	-	1	1	1	2	3	1	2
5	2	2	1	3	1	-	-	-	1	3	2	1	2	1	3
AVg.	2.2	2.2	1.6	2	1.2	-	-	-	1.2	2	1.6	1.8	2.2	1.8	2.6

1 - low, 2 - medium, 3 - high, '-' - no correlation

21150E56F WEB APPLICATION SECURITY L T P C
2 0 2 3

COURSE OBJECTIVES:

- To understand the fundamentals of web application security
- To focus on wide aspects of secure development and deployment of web applications
- To learn how to build secure APIs
- To learn the basics of vulnerability assessment and penetration testing
- To get an insight about Hacking techniques and Tools

UNIT I FUNDAMENTALS OF WEB APPLICATION SECURITY 6

The history of Software Security-Recognizing Web Application Security Threats, Web Application Security, Authentication and Authorization, Secure Socket layer, Transport layer Security, Session Management-InputValidation

UNIT II SECURE DEVELOPMENT AND DEPLOYMENT 5

Web Applications Security - Security Testing, Security Incident Response Planning,The Microsoft Security Development Lifecycle (SDL), OWASP Comprehensive Lightweight Application Security Process (CLASP), The Software Assurance Maturity Model (SAMM)

UNIT III SECURE API DEVELOPMENT 6

API Security- Session Cookies, Token Based Authentication, Securing Natter APIs: Addressing threats with Security Controls, Rate Limiting for Availability, Encryption, Audit logging, Securing service-to-service APIs: API Keys , OAuth2, Securing Microservice APIs: Service Mesh, Locking Down Network Connections, Securing Incoming Requests.

UNIT IV VULNERABILITY ASSESSMENT AND PENETRATION TESTING 6

Vulnerability Assessment Lifecycle, Vulnerability Assessment Tools: Cloud-based vulnerability scanners, Host-based vulnerability scanners, Network-based vulnerability scanners, Database- based vulnerabilityscanners, Types of Penetration Tests: External Testing, Web Application Testing, Internal Penetration Testing, SSID or Wireless Testing, Mobile Application Testing.

UNIT V HACKING TECHNIQUES AND TOOLS 7

Social Engineering, Injection, Cross-Site Scripting(XSS), Broken Authentication and Session Management, Cross-Site Request Forgery, Security Misconfiguration, Insecure Cryptographic

Storage, Failure to Restrict URL Access, Tools: Comodo, OpenVAS, Nexpose, Nikto, Burp Suite,etc.

30 PERIODS

PRACTICAL EXERCISES: **30 PERIODS**

1. Install wireshark and explore the various protocols
    a. Analyze the difference between HTTP vs HTTPS
    b. Analyze the various security mechanisms embedded with different protocols.
2. Identify the vulnerabilities using OWASP ZAP tool
3. Create simple REST API using python for following operation
    . **GET**
    a. PUSH
    b. POST
    c. DELETE
4. Install Burp Suite to do following vulnerabilities:
    . **SQL injection**
    a. cross-site scripting (XSS)
5. Attack the website using Social Engineering method

COURSE OUTCOMES:

CO1: Understanding the basic concepts of web application security and the need for it
CO2: Be acquainted with the process for secure development and deployment of web applicationsCO3: Acquire the skill to design and develop Secure Web Applications that use Secure APIs CO4: Be able to get the importance of carrying out vulnerability assessment and penetration testingCO5: Acquire the skill to think like a hacker and to use hackers tool sets

TOTAL :60 PERIODS

TEXT BOOKS

1. Andrew Hoffman, Web Application Security: Exploitation and Countermeasures for ModernWeb Applications, First Edition, 2020, O'Reilly Media, Inc.
2. Bryan Sullivan, Vincent Liu, Web Application Security: A Beginners Guide, 2012, The McGraw-Hill Companies.
3. Neil Madden, API Security in Action, 2020, Manning Publications Co., NY, USA.

REFERENCES

1. Michael Cross, Developer's Guide to Web Application Security, 2007, Syngress Publishing,Inc.
2. Ravi Das and Greg Johnson, Testing and Securing Web Applications, 2021, Taylor & FrancisGroup, LLC.
3. Prabath Siriwardena, Advanced API Security, 2020, Apress Media LLC, USA.
4. Malcom McDonald, Web Security for Developers, 2020, No Starch Press, Inc.
5. Allen Harper, Shon Harris, Jonathan Ness, Chris Eagle, Gideon Lenkey, and Terron Williams Grey Hat Hacking: The Ethical Hacker's Handbook, Third Edition, 2011, The McGraw-Hill Companies.

CO's-PO's & PSO's MAPPING

CO's	PO's												PSO's		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	1	2	2	1	3	-	-	-	-	-	-	1	-	-	-
2	2	1	2	1	3	-	-	-	-	-	-	-	-	-	-
3	1	1	1	2	3	-	-	-	-	-	-	1	-	-	-
4	1	2	1	1	2	-	-	-	-	-	-	-	-	-	-
5	1	2	2	2	2	-	-	-	-	-	-	1	-	-	-
AVg.	1.2	1.6	1.6	1.4	2.6	-	-	-	-	-	-	0.6	-	-	-

1 - low, 2 - medium, 3 - high, '-' - no correlation

21150E56G **DEVOPS** **L T P C**
2 0 2 3

COURSE OBJECTIVES:

- To introduce DevOps terminology, definition & concepts
- To understand the different Version control tools like Git, Mercurial
- To understand the concepts of Continuous Integration/ Continuous Testing/ Continuous Deployment)
- To understand Configuration management using Ansible
- Illustrate the benefits and drive the adoption of cloud-based Devops tools to solve realworld problems

UNIT I INTRODUCTION TO DEVOPS 6

Devops Essentials - Introduction To AWS, GCP, Azure - Version control systems: Git and Github.

UNIT II COMPILE AND BUILD USING MAVEN & GRADLE 6

Introduction, Installation of Maven, POM files, Maven Build lifecycle, Build phases(compile build, test, package) Maven Profiles, Maven repositories(local, central, global),Maven plugins, Maven create and build Artificats, Dependency management, Installation of Gradle, Understand build usingGradle

UNIT III CONTINUOUS INTEGRATION USING JENKINS 6

Install & Configure Jenkins, Jenkins Architecture Overview, Creating a Jenkins Job, Configuring a Jenkins job, Introduction to Plugins, Adding Plugins to Jenkins, Commonly used plugins (Git Plugin, Parameter Plugin, HTML Publisher, Copy Artifact and Extended choice parameters). Configuring Jenkins to work withjava, Git and Maven, Creating a Jenkins Build and Jenkins workspace.

UNIT IV CONFIGURATION MANAGEMENT USING ANSIBLE 6

Ansible Introduction, Installation, Ansible master/slave configuration, YAML basics, Ansible modules, Ansible Inventory files, Ansible playbooks, Ansible Roles, adhoc commands in ansible

UNIT V BUILDING DEVOPS PIPELINES USING AZURE 6

Create Github Account, Create Repository, Create Azure Organization, Create a new pipeline, Builda samplecode, Modify azure-pipelines.yaml file

COURSE OUTCOMES:

CO1: Understand different actions performed through Version control tools like Git.

CO2: Perform Continuous Integration and Continuous Testing and Continuous DeploymentusingJenkins by building and automating test cases using Maven & Gradle.
CO3: Ability to Perform Automated Continuous Deployment
CO4: Ability to do configuration management using Ansible
CO5: Understand to leverage Cloud-based DevOps tools using Azure DevOps

30 PERIODS

PRACTICAL EXERCISES: 30 PERIODS

1. Create Maven Build pipeline in Azure
2. Run regression tests using Maven Build pipeline in Azure
3. Install Jenkins in Cloud
4. Create CI pipeline using Jenkins
5. Create a CD pipeline in Jenkins and deploy in Cloud
6. Create an Ansible playbook for a simple web application infrastructure
7. Build a simple application using Gradle
8. Install Ansible and configure ansible roles and to write playbooks

TOTAL:60 PERIODS

TEXT BOOKS

1. Roberto Vormittag, “A Practical Guide to Git and GitHub for Windows Users: From Beginner to Expert in Easy Step-By-Step Exercises”, Second Edition, Kindle Edition, 2016.
2. Jason Cannon, “Linux for Beginners: An Introduction to the Linux Operating System and Command Line”, Kindle Edition, 2014

REFERENCES

1. Hands-On Azure Devops: Cicd Implementation For Mobile, Hybrid, And Web Applications Using Azure Devops And Microsoft Azure: CICD Implementation for ... DevOps and Microsoft Azure (English Edition) Paperback – 1 January 2020
2. by Mitesh Soni
3. Jeff Geerling, “Ansible for DevOps: Server and configuration management for humans”, FirstEdition, 2015.
4. David Johnson, “Ansible for DevOps: Everything You Need to Know to Use Ansible for DevOps”, Second Edition, 2016.
5. Mariot Tsitoara, “Ansible 6. Beginning Git and GitHub: A Comprehensive Guide to Version Control, Project Management, and Teamwork for the New Developer”, Second Edition, 2019.
6. https://www.jenkins.io/user-handbook.pdf
7. https://maven.apache.org/guides/getting-started/

CO’s-PO’s & PSO’s MAPPING

CO’s	PO’s												PSO’s		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	3	3	3	2	3	-	-	-	-	-	-	-	2	2	2
2	3	3	3	2	3	-	-	-	-	-	-	-	2	2	2
3	3	3	3	2	3	-	-	-	-	-	-	-	2	2	2
4	3	3	3	2	3	-	-	-	-	-	-	-	2	2	2
5	3	3	3	2	3	-	-	-	-	-	-	-	2	2	2
AVg.	3	3	3	2	3	-	-	-	-	-	-	-	2	2	2

1 - low, 2 - medium, 3 - high, ‘-' - no correlation

21150E56H **PRINCIPLES OF PROGRAMMING LANGUAGES** **L T P C**

3 0 0 3

COURSE OBJECTIVES:

- To understand and describe syntax and semantics of programming languages
- To understand data, data types, and basic statements
- To understand call-return architecture and ways of implementing them
- To understand object-orientation, concurrency, and event handling in programming languages
- To develop programs in non-procedural programming paradigms

UNIT I SYNTAX AND SEMANTICS 9

Evolution of programming languages – describing syntax – context-free grammars – attribute grammars – describing semantics – lexical analysis – parsing – recursive-descent – bottom up parsing

UNIT II DATA, DATA TYPES, AND BASIC STATEMENTS 9

Names – variables – binding – type checking – scope – scope rules – lifetime and garbage collection –primitive data types – strings – array types – associative arrays – record types – union types – pointers and references – Arithmetic expressions – overloaded operators – type conversions – relational and boolean expressions – assignment statements – mixed mode assignments – control structures – selection – iterations – branching – guarded statements

UNIT III SUBPROGRAMS AND IMPLEMENTATIONS 9

Subprograms – design issues – local referencing – parameter passing – overloaded methods – generic methods – design issues for functions – semantics of call and return – implementing simple subprograms – stack and dynamic local variables – nested subprograms – blocks – dynamic scoping

UNIT IV OBJECT-ORIENTATION, CONCURRENCY, AND EVENT HANDLING 9

Object-orientation – design issues for OOP languages – implementation of object-oriented constructs – concurrency – semaphores – monitors – message passing – threads – statement level concurrency – exception handling – event handling

UNIT V FUNCTIONAL AND LOGIC PROGRAMMING LANGUAGES 9

Introduction to lambda calculus – fundamentals of functional programming languages –Programming with Scheme – Programming with ML – Introduction to logic and logic programming – Programmingwith Prolog – multi-paradigm languages

TOTAL: 45 PERIODS

COURSE OUTCOMES:

CO1: Describe syntax and semantics of programming languages

CO2: Explain data, data types, and basic statements of programming languages

CO3: Design and implement subprogram constructs

CO4: Apply object-oriented, concurrency, and event handling programming constructsandDevelop programs in Scheme, ML, and Prolog

CO5: Understand and adopt new programming languages

TEXT BOOKS

1. Robert W. Sebesta, “Concepts of Programming Languages”, Twelfth Edition (Global Edition), Pearson, 2022.
2. Michael L. Scott, “Programming Language Pragmatics”, Fourth Edition, Elsevier, 2018.

3. R. Kent Dybvig, “The Scheme programming language”, Fourth Edition, Prentice Hall, 2011.
4. Jeffrey D. Ullman, “Elements of ML programming”, Second Edition, Pearson, 1997.
5. W. F. Clocksin and C. S. Mellish, “Programming in Prolog: Using the ISO Standard”, Fifth Edition, Springer, 2003.

CO’s-PO’s & PSO’s MAPPING

CO’s	PO’s												PSO’s		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	2	2	3	2	1	-	-	-	-	-	-	3	2	3	-
2	3	3	3	2	2	-	-	-	-	-	-	3	2	3	-
3	3	3	3	2	2	-	-	-	-	-	-	3	2	3	-
4	3	3	3	3	2	2	-	-	-	-	-	-	3	2	-
5	3	3	3	3	3	3	2	2	1	3	1	3	3	3	-
AVg.	**2.8**	**2.8**	**3**	**2.4**	**2**	**2.5**	**2**	**2**	**1**	**3**	**1**	**3**	**2.4**	**2.8**	-

1 - low, 2 - medium, 3 - high, ‘-' - no correlation

ELECTIVE - III

21150E64A **CLOUD COMPUTING** **L T P C**
2 0 2 3

COURSE OBJECTIVES:

- To understand the principles of cloud architecture, models and infrastructure.
- To understand the concepts of virtualization and virtual machines.
- To gain knowledge about virtualization Infrastructure.
- To explore and experiment with various Cloud deployment environments.
- To learn about the security issues in the cloud environment.

UNIT I CLOUD ARCHITECTURE MODELS AND INFRASTRUCTURE 6

Cloud Architecture: System Models for Distributed and Cloud Computing – NIST Cloud Computing Reference Architecture – Cloud deployment models – Cloud service models; Cloud Infrastructure: Architectural Design of Compute and Storage Clouds – Design Challenges

UNIT II VIRTUALIZATION BASICS 6

Virtual Machine Basics – Taxonomy of Virtual Machines – Hypervisor – Key Concepts – Virtualization structure – Implementation levels of virtualization – Virtualization Types: Full Virtualization – Para Virtualization – Hardware Virtualization – Virtualization of CPU, Memory andI/O devices.

UNIT III VIRTUALIZATION INFRASTRUCTURE AND DOCKER 7

Desktop Virtualization – Network Virtualization – Storage Virtualization – System-level of Operating Virtualization – Application Virtualization – Virtual clusters and Resource Management – Containers vs. Virtual Machines – Introduction to Docker – Docker Components – Docker Container – DockerImages and Repositories.

UNIT IV CLOUD DEPLOYMENT ENVIRONMENT 6

Google App Engine – Amazon AWS – Microsoft Azure; Cloud Software Environments – Eucalyptus

– OpenStack.

UNIT V CLOUD SECURITY 5

Virtualization System-Specific Attacks: Guest hopping – VM migration attack – hyperjacking. Data Securityand Storage; Identity and Access Management (IAM) - IAM Challenges - IAM Architectureand Practice.

30 PERIODS

PRACTICAL EXERCISES: 30 PERIODS

1. Install Virtualbox/VMware/ Equivalent open source cloud Workstation with different flavoursof Linux or Windows OS on top of windows 8 and above.
2. Install a C compiler in the virtual machine created using a virtual box and execute Simple Programs
3. Install Google App Engine. Create a hello world app and other simple web applications using python/java.
4. Use the GAE launcher to launch the web applications.
5. Simulate a cloud scenario using CloudSim and run a scheduling algorithm that is not presentin CloudSim.
6. Find a procedure to transfer the files from one virtual machine to another virtual machine.
7. Install Hadoop single node cluster and run simple applications like wordcount.
8. Creating and Executing Your First Container Using Docker.
9. Run a Container from Docker Hub

COURSE OUTCOMES:

CO1: Understand the design challenges in the cloud.

CO2: Apply the concept of virtualization and its types.

CO3: Experiment with virtualization of hardware resources and Docker.

CO4: Develop and deploy services on the cloud and set up a cloud environment.

CO5: Explain security challenges in the cloud environment.

TOTAL:60 PERIODS

TEXT BOOKS

1. Kai Hwang, Geoffrey C Fox, Jack G Dongarra, "Distributed and Cloud Computing, From Parallel Processing to the Internet of Things", Morgan Kaufmann Publishers, 2012.
2. James Turnbull, "The Docker Book", O'Reilly Publishers, 2014.
3. Krutz, R. L., Vines, R. D, "Cloud security. A Comprehensive Guide to Secure Cloud Computing", Wiley Publishing, 2010.

REFERENCES

1. James E. Smith, Ravi Nair, "Virtual Machines: Versatile Platforms for Systems and Processes", Elsevier/Morgan Kaufmann, 2005.
2. Tim Mather, Subra Kumaraswamy, and Shahed Latif, "Cloud Security and Privacy: an enterprise perspective on risks and compliance", O'Reilly Media, Inc., 2009.

CO's-PO's & PSO's MAPPING

CO's	PO's												PSO's		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	3	2	1	1	1	-	-	-	2	3	1	3	2	1	3
2	3	1	2	2	1	-	-	-	1	2	1	3	2	2	1
3	2	3	2	3	1	-	-	-	3	1	1	3	1	1	1
4	1	2	3	3	3	-	-	-	3	3	1	2	1	3	3
5	2	3	3	1	3	-	-	-	2	2	1	2	2	2	3
AVg.	2.2	2.2	2.2	2	1.8	-	-	-	2.2	2.2	1	2.6	1.6	1.8	2.2

1 - low, 2 - medium, 3 - high, '-' - no correlation

21150E64B **VIRTUALIZATION** **L T P C**
2 0 2 3

COURSE OBJECTIVES:

- To Learn the basics and types of Virtualization
- To understand the Hypervisors and its types
- To Explore the Virtualization Solutions
- To Experiment the virtualization platforms

UNIT I INTRODUCTION TO VIRTUALIZATION 7

Virtualization and cloud computing - Need of virtualization – cost, administration, fast deployment, reduce infrastructure cost – limitations- Types of hardware virtualization: Full virtualization - partial virtualization - Paravirtualization-Types of Hypervisors

UNIT II SERVER AND DESKTOP VIRTUALIZATION 6

Virtual machine basics- Types of virtual machines- Understanding Server Virtualization- types of server virtualization- Business Cases for Server Virtualization – Uses of Virtual Server Consolidation
– Selecting Server Virtualization Platform-Desktop Virtualization-Types of Desktop Virtualization

UNIT III NETWORK VIRTUALIZATION 6

Introduction to Network Virtualization-Advantages- Functions-Tools for Network Virtualization-VLAN- WAN Architecture-WAN Virtualization

UNIT IV STORAGE VIRTUALIZATION 5

Memory Virtualization-Types of Storage Virtualization-Block, File-Address space Remapping-Risks of Storage Virtualization-SAN-NAS-RAID

UNIT V VIRTUALIZATION TOOLS 6

VMWare-Amazon AWS-Microsoft HyperV- Oracle VM Virtual Box - IBM PowerVM- Google Virtualization- Case study.

30 PERIODS

PRACTICAL EXERCISES: 30 PERIODS

1. Create type 2 virtualization in VMWARE or any equivalent Open Source Tool. Allocate memoryandstorage space as per requirement. Install Guest OS on that VMWARE.

2.

a. Shrink and extend virtual disk
b. Create, Manage, Configure and schedule snapshots
c. Create Spanned, Mirrored and Striped volume
d. Create RAID 5 volume

3.

a. Desktop Virtualization using VNC
b. Desktop Virtualization using Chrome Remote Desktop

4. Create type 2 virtualization on ESXI 6.5 server 5.Create a VLAN in CISCO packet tracer 6.InstallKVM in Linux
7. Create Nested Virtual Machine(VM under another VM)

COURSE OUTCOMES:

CO1: Analyse the virtualization concepts and Hypervisor CO2: Apply the Virtualization for real-world applications CO3: Install & Configure the different VM platforms CO4:Experiment with the VM with various software

TOTAL:60 PERIODS

TEXT BOOKS

1. Cloud computing a practical approach - Anthony T.Velte , Toby J. Velte Robert Elsenpeter,TATA McGraw- Hill , New Delhi – 2010
2. Cloud Computing (Principles and Paradigms), Edited by Rajkumar Buyya, James Broberg,Andrzej Goscinski, John Wiley & Sons, Inc. 2011
3. David Marshall, Wade A. Reynolds, Advanced Server Virtualization: VMware and Microsoft Platform in the Virtual Data Center, Auerbach
4. Chris Wolf, Erick M. Halter, "Virtualization: From the Desktop to the Enterprise", APress,2005.
5. James E. Smith, Ravi Nair, "Virtual Machines: Versatile Platforms for Systems and Processes", Elsevier/Morgan Kaufmann, 2005.
6. David Marshall, Wade A. Reynolds, "Advanced Server Virtualization: VMware and Microsoft Platform in the Virtual Data Center", Auerbach Publications, 2006.

CO's-PO's & PSO's MAPPING

CO's	PO's												PSO's		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	1	3	1	3	2	-	-	-	1	1	3	1	2	3	2
2	3	2	2	1	2	-	-	-	1	2	2	3	3	2	1
3	3	2	1	3	1	-	-	-	2	2	1	3	3	3	2
4	1	1	2	3	3	-	-	-	3	3	1	1	3	2	2
5	1	3	2	3	1	-	-	-	2	1	3	3	1	1	2
AVg.	1.8	2.2	1.6	2.6	1.8	-	-	-	1.8	1.8	2	2.2	2.4	2.2	1.8

1 - low, 2 - medium, 3 - high, '-' - no correlation

21150E64D DATA WAREHOUSING L T P C
2 0 2 3

COURSE OBJECTIVES:

- To know the details of data warehouse Architecture
- To understand the OLAP Technology
- To understand the partitioning strategy
- To differentiate various schema
- To understand the roles of process manager & system manager

UNIT I INTRODUCTION TO DATA WAREHOUSE 5

Data warehouse Introduction - Data warehouse components- operational database Vs data warehouse – Data warehouse Architecture – Three-tier Data Warehouse Architecture - Autonomous Data Warehouse- Autonomous Data Warehouse Vs Snowflake - Modern Data Warehouse

UNIT II ETL AND OLAP TECHNOLOGY 6

What is ETL – ETL Vs ELT – Types of Data warehouses - Data warehouse Design and Modeling - Delivery Process - Online Analytical Processing (OLAP) - Characteristics of OLAP - Online Transaction Processing (OLTP) Vs OLAP - OLAP operations- Types of OLAP- ROLAP Vs MOLAP Vs HOLAP.

UNIT III META DATA, DATA MART AND PARTITION STRATEGY 7

Meta Data – Categories of Metadata – Role of Metadata – Metadata Repository – Challenges for Meta Management - Data Mart – Need of Data Mart- Cost Effective Data Mart- Designing Data Marts- Costof Data Marts- Partitioning Strategy – Vertical partition – Normalization – Row Splitting – Horizontal Partition

UNIT IV DIMENSIONAL MODELING AND SCHEMA 6

Dimensional Modeling- Multi-Dimensional Data Modeling – Data Cube- Star Schema- Snowflake schema- Star Vs Snowflake schema- Fact constellation Schema- Schema Definition - Process Architecture- Types of Data Base Parallelism – Datawarehouse Tools

UNIT V SYSTEM & PROCESS MANAGERS 6

Data Warehousing System Managers: System Configuration Manager- System Scheduling Manager - System Event Manager - System Database Manager - System Backup Recovery Manager - Data Warehousing Process Managers: Load Manager – Warehouse Manager- Query Manager – Tuning – Testing

30 PERIODS

PRACTICAL EXERCISES: 30 PERIODS

1. Data exploration and integration with WEKA
2. Apply weka tool for data validation
3. Plan the architecture for real time application
4. Write the query for schema definition
5. Design data ware house for real time applications
6. Analyse the dimensional Modeling
7. Case study using OLAP
8. Case study using OTLP
9. Implementation of warehouse testing.

COURSE OUTCOMES:

At the end of the course the students should be able to CO1: Design data warehouse architecture for various Problems**CO2:** Apply the OLAP Technology

CO3: Analyse the partitioning strategy

CO4: Critically analyze the differentiation of various schema for given problem

CO5: Frame roles of process manager & system manager

TOTAL: 60 PERIODS

TEXT BOOKS

1. Alex Berson and Stephen J. Smith “Data Warehousing, Data Mining & OLAP”, Tata McGraw – Hill Edition, Thirteenth Reprint 2008.
2. Ralph Kimball, “The Data Warehouse Toolkit: The Complete Guide to Dimensional Modeling”, Third edition, 2013.

REFERENCES

1. Paul Raj Ponniah, "Data warehousing fundamentals for IT Professionals", 2012.
2. K.P. Soman, ShyamDiwakar and V. Ajay "Insight into Data mining Theory and Practice",Easter Economy Edition, Prentice Hall of India, 2006.

CO's-PO's & PSO's MAPPING

CO	PO											
	1	2	3	4	5	6	7	8	9	10	11	12
1	3	3	3	2	2	-	-	-	3	-	-	3
2	3	2	2	2	3	-	-	-	2	-	2	2
3	3	3	3	3	-	-	-	-	-	-	-	3
4	3	3	3	3	-	-	-	-	-	-	-	3
5	3	2	2	2	-	2	-	-	-	-	2	2
AVg.	3	2.6	2.6	1.2	2.5	1	-	-	2.5	-	2	2.6

1 - low, 2 - medium, 3 - high, '-' - no correlation

21150E64E STORAGE TECHNOLOGIES L T P C
3 0 0 3

COURSE OBJECTIVES:

- Characterize the functionalities of logical and physical components of storage
- Describe various storage networking technologies
- Identify different storage virtualization technologies
- Discuss the different backup and recovery strategies
- Understand common storage management activities and solutions

UNIT I STORAGE SYSTEMS 9

Introduction to Information Storage: Digital data and its types, Information storage, Key characteristics of data center and Evolution of computing platforms. Information Lifecycle Management. Third Platform Technologies: Cloud computing and its essential characteristics, Cloudservices and cloud deployment models,Big data analytics, Social networking and mobile computing, Characteristics of third platform infrastructure and Imperatives for third platform transformation. DataCenter Environment: Building blocks of a data center, Compute systems and compute virtualizationand Software-defined data center.

UNIT II INTELLIGENT STORAGE SYSTEMS AND RAID 5

Components of an intelligent storage system, Components, addressing, and performance of hard disk drivesand solid-state drives, RAID, Types of intelligent storage systems, Scale-up and scale- out storage Architecture.

UNIT III STORAGE NETWORKING TECHNOLOGIES AND VIRTUALIZATION 13

Block-Based Storage System, File-Based Storage System, Object-Based and Unified Storage. FibreChannel SAN: Software-defined networking, FC SAN components and architecture, FC SAN topologies, link aggregation, and zoning, Virtualization in FC SAN environment. Internet Protocol SAN: iSCSI protocol, network components, and connectivity, Link aggregation, switch aggregation,and VLAN, FCIP protocol,

connectivity, and configuration. Fibre Channel over Ethernet SAN: Components of FCoE SAN, FCoE SAN connectivity, Converged Enhanced Ethernet, FCoE architecture.

UNIT IV BACKUP, ARCHIVE AND REPLICATION 12

Introduction to Business Continuity, Backup architecture, Backup targets and methods, Data deduplication, Cloud-based and mobile device backup, Data archive, Uses of replication and its characteristics, Compute based, storage-based, and network-based replication, Data migration, Disaster Recovery as a Service (DRaaS).

UNIT V SECURING STORAGE INFRASTRUCTURE 6

Information security goals, Storage security domains, Threats to a storage infrastructure, Security controls to protect a storage infrastructure, Governance, risk, and compliance, Storage infrastructure management functions, Storage infrastructure management processes.

COURSE OUTCOMES:

CO1: Demonstrate the fundamentals of information storage management and various models ofCloudinfrastructure services and deployment

CO2: Illustrate the usage of advanced intelligent storage systems and RAID

CO3: Interpret various storage networking architectures - SAN, including storage subsystems andvirtualization

CO4: Examine the different role in providing disaster recovery and remote replication technologies

CO5: Infer the security needs and security measures to be employed in information storagemanagement

TOTAL:45 PERIODS

TEXTBOOKS

1. EMC Corporation, Information Storage and Management, Wiley, India
2. Jon Tate, Pall Beck, Hector Hugo Ibarra, Shanmuganathan Kumaravel and Libor Miklas, Introduction to Storage Area Networks, Ninth Edition, IBM - Redbooks, December 2017
3. Ulf Troppens, Rainer Erkens, Wolfgang Mueller-Friedt, Rainer Wolafka, Nils Haustein **,Storage Networks Explained, Second Edition, Wiley, 2009**

CO's-PO's & PSO's MAPPING

CO's	PO's											PSO's		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	1	2	1	3	3	-	-	-	1	1	1	3	1	2	1
2	3	1	2	3	3	-	-	-	3	2	3	2	2	3	1
3	1	1	3	2	2	-	-	-	3	1	1	2	2	3	3
4	3	2	1	2	2	-	-	-	1	1	3	1	3	2	1
5	1	3	2	1	2	-	-	-	1	2	3	1	3	2	1
AVg.	1.8	1.8	1.8	2.2	2.4	-	-	-	1.8	1.4	2.2	1.8	2.2	2.4	1.4

1 - low, 2 - medium, 3 - high, '-' - no correlation

21150E64F SOFTWARE DEFINED NETWORKS **L T P C**
2 0 2 3

COURSE OBJECTIVES:

- To understand the need for SDN and its data plane operations
- To understand the functions of control plane
- To comprehend the migration of networking functions to SDN environment
- To explore various techniques of network function virtualization
- To comprehend the concepts behind network virtualization

UNIT I SDN: INTRODUCTION 6

Evolving Network Requirements – The SDN Approach – SDN architecture - SDN Data Plane , Control plane and Application Plane

UNIT II SDN DATA PLANE AND CONTROL PLANE 6

Data Plane functions and protocols - OpenFLow Protocol - Flow Table - Control Plane Functions - Southbound Interface, Northbound Interface – SDN Controllers - Ryu, OpenDaylight, ONOS - Distributed Controllers

UNIT III SDN APPLICATIONS 6

SDN Application Plane Architecture – Network Services Abstraction Layer – Traffic Engineering – Measurement and Monitoring – Security – Data Center Networking

UNIT IV NETWORK FUNCTION VIRTUALIZATION 6

Network Virtualization - Virtual LANs – OpenFlow VLAN Support - NFV Concepts – Benefits and Requirements – Reference Architecture

UNIT V NFV FUNCTIONALITY 6

NFV Infrastructure – Virtualized Network Functions – NFV Management and Orchestration – NFVUse cases – SDN and NFV

30 PERIODS

PRACTICAL EXERCISES: 30 PERIODS

1) Setup your own virtual SDN lab
   i) Virtualbox/Mininet Environment for SDN - http://mininet.org
   ii) https://www.kathara.org
   iii) GNS3
2) Create a simple mininet topology with SDN controller and use Wireshark to capture and visualize the OpenFlow messages such as OpenFlow FLOW MOD, PACKET IN, PACKET OUT etc.
3) Create a SDN application that uses the Northbound API to program flow table rules on theswitch for various use cases like L2 learning switch, Traffic Engineering, Firewall etc.
4) Create a simple end-to-end network service with two VNFs using vim-emu https://github.com/containernet/vim-emu
5) Install OSM and onboard and orchestrate network service.

COURSE OUTCOMES:

After the successful completion of this course, the student will be able toCO1: Describe the motivation behind SDN
CO2: Identify the functions of the data plane and control plane

CO3: Design and develop network applications using SDN
CO4: Orchestrate network services using NFV
CO5: Explain various use cases of SDN and NFV

TOTAL :60 PERIODS

TEXTBOOKS:

1. **William Stallings, "Foundations of Modern Networking: SDN, NFV, QoE, IoT and Cloud",PearsonEducation, 1st Edition, 2015.**

REFERENCES:

1. Ken Gray, Thomas D. Nadeau, "Network Function Virtualization", Morgan Kauffman, 2016.
2. Thomas D Nadeau, Ken Gray, "SDN: Software Defined Networks", O'Reilly Media, 2013.
3. Fei Hu, "Network Innovation through OpenFlow and SDN: Principles and Design", 1st Edition,CRC Press, 2014.
4. Paul Goransson, Chuck Black Timothy Culver, "Software Defined Networks: A Comprehensive Approach", 2nd Edition, Morgan Kaufmann Press, 2016.
5. Oswald Coker, Siamak Azodolmolky, "Software-Defined Networking with OpenFlow", 2nd Edition, O'Reilly Media, 2017.

CO's-PO's & PSO's MAPPING

CO's	PO's												PSO's		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	1	2	3	1	3	-	-	-	2	3	1	3	1	2	1
2	2	1	2	2	3	-	-	-	2	2	2	2	1	3	2
3	2	2	2	3	3	-	-	-	3	1	1	2	1	3	3
4	2	2	2	3	1	-	-	-	1	3	1	2	2	2	2
5	3	3	1	1	3	-	-	-	1	2	1	2	2	1	3
AVg.	2	2	2	2	2.6	-	-	-	1.8	2.2	1.2	2.2	1.4	2.2	2.2

1 - low, 2 - medium, 3 - high, '-' - no correlation

21150E64G STREAM PROCESSING L T P C
2 0 2 3

COURSE OBJECTIVES:

- Introduce Data Processing terminology, definition & concepts
- Define different types of Data Processing
- Explain the concepts of Real-time Data processing
- Select appropriate structures for designing and running real-time data services in abusiness environment
- Illustrate the benefits and drive the adoption of real-time data services to solve real world problems

UNIT I FOUNDATIONS OF DATA SYSTEMS 6

Introduction to Data Processing, Stages of Data processing, Data Analytics, Batch Processing, Stream processing, Data Migration, Transactional Data processing, Data Mining, Data ManagementStrategy, Storage,Processing, Integration, Analytics, Benefits of Data as a Service, Challenges

UNIT II REAL-TIME DATA PROCESSING 6

Introduction to Big data, Big data infrastructure, Real-time Analytics, Near real-time solution, Lambda architecture, Kappa Architecture, Stream Processing,Understanding Data Streams, Message Broker, Stream Processor, Batch & Real-time ETL tools, Streaming Data Storage

UNIT III DATA MODELS AND QUERY LANGUAGES 6

Relational Model, Document Model, Key-Value Pairs, NoSQL, Object-Relational Mismatch, Many- to-One and Many-to-Many Relationships, Network data models, Schema Flexibility, Structured Query Language, Data Locality for Queries, Declarative Queries, Graph Data models, Cypher QueryLanguage, Graph Queries in SQL, The Semantic Web, CODASYL, SPARQL

UNIT IV EVENT PROCESSING WITH APACHE KAFKA 6

Apache Kafka, Kafka as Event Streaming platform, Events, Producers, Consumers, Topics, Partitions,Brokers, Kafka APIs, Admin API, Producer API, Consumer API, Kafka Streams API, Kafka Connect API.

UNIT V REAL-TIME PROCESSING USING SPARK STREAMING 6

Structured Streaming, Basic Concepts, Handling Event-time and Late Data, Fault-tolerant Semantics, Exactly-once Semantics, Creating Streaming Datasets, Schema Inference, Partitioning of Streaming datasets,Operations on Streaming Data, Selection, Aggregation, Projection, Watermarking, Window operations, Types of Time windows, Join Operations, Deduplication

30 PERIODS

PRACTICAL EXERCISES: 30 PERIODS

1. Install MongoDB
2. Design and Implement Simple application using MongoDB
3. Query the designed system using MongoDB
4. Create a Event Stream with Apache Kafka
5. Create a Real-time Stream processing application using Spark Streaming
6. Build a Micro-batch application
7. Real-time Fraud and Anomaly Detection,
8. Real-time personalization, Marketing, Advertising

COURSE OUTCOMES:

CO1:Understand the applicability and utility of different streaming algorithms.
CO2:Describe and apply current research trends in data-stream processing.
CO3:Analyzethe suitability of stream mining algorithms for data stream systems.CO4:Program and build stream processing systems, services and applications. CO5:Solve problems in real- world applications that process data streams.

TOTAL:60 PERIODS

TEXT BOOKS

1. Streaming Systems: The What, Where, When and How of Large-Scale Data Processing byTyler Akidau, Slava Chemyak, Reuven Lax, O'Reilly publication
2. Designing Data-Intensive Applications by Martin Kleppmann, O'Reilly Media
3. Practical Real-time Data Processing and Analytics : Distributed Computing and Event Processing using Apache Spark, Flink, Storm and Kafka, Packt Publishing

REFERENCES

1. https://spark.apache.org/docs/latest/streaming-programming-guide.html
2. Kafka.apache.org

CO's-PO's & PSO's MAPPING

CO's	PO's												PSO's		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	3	3	2	3	1	-	-	-	2	3	1	2	1	3	3
2	2	1	1	2	2	-	-	-	3	2	2	3	1	2	1
3	3	1	2	3	3	-	-	-	2	2	1	1	2	2	1
4	2	1	3	3	3	-	-	-	3	3	1	1	1	2	1
5	3	3	1	2	2	-	-	-	3	3	2	3	2	3	2
AVg.	2.6	1.8	1.8	2.6	2.2	-	-	-	2.6	2.6	1.4	2	1.4	2.4	1.6

1 - low, 2 - medium, 3 - high, '-' - no correlation

21150E64H SECURITY AND PRIVACY IN CLOUD L T P C
2 0 2 3

COURSE OBJECTIVES:

- To Introduce Cloud Computing terminology, definition & concepts
- To understand the security design and architectural considerations for Cloud
- To understand the Identity, Access control in Cloud
- To follow best practices for Cloud security using various design patterns
- To be able to monitor and audit cloud applications for security

UNIT I FUNDAMENTALS OF CLOUD SECURITY CONCEPTS 7

Overview of cloud security- Security Services - Confidentiality, Integrity, Authentication, Non-repudiation, Access Control - Basic of cryptography - Conventional and public-key cryptography, hash functions, authentication, and digital signatures.

UNIT II SECURITY DESIGN AND ARCHITECTURE FOR CLOUD 6

Security design principles for Cloud Computing - Comprehensive data protection - End-to-end access control - Common attack vectors and threats - Network and Storage - Secure Isolation Strategies - Virtualization strategies - Inter-tenant network segmentation strategies - Data Protection strategies: Data retention, deletion and archiving procedures for tenant data, Encryption, Data Redaction, Tokenization, Obfuscation, PKI and Key

UNIT III ACCESS CONTROL AND IDENTITY MANAGEMENT 6

Access control requirements for Cloud infrastructure - User Identification - Authentication and Authorization - Roles-based Access Control - Multi-factor authentication - Single Sign-on, Identity Federation - Identity providers and service consumers - Storage and network access control options - OS Hardening and minimization - Verified and measured boot - Intruder Detection and prevention

UNIT IV CLOUD SECURITY DESIGN PATTERNS 6

Introduction to Design Patterns, Cloud bursting, Geo-tagging, Secure Cloud Interfaces, Cloud Resource Access Control, Secure On-Premise Internet Access, Secure External Cloud

UNIT V MONITORING, AUDITING AND MANAGEMENT 5

Proactive activity monitoring - Incident Response, Monitoring for unauthorized access, malicious traffic, abuse of system privileges - Events and alerts - Auditing – Record generation, Reporting andManagement, Tamper-proofing audit logs, Quality of Services, Secure Management, User management, Identity management, Security Information and Event Management

30 PERIODS

PRACTICAL EXERCISES: **30 PERIODS**

1. Simulate a cloud scenario using Cloud Sim and run a scheduling algorithm not present inCloud Sim
2. simulate resource management using cloud sim
3. simulate log forensics using cloud sim
4. simulate a secure file sharing using a cloud sim
5. Implement data anonymization techniques over the simple dataset (masking, k-anonymization, etc)
6. Implement any encryption algorithm to protect the images
7. Implement any image obfuscation mechanism
8. Implement a role-based access control mechanism in a specific scenario
9. implement an attribute-based access control mechanism based on a particular scenario
10. Develop a log monitoring system with incident management in the cloud

COURSE OUTCOMES:

CO1: Understand the cloud concepts and fundamentals.

CO2: Explain the security challenges in the cloud.

CO3: Define cloud policy and Identity and Access Management.

CO4: Understand various risks and audit and monitoring mechanisms in the cloud.

CO5: Define the various architectural and design considerations for security in the cloud.

TOTAL:60 PERIODS

TEXTBOOKS

1. Raj Kumar Buyya , James Broberg, andrzejGoscinski, "Cloud Computing:‖, Wiley 2013
2. Dave shackleford, "Virtualization Security‖, SYBEX a wiley Brand 2013.
3. Mather, Kumaraswamy and Latif, "Cloud Security and Privacy‖, OREILLY 2011

REFERENCES

1. Mark C. Chu-Carroll "Code in the Cloud‖,CRC Press, 2011
2. Mastering Cloud Computing Foundations and Applications Programming RajkumarBuyya, Christian Vechhiola, S. ThamaraiSelvi

CO's-PO's & PSO's MAPPING

CO's	PO's												PSO's		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	3	3	3	1	2	-	-	-	1	1	1	3	3	1	2
2	1	3	2	3	1	-	-	-	2	2	3	2	3	1	2
3	3	2	2	3	2	-	-	-	3	1	1	2	2	3	1
4	2	1	2	3	3	-	-	-	3	2	3	3	1	1	2
5	1	3	3	1	1	-	-	-	2	3	3	2	2	3	2
AVg.	2	2.4	2.4	2.2	1.8	-	-	-	2.2	1.8	2.2	2.4	2.2	1.8	1.8

1 - low, 2 - medium, 3 - high, '-' - no correlation

ELECTIVE - IV

21150E65A **ETHICAL HACKING** **L T P C**
2 0 2 3

COURSE OBJECTIVES:

- To understand the basics of computer based vulnerabilities.
- To explore different foot printing, reconnaissance and scanning methods.
- To expose the enumeration and vulnerability analysis methods.
- To understand hacking options available in Web and wireless applications.
- To explore the options for network protection.
- To practice tools to perform ethical hacking to expose the vulnerabilities.

UNIT I INTRODUCTION 6

Ethical Hacking Overview - Role of Security and Penetration Testers .- Penetration-Testing Methodologies- Laws of the Land - Overview of TCP/IP- The Application Layer - The Transport Layer - The Internet Layer
- IP Addressing .- Network and Computer Attacks - Malware - ProtectingAgainst Malware Attacks.- IntruderAttacks - Addressing Physical Security

UNIT II FOOT PRINTING, RECONNAISSANCE AND SCANNING NETWORKS 6

Footprinting Concepts - Footprinting through Search Engines, Web Services, Social Networking Sites, Website, Email - Competitive Intelligence - Footprinting through Social Engineering - Footprinting Tools - Network Scanning Concepts - Port-Scanning Tools - Scanning Techniques - Scanning Beyond IDS and Firewall

UNIT III ENUMERATION AND VULNERABILITY ANALYSIS 6

Enumeration Concepts - NetBIOS Enumeration – SNMP, LDAP, NTP, SMTP and DNS Enumeration - Vulnerability Assessment Concepts - Desktop and Server OS Vulnerabilities - Windows OS Vulnerabilities - Tools for Identifying Vulnerabilities in Windows- Linux OS Vulnerabilities- Vulnerabilities of Embedded Oss

UNIT IV SYSTEM HACKING 6

Hacking Web Servers - Web Application Components- Vulnerabilities - Tools for Web Attackers and Security Testers Hacking Wireless Networks - Components of a Wireless Network – Wardriving- Wireless Hacking - Tools of the Trade –

UNIT V NETWORK PROTECTION SYSTEMS 6

Access Control Lists. - Cisco Adaptive Security Appliance Firewall - Configuration and Risk AnalysisTools for Firewalls and Routers - Intrusion Detection and Prevention Systems - Network-Based and Host-Based IDSs and IPSs - Web Filtering - Security Incident Response Teams – Honeypots.

30 PERIODS

PRACTICAL EXERCISES: **30 PERIODS**

1. Install Kali or Backtrack Linux / Metasploitable/ Windows XP
2. Practice the basics of reconnaissance.
3. Using FOCA / SearchDiggity tools, extract metadata and expanding the target list.
4. Aggregates information from public databases using online free tools like Paterva's Maltego.
5. Information gathering using tools like Robtex.
6. Scan the target using tools like Nessus.
7. View and capture network traffic using Wireshark.

8. Automate dig for vulnerabilities and match exploits using Armitage

FOCA : http://www.informatica64.com/foca.aspx.
Nessus : http://www.tenable.com/products/nessus.
Wireshark : http://www.wireshark.org.
Armitage : http://www.fastandeasyhacking.com/.
Kali or Backtrack Linux, Metasploitable, Windows XP

COURSE OUTCOMES:

At the end of this course, the students will be able:

CO1: To express knowledge on basics of computer based vulnerabilities

CO2: To gain understanding on different foot printing, reconnaissance and scanning methods.

CO3: To demonstrate the enumeration and vulnerability analysis methods

CO4: To gain knowledge on hacking options available in Web and wireless applications.

CO5: To acquire knowledge on the options for network protection.

CO6: To use tools to perform ethical hacking to expose the vulnerabilities.

TOTAL:60 PERIODS

TEXTBOOKS

1. Michael T. Simpson, Kent Backman, and James E. Corley, Hands-On Ethical Hacking andNetwork Defense, Course Technology, Delmar Cengage Learning, 2010.
2. The Basics of Hacking and Penetration Testing - Patrick Engebretson, SYNGRESS,Elsevier, 2013.
3. The Web Application Hacker's Handbook: Finding and Exploiting Security Flaws, Dafydd Stuttard and Marcus Pinto, 2011.

REFERENCES

1. **Black Hat Python: Python Programming for Hackers and Pentesters, Justin Seitz , 2014.**

CO's-PO's & PSO's MAPPING

CO's	PO's												PSO's		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	2	2	3	2	1	-	-	-	1	2	2	1	1	2	3
2	1	2	1	2	1	-	-	-	2	2	1	1	1	2	2
3	2	2	3	3	1	-	-	-	1	2	1	2	2	3	1
4	2	1	1	2	1	-	-	-	1	3	3	3	3	2	1
5	2	3	1	1	2	-	-	-	2	1	1	1	1	1	3
AVg.	1.8	2	1.8	2	1.2	-	-	-	1.4	2	1.6	1.6	1.6	2	2

1 - low, 2 - medium, 3 - high, '-' - no correlation

21150E65B

DIGITAL AND MOBILE FORENSICS

L T P C
2 0 2 3

COURSE OBJECTIVES:

- To understand basic digital forensics and techniques.
- To understand digital crime and investigation.
- To understand how to be prepared for digital forensic readiness.
- To understand and use forensics tools for iOS devices.
- To understand and use forensics tools for Android devices.

UNIT I INTRODUCTION TO DIGITAL FORENSICS 6

Forensic Science – Digital Forensics – Digital Evidence – The Digital Forensics Process – Introduction – The Identification Phase – The Collection Phase – The Examination Phase – The Analysis Phase – The Presentation Phase

UNIT II DIGITAL CRIME AND INVESTIGATION 6

Digital Crime – Substantive Criminal Law – General Conditions – Offenses – Investigation Methods for Collecting Digital Evidence – International Cooperation to Collect Digital Evidence

UNIT III DIGITAL FORENSIC READINESS 6

Introduction – Law Enforcement versus Enterprise Digital Forensic Readiness – Rationale for Digital Forensic Readiness – Frameworks, Standards and Methodologies – Enterprise Digital Forensic Readiness – Challenges in Digital Forensics

UNIT IV iOS FORENSICS 6

Mobile Hardware and Operating Systems - iOS Fundamentals – Jailbreaking – File System – Hardware – iPhone Security – iOS Forensics – Procedures and Processes – Tools – Oxygen Forensics – MobilEdit – iCloud

UNIT V ANDROID FORENSICS 6

Android basics – Key Codes – ADB – Rooting Android – Boot Process – File Systems – Security – Tools – Android Forensics – Forensic Procedures – ADB – Android Only Tools – Dual Use Tools – Oxygen Forensics – MobilEdit – Android App Decompiling

COURSE OUTCOMES:

On completion of the course, the students will be able to:

CO1: Have knowledge on digital forensics.

CO2: Know about digital crime and investigations.

CO3: Be forensic ready.

CO4: Investigate, identify and extract digital evidence from iOS devices.

CO5: Investigate, identify and extract digital evidence from Android devices.

30 PERIODS

LAB EXPERIMENTS:

1. Installation of Sleuth Kit on Linux. List all data blocks. Analyze allocated as well as unallocatedblocks of a disk image.
2. Data extraction from call logs using Sleuth Kit.
3. Data extraction from SMS and contacts using Sleuth Kit.
4. Install Mobile Verification Toolkit or MVT and decrypt encrypted iOS backups.
5. Process and parse records from the iOS system.
6. Extract installed applications from Android devices.
7. Extract diagnostic information from Android devices through the adb protocol.
8. Generate a unified chronological timeline of extracted records,

30 PERIODS

TOTAL : 60 PERIODS

TEXT BOOK:

1. Andre Arnes, “Digital Forensics”, Wiley, 2018.
2. Chuck Easttom, “An In-depth Guide to Mobile Device Forensics”, First Edition, CRCPress, 2022.

REFERENCES

1. Vacca, J, Computer Forensics, Computer Crime Scene Investigation, 2nd Ed, CharlesRiver Media, 2005, ISBN: 1-58450-389.

CO's-PO's & PSO's MAPPING

CO's	PO's												PSO's		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	3	1	3	2	1	-	-	-	1	1	3	3	1	3	1
2	3	3	3	3	3	-	-	-	2	2	1	2	1	3	1
3	3	3	2	3	1	-	-	-	3	2	1	1	3	2	3
4	3	1	2	2	3	-	-	-	1	3	3	2	1	3	3
5	1	3	2	3	2	-	-	-	2	3	2	3	1	2	1
AVg.	3	2	2	3	2	-	-	-	2	2	2	2	1	3	2

1 - low, 2 - medium, 3 - high, '-' - no correlation

21150E65C SOCIAL NETWORK SECURITY L T P C
2 0 2 3

COURSE OBJECTIVES:

- To develop semantic web related simple applications
- To explain Privacy and Security issues in Social Networking
- To explain the data extraction and mining of social networks
- To discuss the prediction of human behavior in social communities
- To describe the Access Control, Privacy and Security management of social networks

UNIT I FUNDAMENTALS OF SOCIAL NETWORKING 6

Introduction to Semantic Web, Limitations of current Web, Development of Semantic Web, Emergence of the Social Web, Social Network analysis, Development of Social Network Analysis, Key concepts and measures in network analysis, Historical overview of privacy and security, Major paradigms, for understanding privacy and security

UNIT II SECURITY ISSUES IN SOCIAL NETWORKS 6

The evolution of privacy and security concerns with networked technologies, Contextual influences on privacy attitudes and behaviors, Anonymity in a networked world

UNIT III EXTRACTION AND MINING IN SOCIAL NETWORKING DATA 6

Extracting evolution of Web Community from a Series of Web Archive, Detecting communities in social networks, Definition of community, Evaluating communities, Methods for community detectionand mining, Applications of community mining algorithms, Tools for detecting communities social network infrastructures and communities, Big data and Privacy

UNIT IV PREDICTING HUMAN BEHAVIOR AND PRIVACY ISSUES 6

Understanding and predicting human behavior for social communities, User data Management, Inference and Distribution, Enabling new human experiences, Reality mining, Context, Awareness, Privacy in online social networks, Trust in online environment, What is Neo4j, Nodes, Relationships,Properties.

UNIT V ACCESS CONTROL, PRIVACY AND IDENTITY MANAGEMENT 6

Understand the access control requirements for Social Network, Enforcing Access Control Strategies, Authentication and Authorization, Roles-based Access Control, Host, storage and network access control options, Firewalls, Authentication, and Authorization in Social Network, Identity & Access Management, Single Sign-on, Identity Federation, Identity providers and service consumers, The role of Identity provisioning

COURSE OUTCOMES:

CO1: Develop semantic web related simple applications
CO2 : Address Privacy and Security issues in Social Networking
CO3: Explain the data extraction and mining of social networks
CO4: Discuss the prediction of human behavior in social communitiesCO5: Describe the applications of social networks

30 PERIODS

PRACTICALEXERCISES: 30 PERIODS

1. Design own social media application
2. Create a Network model using Neo4j
3. Read and write Data from Graph Database
4. Find "Friend of Friends" using Neo4j
5. Implement secure search in social media
6. Create a simple Security & Privacy detector

TOTAL:60 PERIODS

TEXT BOOKS

1. Peter Mika, Social Networks and the Semantic Web, First Edition, Springer 2007.
2. BorkoFurht, Handbook of Social Network Technologies and Application, First Edition, Springer, 2010.
3. Learning Neo4j 3.x Second Edition By Jérôme Baton, Rik Van Bruggen, Packt publishing
4. David Easley, Jon Kleinberg, Networks, Crowds, and Markets: Reasoning about a Highly Connected World‖, First Edition, Cambridge University Press, 2010.

REFERENCES

1. Easley D. Kleinberg J., Networks, Crowds, and Markets – Reasoning about a Highly Connected World‖, Cambridge University Press, 2010.
2. Jackson, Matthew O., Social and Economic Networks‖, Princeton University Press, 2008.
3. GuandongXu ,Yanchun Zhang and Lin Li, ―Web Mining and Social Networking – Techniques and applications‖, First Edition, Springer, 2011.
4. Dion Goh and Schubert Foo, Social information Retrieval Systems: Emerging Technologies and Applications for Searching the Web Effectively‖, IGI Global Snippet, 2008.
5. Max Chevalier, Christine Julien and Chantal Soulé-Dupuy, Collaborative and Social Information Retrieval and Access: Techniques for Improved user Modeling‖, IGI Global Snippet, 2009.
6. John G. Breslin, Alexander Passant and Stefan Decker, The Social Semantic Web‖, Springer, 2009.

CO's-PO's & PSO's MAPPING

CO's	PO's												PSO's		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	3	1	2	3	2	-	-	-	3	2	1	2	3	3	2
2	2	2	2	3	3	-	-	-	1	2	2	3	3	3	2
3	2	1	1	3	2	-	-	-	1	2	1	1	1	3	3
4	3	3	3	3	2	-	-	-	1	1	1	1	2	1	3
5	1	3	2	2	2	-	-	-	1	1	3	1	2	3	3
AVg.	2.2	2	2	2.8	2.2	-	-	-	1.4	1.6	1.6	1.6	2.2	2.6	2.6

1 - low, 2 - medium, 3 - high, '-' - no correlation

21150E65D

MODERN CRYPTOGRAPHY

L T P C
2 0 2 3

COURSE OBJECTIVES:

- To learn about Modern Cryptography.
- To focus on how cryptographic algorithms and protocols work and how to use them.
- To build a Pseudorandom permutation.
- To construct Basic cryptanalytic techniques.
- To provide instruction on how to use the concepts of block ciphers and message authentication codes.

UNIT I INTRODUCTION 6

Basics of Symmetric Key Cryptography, Basics of Asymmetric Key Cryptography, Hardness of Functions. Notions of Semantic Security (SS) and Message Indistinguishability (MI): Proof of Equivalence of SS and MI, Hard Core Predicate, Trap-door permutation, Goldwasser-Micali Encryption. Goldreich-Levin Theorem: Relation between Hardcore Predicates and Trap-door permutations.

UNIT II FORMAL NOTIONS OF ATTACKS 6

Attacks under Message Indistinguishability: Chosen Plaintext Attack (IND-CPA), Chosen CiphertextAttacks(IND-CCA1 and IND-CCA2), Attacks under Message Non-malleability: NM-CPA and NM- CCA2, Inter- relations among the attack model

UNIT III RANDOM ORACLES 6

Provable Security and asymmetric cryptography, hash functions. One-way functions: Weak and Strong one- way functions. Pseudo-random Generators (PRG): Blum-Micali-Yao Construction, Construction of more powerful PRG, Relation between One-way functions and PRG, Pseudo- random Functions (PRF)

UNIT IV BUILDING A PSEUDORANDOM PERMUTATION 6

The LubyRackoff Construction: Formal Definition, Application of the LubyRackoff Construction to the construction of Block Ciphers, The DES in the light of LubyRackoff Construction.

UNIT V MESSAGE AUTHENTICATION CODES 6

Left or Right Security (LOR). Formal Definition of Weak and Strong MACs, Using a PRF as a MAC, Variable length MAC. Public Key Signature Schemes: Formal Definitions, Signing and Verification,

Formal Proofs of Security of Full Domain Hashing. Assumptions for Public Key Signature Schemes: One-way functions Imply Secure One-time Signatures. Shamir's Secret Sharing Scheme. FormallyAnalyzingCryptographic Protocols. Zero Knowledge Proofs and Protocols.

30 PERIODS

PRACTICAL EXERCISES: **30 PERIODS**

1. Implement Feige-Fiat-Shamir identification protocol.
2. Implement GQ identification protocol.
3. Implement Schnorr identification protocol.
4. Implement Rabin one-time signature scheme.
5. Implement Merkle one-time signature scheme.
6. Implement Authentication trees and one-time signatures.
7. Implement GMR one-time signature scheme.

COURSE OUTCOMES:

CO1: Interpret the basic principles of cryptography and general cryptanalysis.
CO2: Determine the concepts of symmetric encryption and authentication.
CO3: Identify the use of public key encryption, digital signatures, and key establishment.
CO4: Articulate the cryptographic algorithms to compose, build and analyze simple cryptographicsolutions.
CO5: Express the use of Message Authentication Codes.

TOTAL:60 PERIODS

TEXT BOOKS:

1. Hans Delfs and Helmut Knebl, Introduction to Cryptography: Principles and Applications, Springer Verlag.Wenbo Mao, Modern Cryptography, Theory and Practice, Pearson Education (Low PricedEdition)

REFERENCES:

1. ShaffiGoldwasser and MihirBellare, Lecture Notes on Cryptography, Available at http://citeseerx.ist.psu.edu/.
2. OdedGoldreich, Foundations of Cryptography, CRC Press (Low Priced Edition Available),Part 1 and Part 23
3. William Stallings, “Cryptography and Network Security: Principles and Practice”, PHI 3rd Edition, 2006.

CO’s-PO’s & PSO’s MAPPING

CO’s	PO’s												PSO’s		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	3	3	3	3	1	-	-	-	2	1	1	2	2	1	1
2	1	3	2	1	2	-	-	-	3	2	2	2	2	1	3
3	1	1	2	3	2	-	-	-	1	1	1	3	1	1	3
4	3	1	2	1	3	-	-	-	3	2	1	2	3	2	1
5	2	3	3	3	3	-	-	-	3	1	1	1	2	1	1
AVg.	2	2.2	2.4	2.2	2.2	-	-	-	2.4	1.4	1.2	2	2	1.2	1.8

1 - low, 2 - medium, 3 - high, ‘-' - no correlation

21150E65E **ENGINEERING SECURE SOFTWARE SYSTEMS** **L T P C**
2 0 2 3

COURSE OBJECTIVES:

- Know the importance and need for software security.
- Know about various attacks.
- Learn about secure software design.
- Understand risk management in secure software development.
- Know the working of tools related to software security.

UNIT I NEED OF SOFTWARE SECURITY AND LOW-LEVEL ATTACKS 6

Software Assurance and Software Security - Threats to software security - Sources of software insecurity - Benefits of Detecting Software Security - Properties of Secure Software – Memory- Based Attacks: Low- Level Attacks Against Heap and Stack - Defense Against Memory-Based Attacks

UNIT II SECURE SOFTWARE DESIGN 7

Requirements Engineering for secure software - SQUARE process Model - Requirements elicitation and prioritization- Isolating The Effects of Untrusted Executable Content - Stack Inspection – Policy Specification Languages – Vulnerability Trends – Buffer Overflow – Code Injection - Session Hijacking. Secure Design - Threat Modeling and Security Design Principles

UINT III SECURITY RISK MANAGEMENT 5

Risk Management Life Cycle – Risk Profiling – Risk Exposure Factors – Risk Evaluation andMitigation – Risk Assessment Techniques – Threat and Vulnerability Management

UNIT IV SECURITY TESTING 8

Traditional Software Testing – Comparison - Secure Software Development Life Cycle - Risk Based Security Testing – Prioritizing Security Testing With Threat Modeling – Penetration Testing – Planning and Scoping - Enumeration – Remote Exploitation – Web Application Exploitation - Exploits and Client Side Attacks – Post Exploitation – Bypassing Firewalls and Avoiding Detection - Tools for Penetration Testing

UNIT V SECURE PROJECT MANAGEMENT 4

Governance and security - Adopting an enterprise software security framework - Security andprojectmanagement - Maturity of Practice

30 PERIODS

PRACTICAL EXERCISES

1. Implement the SQL injection attack.
2. Implement the Buffer Overflow attack.
3. Implement Cross Site Scripting and Prevent XSS.
4. Perform Penetration testing on a web application to gather information about the system, theninitiate XSS and SQL injection attacks using tools like Kali Linux.
5. Develop and test the secure test cases
6. Penetration test using kali Linux

30 PERIODS

COURSE OUTCOMES:

Upon completion of the course, the student will be able to

CO1: Identify various vulnerabilities related to memory attacks.

CO2: Apply security principles in software development.
CO3: Evaluate the extent of risks.
CO4: Involve selection of testing techniques related to software security in the testing phase ofsoftwaredevelopment.
CO5: Use tools for securing software.

TOTAL: 60 PERIODS

TEXT BOOKS:

1. Julia H. Allen, "Software Security Engineering", Pearson Education, 2008
2. Evan Wheeler, "Security Risk Management: Building an Information Security Risk Management Program from the Ground Up", First edition, Syngress Publishing, 2011
3. Chris Wysopal, Lucas Nelson, Dino Dai Zovi, and Elfriede Dustin, "The Art of Software Security Testing: Identifying Software Security Flaws (Symantec Press)", Addison-Wesley Professional, 2006

REFERENCES:

1. Robert C. Seacord, "Secure Coding in C and C++ (SEI Series in Software Engineering)", Addison-Wesley Professional, 2005.
2. Jon Erickson, "Hacking: The Art of Exploitation", 2nd Edition, No Starch Press, 2008.
3. Mike Shema, "Hacking Web Apps: Detecting and Preventing Web Application Security Problems", First edition, Syngress Publishing, 2012
4. Bryan Sullivan and Vincent Liu, "Web Application Security, A Beginner's Guide", Kindle Edition, McGraw Hill, 2012
5. Lee Allen, "Advanced Penetration Testing for Highly-Secured Environments: The Ultimate Security Guide (Open Source: Community Experience Distilled)", Kindle Edition, Packt Publishing,2012
6. Jason Grembi, "Developing Secure Software"

CO's-PO's & PSO's MAPPING

CO's	PO's												PSO's		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	2	3	2	3	2	-	-	-	2	1	2	2	2	2	1
2	2	2	2	3	3	-	-	-	2	1	2	2	1	2	1
3	1	2	2	2	1	-	-	-	1	1	2	1	2	2	1
4	2	3	2	2	2	-	-	-	2	1	2	2	2	2	1
5	2	1	2	2	3	-	-	-	2	1	1	2	2	1	2
AVg.	1.8	2.2	2	2.4	2.2	-	-	-	1.8	1	1.8	1.8	1.8	1.8	1.2

1 - low, 2 - medium, 3 - high, '-' - no correlation

21150E65F CRYPTOCURRENCY AND BLOCKCHAIN TECHNOLOGIES L T P C
2 0 2 3

COURSE OBJECTIVES:

- To understand the basics of Blockchain
- To learn Different protocols and consensus algorithms in Blockchain
- To learn the Blockchain implementation frameworks
- To understand the Blockchain Applications
- To experiment the Hyperledger Fabric, Ethereum networks

UNIT I INTRODUCTION TO BLOCKCHAIN 7

Blockchain- Public Ledgers, Blockchain as Public Ledgers - Block in a Blockchain, Transactions- The Chainand the Longest Chain - Permissioned Model of Blockchain, Cryptographic -Hash Function, Properties of a hash function-Hash pointer and Merkle tree

UNIT II BITCOIN AND CRYPTOCURRENCY 6

A basic crypto currency, Creation of coins, Payments and double spending, FORTH – the precursor for Bitcoin scripting, Bitcoin Scripts , Bitcoin P2P Network, Transaction in Bitcoin Network, Block Mining, Block propagation and block relay

UNIT III BITCOIN CONSENSUS 6

itcoin Consensus, Proof of Work (PoW)- Hashcash PoW , Bitcoin PoW, Attacks on PoW ,monopoly problem- Proof of Stake- Proof of Burn - Proof of Elapsed Time - Bitcoin Miner, Mining Difficulty, Mining Pool-Permissioned model and use cases.

UNIT IV HYPERLEDGER FABRIC & ETHEREUM 5

Architecture of Hyperledger fabric v1.1- chain code- Ethereum: Ethereum network, EVM, Transaction fee, Mist Browser, Ether, Gas, Solidity.

UNIT V BLOCKCHAIN APPLICATIONS 6

Smart contracts, Truffle Design and issue- DApps- NFT. Blockchain Applications in Supply Chain Management, Logistics, Smart Cities, Finance and Banking, Insurance,etc- Case Study.

COURSE OUTCOMES:

CO1: Understand emerging abstract models for Blockchain Technology

CO2: Identify major research challenges and technical gaps existing between theory and practicein thecrypto currency domain.

CO3: It provides conceptual understanding of the function of Blockchain as a method of securingdistributedledgers, how consensus on their contents is achieved, and the new applications that they enable.

CO4: Apply hyperledger Fabric and Ethereum platform to implement the Block chain Application.

30 PERIODS

PRACTICAL 30 PERIODS

1. Install and understand Docker container, Node.js, Java and Hyperledger Fabric, Ethereum and perform necessary software installation on local machine/create instance on cloud to run.
2. Create and deploy a blockchain network using Hyperledger Fabric SDK for Java Set up andinitialize the channel, install and instantiate chain code, and perform invoke and query on your blockchain network.
3. Interact with a blockchain network. Execute transactions and requests against a blockchainnetwork by creating an app to test the network and its rules.
4. Deploy an asset-transfer app using blockchain. Learn app development within a Hyperledger Fabric network.
5. Use blockchain to track fitness club rewards. Build a web app that uses Hyperledger Fabric to track and trace member rewards.

6. **Car auction network: A Hello World example with Hyperledger Fabric Node SDK and IBM Blockchain Starter Plan. Use Hyperledger Fabric to invoke chain code while storing results and data in the starter plan**

TOTAL: 60 PERIODS

TEXT BOOKS

1. Bashir and Imran, Mastering Blockchain: Deeper insights into decentralization, cryptography,Bitcoin, and popular Blockchain frameworks, 2017.
2. 2.Andreas Antonopoulos, “Mastering Bitcoin: Unlocking Digital Cryptocurrencies”, O’Reilly, 2014.

REFERENCES:

1. Daniel Drescher, “Blockchain Basics”, First Edition, Apress, 2017.
2. Arvind Narayanan, Joseph Bonneau, Edward Felten, Andrew Miller, and Steven Goldfeder. Bitcoin and cryptocurrency technologies: a comprehensive introduction. Princeton UniversityPress, 2016.
3. Melanie Swan, “Blockchain: Blueprint for a New Economy”, O’Reilly, 2015
4. Ritesh Modi, “Solidity Programming Essentials: A Beginner’s Guide to Build Smart Contracts for Ethereum and Blockchain”, Packt Publishing
5. Handbook of Research on Blockchain Technology, published by Elsevier Inc. ISBN: 9780128198162, 2020.

CO’s-PO’s & PSO’s MAPPING

CO’s	PO’s												PSO’s		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	3	3	2	2	1	-	-	-	1	-	-	2	3	1	1
2	3	3	3	3	1	-	-	-	2	-	-	2	1	2	1
3	3	3	3	3	2	-	-	-	3	-	-	2	2	3	3
4	3	2	3	2	3	-	-	-	3	-	-	2	2	2	3
AVg.	3	2.75	2.75	2.5	1.75				2.25			2	3	2.75	2

1 - low, 2 - medium, 3 - high, ‘-' - no correlation

21150E65G

NETWORK SECURITY

L T P C
2 0 2 3

COURSE OBJECTIVES:

- To learn the fundamentals of cryptography.
- To learn the key management techniques and authentication approaches.
- To explore the network and transport layer security techniques.
- To understand the application layer security standards.
- To learn the real time security practices.

UNIT I INTRODUCTION 8

Basics of cryptography, conventional and public-key cryptography, hash functions, authentication, and digital signatures.

UNIT II KEY MANAGEMENT AND AUTHENTICATION 7

Key Management and Distribution: Symmetric Key Distribution, Distribution of Public Keys, X.509 Certificates, Public-Key Infrastructure. User Authentication: Remote User-Authentication Principles,RemoteUser-Authentication Using Symmetric Encryption, Kerberos Systems, Remote User Authentication Using Asymmetric Encryption.

UNIT III ACCESS CONTROL AND SECURITY 4

Network Access Control: Network Access Control, Extensible Authentication Protocol, IEEE 802.1XPort- Based Network Access Control - IP Security - Internet Key Exchange (IKE). Transport-Level Security: Web Security Considerations, Secure Sockets Layer, Transport Layer Security, HTTPS standard, Secure Shell (SSH) application.

UNIT IV APPLICATION LAYER SECURITY 5

Electronic Mail Security: Pretty Good Privacy, S/MIME, DomainKeys Identified Mail. Wireless Network Security: Mobile Device Security

UNIT V SECURITY PRACTICES 6

Firewalls and Intrusion Detection Systems: Intrusion Detection Password Management, Firewall Characteristics Types of Firewalls, Firewall Basing, Firewall Location and Configurations. Blockchains, Cloud Security and IoT security

30 PERIODS

PRACTICALEXERCISES: 30 PERIODS

1. Implement symmetric key algorithms
2. Implement asymmetric key algorithms and key exchange algorithms
3. Implement digital signature schemes
4. Installation of Wire shark, tcpdump and observe data transferred in client-server communication using UDP/TCP and identify the UDP/TCP datagram.
5. Check message integrity and confidentiality using SSL
6. Experiment Eavesdropping, Dictionary attacks, MITM attacks
7. Experiment with Sniff Traffic using ARP Poisoning
8. Demonstrate intrusion detection system using any tool.
9. Explore network monitoring tools
10. Study to configure Firewall, VPN

COURSE OUTCOMES:

At the end of this course, the students will be able:

CO1: Classify the encryption techniques

CO2: Illustrate the key management technique and authentication.

CO3 Evaluate the security techniques applied to network and transport layer

CO4: Discuss the application layer security standards.

CO5: Apply security practices for real time applications.

TOTAL:60 PERIODS

TEXT BOOKS:

1. Cryptography and Network Security: Principles and Practice, 6th Edition, William Stallings,2014, Pearson, ISBN 13:9780133354690.

REFERENCES:

1. Network Security: Private Communications in a Public World, M. Speciner, R. Perlman, C. Kaufman, Prentice Hall, 2002.
2. Linux iptables Pocket Reference, Gregor N. Purdy, O'Reilly, 2004, ISBN-13: 978-0596005696.
3. Linux Firewalls, by Michael Rash, No Starch Press, October 2007, ISBN: 978-1-59327-141-1.

4. Network Security, Firewalls And VPNs, J. Michael Stewart, Jones & Bartlett Learning, 2013,ISBN-10: 1284031675, ISBN-13: 978-1284031676.
5. The Network Security Test Lab: A Step-By-Step Guide, Michael Gregg, Dreamtech Press,2015, ISBN-10:8126558148, ISBN-13: 978-8126558148.

CO's-PO's & PSO's MAPPING

CO's	PO's												PSO's		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	3	3	2	2	2	-	-	-	2	1	2	1	2	3	1
2	1	1	3	2	2	-	-	-	2	2	1	1	3	1	2
3	1	2	1	1	2	-	-	-	3	3	1	3	2	1	3
4	2	2	3	2	3	-	-	-	3	3	2	1	2	1	3
5	2	1	3	2	2	-	-	-	2	1	1	3	2	1	1
AVg.	1.8	1.8	2.4	1.8	2.2	-	-	-	2.4	2	1.4	1.8	2.2	1.4	2

1 - low, 2 - medium, 3 - high, '-' - no correlation

ELECTIVE - V

21150E66A AUGMENTED REALITY/VIRTUAL REALITY L T P C
2 0 2 3

COURSE OBJECTIVES:

- To impart the fundamental aspects and principles of AR/VR technologies.
- To know the internals of the hardware and software components involved in the development of AR/VR enabled applications.
- To learn about the graphical processing units and their architectures.
- To gain knowledge about AR/VR application development.
- To know the technologies involved in the development of AR/VR based applications.

UNIT I INTRODUCTION 7

Introduction to Virtual Reality and Augmented Reality – Definition – Introduction to Trajectories and Hybrid Space-Three I's of Virtual Reality – Virtual Reality Vs 3D Computer Graphics – Benefits of Virtual Reality – Components of VR System – Introduction to AR-AR Technologies-Input Devices – 3D Position Trackers – Types of Trackers – Navigation and Manipulation Interfaces – Gesture Interfaces – Types of Gesture Input Devices – Output Devices – Graphics Display – Human VisualSystem – Personal Graphics Displays – Large Volume Displays – Sound Displays – Human Auditory System.

UNIT II VR MODELING 6

Modeling – Geometric Modeling – Virtual Object Shape – Object Visual Appearance – Kinematics Modeling – Transformation Matrices – Object Position – Transformation Invariants –Object Hierarchies – Viewing the 3D World – Physical Modeling – Collision Detection – Surface Deformation – Force Computation – Force Smoothing and Mapping – Behavior Modeling – Model Management.

UNIT III VR PROGRAMMING 6

VR Programming – Toolkits and Scene Graphs – World ToolKit – Java 3D – Comparison of World ToolKit and Java 3D

UNIT IV APPLICATIONS 6

Human Factors in VR – Methodology and Terminology – VR Health and Safety Issues – VR and Society-Medical Applications of VR – Education, Arts and Entertainment – Military VR Applications

– Emerging Applications of VR – VR Applications in Manufacturing – Applications of VR in Robotics – Information Visualization – VR in Business – VR in Entertainment – VR in Education.

UNIT V AUGMENTED REALITY 5

Introduction to Augmented Reality-Computer vision for AR-Interaction-Modelling and Annotation-Navigation-Wearable devices

30 PERIODS

PRACTICAL EXERCISES: 30 PERIODS

1. Study of tools like Unity, Maya, 3DS MAX, AR toolkit, Vuforia and Blender.
2. Use the primitive objects and apply various projection types by handling camera.
3. Download objects from asset store and apply various lighting and shading effects.
4. Model three dimensional objects using various modelling techniques and apply textures overthem.
5. Create three dimensional realistic scenes and develop simple virtual reality enabled mobile applications which have limited interactivity.
6. Add audio and text special effects to the developed application.
7. Develop VR enabled applications using motion trackers and sensors incorporating full haptic interactivity.
8. Develop AR enabled applications with interactivity like E learning environment, Virtual walkthroughs and visualization of historic places.
9. Develop AR enabled simple applications like human anatomy visualization, DNA/RNAstructure visualization and surgery simulation.
10. Develop simple MR enabled gaming applications.

COURSE OUTCOMES:

On completion of the course, the students will be able to: CO1: Understand the basic concepts of AR and VR **CO2:**Understand the tools and technologies related to AR/VR **CO3**:Know the working principle of AR/VR related Sensor devices**CO4:**Design of various models using modeling techniques **CO5:**Develop AR/VR applications in different domains

TOTAL:60 PERIODS

TEXTBOOKS:

1. Charles Palmer, John Williamson, "Virtual Reality Blueprints: Create compelling VR experiences for mobile", Packt Publisher, 2018
2. Dieter Schmalstieg, Tobias Hollerer, "Augmented Reality: Principles & Practice", Addison Wesley, 2016
3. John Vince, "Introduction to Virtual Reality", Springer-Verlag, 2004.
4. William R. Sherman, Alan B. Craig: Understanding Virtual Reality – Interface, Application, Design", Morgan Kaufmann, 2003

CO’s-PO’s & PSO’s MAPPING

CO’s	PO’s												PSO’s		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	3	2	2	-	3	-	-	-	2	2	1	2	2	1	2
2	3	2	2	1	3	-	-	-	3	2	2	3	3	1	2
3	3	3	2	2	3	-	-	-	3	2	1	2	3	2	2
4	3	3	3	2	3	-	-	-	3	2	2	3	3	2	2
5	3	3	3	3	3	-	-	-	3	3	3	3	3	3	3
AVg.	3.00	2.60	2.40	2.00	3.00	-	-	-	2.80	2.20	1.80	2.60	2.80	1.80	2.20

1 - low, 2 - medium, 3 - high, ‘-' - no correlation

21150E66B MULTIMEDIA AND ANIMATION L T P C
2 0 2 3

COURSE OBJECTIVES:

- To grasp the fundamental knowledge of Multimedia elements and systems
- To get familiar with Multimedia file formats and standards
- To learn the process of Authoring multimedia presentations
- To learn the techniques of animation in 2D and 3D and for the mobile UI
- To explore different popular applications of multimedia

UNIT I INTRODUCTION TO MULTIMEDIA 6

Definitions, Elements, Multimedia Hardware and Software, Distributed multimedia systems, challenges: security, sharing / distribution, storage, retrieval, processing, computing. Multimedia metadata, Multimedia databases, Hypermedia, Multimedia Learning.

UNIT II MULTIMEDIA FILE FORMATS AND STANDARDS 6

File formats – Text, Image file formats, Graphic and animation file formats, Digital audio and Video file formats, Color in image and video, Color Models. Multimedia data and file formats for the web.

UNIT III MULTIMEDIA AUTHORING 6

Authoring metaphors, Tools Features and Types: Card and Page Based Tools, Icon and ObjectBasedTools, Time Based Tools, Cross Platform Authoring Tools, Editing Tools, Painting and Drawing Tools, 3D Modeling and Animation Tools, Image Editing Tools, audio Editing Tools, Digital Movie Tools, Creating interactive presentations, virtual learning,simulations.

UNIT IV ANIMATION 6

Principles of animation: staging, squash and stretch, timing, onion skinning, secondary action, 2D, 2 ½ D, and 3D animation, Animation techniques: Keyframe, Morphing, Inverse Kinematics, Hand Drawn, Character rigging, vector animation, stop motion, motion graphics, , Fluid Simulation, skeletal animation, skinning Virtual Reality, Augmented Reality.

UNIT V MULTIMEDIA APPLICATIONS 6

Multimedia Big data computing, social networks, smart phones, surveillance, Analytics, Multimedia Cloud Computing, Multimedia streaming cloud, media on demand, security and forensics, Online social networking, multimedia ontology, Content based retrieval from digital libraries.

TOTAL : 30 PERIODS

LIST OF EXPERIMENTS:

Working with Image Editing tools:

Install tools like GIMP/ InkScape / Krita / Pencil and perform editing operations:ØUse different selection and transform tools to modify or improve an image

Ø Create logos and banners for home pages of websites.

Working with Audio Editing tools:

Ø Install tools like, Audacity / Ardour for audio editing, sound mixing and special effects like fade-inorfade-out etc.,

Ø Perform audio compression by choosing a proper codec.

Working with Video Editing and conversion tools:

Install tools like OpenShot / Cinelerra / HandBrake for editing video content.Ø Edit and mix video content, remove noise, create special effects, add captions. Ø Compressand convert video file format to other popular formats.

Working with web/mobile authoring tools:

Adapt / KompoZer/ BlueGriffon / BlueFish / Aptana Studio/ NetBeans / WordPress /Expression Web:ØDesign simple Home page with banners, logos, tables quick links etc

Ø Provide a search interface and simple navigation from the home page to the inside pages of thewebsite.Ø Design Responsive web pages for use on both web and mobile interfaces.

Working with Animation tools:

Install tools like, Krita, Wick Editor, Blender:Ø Perform a simple 2D animation with sprites

Ø Perform simple 3D animation with keyframes, kinematics

Working with Mobile UI animation tools: Origami studio / Lottie / Framer etc.,

Working with E-Learning authoring tools:

Install tools like EdApp / Moovly / CourseLab/ IsEazy and CamStudio/Ampache, VideoLAN:ØDemonstrate screen recording and further editing for e-learning content.

Ø Create a simple E-Learning module for a topic of your choice.

Creating VR and AR applications:

Ø Any affordable VR viewer like Google Cardboard and any development platform like Openspace3D /ARCore etc.

Note: all tools listed are open source. Usage of any proprietary tools in place of open source toolsis not restricted.

30 PERIODS

TOTAL: 60 PERIODS

WEB REFERENCES:

1. https://itsfoss.com/
2. https://www.ucl.ac.uk/slade/know/3396
3. https://handbrake.fr/
4. https://opensource.com/article/18/2/open-source-audio-visual-production-tools

https://camstudio.org/

5. https://developer.android.com/training/animation/overview
6. https://developer.android.com/training/animation/overview (UNIT-IV)

COURSE OUTCOMES:

- Get the bigger picture of the context of Multimedia and its applications
- Use the different types of media elements of different formats on content pages
- Author 2D and 3D creative and interactive presentations for different target multimedia applications.
- Use different standard animation techniques for 2D, 21/2 D, 3D applications
- Understand the complexity of multimedia applications in the context of cloud, security,bigdata streaming, social networking, CBIR etc.,

TEXT BOOKS:

1. Ze-Nian Li, Mark S. Drew, Jiangchuan Liu, Fundamentals of Multimedia", Third Edition,SpringerTexts in Computer Science, 2021. (UNIT-I, II, III)

REFERENCES:

1. John M Blain, The Complete Guide to Blender Graphics: Computer Modeling & Animation,CRC press, 3rd Edition, 2016.
2. Gerald Friedland, Ramesh Jain, "Multimedia Computing", Cambridge University Press,2018.
3. Prabhat K.Andleigh, Kiran Thakrar, "Multimedia System Design", Pearson Education, 1st Edition, 2015.
4. Mohsen Amini Salehi, Xiangbo Li, "Multimedia Cloud Computing Systems", Springer Nature,1st Edition, 2021.
5. Mark Gaimbruno, "3D Graphics and Animation", Second Edition, New Riders, 2002.
6. Rogers David, "Animation: Master – A Complete Guide (Graphics Series)", Charles River Media, 2006.
7. Rick parent, "Computer Animation: Algorithms and Techniques", Morgan Kauffman, 3rd Edition, 2012.
8. Emilio Rodriguez Martinez, Mireia Alegre Ruiz, "UI Animations with Lottie and After Effects: Create, render, and ship stunning After Effects animations natively on mobile with React Native", Packt Publishing, 2022.

CO's-PO's & PSO's MAPPING

CO's	PO's												PSO's		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	3	2	3	2	3	-	-	-	3	2	1	2	3	2	3
2	3	3	3	3	3	-	-	-	3	3	2	2	3	2	3
3	3	3	3	3	3	-	-	-	3	3	2	3	3	2	3

4	3	3	3	3	3	2	-	-	3	3	3	3	3	3	3
5	3	3	3	3	3	2	-	-	3	3	3	3	3	3	3
AVg.	3.00	2.80	3.00	2.80	3.00	2.00	-	-	3.00	2.80	2.20	2.60	3.00	2.40	3.00

1 - low, 2 - medium, 3 - high, '-' - no correlation

21150E66C VIDEO CREATION AND EDITING L T P C
2 0 2 3

COURSE OBJECTIVES:

- To introduce the broad perspective of linear and nonlinear editing concepts.
- To understand the concept of Storytelling styles.
- To be familiar with audio and video recording. To apply different media tools.
- To learn and understand the concepts of AVID XPRESS DV 4.

UNIT I FUNDAMENTALS 6

Evolution of filmmaking - linear editing - non-linear digital video - Economy of Expression - risks associated with altering reality through editing.

UNIT II STORYTELLING 6

Storytelling styles in a digital world through jump cuts, L-cuts, match cuts, cutaways, dissolves, split edits - Consumer and pro NLE systems - digitizing images - managing resolutions - mechanics of digital editing - pointer files - media management.

UNIT III USING AUDIO AND VIDEO 6

Capturing digital and analog video importing audio putting video on exporting digital video to tape recording to CDs and VCDs.

UNIT IV WORKING WITH FINAL CUT PRO 6

Working with clips and the Viewer - working with sequences, the Timeline, and the canvas - Basic Editing - Adding and Editing Testing Effects - Advanced Editing and Training Techniques - Workingwith Audio - Using Media Tools - Viewing and Setting Preferences.

UNIT V WORKING WITH AVID XPRESS DV 4 6

Starting Projects and Working with Project Window - Using Basic Tools and Logging - Preparing to Record and Recording - Importing Files - Organizing with Bins - Viewing and Making Footage - Using Timeline and Working in Trim Mode - Working with Audio - Output Options.

30 PERIODS

LIST OF EXPERIMENTS 30 PERIODS

1. Write a Movie Synopsis (Individual/Team Writing)
2. Present team stories in class.
3. Script/Storyboard Writing(Individual Assignment)
4. Pre-Production: Personnel, budgeting, scheduling, location scouting, casting, contracts & agreements
5. Production: Single camera production personnel & equipment, Documentary Production
6. Writing The Final Proposal: Overview, Media Treatments, Summary, Pitching

7. Write Documentary & Animation Treatment
8. Post-production: Editing, Sound design, Finishing

TOTAL: 60 PERIODS

COURSE OUTCOMES:

On completion of the course, the students will be able to: CO1:Compare the strengths and limitations of Nonlinear editing.CO2:Identify the infrastructureand significance of storytelling.
CO3:Apply suitable methods for recording to CDs and VCDs. CO4:Address thecore issues of advanced editing and training techniques.CO5:Design and developprojects using AVID XPRESS DV 4

TEXT BOOKS

1. Xpress DV 4 User Guide, 2007.
2. Final Cut Pro 6 User Manual, 2004.

3. Keith Underdahl, "Digital Video for Dummies", Third Edition, Dummy Series, 2001.
4. Robert M. Goodman and Partick McGarth, "Editing Digital Video: The Complete Creativeand Technical Guide", Digital Video and Audio, McGraw – Hill 2003.

CO's-PO's & PSO's MAPPING

CO's	PO's											PSO's		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	3	1	2	1	1	-	-	-	1	2	3	2	3	1	1
2	2	3	3	3	1	-	-	-	1	2	2	1	1	1	1
3	2	2	3	3	1	-	-	-	3	1	1	1	2	1	2
4	2	2	2	2	1	-	-	-	3	1	1	1	2	2	2
5	2	1	3	3	1	-	-	-	3	2	1	2	2	2	1
AVg.	2.2	1.8	2.6	2.4	1	-	-	-	2.2	1.6	1.6	1.4	2	1.4	1.4

1 - low, 2 - medium, 3 - high, '-' - no correlation

21150E66E

DIGITAL MARKETING **L T P C**
2 0 2 3

COURSE OBJECTIVES:

- The primary objective of this module is to examine and explore the role and importance ofdigital marketing in today's rapidly changing business environment.
- It also focuses on how digital marketing can be utilized by organizations and howits effectiveness can be measured.

UNIT I INTRODUCTION TO ONLINE MARKET 6

Online Market space- Digital Marketing Strategy- Components - Opportunities for building Brand Website - Planning and Creation - Content Marketing.

UNIT II SEARCH ENGINE OPTIMISATION 6

Search Engine optimisation - Keyword Strategy- SEO Strategy - SEO success factors -On-Page Techniques - Off-Page Techniques. Search Engine Marketing- How Search Engine works- SEM components- PPC advertising -Display Advertisement

UNIT III E- MAIL MARKETING 6

E- Mail Marketing - Types of E- Mail Marketing - Email Automation - Lead Generation - Integrating Email with Social Media and Mobile- Measuring and maximizing email campaign effectiveness. Mobile Marketing- Mobile Inventory/channels- Location based; Context based; Coupons and offers, Mobile Apps, Mobile Commerce, SMS Campaigns-Profiling and targeting

UNIT IV SOCIAL MEDIA MARKETING 6

Social Media Marketing - Social Media Channels- Leveraging Social media for brand conversations and buzz. Successful /benchmark Social media campaigns. Engagement Marketing- Building Customer relationships - Creating Loyalty drivers - Influencer Marketing.

UNIT V DIGITAL TRANSFORMATION 6

Digital Transformation & Channel Attribution- Analytics- Ad-words, Email, Mobile, Social Media, Web Analytics - Changing your strategy based on analysis- Recent trends in Digital marketing.

30 PERIODS

PRACTICAL EXERCISES: 30 PERIODS

1. Subscribe to a weekly/quarterly newsletter and analyze how its content and structure aidwith the branding of the company and how it aids its potential customer segments.
2. Perform keyword search for a skincare hospital website based on search volume and competition using Google keyword planner tool.
3. Demonstrate how to use the Google WebMasters Indexing API
4. Discuss an interesting case study regarding how an insurance company manages leads.
5. Discuss negative and positive impacts and ethical implications of using social media forpolitical advertising.
6. Discuss how Predictive analytics is impcting marketing automation

COURSE OUTCOMES:

CO1: To examine and explore the role and importance of digital marketing in today'srapidlychanging business environment..

CO2: To focuses on how digital marketing can be utilized by organizations and how itseffectivenesscan be measured.

CO3: To know the key elements of a digital marketing strategy.

CO4: To study how the effectiveness of a digital marketing campaign can be measured

CO5: To demonstrate advanced practical skills in common digital marketing tools such as SEO,SEM, Socialmedia and Blogs.

TOTAL:60 PERIODS

TEXT BOOKS

1. **Fundamentals of Digital Marketing by Puneet Singh Bhatia;Publisher: Pearson Education;**
2. **First edition (July 2017);ISBN-10: 933258737X;ISBN-13: 978-9332587373.**
3. Digital Marketing by Vandana Ahuja ;Publisher: Oxford University Press (April 2015). ISBN-10: 0199455449
4. Marketing 4.0: Moving from Traditional to Digital by Philip Kotler;Publisher: Wiley; 1st edition(April 2017); ISBN10: 9788126566938;ISBN 13: 9788126566938;ASIN: 8126566930.
5. Ryan, D. (2014). Understanding Digital Marketing: Marketing Strategies for Engaging theDigital Generation, Kogan Page Limited..
6. Barker, Barker, Bormann and Neher(2017), Social Media Marketing: A Strategic Approach,2E South-Western ,Cengage Learning.
7. Pulizzi,J Beginner's Guide to Digital Marketing , Mcgraw Hill Education

CO's-PO's & PSO's MAPPING

CO's	PO's												PSO's		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	3	3	2	1	3	-	-	-	1	2	3	3	3	3	3
2	2	2	2	1	3	-	-	-	1	2	3	3	3	3	3
3	1	1	1	2	2	-	-	-	1	2	1	1	3	2	1
4	3	2	2	3	1	-	-	-	1	3	2	3	2	3	2
5	2	3	1	3	3	-	-	-	2	3	1	2	1	2	1
AVg.	2.2	2.2	1.6	2	2.4	-	-	-	1.2	2.4	2	2.4	2.4	2.6	2

1 - low, 2 - medium, 3 - high, '-' - no correlation

21150E66F **VISUAL EFFECTS** **L T P C**
2 0 2 3

COURSE OBJECTIVES

- To get a basic idea on animation principles and techniques
- To get exposure to CGI, color and light elements of VFX
- To have a better understanding of basic special effects techniques
- To have a knowledge of state of the art vfx techniques
- To become familiar with popular compositing techniques

UNIT I ANIMATION BASICS 6

VFX production pipeline, Principles of animation, Techniques: Keyframe, kinematics, Full animation,limitedanimation, Rotoscoping, stop motion, object animation, pixilation, rigging, shape keys, motionpaths.

UNIT II CGI, COLOR, LIGHT 6

CGI – virtual worlds, Photorealism, physical realism, function realism, 3D Modeling and Rendering: color - Color spaces, color depth, Color grading, color effects, HDRI, Light – Area and mesh lights, image based lights, PBR lights, photometric light, BRDF shading model

UNIT III SPECIAL EFFECTS 6

Special Effects – props, scaled models, animatronics, pyrotechniques, Schüfftan process, Particle effects –wind, rain, fog, fire

UNIT IV VISUAL EFFECTS TECHNIQUES 6

Motion Capture, Matt Painting, Rigging, Front Projection.Rotoscoping, Match Moving – Tracking, camera reconstruction, planar tracking, Calibration, Point Cloud Projection, Ground planedetermination, 3D Match Moving

UNIT V COMPOSITING 6

Compositing – chroma key, blue screen/green screen, background projection, alpha compositing, deep image compositing, multiple exposure, matting, VFX tools - Blender, Natron, GIMP.

30 PERIODS

Laboratory Experiments:

Using Natron:

- Understanding Natron Environment:
- Working with color and using color grading
- using Channels
- Merging images
- Using Rotopaint
- performing Tracking and stabilizing
- Transforming elements
- Stereoscopic compositing

Using Blender:

Ø Motion Tracking – camera and object trackingØCamera fx, color grading, vignettes

Ø Compositing images and video filesØMultilayer rendering

30 PERIODS

TOTAL: 60 PERIODS

COURSE OUTCOMES

At the end of the course, the student will be able to:

CO1:To implement animation in 2D / 3D following the principles and techniques

CO2:To use CGI, color and light elements in VFX applications

CO3:Tocreate special effects using any of the state of the art tools

CO4:To applypopular visual effects techniques using advanced tools

CO5:To use compositing tools for creating VFX for a variety of applications

TEXT BOOKS:

1. Chris Roda, Real Time Visual Effects for the Technical Artist, CRC Press, 1st Edition, 2022.
2. Steve Wright, Digital Compositing for film and video, Routledge, 4th Edition, 2017.
3. John Gress, Digital Visual Effects and Compositing**,** New Riders Press, 1st Edition, 2014.

REFERENCES:

1. Jon Gress, "Digital Visual Effects and Compositing", New Riders Press, 1st Edition, 2014.
2. Robin Brinkman, The Art and Science of Digital Compositing: Techniques for Visual Effects, Animation and Motion Graphics", Morgan Kauffman, 2008.
3. Luiz Velho, Bruno Madeira, "Introduction to Visual Effects A Computational Approach", Routledge, 2023.
4. Jasmine Katatikarn, Michael Tanzillo, "Lighting for Animation: The art of visual storytelling **, Routledge, 1st Edition, 2016.**
5. Eran Dinur, "The Complete guide to Photorealism, for Visual Effects, Visualization
6. Jeffrey A. Okun, Susan Zwerman, Christopher McKittrick, " The VES Handbook of Visual Effects: Industry Standard VFX Practices and Procedures", Third Edition, 2020.and Games", Routledge, 1st Edition, 2022.
7. https://www.blender.org/features/vfx/
8. https://natrongithub.github.io/

CO's-PO's & PSO's MAPPING

CO's	PO's												PSO's		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	3	3	3	3	1	-	-	-	1	2	1	1	3	3	2
2	1	3	3	2	1	-	-	-	3	2	2	2	1	1	1
3	2	3	3	2	1	-	-	-	1	2	1	2	2	2	2
4	3	3	2	2	3	-	-	-	3	3	2	2	2	3	1
5	1	2	1	1	2	-	-	-	1	3	2	3	2	3	1
AVg.	2	2.8	2.4	2	1.6	-	-	-	1.8	2.4	1.6	2	2	2.4	1.4

1 - low, 2 - medium, 3 - high, '-' - no correlation

21150E66G **GAME DEVELOPMENT** **L T P C**
2 0 2 3

COURSE OBJECTIVES:

- To know the basics of 2D and 3D graphics for game development.
- To know the stages of game development.
- To understand the basics of a game engine.
- To survey the gaming development environment and tool kits.
- To learn and develop simple games using Pygame environment

UNIT I 3D GRAPHICS FOR GAME DESIGN 6

Genres of Games, Basics of 2D and 3D Graphics for Game Avatar, Game Components – 2D and 3D Transformations – Projections – Color Models – Illumination and Shader Models – Animation – Controller Based Animation.

UNIT II GAME DESIGN PRINCIPLES 6

Character Development, Storyboard Development for Gaming – Script Design – Script Narration, Game Balancing, Core Mechanics, Principles of Level Design – Proposals – Writing for Preproduction, Production and Post – Production.

UNIT III GAME ENGINE DESIGN 6

Rendering Concept – Software Rendering – Hardware Rendering – Spatial Sorting Algorithms – Algorithms for Game Engine– Collision Detection – Game Logic – Game AI – Pathfinding.

UNIT IV OVERVIEW OF GAMING PLATFORMS AND FRAMEWORKS 6

Pygame Game development – Unity – Unity Scripts –Mobile Gaming, Game Studio, UnitySingleplayer and Multi-Player games.

UNIT V GAME DEVELOPMENT USING PYGAME 6

Developing 2D and 3D interactive games using Pygame – Avatar Creation – 2D and 3D Graphics Programming – Incorporating music and sound – Asset Creations – Game Physics algorithms Development – Device Handling in Pygame – Overview of Isometric and Tile Based arcade Games – Puzzle Games.

30 PERIODS

COURSE OUTCOMES:

CO1:Explain the concepts of 2D and 3d Graphics
CO2:Design game design documents.
CO3:Implementation of gaming engines. CO4:Survey gaming environments and frameworks.CO5:Implement asimple game in Pygame.

EXPERIMENTS: 30 PERIODS

1. Installation of a game engine, e.g., Unity, Unreal Engine, familiarization of the GUI. Conceptualize the theme for a 2D game.
2. Character design, sprites, movement and character control
3. Level design: design of the world in the form of tiles along with interactive and collectible objects.
4. Design of interaction between the player and the world, optionally using the physics engine.
5. Developing a 2D interactive using Pygame
6. Developing a Puzzle game
7. Design of menus and user interaction in mobile platforms.
8. Developing a 3D Game using Unreal
9. Developing a Multiplayer game using unity

TOTAL: 60 PERIODS

REFERENCES

1. Sanjay Madhav, "Game Programming Algorithms and Techniques: A Platform Agnostic Approach", Addison Wesley,2013.
2. Will McGugan, "Beginning Game Development with Python and Pygame: From Novice to Professional", Apress,2007.
3. Paul Craven, "Python Arcade games", Apress Publishers,2016.
4. David H. Eberly, "3D Game Engine Design: A Practical Approach to Real-Time Computer Graphics", Second Edition, CRC Press,2006.
5. Jung Hyun Han, "3D Graphics for Game Programming", Chapman and Hall/CRC, 2011.

CO's-PO's & PSO's MAPPING

CO's	PO's												PSO's		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	3	2	2	1	2	-	-	-	-	-	-	-	2	2	2
2	1	2	2	1	2	-	-	-	-	-	-	-	2	2	1
3	1	1	1	2	1	-	-	-	-	-	-	-	2	2	2
4	3	3	1	3	3	-	-	-	-	-	-	-	2	2	3
5	3	3	2	1	3	-	-	-	-	-	-	-	2	2	3
AVg.	2.2	2.2	1.6	1.6	2.2	-	-	-	-	-	-	-	2	2	2.2

1 - low, 2 - medium, 3 - high, '-' - no correlation

21150E66H MULTIMEDIA DATA COMPRESSION AND STORAGE

L T P C
2 0 2 3

COURSE OBJECTIVES:

- To understand the basics of compression techniques
- To understand the categories of compression for text, image and video
- To explore the modalities of text, image and video compression algorithms
- To know about basics of consistency of data availability in storage devices
- To understand the concepts of data streaming services

UNIT I BASICS OF DATA COMPRESSION 6

Introduction —Lossless and LossyCompression– Basics of Huffmann coding- Arithmetic coding- Dictionary techniques- Context based compression – Applications

UNIT II IMAGE COMPRESSION 6

Lossless Image compression – JPEG-CALIC-JPEG LS-Prediction using conditional averages – Progressive Image Transmission – Lossless Image compression formats – Applications - Facsimile encoding

UNIT III VIDEO COMPRESSION 6

Introduction – Motion Compensation – Video Signal Representation – H.261 – MPEG-1- MPEG-2- H.263.

UNIT IV DATA PLACEMENT ON DISKS 6

Statistical placement on Disks – Striping on Disks – Replication Placement on Disks – Constraint allocation on Disks – Tertiary storage Devices – Continuous Placement on Hierarchical storagesystem – Statistical placement on Hierarchical storage systems – Constraint allocation on Hierarchical storage system

UNIT V DISK SCHEDULING METHODS 6

Scheduling methods for disk requests – Feasibility conditions of concurrent streams– Schedulingmethodsfor request streams

30 PERIODS

LIST OF EXPERIMENTS

1. Construct Huffman codes for given symbol probabilities.
2. Encode run lengths with fixed-length code.
3. Lempel-Ziv algorithm for adaptive variable-length encoding
4. Compress the given word using arithmetic coding based on the frequency of the letters.
5. Write a shell script, which converts all images in the current directory in JPEG.
6. Write a program to split images from a video without using any primitives.
7. Create a photo album of a trip by applying appropriate image dimensions and format.
8. Write the code for identifying the popularity of content retrieval from media server.
9. Write the code for ensuring data availability in disks using strip based method.
10. Program for scheduling requests for data streams.

30 PERIODSTOTAL : 60 PERIODS

COURSE OUTCOMES:

CO1: Understand the basics of text, Image and Video compression

CO2: Understand the various compression algorithms for multimedia content

CO3: Explore the applications of various compression techniques

CO4: Explore knowledge on multimedia storage on disks

CO5: Understand scheduling methods for request streams

TEXT BOOKS

1. Khalid Sayood, Introduction to Data Compression, Morgan Kaufmann Series in Multimedia Information and Systems, 2018, 5th Edition.
2. Philip K.C.Tse, Multimedia Information Storage and Retrieval: Techniques and Technologies, 2008

REFERENCES

1. David Salomon, A concise introduction to data compression, 2008.
2. Lenald Best, Best's Guide to Live Stream Video Broadcasting, BCB Live Teaching series,2017.
3. Yun-Qing Shi, Image And Video Compression For Multimedia Engineering Fundamentals Algorithms And Standards, Taylor& Francis,2019
4. Irina Bocharova, Compression for Multimedia, Cambridge University Press; 1st edition,2009

CO's-PO's & PSO's MAPPING

CO's	PO's												PSO's		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	3	2	2	1	1	-	-	-	-	-	-	-	2	2	2
2	3	2	2	1	2	-	-	-	-	-	-	-	2	2	2
3	3	2	2	1	2	-	-	-	-	-	-	-	2	2	2
4	3	2	2	1	1	-	-	-	-	-	-	-	2	2	2
5	3	2	2	1	1	-	-	-	-	-	-	-	2	2	2
AVg.	3	2	2	1	1.4	-	-	-	-	-	-	-	2	2	2

1 - low, 2 - medium, 3 - high, '-' - no correlation

21150E67B ROBOTIC PROCESS AUTOMATION L T P C
2 0 2 3

COURSE OBJECTIVES:

- To understand the basic concepts of Robotic Process Automation.
- To expose to the key RPA design and development strategies and methodologies.
- To learn the fundamental RPA logic and structure.
- To explore the Exception Handling, Debugging and Logging operations in RPA.
- To learn to deploy and Maintain the software bot.

UNIT I INTRODUCTION TO ROBOTIC PROCESS AUTOMATION 6

Emergence of Robotic Process Automation (RPA), Evolution of RPA, Differentiating RPA from Automation - Benefits of RPA - Application areas of RPA, Components of RPA, RPA Platforms. Robotic Process Automation Tools - Templates, User Interface, Domains in Activities, Workflow Files.

UNIT II AUTOMATION PROCESS ACTIVITIES 6

Sequence, Flowchart & Control Flow: Sequencing the Workflow, Activities, Flowchart, Control Flow for Decision making. Data Manipulation: Variables, Collection, Arguments, Data Table, Clipboard management, File operations Controls: Finding the control, waiting for a control, Act on a control, UiExplorer, Handling Events

UNIT III APP INTEGRATION, RECORDING AND SCRAPING 6

App Integration, Recording, Scraping, Selector, Workflow Activities. Recording mouse and keyboardactionsto perform operation, Scraping data from website and writing to CSV. Process Mining.

UNIT IV EXCEPTION HANDLING AND CODE MANAGEMENT 6

Exception handling, Common exceptions, Logging- Debugging techniques, Collecting crash dumps, Error reporting. Code management and maintenance: Project organization, Nesting workflows, Reusability, Templates, Commenting techniques, State Machine.

UNIT V DEPLOYMENT AND MAINTENANCE 6

Publishing using publish utility, Orchestration Server, Control bots, Orchestration Server to deploy bots, License management, Publishing and managing updates. RPA Vendors - Open Source RPA, Future of RPA

30 PERIODS

PRACTICAL EXERCISES: 30 PERIODS

Setup and Configure a RPA tool and understand the user interface of the tool:

1. Create a Sequence to obtain user inputs display them using a message box;
2. Create a Flowchart to navigate to a desired page based on a condition;
3. Create a State Machine workflow to compare user input with a random number.
4. Build a process in the RPA platform using UI Automation Activities.
5. Create an automation process using key System Activities, Variables and Arguments
6. Also implement Automation using System Trigger
7. Automate login to (web)Email account
8. Recording mouse and keyboard actions.
9. Scraping data from website and writing to CSV
10. Implement Error Handling in RPA platform
11. Web Scraping
12. Email Query Processing

TOTAL:60 PERIODS

COURSE OUTCOMES:

By the end of this course, the students will be able to:

- **Enunciate the key distinctions between RPA and existing automation techniques andplatforms.**
- **Use UiPath to design control flows and work flows for the target process**
- **Implement recording, web scraping andprocess mining by automation**
- **Use UIPath Studio to detect, and handle exceptions in automation processes**
- **Implement and use Orchestrator for creation, monitoring, scheduling, and controlling of automated bots and processes.**

TEXT BOOKS:

1. Learning Robotic Process Automation: Create Software robots and automate businessprocesses with the leading RPA tool - UiPath by Alok Mani Tripathi, Packt Publishing, 2018.
2. Tom Taulli , "The Robotic Process Automation Handbook: A Guide to Implementing RPA Systems", Apress publications, 2020.

REFERENCES:

1. Frank Casale (Author), Rebecca Dilla (Author), Heidi Jaynes (Author), Lauren Livingston (Author), Introduction to Robotic Process Automation: a Primer, Institute of Robotic Process Automation, Amazon Asia-Pacific Holdings Private Limited, 2018
2. Richard Murdoch, Robotic Process Automation: Guide To Building Software Robots, Automate Repetitive Tasks & Become An RPA Consultant, Amazon Asia-Pacific Holdings Private Limited, 2018
3. A Gerardus Blokdyk, "Robotic Process Automation Rpa A Complete Guide ", 2020

CO's-PO's & PSO's MAPPING

CO's	PO's												PSO's		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	3	2	2	1	3	-	-	-	1	3	3	2	2	2	1
2	1	1	2	3	3	-	-	-	1	2	3	1	3	2	1
3	2	3	2	3	3	-	-	-	2	3	1	1	3	3	3
4	1	2	1	2	2	-	-	-	1	2	1	3	3	3	2
5	3	3	3	3	3	-	-	-	3	1	1	1	3	2	1
AVg.	2	2.2	2	2.4	2.8	-	-	-	1.6	2.2	1.8	1.6	2.8	2.4	1.6

1 - low, 2 - medium, 3 - high, '-' - no correlation

21150E67D **CYBER SECURITY** **L T P C**
2 0 2 3

COURSE OBJECTIVES:

- To learn cybercrime and cyberlaw.
- To understand the cyber attacks and tools for mitigating them.
- To understand information gathering.
- To learn how to detect a cyber attack.
- To learn how to prevent a cyber attack.

UNIT I INTRODUCTION 6

Cyber Security – History of Internet – Impact of Internet – CIA Triad; Reason for Cyber Crime – Need for Cyber Security – History of Cyber Crime; Cybercriminals – Classification of Cybercrimes – A Global Perspective on Cyber Crimes; Cyber Laws – The Indian IT Act – Cybercrime and Punishment.

UNIT II ATTACKS AND COUNTERMEASURES 6

OSWAP; Malicious Attack Threats and Vulnerabilities: Scope of Cyber-Attacks – Security Breach – Types of Malicious Attacks – Malicious Software – Common Attack Vectors – Social engineering Attack – Wireless Network Attack – Web Application Attack – Attack Tools – Countermeasures.

UNIT III RECONNAISSANCE 5

Harvester – Whois – Netcraft – Host – Extracting Information from DNS – Extracting Information from E-mail Servers – Social Engineering Reconnaissance; Scanning – Port Scanning – NetworkScanning and Vulnerability Scanning – Scanning Methodology – Ping Sweer Techniques – Nmap Command Switches
– SYN – Stealth – XMAS – NULL – IDLE – FIN Scans – Banner Grabbing and OS Finger printing Techniques.

UNIT IV INTRUSION DETECTION 5

Host -Based Intrusion Detection – Network -Based Intrusion Detection – Distributed or Hybrid Intrusion Detection – Intrusion Detection Exchange Format – Honeypots – Example System Snort.

UNIT V INTRUSION PREVENTION 5

Firewalls and Intrusion Prevention Systems: Need for Firewalls – Firewall Characteristics and Access Policy – Types of Firewalls – Firewall Basing – Firewall Location and Configurations – Intrusion Prevention Systems – Example Unified Threat Management Products.

30 PERIODS

PRACTICAL EXERCISES: 30 PERIODS

1. Install Kali Linux on Virtual box
2. Explore Kali Linux and bash scripting
3. Perform open source intelligence gathering using Netcraft, Whois Lookups, DNS Reconnaissance, Harvester and Maltego
4. Understand the nmap command d and scan a target using nmap
5. Install metasploitable2 on the virtual box and search for unpatched vulnerabilities
6. Use Metasploit to exploit an unpatched vulnerability
7. Install Linus server on the virtual box and install ssh
8. Use Fail2banto scan log files and ban Ips that show the malicious signs
9. Launch brute-force attacks on the Linux server using Hydra.
10. Perform real-time network traffic analysis and data pocket logging using Snort

COURSE OUTCOMES:

On successful completion of this course, the student will be able to

CO1: Explain the basics of cyber security, cyber crime and cyber law (K2)

CO2: Classify various types of attacks and learn the tools to launch the attacks (K2)

CO3 Apply various tools to perform information gathering (K3)

CO4: Apply intrusion techniques to detect intrusion (K3)

CO5: Apply intrusion prevention techniques to prevent intrusion (K3)

TOTAL:60 PERIODS

TEXTBOOKS

1. Anand Shinde, "Introduction to Cyber Security Guide to the World of Cyber Security", NotionPress, 2021 (Unit 1)
2. Nina Godbole, Sunit Belapure, "Cyber Security: Understanding Cyber Crimes, Computer Forensics and Legal Perspectives", Wiley Publishers, 2011 (Unit 1)
3. https://owasp.org/www-project-top-ten/

REFERENCES

1. David Kim, Michael G. Solomon, "Fundamentals of Information Systems Security", Jones & Bartlett Learning Publishers, 2013 (Unit 2)
2. Patrick Engebretson, "The Basics of Hacking and Penetration Testing: Ethical Hacking and Penetration Testing Made easy", Elsevier, 2011 (Unit 3)
3. Kimberly Graves, "CEH Official Certified Ethical hacker Review Guide", Wiley Publishers,2007 (Unit 3)
4. William Stallings, Lawrie Brown, "Computer Security Principles and Practice", Third Edition, Pearson Education, 2015 (Units 4 and 5)
5. Georgia Weidman, "Penetration Testing: A Hands-On Introduction to Hacking", No StarchPress, 2014 (Lab)

CO's-PO's & PSO's MAPPING

CO's	PO's												PSO's		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	1	1	1	1	-	1	-	-	-	-	1	-	2	2	2
2	1	3	1	3	2	1	-	-	-	-	-	-	2	2	1
3	2	1	1	1	-	1	-	-	-	-	1	-	2	2	2
4	3	3	2	2	2	1	-	-	-	-	-	-	2	2	3
5	3	2	1	1	1	1	-	1	-	-	1	-	2	2	2
AVg.	2	2	1.2	1.6	1	1	0	0.2	0	0	0.6	0	2	2	2

1 - low, 2 - medium, 3 - high, '-' - no correlation

21150E67E QUANTUM COMPUTING L T P C
2 0 2 3

COURSE OBJECTIVES:

- To know the background of classical computing and quantum computing.
- To learn the fundamental concepts behind quantum computation.
- To study the details of quantum mechanics and its relation to Computer Science.
- To gain knowledge about the basic hardware and mathematical models of quantum computation.
- To learn the basics of quantum information and the theory behind it.

UNIT I QUANTUM COMPUTING BASIC CONCEPTS 6

Complex Numbers - Linear Algebra - Matrices and Operators - Global Perspectives Postulates ofQuantumMechanics – Quantum Bits - Representations of Qubits - Superpositions

UNIT II QUANTUM GATES AND CIRCUITS 5

Universal logic gates - Basic single qubit gates - Multiple qubit gates - Circuit development - Quantum error correction

UNIT III QUANTUM ALGORITHMS 7

Quantum parallelism - Deutsch's algorithm - The Deutsch–Jozsa algorithm - Quantum Fourier transform and its applications - Quantum Search Algorithms: Grover's Algorithm

UNIT IV QUANTUM INFORMATION THEORY 6

Data compression - Shannon's noiseless channel coding theorem - Schumacher's quantumnoiseless channelcoding theorem - Classical information over noisy quantum channels

UNIT V QUANTUM CRYPTOGRAPHY 6

Classical cryptography basic concepts - Private key cryptography - Shor's Factoring Algorithm - Quantum Key Distribution - BB84 - Ekart 91

30 PERIODS

PRACTICAL EXERCISES 30 PERIODS

1. Single qubit gate simulation - Quantum Composer
2. Multiple qubit gate simulation - Quantum Composer
3. Composing simple quantum circuits with q-gates and measuring the output into classicalbits.
4. IBM Qiskit Platform Introduction

5. Implementation of Shor's Algorithms
6. Implementation of Grover's Algorithm
7. Implementation of Deutsch's Algorithm
8. Implementation of Deutsch-Jozsa's Algorithm
9. Integer factorization using Shor's Algorithm
10. QKD Simulation
11. Mini Project such as implementing an API for efficient search using Grover's Algorithms or

COURSE OUTCOMES:

On completion of the course, the students will be able to:

CO1: Understand the basics of quantum computing.

CO2: Understand the background of Quantum Mechanics.

CO3: Analyze the computation models.

CO4: Model the circuits using quantum computation.
environments and frameworks.

CO5: Understand the quantum operations such as noise and error–correction.

TOTAL:60 PERIODS

TEXTBOOKS:

1. Parag K Lala, Mc Graw Hill Education, "Quantum Computing, A Beginners Introduction",First edition (1 November 2020).
2. Michael A. Nielsen, Issac L. Chuang, "Quantum Computation and Quantum Information",Tenth Edition, Cambridge University Press, 2010.
3. Chris Bernhardt, The MIT Press; Reprint edition (8 September 2020), "Quantum Computingfor Everyone".

REFERENCES

1. Scott Aaronson, "Quantum Computing Since Democritus", Cambridge University Press,2013.
2. N. David Mermin, "Quantum Computer Science: An Introduction", Cambridge UniversityPress, 2007.

CO's-PO's & PSO's MAPPING

CO's	PO's												PSO's		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	3	2	2	2	-	-	-	-	2	-	-	-	2	3	2
2	3	2	2	2	-	-	-	-	2	-	-	-	2	3	1
3	3	3	3	3	2	-	-	-	3	-	-	-	3	2	2
4	3	3	3	3	3	-	-	-	3	-	-	-	1	3	2
5	3	3	2	3	-	-	-	-	2	-	-	-	1	3	3
AVg.	3	2.6	2.4	2.6	1	-	-	-	2.4	-	-	-	1.8	2.8	2

1 - low, 2 - medium, 3 - high, '-' - no correlation

21150E67H

3D PRINTING AND DESIGN **L T P C**

2 0 2 3

COURSE OBJECTIVES:

- To discuss on basics of 3D printing
  To explain the principles of 3D printing technique
- To explain and illustrate inkjet technology
- To explain and illustrate laser technology
- To discuss the applications of 3D printing

UNIT I INTRODUCTION 6

Introduction; Design considerations – Material, Size, Resolution, Process; Modelling and viewing - 3D; Scanning; Model preparation – Digital; Slicing; Software; File formats

UNIT II PRINCIPLE 6

Processes – Extrusion, Wire, Granular, Lamination, Photopolymerisation; Materials - Paper, Plastics, Metals, Ceramics, Glass, Wood, Fiber, Sand, Biological Tissues, Hydrogels, Graphene; Material Selection - Processes, applications, limitations;

UNIT III INKJET TECHNOLOGY 6

Printer - Working Principle, Positioning System, Print head, Print bed, Frames, Motion control; Printhead Considerations – Continuous Inkjet, Thermal Inkjet, Piezoelectric Drop-On-Demand; Material Formulation for jetting; Liquid based fabrication – Continous jet, Mulitjet; Powder based fabrication
– Colourjet.

UNIT IV LASER TECHNOLOGY 6

Light Sources – Types, Characteristics; Optics – Deflection, Modulation; Material feeding and flow – Liquid, powder; Printing machines – Types, Working Principle, Build Platform, Print bed Movement, Support structures;

UNIT V INDUSTRIAL APPLICATIONS 6

Product Models, manufacturing – Printed electronics, Biopolymers, Packaging, Healthcare, Food,Medical, Biotechnology, Displays; Future trends;

30 PERIODS

PRACTICAL EXERCISES: 30 PERIODS

1. Study the interface and basic tools in the CAD software.
2. Study 3D printer(s) including print heads, build envelope, materials used and related support removal system(s).
3. Review of geometry terms of a 3D mesh.
4. Commands for moving from 2D to 3D.
5. Advanced CAD commands to navigate models in 3D space
6. Design any four everyday objects
   Refer to web sites like Thingiverse, Shapeways and GitFab to design four everyday objects that utilize the advantages of 3D printing

. Choose four models from a sharing site like Thingiverse, Shapeways or Gitfab.

a. Improve upon a file and make it your own. Some ideas include:

• Redesign it with a specific user in mind

• Redesign it for a slightly different purpose
• Improve the look of the product

7. Use the CAM software to prepare files for 3D printing.
8. Manipulate machine movement and material layering.
9. Repair a 3D mesh using

a) Freeware utilities: Autodesk MeshMixer (http://goo.gl/x5nhYc), MeshLab (http://goo.gl/fgztLl) orNetfabb Basic or Cloud Service (http://goo.gl/Q1P47a)
b) Freeware tool tutorials: Netfabb Basic or Cloud Service (http://goo.gl/Q1P47a), Netfabb and MeshLab (http://goo.gl/WPOVec)
c) Professional tools: Magics or Netfabb

Equipment : one 3D printer for every 10-15 students

COURSE OUTCOMES:

At the end of this course, the students will be able to:

CO1:Outline and examine the basic concepts of 3D printing technology

CO2:Outline 3D printing workflow`

CO3: Explain and categorise the concepts and working principles of 3D printing using inkjettechnique

CO4: Explain and categorise the working principles of 3D printing using laser technique

CO5: Explain various method for designing and modeling for industrial applications

TOTAL:60 PERIODS

TEXT BOOKS

1. Christopher Barnatt, 3D Printing: The Next Industrial Revolution, CreateSpace Independent Publishing Platform, 2013.
2. Ian M. Hutchings, Graham D. Martin, Inkjet Technology for Digital Fabrication, John Wiley &Sons, 2013.

REFERENCES:

1. Chua, C.K., Leong K.F. and Lim C.S., Rapid prototyping: Principles and applications, secondedition, World Scientific Publishers, 2010
2. Ibrahim Zeid, Mastering CAD CAM Tata McGraw-Hill Publishing Co., 2007
3. Joan Horvath, Mastering 3D Printing, APress, 2014

CO's-PO's & PSO's MAPPING

CO's	PO's												PSO's		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	1	1	2	2	3	1	-	-	2	-	2	2	3	2	1
2	3	2	3	3	3	2	-	-	3	-	3	2	3	2	3
3	2	2	2	2	2	2	-	-	2	-	2	2	3	2	2
4	2	2	2	2	3	2	-	-	2	-	2	2	3	3	2
5	1	3	3	3	3	3	-	-	3	-	3	3	3	3	1
AVg.	1.8	2	2.4	2.4	2.8	2	-	-	2.4	-	2.4	2.2	3	2.4	1.8

1 - low, 2 - medium, 3 - high, '-' - no correlation

SOFT CORE – MANAGEMENT

ELECTIVE – VII

21160E75A

PRINCIPLES OF MANAGEMENT

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

- Sketch the Evolution of Management.
- Extract the functions and principles of management.
- Learn the application of the principles in an organization.
- Study the various HR related activities.
- Analyze the position of self and company goals towards business.

UNIT I INTRODUCTION TO MANAGEMENT AND ORGANIZATIONS 9

Definition of Management – Science or Art – Manager Vs Entrepreneur- types of managers- managerial roles and skills – Evolution of Management –Scientific, human relations, system and contingency approaches– Types of Business organization- Sole proprietorship, partnership, company-public and private sector enterprises- Organization culture and Environment – Current trends and issues in Management.

UNIT II PLANNING 9

Nature and purpose of planning – Planning process – Types of planning – Objectives – Setting objectives – Policies – Planning premises – Strategic Management – Planning Tools and Techniques – Decision making steps and process.

UNIT III ORGANISING 9

Nature and purpose – Formal and informal organization – Organization chart – Organization structure – Types – Line and staff authority – Departmentalization – delegation of authority – Centralization and decentralization – Job Design - Human Resource Management – HR Planning, Recruitment, selection, Training and Development, Performance Management, Career planning and management.

UNIT IV DIRECTING

Foundations of individual and group behaviour– Motivation – Motivation theories – Motivational techniques – Job satisfaction – Job enrichment – Leadership – types and theories of leadership – Communication – Process of communication – Barrier in communication – Effective communication – Communication and IT.

UNIT V CONTROLLING 9

System and process of controlling – Budgetary and non - Budgetary control techniques – Use of computers and IT in Management control – Productivity problems and management – Control and performance – Direct and preventive control – Reporting.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

CO1: Upon completion of the course, students will be able to have clear understanding of managerial functions like planning, organizing, staffing, leading & controlling.

CO2: Have same basic knowledge on international aspect of management.

CO3: Ability to understand management concept of organizing.CO4: Ability to understand management concept of directing. CO5: Ability to understand management concept of controlling.

TEXT BOOKS:

1. Harold Koontz and Heinz Weihrich "Essentials of management" Tata McGraw Hill,1998.
2. Stephen P. Robbins and Mary Coulter, " Management", Prentice Hall (India)Pvt. Ltd.,10th Edition, 2009.

REFERENCES:

1. Robert Kreitner and MamataMohapatra, " Management", Biztantra, 2008.
2. Stephen A. Robbins and David A. Decenzo and Mary Coulter, "Fundamentals of Management" Pearson Education, 7th Edition, 2011.
3. Tripathy PC and Reddy PN, "Principles of Management", Tata Mcgraw Hill, 1999.

CO's-PO's & PSO's MAPPING

CO's	PO's												PSO's		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	3		-	-	-	1	-	-	-	-	-	-	2	1	1
2	-	1	1	-	-	-	-	-	-	-	-	-	2	1	-
3	1		-	2	-	-	1	-	2	-	1	1	-	-	2
4	-	1	1	1	2	-	-	1	2	-	-	-	1	1	1
5	1		-	-	1	1	-	-	-	3	-	1	1	-	1
AVg.	1.66	1	1	1.5	1.5	1	1	1	2	3	1	1	1.5	1	1.25

1 - low, 2 - medium, 3 - high, '-"- no correlation

21160E75B TOTAL QUALITY MANAGEMENT L T P C
3 0 0 3

COURSE OBJECTIVES:

- Teach the need for quality, its evolution, basic concepts, contribution of quality gurus, TQMframework, Barriers and Benefits of TQM.
- Explain the TQM Principles for application.
- Define the basics of Six Sigma and apply Traditional tools, New tools, Benchmarking andFMEA.
- Describe Taguchi's Quality Loss Function, Performance Measures and apply Techniqueslike QFD, TPM, COQ and BPR.
- Illustrate and apply QMS and EMS in any organization.

UNIT I INTRODUCTION 9

Introduction - Need for quality - Evolution of quality - Definition of quality - Dimensions of product and service quality –Definition of TQM-- Basic concepts of TQM - Gurus of TQM (Brief introduction) -- TQM Framework- Barriers to TQM –Benefits of TQM.

UNIT II TQM PRINCIPLES 9

Leadership - Deming Philosophy, Quality Council, Quality statements and Strategic planning- Customer Satisfaction –Customer Perception of Quality, Feedback, Customer complaints, Service Quality, KanoModel and Customer retention – Employee involvement – Motivation, Empowerment,

Team and Teamwork, Recognition & Reward and Performance Appraisal-- Continuous process improvement –Juran Trilogy, PDSA cycle, 5S and Kaizen - Supplier partnership – Partnering, Supplier selection, Supplier Rating and Relationship development.

UNIT III TQM TOOLS & TECHNIQUES I 9

The seven traditional tools of quality - New management tools - Six-sigma Process Capability- Bench marking - Reasons to benchmark, Benchmarking process, What to Bench Mark, Understanding Current Performance, Planning, Studying Others, Learning from the data, Using thefindings, Pitfalls and Criticisms of Benchmarking - FMEA - Intent , Documentation, Stages: Design FMEA and Process FMEA.

UNIT IV TQM TOOLS & TECHNIQUES II 9

Quality circles – Quality Function Deployment (QFD) - Taguchi quality loss function – TPM – Concepts, improvement needs – Performance measures- Cost of Quality - BPR.

UNIT V QUALITY MANAGEMENT SYSTEM 9

Introduction-Benefits of ISO Registration-ISO 9000 Series of Standards-Sector-Specific Standards - AS 9100, TS16949 and TL 9000-- ISO 9001 Requirements-Implementation-Documentation- Internal Audits-Registration-ENVIRONMENTAL MANAGEMENT SYSTEM: Introduction—ISO 14000 Series Standards—Concepts of ISO 14001—Requirements of ISO 14001-Benefits of EMS.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

CO1: Ability to apply TQM concepts in a selected enterprise.
CO2: Ability to apply TQM principles in a selected enterprise.
CO3: Ability to understand Six Sigma and apply Traditional tools, New tools,Benchmarking andFMEA.
CO4: Ability to understand Taguchi's Quality Loss Function, Performance Measures andapplyQFD, TPM, COQ and BPR.
CO5: Ability to apply QMS and EMS in any organization.

CO's-PO's & PSO's MAPPING

CO's	PO's												PSO's		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1		3										3	2		3
2						3						3		2	
3					3				3					2	3
4		2			3	2	3	2				3	3	2	
5			3			3	3	2							
Avg		2.5				2.6	3	2	3			3	2.5	2	3

1 - low, 2 - medium, 3 - high, '-'- no correlation

TEXT BOOK:

1. Dale H.Besterfiled, Carol B.Michna,Glen H. Bester field,MaryB.Sacre, HemantUrdhwareshe and RashmiUrdhwareshe, "Total Quality Management", Pearson Education Asia, Revised Third Edition, Indian Reprint, Sixth Impression,2013.

REFERENCES:

1. Joel.E. Ross, “Total Quality Management – Text and Cases”,Routledge.,2017.
2. Kiran.D.R, “Total Quality Management: Key concepts and case studies, Butterworth – Heinemann Ltd, 2016.
3. Oakland, J.S. “TQM – Text with Cases”, Butterworth – Heinemann Ltd., Oxford, Third **Edition,2003.**
4. Suganthi,L and Anand Samuel, “Total Quality Management”, Prentice Hall (India) Pvt.Ltd.,2006 .

21160E75C	**INDUSTRIAL MANAGEMENT**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

COURSE OBJECTIVES

- To study the basic concepts of management; approaches to management; contributors to management studies; various forms of business organization and trade unions function in professional organizations.
- To study the planning; organizing and staffing functions of management in professional organization.
- To study the leading; controlling and decision making functions of management in professional organization.
- To learn the organizational theory in professional organization.
- To learn the principles of productivity and modern concepts in management in professional organization.

UNIT I INTRODUCTION TO MANAGEMENT 9

Management: Introduction; Definition and Functions – Approaches to the study of Management – Mintzberg’s Ten Managerial Roles – Principles of Taylor; Fayol; Weber; Parker – Forms of Organization: Sole Proprietorship; Partnership; Company (Private and Public); Cooperative – Public Sector Vs Private Sector Organization – Business Environment: Economic; Social; Political; Legal – Trade Union: Definition; Functions; Merits & Demerits.

UNIT II FUNCTIONS OF MANAGEMENT - I 9

Planning: Characteristics; Nature; Importance; Steps; Limitation; Planning Premises; Strategic Planning; Vision & Mission statement in Planning– Organizing: Organizing Theory; Principles; Types; Departmentalization; Centralization and Decentralization; Authority & Responsibility – Staffing: Systems Approach; Recruiting and Selection Process; Human Resource Development (HRD) Concept andDesign.

UNIT III FUNCTIONS OF MANAGEMENT - II 9

Directing (Leading): Leadership Traits; Style; Morale; Managerial Grids (Blake-Mounton, Reddin) – Communication: Purpose; Model; Barriers – Controlling: Process; Types; Levels; Guidelines; Audit (External, Internal, Merits); Preventive Control – Decision Making: Elements; Characteristics; Nature; Process; Classifications.

UNIT IV ORGANIZATION THEORY 9

Organizational Conflict: Positive Aspects; Individual; Role; Interpersonal; Intra Group; Inter Group; Conflict Management – Maslow's hierarchy of needs theory; Herzberg's motivation-hygiene theory; McClelland's three needs motivation theory; Vroom's valence-expectancy theory – Change Management: Concept of Change; Lewin's Process of Change Model; Sources of Resistance; Overcoming Resistance; Guidelines to managing Conflict.

UNIT – V PRODUCTIVITY AND MODERN TOPICS 9

Productivity: Concept; Measurements; Affecting Factors; Methods to Improve – Modern Topics (concept, feature/characteristics, procedure, merits and demerits): Business Process Reengineering (BPR); Benchmarking; SWOT/SWOC Analysis; Total Productive Maintenance; Enterprise Resource Planning (ERP); Management of Information Systems (MIS).

TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of the course the students would be able to

CO1 Explain basic concepts of management; approaches to management; contributors to managementstudies; various forms of business organization and trade unions function inprofessional organizations.

CO2 Discuss the planning; organizing and staffing functions of management in professional organization.

CO3 Apply the leading; controlling and decision making functions of management in professional organization.

CO4 Discuss the organizational theory in professional organization.

CO5 Apply principles of productivity and modern concepts in management in professional organization.

TEXTBOOKS:

1. M. Govindarajan and S. Natarajan, "Principles of Management", Prentice Hall of India, NewDelhi, 2009.
2. Koontz. H. and Weihrich. H., "Essentials of Management: An International Perspective", 8th Edition, Tata McGrawhill, New Delhi, 2010.

REFERENCES:

1. Joseph J, Massie, "Essentials of Management", 4th Edition, Pearson Education, 1987.
2. Saxena, P. K., "Principles of Management: A Modern Approach", Global India Publications, 2009.
3. S.Chandran, "Organizational Behaviours", Vikas Publishing House Pvt. Ltd., 1994.
4. Richard L. Daft, "Organization Theory and Design", South Western College Publishing, 11th Edition, 2012.
5. S. TrevisCerto, "Modern Management Concepts and Skills", Pearson Education, 2018.

CO's-PO's & PSO's MAPPING

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	1	1	1	1	1	3	2	3	2	3	1	3	1	1	1
2	1	1	1	1	1	3	2	3	2	3	1	3	1	1	1
3	1	1	1	1	1	3	2	3	2	3	1	3	1	1	1
4	1	1	1	1	1	3	2	3	2	3	1	3	1	1	1

1 - low, 2 - medium, 3 - high, ‘-“- no correlation

MANDATORY COURSES I

21147MC51A **INTRODUCTION TO WOMEN AND GENDER STUDIES** **L T P C**
3 0 0 0

COURSE OUTLINE

UNIT I CONCEPTS
Sex vs. Gender, masculinity, femininity, socialization, patriarchy, public/ private, essentialism, binaryism, power, hegemony, hierarchy, stereotype, gender roles, gender relation, deconstruction, resistance, sexual division of labour.

UNIT II FEMINIST THEORY
Liberal, Marxist, Socialist, Radical, Psychoanalytic, postmodernist, ecofeminist.

UNIT III WOMEN’S MOVEMENTS: GLOBAL, NATIONAL AND LOCAL
Rise of Feminism in Europe and America.Women’s Movement in India.

UNIT IV GENDER AND LANGUAGE
Linguistic Forms and Gender.Gender and narratives.

UNIT V GENDER AND REPRESENTATION
Advertising and popular visual media.

Gender and Representation in Alternative Media.Gender and social media.

TOTAL : 45 PERIODS

21147MC51B **ELEMENTS OF LITERATURE** **L T P C**
3 0 0 0

COURSE OBJECTIVE:

- To make the students aware about the finer sensibilities of human existence through an art form. The students will learn to appreciate different forms of literature as suitable modes of expressing human experience.

1. COURSE CONTENTS

Introduction to Elements of Literature

1. Relevance of literature

165

a) Enhances Reading, thinking, discussing and writing skills.

b) Develops finer sensibility for better human relationship.

c) Increases understanding of the problem of humanity without bias.

d) Providing space to reconcile and get a cathartic effect.

2. Elements of fiction

a) Fiction, fact and literary truth.

b) Fictional modes and patterns.

c) Plot character and perspective.

3. Elements of poetry

a) Emotions and imaginations.

b) Figurative language.

c) (Simile, metaphor, conceit, symbol, pun and irony).

d) Personification and animation.

e) Rhetoric and trend.

4. Elements of drama

a) Drama as representational art.

b) Content mode and elements.

c) Theatrical performance.

d) Drama as narration, mediation and persuasion.

e) Features of tragedy, comedy and satire.

3. READINGS:

1. An Introduction to the Study of English Literature, W.H. Hudson, Atlantic, 2007.

2. An Introduction to Literary Studies, Mario Klarer, Routledge, 2013.

3. The Experience of Poetry, Graham Mode, Open college of Arts with Open Unv Press, 1991.

4. The Elements of Fiction: A Survey, Ulf Wolf (ed), Wolfstuff, 2114.

5. The Elements of Drama, J.L.Styan, Literary Licensing, 2011.

Textbook:

***Reference Books:: To be decided by the teacher and student, on the basis of individual studentsoas to enablehim or her to write the term paper.**

4. OTHER SESSION:

***Tutorials:*Laboratory:**

***Project: The students will write a term paper to show their understanding of a particular piece of literature**

5. *ASSESSMENT:

HA:

Quizzes-HA:

Periodical Examination: one

Project/Lab: one (under the guidance of the teachers the students will take a volume of poetry, fiction or drama and write a term paper to show their understanding of it in a given context; sociological, psychological, historical, autobiographical etc.

Final Exam:

OUTCOME OF THE COURSE:

- Students will be able to understand the relevance of literature in human life and appreciateits aspects in developing finer sensibilities.

21147MC51C **FILM APPRECIATION** **L T P C**
3 0 0 0

In this course on film appreciation, the students will be introduced broadly to the development of filmas an artand entertainment form. It will also discuss the language of cinema as it evolved over a century. The studentswill be taught as to how to read a film and appreciate the various nuances of a film as a text. The students will be guided to study film joyfully.

Theme - A: The Component of Films

A-1: The material and equipment
A-2: The story, screenplay and script
A-3: The actors, crew members, and the director
A-4: The process of film making… structure of a film

Theme - B: Evolution of Film Language

B-1: Film language, form, movement etc.
B-2: Early cinema… **silent film** (Particularly French)
B-3: The emergence of feature films: **Birth of a Nation**
B-4: Talkies

Theme - C: Film Theories and Criticism/Appreciation

C-1: Realist theory; Auteurists
C-2: Psychoanalytic, Ideological,
FeministsC-3: How to read films?
C-4: Film Criticism / Appreciation

Theme – D: Development of Films

D-1: Representative Soviet films
D-2: Representative Japanese
filmsD-3: Representative Italian
films
D-4: Representative Hollywood film and the studio system

Theme - E: Indian Films

E-1: The early era
E-2: The important films made by the
directorsE-3: The regional films
E-4: The documentaries in India

READING:

A Reader containing important articles on films will be prepared and given to the students. Thestudentsmust read them and present in the class and have discussion on these.

21147MC51D DISASTER RISK REDUCTION AND MANAGEMENT L T P C

3 0 0 0

COURSE OBJECTIVE

- To impart knowledge on concepts related to disaster, disaster risk reduction, disaster management
- To acquaint with the skills for planning and organizing disaster response

UNIT I HAZRADS, VULNERABILITY AND DISASTER RISKS 9

Definition: Disaster, Hazard, Vulnerability, Resilience, Risks – Types of Disasters: Natural, Human induced,Climate change induced –Earthquake, Landslide, Flood, Drought, Fire etc – Technological disasters- Structural collapse, Industrial accidents, oil spills -Causes, Impacts including social, Economic, political, environmental, health, psychosocial, etc.- Disaster vulnerability profile of India and Tamil Nadu - Global trends in disasters: urban disasters, pandemics, Complex emergencies, -
-, Inter relations between Disasters and Sustainable development Goals

UNIT II DISASTER RISK REDUCTION (DRR) 9

Sendai Framework for Disaster Risk Reduction, Disaster cycle - Phases, Culture of safety, prevention, mitigation and preparedness community Based DRR, Structural- nonstructural measures, Roles and responsibilities of- community, Panchayati Raj Institutions / Urban Local Bodies (PRIs/ULBs), States, Centre, and other stakeholders- Early Warning System – Advisories from Appropriate Agencies.- Relevance of indigenous Knowledge, appropriate technology and Localresources.

UNIT III DISASTER MANAGEMENT 9

Components of Disaster Management – Preparedness of rescue and relief, mitigation, rehabilitation and reconstruction- Disaster Risk Management and post disaster management – Compensation and Insurance- Disaster Management Act (2005) and Policy - Other related policies, plans, programmers andlegislation - Institutional Processes and Framework at State and Central Level- (NDMA –SDMA-DDMA- NRDF- Civic Volunteers)

UNIT IV TOOLS AND TECHNOLOGY FOR DISASTER MANAGEMENT 9

Early warning systems -Components of Disaster Relief: Water, Food, Sanitation, Shelter, Health, Waste Management, Institutional arrangements (Mitigation, Response and Preparedness, – Role of GIS and Information Technology Components in Preparedness, Risk Assessment, Response and Recovery Phases of Disaster – Disaster Damage Assessment. - Elements of Climate Resilient Development – Standard operation Procedure for disaster response – Financial planning for disasterManagement

UNIT V DISASTER MANAGEMENT: CASE STUDIES 9

Discussion on selected case studies to analyse the potential impacts and actions in the contest of disasters-Landslide Hazard Zonation: Earthquake Vulnerability Assessment of Buildings and Infrastructure: Case Studies, Drought Assessment: Case Studies, Coastal Flooding: Storm Surge Assessment, Floods: Fluvial and Pluvial Flooding: Case Studies; Forest Fire: Case Studies, Man Made disasters: Case Studies, Space Based Inputs for Disaster Mitigation and Management and field works related to disaster management.- Field work-Mock drill -

TOTAL : 45 PERIODS

TEXT BOOKS:

1 Taimpo (2016), Disaster Management and Preparedness, CRC Publications
2 Singh R (2017), Disaster Management Guidelines for earthquakes, Landslides, Avalanches andtsunami, Horizon Press Publications
3 Singhal J.P. "Disaster Management", Laxmi Publications, 2010. ISBN-10: 9380386427 ISBN-13: 978-9380386423
4 Tushar Bhattacharya, "Disaster Science and Management", McGraw Hill India Education Pvt. Ltd., 2012. **ISBN-10:** 1259007367, **ISBN-13:** 978-1259007361]

REFERENCES

1. Govt. of India: Disaster Management Act, Government of India, New Delhi, 2005.
2. Government of India, National Disaster Management Policy, 2009.
3. Shaw R (2016), Community based Disaster risk reduction, Oxford University Press

COURSE OUTCOME:

CO1: To impart knowledge on the concepts of Disaster, Vulnerability and Disaster Risk reduction(DRR)
CO2: To enhance understanding on Hazards, Vulnerability and Disaster Risk Assessmentpreventionand risk reduction
CO3: To develop disaster response skills by adopting relevant tools and technology
CO4: Enhance awareness of institutional processes for Disaster response in the country and CO5: Develop rudimentary ability to respond to their surroundings with potential Disaster responsein areas where they live,with due sensitivity

CO's-PO's & PSO's MAPPING

CO's	PO's												PSO's		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	3	3	2	3	-	-	2	2	-	-	2	-	2	-	1
2	3	3	3	3	-	-	2	1	-	-	2	-	2	-	1
3	3	3	3	3	-	-	2	2	-	-	-	-	2	-	1
4	3	3	2	3	-	-	2	1	-	-	2	-	2	-	1
5	3	3	2	3	-	-	2	2	-	-	2	-	3	-	1
AVG	3	3	3	3	-	-	2	2	-	-	2	-	2	-	1

1 - low, 2 - medium, 3 - high, '-"- no correlation

MANDATORY COURSES II

21147MC61A **WELL-BEING WITH TRADITIONAL PRACTICES-YOGA, AYURVEDA AND SIDDHA**

L T P C
3 0 0 0

COURSE OBJECTIVES:

- **To enjoy life happily with fun filled new style activities that help to maintain health**
- **alsoTo adapt a few lifestyle changes that will prevent many health disorders**
- **To be cool and handbill every emotion very smoothly in every walk of life**
- **To learn to eat cost effective but healthy foods that are rich in essential nutrients**
- **To develop immunity naturally that will improve resistance against many health disorders**

UNIT I HEALTH AND ITS IMPORTANCE 2+4

Health: Definition - Importance of maintaining health - More importance on prevention than treatment

Ten types of health one has to maintain - Physical health - Mental health - Social health - Financial health - Emotional health - Spiritual health - Intellectual health - Relationship health - Environmental health - Occupational/Professional heath.

Present health status - The life expectancy-present status - mortality rate - dreadful diseases - Non-communicable diseases (NCDs) the leading cause of death - 60% - heart disease – cancer – diabetes - chronic pulmonary diseases - risk factors – tobacco – alcohol - unhealthy diet - lack of physical activities.

Types of diseases and disorders - Lifestyle disorders – Obesity – Diabetes - Cardiovascular diseases – Cancer – Strokes – COPD - Arthritis - Mental health issues.

Causes of the above diseases / disorders - Importance of prevention of illness - Takes care of health - Improves quality of life - Reduces absenteeism - Increase satisfaction - Saves time

Simple lifestyle modifications to maintain health - Healthy Eating habits (Balanced diet according to age) Physical Activities (Stretching exercise, aerobics, resisting exercise) - Maintaining BMI-Importance and actions to be taken

UNIT II DIET 4+6

Role of diet in maintaining health - energy one needs to keep active throughout the day - nutrientsone needsfor growth and repair - helps one to stay strong and healthy - helps to prevent diet-relatedillness, such as somecancers - keeps active and - helps one to maintain a healthy weight - helps toreduce risk of developing lifestyle disorders like diabetes – arthritis – hypertension – PCOD – infertility – ADHD – sleeplessness -helps to reduce the risk of heart diseases - keeps the teeth and bones strong.

Balanced Diet and its 7 Components - Carbohydrates – Proteins – Fats – Vitamins – Minerals -Fibre and Water.

Food additives and their merits & demerits - Effects of food additives - Types of food additives - Food additives and processed foods - Food additives and their reactions

Definition of BMI and maintaining it with diet

Importance - Consequences of not maintaining BMI - different steps to maintain optimal BM

Common cooking mistakes

Different cooking methods, merits and demerits of each method

UNIT III ROLE OF AYURVEDA & SIDDHA SYSTEMS IN MAINTAINING HEALTH 4+4

AYUSH systems and their role in maintaining health - preventive aspect of AYUSH - AYUSH asa soft therapy.

Secrets of traditional healthy living - Traditional Diet and Nutrition - Regimen of Personal and Social Hygiene - Daily routine (Dinacharya) - Seasonal regimens (Ritucharya) - basic sanitation andhealthy living environment - Sadvritta (good conduct) - for conducive social life.

Principles of Siddha & Ayurveda systems - Macrocosm and Microcosm theory - PancheekaranaTheory / **(**Five Element Theory) 96 fundamental Principles - Uyir Thathukkal **(**Tri-Dosha Theory) - Udal Thathukkal

Prevention of illness with our traditional system of medicine

Primary Prevention - To decrease the number of new cases of a disorder or illness - Health promotion/education, and - Specific protective measures - Secondary Prevention - To lower the rate of established cases of a disorder or illness in the population (prevalence) - Tertiary Prevention - Todecrease theamount of disability associated with an existing disorder.

UNIT IV MENTAL WELLNESS 3+4

Emotional health - Definition and types - Three key elements: the subjective experience - the physiological response - the behavioral response - Importance of maintaining emotional health - Role of emotions in daily life -Short term and long term effects of emotional disturbances - Leading a healthy life with emotions - Practices for emotional health - Recognize how thoughts influence emotions - Cultivate positive thoughts - Practice self-compassion - Expressing a full range of emotions.

Stress management - Stress definition - Stress in daily life - How stress affects one's life - Identifying the cause of stress - Symptoms of stress - Managing stress (habits, tools, training, professional help) - Complications of stress mismanagement.

Sleep - Sleep and its importance for mental wellness - Sleep and digestion.

Immunity - Types and importance - Ways to develop immunity

UNIT V YOGA 2+12

Definition and importance of yoga - Types of yoga - How to Choose the Right Kind for individuals according to their age - The Eight Limbs of Yoga - Simple yogasanas for cure and prevention of health disorders - What yoga can bring to our life.

TOTAL : 45 PERIODS

TEXT BOOKS:

1. Nutrition and Dietetics - Ashley Martin, Published by White Word Publications,New York, NY 10001, USA
2. Yoga for Beginners_ 35 Simple Yoga Poses to Calm Your Mind and Strengthen Your Body,by Cory Martin, Copyright © 2015 by Althea Press, Berkeley, California

REFERENCES:

1. WHAT WE KNOW ABOUT EMOTIONAL INTELLIGENCE How It Affects Learning, Work, Relationships, and Our Mental Health, by Moshe Zeidner, Gerald Matthews, and Richard D.Roberts
2. A Bradford Book, The MIT Press, Cambridge, Massachusetts, London, England TheMindful Self-Compassion Workbook, Kristin Neff, Ph.D Christopher Germer, Ph.D, Published by The Guilford Press A Division of Guilford Publications, Inc.370 SeventhAvenue, Suite 1200, New York, NY 10001

1. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4799645/
2. **Simple lifestyle modifications to maintain health**

https://www.niddk.nih.gov/health-information/diet-nutrition/changing-habits-better-

health#:~:text=Make%20your%20new%20healthy%20habit,t%20have%20time%20to%20cook.

3. **Read more**: https://www.legit.ng/1163909-classes-food-examples-functions.html
4. https://www.yaclass.in/p/science-state-board/class-9/nutrition-and-health-5926
5. **Benefits of healthy eating** https://www.cdc.gov/nutrition/resources-publications/benefits-of-healthy-eating.html
6. **Food additives** https://www.betterhealth.vic.gov.au/health/conditionsandtreatments/food-additives
7. **BMI** https://www.hsph.harvard.edu/nutritionsource/healthy-weight/ https://www.who.int/europe/news-room/fact-sheets/item/a-healthy-lifestyle---who-**recommendations**
8. **Yoga** https://www.healthifyme.com/blog/types-of-yoga/ https://yogamedicine.com/guide-types-yoga-styles/
   Ayurveda : https://vikaspedia.in/health/ayush/ayurveda-1/concept-of-healthy-living-in-ayurveda
9. **Siddha** : http://www.tkdl.res.in/tkdl/langdefault/Siddha/Sid_Siddha_Concepts.asp
10. **CAM :** https://www.hindawi.com/journals/ecam/2013/376327/
11. **Preventive** herbs : https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3847409/

COURSE OUTCOMES:

After completing the course, the students will be able to:

CO1:Learn the importance of different components of health

CO2:Gain confidence to lead a healthy life

CO3:Learn new techniques to prevent lifestyle health disorders

CO4:Understand the importance of diet and workouts in maintaining health

21147MC61B HISTORY OF SCIENCE AND TECHNOLOGY IN INDIA L T P C

3 0 0 0

UNIT I CONCEPTS AND PERSPECTIVES

Meaning of History

Objectivity, Determinism, Relativism, Causation, Generalization in History; Moral judgment in historyExtentof subjectivity, contrast with physical sciences, interpretation and speculation, causation verses evidence, concept of historical inevitability, Historical Positivism.

Science and Technology-Meaning, Scope and Importance, Interaction of science, technology & society, Sources of history on science and technology in India.

UNIT II HISTORIOGRAPHY OF SCIENCE AND TECHNOLOGY IN INDIA

Introduction to the works of D.D. Kosambi, Dharmpal, Debiprasad Chattopadhyay, Rehman, S. IrfanHabib, Deepak Kumar, Dhruv Raina, and others.

UNIT III SCIENCE AND TECHNOLOGY IN ANCIENT INDIA

Technology in pre-historic period

Beginning of agriculture and its impact on technology Science andTechnology during Vedic and Later Vedic timesScience and technology from 1st century AD to C-1200.

UNIT IV SCIENCE AND TECHNOLOGY IN MEDIEVAL INDIA

Legacy of technology in Medieval India, Interactions with Arabs

Development in medical knowledge, interaction between Unani and Ayurveda and alchemyAstronomyand Mathematics: interaction with Arabic Sciences
Science and Technology on the eve of British conquest

UNIT V SCIENCE AND TECHNOLOGY IN COLONIAL INDIA

Science and the Empire
Indian response to Western Science
Growth oftechno-scientific institutions

UNIT VI SCIENCE AND TECHNOLOGY IN A POST-INDEPENDENT INDIA

Science, Technology and Development discourse Shaping of the Science and Technology Policy Developments in the fieldof Science and TechnologyScience and technology in globalizing India
Social implications of new technologies like the Information Technology and Biotechnology

TOTAL : 45 PERIODS

21147MC61C POLITICAL AND ECONOMIC THOUGHT FOR A HUMANE SOCIETY

L	T	P	C
3	0	0	0

Pre-Requisite: None. (Desirable: Universal Human Values 1, Universal Human Values 2)

COURSE OBJECTIVES:

- This course will begin with a short overview of human needs and desires and how different political-economic systems try to fullfill them. In the process, we will end with a critique of different systems and their implementations in the past, with possible future directions.

COURSE TOPICS:

Considerations for humane society, holistic thought, human being's desires, harmony in self,harmony inrelationships, society, and nature, societal systems. (9 lectures, 1 hour each)

(Refs: A Nagaraj, M K Gandhi, JC Kumarappa)

Capitalism – Free markets, demand-supply, perfect competition, laissez-faire, monopolies,imperialism. Liberal democracy. (5 lectures)

(Refs: Adam smith, J S Mill)

Fascism and totalitarianism. World war I and II. Cold war. (2 lectures)

Communism – Mode of production, theory of labour, surplus value, class struggle, dialecticalmaterialism,historical materialism, Russian and Chinese models.

(Refs: Marx, Lenin, Mao, M N Roy) **(5 lectures)**

Welfare state. Relation with human desires. Empowered human beings, satisfaction. (3 lectures)

Gandhian thought. Swaraj, Decentralized economy & polity, Community. Control over one's lives.Relationship withnature. (6 lectures)

(Refs: M K Gandhi, Schumacher, Kumarappa)

Essentialelements of Indian civilization. (3

lectures)(Refs: Pt Sundarlal, R C Mazumdar,

Dharampal)

Technology as driver of society, Role of education in shaping of society. Future directions. (4lectures) (Refs: Nandkishore Acharya, David Dixon, Levis Mumford)

Conclusion (2 lectures)

Total lectures: 39

Preferred Textbooks: See Reference Books

Reference Books: Authors mentioned along with topics above. Detailed reading list will beprovided.

GRADING:

Mid sems	30
End sem	20
Home Assign	10
Term paper	40

TOTAL : 45 PERIODS

COURSE OUTCOME:

- The students will get an understanding of how societies are shaped by philosophy, political and economic system, how they relate to fulfilling human goals & desires with some case studies ofhow different attempts have been made in the past and how they have fared.

21147MC61D STATE, NATION BUILDING AND POLITICS IN INDIA L T P C

3 0 0 0

COURSE OBJECTIVE:

The objective of the course is to provide an understanding of the state, how it works through its mainorgans, primacy of politics and political process, the concept of sovereignty and its changing contours in a globalizedworld. In the light of this, an attempt will be made to acquaint the students with the main development and legacies of national movement and constitutional development in India, reasons for adopting a Parliamentary-federal system, the broad philosophy of the Constitutionof India and the changing nature of Indian Political System. Challenges/ problems and issues concerning national integration and nation-building will also be discussed in the contemporary context with the aim of developing a future vision for a better India.

TOPICS:

Understanding the need and role of State and politics.

Development of Nation-State, sovereignty, sovereignty in a globalized world.

Organs of State – Executive, Legislature, Judiciary. Separation of powers, forms of government- unitary- federal, Presidential-Parliamentary,
The idea of India.

1857 and the national awakening.

1885 Indian National Congress and development of national movement – itslegacies.Constitution making and the Constitution of India.
Goals, objective and philosophy.Whya federal system?
National integration and nation-building.

Challenges of nation-building – State against democracy (Kothari)New social movements.
The changing nature of Indian Political System, the future scenario.What canwe do?

OUTCOME OF THE COURSE:

It is expected that this course will make students aware of the theoretical aspect of the state, its organs, its operationalization aspect, the background and philosophy behind the founding of the present political system, broad streams and challenges of national integration and nation-building in India. It will equip the students with the real understanding of our political system/ process in correctperspective and make them sit up and think for devising ways for better participation in the system with a view to making the governance and delivery system better for the common man who is oftenleft unheard and unattended in our democratic setup besides generating a lot of dissatisfaction anddifficulties for the system.

SUGGESTED READING:

i. Sunil Khilnani, The Idea of India. Penguin India Ltd., New Delhi.
ii. Madhav Khosla, The Indian Constitution, Oxford University Press. New Delhi, 2012.
iii. Brij Kishore Sharma, Introduction to the Indian Constitution, PHI, New Delhi, latest edition.
iv. Sumantra Bose, Transforming India: Challenges to the World's Largest Democracy,Picador India, 2013.
v. Atul Kohli, Democracy and Discontent: India's Growing Crisis of Governability, Cambridge University Press, Cambridge, U. K., 1991.
vi. M. P. Singh and Rekha Saxena, Indian Politics: Contemporary Issues and Concerns, PHI,New Delhi, 2008, latest edition.
vii. Rajni Kothari, Rethinking Democracy, Orient Longman, New Delhi, 2005.

TOTAL : 45 PERIODS

21147MC61E **INDUSTRIAL SAFETY** **L T P C**

3 0 0 0

COURSE OBJECTIVES

- To Understand the Introduction and basic Terminologies safety.
- To enable the students to learn about the Important Statutory Regulations and standards.
- To enable students to Conduct and participate the various Safety activities in the Industry.
- To have knowledge about Workplace Exposures and Hazards.
- To assess the various Hazards and consequences through various Risk Assessment Techniques.

UNIT I SAFETY TERMINOLOGIES

Hazard-Types of Hazard- Risk-Hierarchy of Hazards Control Measures-Lead indicators- lag Indicators- Flammability- Toxicity Time-weighted Average (TWA) - Threshold LimitValue (TLV) - Short Term Exposure Limit (STEL)- Immediately dangerous to life or health (IDLH)- acute and chronic Effects- Routes of Chemical Entry-Personnel Protective Equipment- Health and Safety Policy-Material Safety Data Sheet MSDS

UNIT II STANDARDS AND REGULATIONS

Indian Factories Act-1948- Health- Safety- Hazardous materials and Welfare- ISO 45001:2018 occupational health and safety (OH&S) - Occupational Safety and Health Audit IS14489:1998- Hazard Identification and Risk Analysis- code of practice IS 15656:2006

UNIT III SAFETY ACTIVITIES

Toolbox Talk- Role of safety Committee- Responsibilities of Safety Officers and Safety Representatives- Safety Training and Safety Incentives- Mock Drills- On-site Emergency Action Plan- Off-site Emergency Action Plan- Safety poster and Display- Human Error Assessment

UNIT IV WORKPLACE HEALTH AND SAFETY

Noise hazard- Particulate matter- musculoskeletal disorder improper sitting poster and lifting Ergonomics RULE & REBA- Unsafe act & Unsafe Condition- Electrical Hazards- Crane Safety- Toxic gas Release

UNIT V HAZARD IDENTIFICATION TECHNIQUES

Job Safety Analysis-Preliminary Hazard Analysis-Failure mode and Effects Analysis- Hazard and Operability- Fault Tree Analysis- Event Tree Analysis Qualitative and Quantitative Risk Assessment- Checklist Analysis- Root cause analysis- What-If Analysis- and Hazard Identification and Risk Assessment

TOTAL : 45 PERIODS

COURSE OUTCOMES:

Course outcomes on completion of this course the student will be able:

CO1:Understand the basic concept of safety.

CO2:Obtain knowledge of Statutory Regulations and standards.

CO3:Know about the safety Activities of the Working Place.

CO4:Analyze on the impact of Occupational Exposures and their Remedies

CO5:Obtain knowledge of Risk Assessment Techniques.

TEXTBOOKS

1. R.K. Jain and Prof. Sunil S. Rao Industrial Safety, Health and Environment ManagementSystems KHANNA PUBLISHER
2. L. M. Deshmukh Industrial Safety Management: Hazard Identification and Risk Control

McGraw-Hill Education

REFERENCES

1. Frank Lees (2012) 'Lees' Loss Prevention in Process Industries.Butterworth-Heinemann publications, UK, 4th Edition.
2. John Ridley & John Channing (2008)Safety at Work: Routledge, 7th Edition.
3. Dan Petersen (2003) Techniques of Safety Management: A System Approach.
4. Alan Waring.(1996).Safety management system: Chapman &Hall,England
5. Society of Safety Engineers, USA

ONLINE RESOURCES

ISO 45001:2018 occupational health and safety (OH&S) International Organization for Standardization https://www.iso.org/standard/63787.html

Indian Standard code of practice on occupational safety and health audithttps://law.resource.org/pub/in/bis/S02/is.14489.1998.pdf

Indian Standard code of practice on Hazard Identification and Risk Analysis IS 15656:2006 https://law.resource.org/pub/in/bis/S02/is.15656.2006.pdf

CO's-PO's & PSO's MAPPING

Course Outcomes	Statement	Program Outcome														
		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO12	PSO1	PSO2	PSO3
CO1	Understand the basic concept of safety.	3	3	3	1	1	3	2	2	3	3	1	3	3	3	3
CO2	Obtain knowledge of Statutory Regulations and standards.	2	3	2	2	1	3	2	3	3	2	1	3	3	3	3
CO3	Know about the safety Activities of the Working Place.	2	2	2	2	1	2	2	2	3	2	1	2	3	3	3
CO4	Analyze on the impact of Occupational Exposures and their Remedies	3	3	3	2	2	3	2	2	3	2	1	3	3	3	3
CO5	Obtain knowledge of Risk Assessment Techniques.	3	2	3	2	2	3	2	2	3	2	2	3	3	3	3
Industrial safety		3	3	3	2	1	3	2	2	3	2	1	3	3	3	3

1 - low, 2 - medium, 3 - high, '-"- no correlation

21154OE61 INTRODUCTION TO INDUSTRIAL ENGINEERING L T P C
3 0 0 3

COURSE OBJECTIVES:

The objective of this course is to provide foundation in Industrial Engineering in order to enable thestudentsto make significant contributions for improvements in diverse organizations.

- Explain the concepts productivity and productivity measurement approaches.
- Explain the basic principles in facilities planning and plant location.
- Apply work study and ergonomic principles to design workplaces for the improvement ofhuman performance
- Impart knowledge to design and implement Statistical Process control in any industry.
- Recognize the concept of Production and Operations Management in creating and enhancinga firm's competitive advantages

UNIT I INTRODUCTION 9

Concepts of Industrial Engineering – History and development of Industrial Engineering – Roles of Industrial Engineer – Applications of Industrial Engineering – Production Management Vs Industrial Engineering – Production System – Input Output Model – Productivity – Factors affecting Productivity – Increasing Productivity of resources – Kinds of Productivity measures.

UNIT II PLANT LOCATION AND LAYOUT 9

Factors affecting Plant location – COURSE OBJECTIVES of Plant Layout – Principles of Plant Layout – Types of Plant Layout – Methods of Plant and Facility Layout – Storage Space requirements – Plant Layout procedure – Line Balancing methods.

UNIT III WORK SYSTEM DESIGN& ERGONOMICS 9

Need – COURSE OBJECTIVES – Method Study procedure – Principles of Motion Economy – Work Measurement procedures – Time Study –Work sampling- Ergonomics and its areas of application in the work system - Physical work load and energy expenditure, Anthropometry – measures – design procedure, Work postures-sitting, standing.

UNIT IV STATISTICAL QUALITY CONTROL 9

Definition and Concepts – Fundamentals – Control Charts for variables – Control Charts for attributes – Acceptance Sampling- O.C curve –Single sampling plan- Double sampling plan.

UNIT V PRODUCTION PLANNING AND CONTROL 9

Forecasting – Qualitative and Quantitative forecasting techniques – Types of production – Process planning – Economic Batch Quantity– Loading – Scheduling and control of production – Dispatching– Progress control.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of the course, Students will be able to

CO1: Ability To define the concepts of productivity and productivity measurement approaches. CO2: Ability to evaluate appropriate location models for various facility types and design variousfacility layoutsCO3: Ability To conduct a method study and time study to improve the efficiency of the system.CO4: Ability to Control the quality of processes using control charts in manufacturing/service industries.

CO5: Ability to define the Planning strategies and Material Requirement Plan.

CO's- PO's & PSO's MAPPING

CO's	PO's												PSO's		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	2											1		1	
2	2	2	3	2											
3	2	2	2	1	1			2			1		2		
4	2	2	3	1	1										
5	1	2	2									1			3
Avg.	2.2	2	2.5	1.3	1			2			1	1	2	1	3

1 - low, 2 - medium, 3 - high, '-' - no correlation

TEXT BOOK:

1. O.P.Khanna, 2010, Industrial Engineering and Management, Dhanpat Rai Publications.

REFERENCES:

1. Ravi Shankar, 2009, Industrial Engineering and Management, Galgotia Publications & PrivateLimited.
2. Martand Telsang,2006, Industrial Engineering and Production Management, S. Chand andCompany

21153OE61 RENEWABLE ENERGY SYSTEM L T P C

3 0 0 3

COURSE OBJECTIVES:

- To Provide knowledge about various renewable energy technologies
- To enable students to understand and design a PV system.
- To provide knowledge about wind energy system.
- To Provide knowledge about various possible hybrid energy systems
- To gain knowledge about application of various renewable energy technologies

UNIT I INTRODUCTION

Primary energy sources, renewable vs. non-renewable primary energy sources, renewable energy resources in India, Current usage of renewable energy sources in India, future potential of renewableenergy in power production and development of renewable energy technologies.

UNIT II SOLAR ENERGY 9

Solar Radiation and its measurements, Solar Thermal Energy Conversion from plate Solar Collectors, Concentrating Collectors and its Types, Efficiency and performance of collectors,. Direct Solar Electricity Conversion from Photovoltaic, types of solar cells and its application of battery charger, domestic lighting, street lighting, and water pumping, power generation schemes. Recent Advances in PV Applications: Building Integrated PV, Grid Connected PV Systems,

UNIT III WIND ENERGY 9

Wind energy principles, wind site and its resource assessment, wind assessment, Factors influencing wind, wind turbine components, wind energy conversion systems (WECS), Classification of WECS devices, wind electric generating and control systems, characteristics and applications.

UNIT IV BIO-ENERGY 9

Energy from biomass, Principle of biomass conversion technologies/process and their classification, Bio gasgeneration, types of biogas plants, selection of site for biogas plant, classification of biogas plants, Advantage and disadvantages of biogas generation, thermal gasification of biomass, biomass gasifies, Application of biomass and biogas plants and their economics.

UNIT V OTHER TYPES OF ENERGY 9

Energy conversion from Hydrogen and Fuel cells, Geo thermal energy Resources, types of wells, methods of harnessing the energy, potential in India. OTEC, Principles utilization, setting of OTEC plants, thermodynamic cycles. Tidal and wave energy: Potential and conversion techniques, mini- hydel power plants and their economics.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of the course students will be able to:

CO1: Attained knowledge about various renewable energy technologies

CO2: Ability to understand and design a PV system.

CO3: Understand the concept of various wind energy system.

CO4: Gained knowledge about various possible hybrid energy systems

CO5: Attained knowledge about various application of renewable energy technologies

REFERENCES

1. Twidell & Wier,'Renewable Energy Resources' CRC Press(Taylor & Francis).
2. Tiwari and Ghosal/ Narosa,'Renewable energy resources'.
3. D.P.Kothari, K.C.Singhal,'Renewable energy sources and emerging technologies', P.H.I.
4. D.S.Chauhan, S.K. Srivastava, 'Non – Conventional Energy Resources', New Age Publishers, 2006.
5. B.H.Khan, 'Non – Conventional Energy Resources', Tata Mc Graw Hill, 2006.

CO's-PO's & PSO's MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	-	-	-	-	-	-	-	-	-	-	2	3	3	3
CO2	3	2	-	-	-	-	-	-	-	-	-	2	3	3	3
CO3	3	2	-	-	-	-	-	-	-	-	-	2	3	3	3
CO4	3	2	-	-	-	-	-	-	-	-	-	2	3	3	3
CO5	3	2	-	-	-	-	-	-	-	-	-	2	3	3	3
AVg.	3	2	-	-	-	-	-	-	-	-	-	2	3	3	3

1 - low, 2 - medium, 3 - high, '-"- no correlation

21153OE72 INTRODUCTION TO INDUSTRIAL INSTRUMENTATION AND CONTROL

L T P C
3 0 0 3

COURSE OBJECTIVES:

- To introduce common unit operations carried out in process industries.
- To impact knowledge about the important unit operations taking place in process industries.
- To prepare them to take up a case study on selected process industries like petrochemical industry, power plant industry and paper & pulp industry to make the students understand the different measurement and control techniques for important processes.
- Facilitate the students to apply knowledge to select appropriate measurement technique andcontrol strategy for a given process.

UNIT I COMMON UNIT OPERATIONS IN PROCESS INDUSTRIES -I 9

Unit Operation, Measurement and Control:-Transport of solid, liquid and gases - Evaporators –Crystallizers-Dryers.

UNIT II COMMON UNIT OPERATIONS IN PROCESS INDUSTRIES -II 9

Unit Operation, Measurement and Control: - Distillation – Refrigeration processes – Chemicalreactors.

UNIT III PROCESS MEASUREMENT AND CONTROL IN PETROCHEMICAL INDUSTRY 9

Process flow diagram of Petro Chemical Industry - Gas oil separation in production platform – wetgasprocessing – Fractionation Column – Catalytic Cracking unit – Catalytic reforming unit

UNIT IV PROCESS MEASUREMENT AND CONTROL IN THERMAL POWER PLANT INDUSTRY 9

Process flow diagram of Coal fired thermal Power Plant– Coal pulverizer - Deaerator – Boiler drum - Superheater – Turbines.

UNIT V PROCESS MEASUREMENT AND CONTROL IN PAPER & PULP INDUSTRY 9

Process flow diagram of paper and pulp industry – Batch digestor – Continuous sulphatedigestor – Controlproblems on the paper machine.

TOTAL: 45 PERIODS

SKILL DEVELOPMENT ACTIVITIES (Group Seminar/Mini Project/Assignment/Content Preparation / Quiz/ Surprise Test / Solving GATE questions/ etc) 5

Study the characteristics of various processing units involved in chemical plant.
Develop the process model by using predefined unit operations (e.g. mixing, distillation, heating)from thelibrary of any process simulator.
Analyse the functioning of each processing units with help of virtual unit operations packages.Perform aphysical property analysis using simulation packages
Implement distillation column analysis using simulation software.Create process flow models and diagrams

COURSE OUTCOMES:

Students able to

CO1 **understand common unit operations in process industries. L2**

CO2 **Identify the dynamics of important unit operations in petro chemical industry. L2**

CO3 **develop understanding of important processes taking place selected case studies namelypetrochemical industry, power plant industry and paper & pulp industry. L5**

CO4 **Select appropriate measurement techniques for selective processes. L5**

CO5 **Develop controller structure based on the process knowledge. L5**

CO6 **Analyze the operation and challenges in integrated industrial processes. L4**

TEXT BOOKS:

1. Balchen ,J.G., and Mumme, K.J., " Process Control structures and applications", Van Nostrand Reinhold Co., New York, 1988
2. Warren L. McCabe, Julian C. Smith and Peter Harriot, "Unit Operations of Chemical Engineering", McGraw-Hill International Edition, New York, Sixth Edition, 2001.

REFERENCES:

1. Liptak B.G., "Instrument and Automation Engineers' Handbook: Process Measurement and Analysis", Fifth Edition, CRC Press, 2016.
2. James R.couper, Roy Penny, W., James R.Fair and Stanley M.Walas, "Chemical ProcessEquipment: Selection and Design", Gulf Professional Publishing, 2010.
3. Austin G.T and Shreeves, A.G.T., "Chemical Process Industries", McGraw–Hill International student, Singapore, 1985.
4. Luyben W.C., "Process Modeling, Simulation and Control for Chemical Engineers", McGraw-Hill International edition, USA, 1989.
5. K. Krishnaswamy, Process Control, new age publishers , 2009.

List of Open Source Software/ Learning website:

1. https://www.aspentech.com/en
2. http://avtechscientific.com/
3. https://www.chemstations.com/CHEMCAD/
4. https://www.prosim.net/en/product/prosimplus-steady-state-simulation-and-optimization- of-processes/
5. https://www.cocosimulator.org/
6. https://dwsim.fossee.in/

CO's-PO's & PSO's MAPPING

PO,PSO / CO	PO 01	PO 02	PO 03	PO 04	PO 05	PO 06	PO 07	PO 08	PO 09	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	3	3	1					1		1					
CO2	3	3	1					1		1	2				2
CO3	3	3	1					1		1					
CO4	3	3	1	3	3			1		1			3	3	
CO5	3	3	3			3		1		1			3	3	3
CO6	3	3	2	3	2	1	2	1		2	1	1			2
Avg	3	3	1.5	3	2.5	2	2	1		1.16	1.5	1	3	3	2.33

1- low, 2-medium, 3-high, '-"- no correlation

21150OE61 **GRAPH THEORY** **L T P C**
3 0 0 3

COURSE OBJECTIVES

- To understand the graph models and basic concepts of graphs.
- To study the characterization and properties of trees and graph connectivity.
- To provide an exposure to the Eulerian and Hamiltonian graphs.
- To introduce Graph colouring and explain its significance.
- To provide an understanding of Optimization Graph Algorithms.

UNIT I INTRODUCTION TO GRAPHS 9

Graphs and Graph Models – Connected graphs – Common classes of graphs – Multi graphs andDigraphs – Degree of a vertex – Degree Sequence – Graphs and Matrices – Isomorphism of graphs.

UNIT I TREES AND CONNECTIVITY 9

Bridges – Trees – Characterization and properties of trees – Cut vertices – Connectivity.

UNIT III TRAVERSABILITY 9

Eulerian graphs – Characterization of Eulerian graphs – Hamiltonian graphs – Necessary condition for Hamiltonian graphs – Sufficient condition for Hamiltonian graphs.

UNIT IV PLANARITY AND COLOURING 9

Planar Graphs – The Euler Identity – Non planar Graphs – Vertex Colouring – Lower and Upper bounds of chromatic number.

UNIT V OPTIMIZATION GRAPH ALGORITHMS 9

Dijkstra's shortest path algorithm – Kruskal's and Prim's minimum spanning tree algorithms – Transport Network – The Max-Flow Min-Cut Theorem – The Labeling Procedure – Maximum flow problem.

TOTAL: 45 PERIODS

COURSE OUTCOMES

At the end of this course, the student will be able to

CO1:Apply graph models for solving real world problem.
CO2:Understand the importance the natural applications of trees and graph connectivity.
CO3:Understand the characterization study of Eulerian graphs and Hamiltonian graphs.
CO4:Apply the graph colouring concepts in partitioning problems.
CO5:Apply the standard optimization graph algorithms in solving application problems.

TEXT BOOKS

1. Gary Chatrand and Ping Zhang, "Introduction to Graph Theory", Tata McGraw – Hill companies Inc., New York, 2006.
2. Ralph P. Grimaldi, "Discrete and Combinatorial Mathematics, An applied introduction" Fifth edition, Pearson Education, Inc, Singapore, 2004.

REFERENCES

1. **Balakrishnan R. and Ranganathan K., "A Text Book of Graph Theory",Springer – Verlag, New York, 2012.**

2. Douglas B. West, "Introduction to Graph Theory", Pearson, Second Edition,NewYork,2018.

CO's-PO's & PSO's MAPPING

	PO 01	PO 02	PO0 3	PO0 4	PO0 5	PO0 6	PO0 7	PO0 8	PO0 9	PO1 0	PO1 1	PO1 2	PS O1	PS O2	PS O3
CO1	3	3	3												
CO2		2	2		2										
CO3		2	2	2						2					
CO4	2	2	2												
CO5		3	2		2					3					
CO6															

1 - low, 2 - medium, 3 - high, '-"- no correlation

21155OE72 IT IN AGRICULTURAL SYSTEM L T P C

3 0 0 3

COURSE OBJECTIVES:

- To introduce the students to areas of agricultural systems in which IT and computersplay amajor role.
- To also expose the students to IT applications in precision farming, environmental controlsystems, agricultural systems management and weather prediction models.

UNIT I PRECISION FARMING 9

Precision agriculture and agricultural management – Ground based sensors, Remotesensing, GPS,GISand mapping software, Yield mapping systems, Crop production modeling.

UNIT II ENVIRONMENT CONTROL SYSTEMS 9

Artificial light systems, management of crop growth in greenhouses, simulation of CO2 consumptionin greenhouses, on-line measurement of plant growth in the greenhouse, models of plant productionand expert systems in horticulture.

UNIT III AGRICULTURAL SYSTEMS MANAGEMENT 9

Agricultural systems - managerial overview, Reliability of agricultural systems, Simulation of crop growth and field operations, Optimizing the use of resources, Linear programming, Project scheduling, Artificial intelligence and decision support systems.

UNIT IV WEATHER PREDICTION MODELS 9

Importance of climate variability and seasonal forecasting, Understanding and predicting world's climate system, Global climatic models and their potential for seasonal climate forecasting, Generalsystems approach to applying seasonal climate forecasts.

UNIT V E-GOVERNANCE IN AGRICULTURAL SYSTEMS 9

Expert systems, decision support systems, Agricultural and biological databases, e- commerce, e- business systems & applications, Technology enhanced learning systems and

solutions, e-learning,Rural development and information society.

TOTAL: 45 PERIODS

TEXTBOOKS:

1. National Research Council, "Precision Agriculture in the 21st Century", National AcademiesPress, Canada, 1997.
2. H. Krug, Liebig, H.P. "International Symposium on Models for Pant Growth, EnvironmentalControl and Farm Management in Protected Cultivation", 1989.

REFERENCES:

1. Peart, R.M., and Shoup, W. D., "Agricultural Systems Management", Marcel Dekker, NewYork, 2004.
2. Hammer, G.L., Nicholls, N., and Mitchell, C., "Applications of Seasonal Climate", Springer,Germany, 2000.

COURSE OUTCOME:

CO1:The students shall be able to understand the applications of IT in remote sensingapplicationssuch asDrones etc.

CO2:The students will be able to get a clear understanding of how a greenhouse can be automatedand its advantages.

CO3:The students will be able to apply IT principles and concepts for management of fieldoperations.

CO4:The students will get an understanding about weather models, their inputs and applications.

CO5:The students will get an understanding of how IT can be used for e-governance in agriculture.

's-PO's & PSO's MAPPING

1 - low, 2 - medium, 3 - high, '-"- no correlation

21153OE72 INTRODUCTION TO CONTROL ENGINEERING L T P C

3 0 0 3

COURSE OBJECTIVES:

- To introduce the control system components and transfer function model with their graphicalrepresentation
- To understand the analysis of system in time domain along with steady state error.
- To introduce frequency response analysis of systems.
- To accord basic knowledge in design of compensators.
- To introduce the state space models.

UNIT I MATHEMATICAL MODELLING 9

Introduction – transfer function – simple electrical, mechanical, ,pneumatic , hydraulic and thermal systems–analogies

UNIT II FEEDBACK CONTROL SYSTEMS 9

Control system components - Block diagram representation of control systems, Reductionof block diagrams, Signal flow graphs, Output to input ratios

UNIT III TIME DOMAIN ANALYSIS 9

Response of systems to different inputs viz., Step impulse, pulse, parabolic and sinusoidal inputs, Time response of first and second order systems, steady state errors and error constants of unity feedback circuit.

UNIT IV STABILITY ANALYSIS 9

Necessary and sufficient conditions, Routh-Hurwitz criteria of stability,Rootlocus and Bodetechniques,Concept and construction,frequency response.

UNIT V STATE SPACE TECHNIQUE 9

State vectors–state space models-Digital Controllers–design aspects.

TOTAL: 45 PERIODS

SKILL DEVELOPMENT ACTIVITIES (Group Seminar/Mini Project/Assignment/ ContentPreparation / Quiz/ Surprise Test / Solving GATE questions/ etc) 5

Explore various controllers presently used in industries.

a. Develop control structures for industrial processes.

b. Implement the controllers for various transfer functions of industrial systems.

2. Using software tools for practical exposures to the controllers used in industries by undergoingtraining.

a. Realisation of various stability criterion techniques for economical operation of process.

COURSE OUTCOMES:

CO1 To represent and develop systems in different forms using the knowledge gained (L5).

CO2 To analyses the system in time and frequency domain (L4).

CO3 Ability to Derive Transfer function Model of Electrical and Mechanical Systems. (L2)

CO4 Ability to Obtain the transfer Function by the Reduction of Block diagram &Signal flowgraph (L3)

CO5 To analyses the stability of physical systems(L4).

CO6 To acquire and analyse knowledge in State variable model for MIMO systems(L1)

TEXT BOOKS:

1. Nagarath, I.J. and Gopal, M., “Control Systems Engineering”, New Age InternationalPublishers,2017.
2. Benjamin C. Kuo, “Automatic Control Systems”, Wiley, 2014

REFERENCES:

1. Katsuhiko Ogata, “Modern Control Engineering”, Pearson, 2015.
2. Richard C. Dorf and Bishop, R.H., “Modern Control Systems”, Pearson Education,2009.
3. John J.D., Azzo Constantine, H. and HoupisSttuart, N Sheldon, “Linear Control SystemAnalysis and Design with MATLAB”, CRC Taylor& Francis Reprint 2009.
4. RamesC.Panda and T. Thyagarajan, “An Introduction to Process Modelling Identification andControl of Engineers”, Narosa Publishing House, 2017.
5. M. Gopal, “Control System: Principle and design”, McGraw Hill Education, 2012.
6. NPTEL Video Lecture Notes on “Control Engineering “by Prof. S. D. Agashe, IIT Bombay.

List of Open Source Software/ Learning website:

1. https://nptel.ac.in/courses/112107240
2. https://onlinecourses.nptel.ac.in/noc20_me25/preview
3. https://onlinecourses.nptel.ac.in/noc20_ee90/preview

4. https://www.classcentral.com/course/swayam-automatic-control-9850

CO's-PO's & PSO's MAPPING

CO's	PO's												PSO's		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1 L5	3	3	3	3	-	-	-	1	-	1	-	1			
2 L4	3	3	3	2	-	-	-	1	-	1	-	1			
3 L2	2	1	2	1	-	-	-	1	-	1	-	1			
4 L5	3	3	3	3	-	-	-	1	-	1	-	1			
5 L4	3	3	3	2	-	-	-	1	-	1	-	1			
6 L4	3	3	3	2	-	-	-	1	-	1	-	1			
AVg.	2.8	2.6	3	2.1	-	-	-	1	-	1	-	1			

1-low, 2-medium, 3-high, '-"- no correlation

Note: The average value of this course to be used for program articulation matrix.

forecasting, aerodromes work etc.

21153OE61 **RENEWABLE ENERGY TECHNOLOGIES** **L T P C**
3 0 0 3

COURSE OBJECTIVES

- To know the Indian and global energy scenario
- To learn the various solar energy technologies and its applications.
- To educate the various wind energy technologies.
- To explore the various bio-energy technologies.
- To study the ocean and geothermal technologies.

UNIT I ENERGY SCENARIO **9**

Indian energy scenario in various sectors – domestic, industrial, commercial, agriculture, transportation and others – Present conventional energy status – Present renewable energy status-Potential of various renewable energy sources-Global energy status-Per capita energy consumption - Future energy plans

UNIT II SOLAR ENERGY **9**

Solar radiation – Measurements of solar radiation and sunshine – Solar spectrum - Solarthermal collectors – Flat plate and concentrating collectors – Solar thermal applications – Solar thermal energy storage – Fundamentals of solar photo voltaic conversion – Solar cells
– Solar PV Systems
– Solar PV applications.

UNIT III WIND ENERGY **9**

Wind data and energy estimation – Betz limit - Site selection for windfarms – characteristics - Windresource assessment - Horizontal axis wind turbine – components - Vertical axis wind turbine – Wind turbine generators and its performance – Hybrid systems – Environmental issues - Applications.

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UNIT IV BIO-ENERGY 9

Bio resources – Biomass direct combustion – thermochemical conversion - biochemical conversion- mechanical conversion - Biomass gasifier - Types of biomass gasifiers - Cogeneration –- Carbonisation – Pyrolysis - Biogas plants – Digesters –Biodiesel production – Ethanol production - Applications.

UNIT V OCEAN AND GEOTHERMAL ENERGY 9

Small hydro - Tidal energy – Wave energy – Open and closed OTEC Cycles – Limitations – Geothermal energy – Geothermal energy sources - Types of geothermal power plants – Applications
- Environmental impact.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of the course the students would be able to

- Discuss the Indian and global energy scenario.
- Describe the various solar energy technologies and its applications.
- Explain the various wind energy technologies.
- Explore the various bio-energy technologies.
- Discuss the ocean and geothermal technologies.

TEXT BOOKS:

1. Fundamentals and Applications of Renewable Energy | Indian Edition, by Mehmet Kanoglu, Yunus A. Cengel, John M. Cimbala, cGraw Hill; First edition (10 December 2020), ISBN-10 : 9390385636
2. Renewable Energy Sources and Emerging Technologies, by Kothari, Prentice Hall India Learning Private Limited; 2nd edition (1 January 2011), ISBN-10 : 8120344707

REFERENCES:

1. Godfrey Boyle, "Renewable Energy, Power for a Sustainable Future", Oxford UniversityPress, U.K., 2012.
2. Rai.G.D., "Non-Conventional Energy Sources", Khanna Publishers, New Delhi, 2014.
3. Sukhatme.S.P., "Solar Energy: Principles of Thermal Collection and Storage", TataMcGraw Hill Publishing Company Ltd., New Delhi, 2009.
4. Tiwari G.N., "Solar Energy – Fundamentals Design, Modelling and applications", AlphaScience Intl Ltd, 2015.
5. Twidell, J.W. & Weir A., "Renewable Energy Resources", EFNSpon Ltd., UK, 2015.

CO's-PO's & PSO's MAPPING

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	1	1	1	1	1	2	3	2	2	1	1	3	2	1	2
2	3	2	2	1	1	1	3	1	1	1	2	3	2	1	2
3	3	2	3	1	2	1	3	1	1	1	1	3	1	1	2
4	2	2	2	1	2	1	3	1	1	1	2	3	2	2	2
5	2	1	2	1	2	1	3	1	1	1	1	3	2	1	2
Low (1) ; Medium (2) ; High (3)															

1 - low, 2 - medium, 3 - high, '-"- no correlation

1. , Oxford, UK,2009.

REFERENCES:

1. Smith, E.E. and Harmathy, T.Z. (Editors),"Design of buildings for fire safety". ASTM SpecialPublication 685, American Society for Testing and Materials, Boston, U.S.A,1979.
2. Butcher, E. G. and Parnell, A. C, "Designing of fire safety". JohnWiley and SonsLtd., NewYork, U.S.A.1983.
3. Jain, V.K,"Fire safety in buildings" (2nd edn.). New Age International(P) Ltd., New Delhi,2010.
4. Hazop&Hazan,"Identifying and Assessing Process Industry Hazards", FourthEdition ,

4. Frank R. Spellman, Nancy E. Whiting,"The Handbook of Safety Engineering: Principles and Applications", 2009

CO's- PO's & PSO's MAPPING

CO's	PO's												PSO's		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	2	-	1	-	-	1	-	-	-	-	-	-	-	-	-
2	-	-	3	-	-	-	-	-	-	-	-	-	-	-	-
3	1	-	2	-	-	-	3	-	-	1	-	-	-	-	-
4	-	-	-	-	-	1	1	-	-	-	-	-	-	-	-
5	2	-	1	-	-	1	1	1	-	1	-	1	-	-	-
AVg.	1.3	-	1.75	-	-	1	1.3	1		1	-	1	-	-	-

1 - low, 2 - medium, 3 - high, '-"- no correlation

PRIST DEEMED TO BE UNIVERSITY

School of Engineering & Technology

DEPARTMENT OF CIVIL ENGINEERING

Mapping of Courses to Cross Cutting Issues

B.Tech – Civil Engineering FT (R-2021)

Programme Name & Code	Course Code	Title of the Course	Cross Cutting Issues							
			Gender Sensitization and Human Values	Professional Ethics and Human Values	Environment and Sustainability and Human Values	Human Values	Professional Ethics	Environment and Sustainability	Professional Ethics, Human Values and Environment and Sustainability	Gender Sensitization
B.Tech-21UGCVLFT	21147IP	Induction Programme								
B.Tech-21UGCVLFT	21147S11	Professional English-I					✓			
B.Tech-21UGCVLFT	21148S12	Matrices and Calculus					✓			
B.Tech-21UGCVLFT	21149S13	Engineering Physics								
B.Tech-21UGCVLFT	21149S14	Engineering Chemistry								
B.Tech-21UGCVLFT	21150S15	Problem Solving and Python Programming								
B.Tech-21UGCVLFT	21147S21	Professional English-II					✓			
B.Tech-21UGCVLFT	21148S22	Statistics and Numerical Methods					✓			

B.Tech-21UGCVLFT	21149S23E	Physics for Civil Engineering								
B.Tech-21UGCVLFT	21154S24	Engineering Graphics								
B.Tech-21UGCVLFT	21153S25C	Basic Electrical, Electronics and Instrumentation Engineering								
B.Tech-21UGCVLFT	21148S31D	Transforms and Partial Differential Equations					✓			
B.Tech-21UGCVLFT	21154S32	Engineering Mechanics								
B.Tech-21UGCVLFT	21155C33	Fluid Mechanics								
B.Tech-21UGCVLFT	21155C34	Construction Materials and Technology								
B.Tech-21UGCVLFT	21155C35	Water Supply and Wastewater Engineering						✓		
B.Tech-21UGCVLFT	21155C36	Surveying and Levelling								
B.Tech-21UGCVLFT	21155C41	Applied Hydraulics Engineering								
B.Tech-21UGCVLFT	21155C42	Strength of Materials					✓			
B.Tech-21UGCVLFT	21155C43	Concrete Technology								
B.Tech-21UGCVLFT	21155C44	Soil Mechanics								
B.Tech-21UGCVLFT	21155C45	Highway and Railway Engineering								
B.Tech-21UGCVLFT	21149S46	Environmental Sciences and Sustainability						✓		
B.Tech-	21155C51	Design of								

21UGCVLFT		Reinforced Concrete Structural Elements								
B.Tech-21UGCVLFT	21155C52	Structural Analysis I								
B.Tech-21UGCVLFT	21155C53	Foundation Engineering								
B.Tech-21UGCVLFT	21155E54A	Airports and Harbours								
B.Tech-21UGCVLFT	21155E54B	Concrete Structures								
B.Tech-21UGCVLFT	21155E54C	Groundwater Engineering						✓		
B.Tech-21UGCVLFT	21155E54D	Dynamics and Earthquake Resistant Structures								
B.Tech-21UGCVLFT	21155E54E	Introduction to Finite Element Method								
B.Tech-21UGCVLFT	21155E54F	Steel Concrete Composite Structures								
B.Tech-21UGCVLFT	21155E54G	Environmental Quality Monitoring						✓		
B.Tech-21UGCVLFT	21155E54H	Transport and Environment						✓		
B.Tech-21UGCVLFT	21155E54I	Rainwater Harvesting								
B.Tech-21UGCVLFT	21155E54J	Marine Geotechnical Engineering								
B.Tech-21UGCVLFT	21155E55A	Steel Structures								
B.Tech-21UGCVLFT	21155E55B	Air and Noise Pollution Control Engineering						✓		
B.Tech-21UGCVLFT	21155E55C	Rehabilitation/ Heritage Restoration								

B.Tech-21UGCVLFT	21155E55D	Formwork Engineering								
B.Tech-21UGCVLFT	21155E55E	Digitalized Construction Lab								
B.Tech-21UGCVLFT	21155E55F	Sustainable Construction And Lean Construction								
B.Tech-21UGCVLFT	21155E55G	Environmental Quality Monitoring						✓		
B.Tech-21UGCVLFT	21155E55H	Coastal Engineering								
B.Tech-21UGCVLFT	21155E55I	Ocean Wave Dynamics								
B.Tech-21UGCVLFT	21155E56A	Water Quality and Management					✓			
B.Tech-21UGCVLFT	21155E56B	Prefabricated Structures								
B.Tech-21UGCVLFT	21155E56C	Total Station and GPS Surveying								
B.Tech-21UGCVLFT	21155E56D	Rock Mechanics								
B.Tech-21UGCVLFT	21155E56E	Earth and Earth Retaining Structures								
B.Tech-21UGCVLFT	21155E56F	Tunneling Engineering								
B.Tech-21UGCVLFT	21155E56G	Soil Dynamics and Machine Foundations								
B.Tech-21UGCVLFT	21155E56H	Port and Harbour Engineering								
B.Tech-21UGCVLFT	21155E56I	Watershed Conservation and Management					✓			
B.Tech-21UGCVLFT	21147MC51A	Introduction to Women and Gender Studies	✓							
B.Tech-21UGCVLFT	21147MC51B	Elements of Literature								
B.Tech-21UGCVLFT	21147MC51C	Film Appreciation								
B.Tech-	21147MC51D	Disaster					✓			

21UGCVLFT		Management								
B.Tech-21UGCVLFT	21150OE61A	IoT Concepts and Applications (CSE)								
B.Tech-21UGCVLFT	21150OE61B	Augmented and Virtual Reality (CSE)								
B.Tech-21UGCVLFT	21155C62	Design of Steel Structural Elements								
B.Tech-21UGCVLFT	21155C63	Structural Analysis II								
B.Tech-21UGCVLFT	21155C64	Hydrology and Water Resource Engineering						✓		
B.Tech-21UGCVLFT	21155E65A	Prestressed Concrete Structures								
B.Tech-21UGCVLFT	21155E65B	Water Resources Systems Engineering						✓		
B.Tech-21UGCVLFT	21155E65C	Remote Sensing Concepts								
B.Tech-21UGCVLFT	21155E65D	Satellite Image Processing								
B.Tech-21UGCVLFT	21155E65E	Cartography and GIS								
B.Tech-21UGCVLFT	21155E65F	Photogrammetry								
B.Tech-21UGCVLFT	21155E65G	Airborne and Terrestrial Laser Mapping								
B.Tech-21UGCVLFT	21155E65H	Hydrographic Surveying						✓		
B.Tech-21UGCVLFT	21155E65I	Participatory Water Resources Management						✓		
B.Tech-21UGCVLFT	21155E65J	Design of Plate and Shell Structures								
B.Tech-21UGCVLFT	21155E66A	Pile Foundation								
B.Tech-21UGCVLFT	21155E66B	Urban Planning and Development								

B.Tech-21UGCVLFT	21155E66C	Construction Equipment and Machinery								
B.Tech-21UGCVLFT	21155E66D	Smart Cities								
B.Tech-21UGCVLFT	21155E66E	Intelligent Transport Systems								
B.Tech-21UGCVLFT	21155E66F	Transportation Planning Process								
B.Tech-21UGCVLFT	21155E66G	Coastal Hazards and Mitigation								
B.Tech-21UGCVLFT	21155E66H	Solid and Hazardous Waste Management					✓			
B.Tech-21UGCVLFT	21155E66I	Green Building Design								
B.Tech-21UGCVLFT	21155E66J	Powerplant Structures								
B.Tech-21UGCVLFT	21155E67A	Advanced Construction Techniques								
B.Tech-21UGCVLFT	21155E67B	Traffic Engineering and Management					✓			
B.Tech-21UGCVLFT	21155E67C	Dynamics and Earthquake Resistant Structures								
B.Tech-21UGCVLFT	21155E67D	Climate Change Adaptation and Mitigation								
B.Tech-21UGCVLFT	21155E67E	Environmental Health and Safety						✓		
B.Tech-21UGCVLFT	21155E67F	Industrial Wastewater Management					✓			
B.Tech-21UGCVLFT	21155E67G	Coastal Zone Management and Remote Sensing					✓			
B.Tech-21UGCVLFT	21155E67H	Computational Fluid Dynamics								

B.Tech-21UGCVLFT	21155E67I	Earth and Rockfill Dams								
B.Tech-21UGCVLFT	21155E67J	Finance for Engineers								
B.Tech-21UGCVLFT	21147MC61A	Well Being with Traditional Practices (Yoga, Ayurveda and Siddha)								
B.Tech-21UGCVLFT	21147MC61B	History of Science and Technology in India								
B.Tech-21UGCVLFT	21147MC61C	Political and Economic Thought for a Humane Society				✓				
B.Tech-21UGCVLFT	21147MC61D	State, Nation Building And Politics in India								
B.Tech-21UGCVLFT	21147MC61E	Safety In Engineering Industries								
B.Tech-21UGCVLFT	21147S71	Human Values and Ethics				✓				
B.Tech-21UGCVLFT	21150OE72A	Data Science Fundamentals (CSE)								
B.Tech-21UGCVLFT	21150OE72B	Artificial Intelligence and Machine Learning Fundamentals								
B.Tech-21UGCVLFT	21147OE73A	English for Competitive Examinations								
B.Tech-21UGCVLFT	21153OE73A	Renewable Energy Technologies								
B.Tech-21UGCVLFT	21153OE73B	Electric and Hybrid Vehicle								
B.Tech-21UGCVLFT	21154OE73A	Introduction to non-Destructive testing								

B.Tech-21UGCVLFT	21154OE73B	Industrial Management					✓			
B.Tech-21UGCVLFT	21152OE73A	Biomedical Instrumentation								
B.Tech-21UGCVLFT	21152OE73B	Fundamentals of Electronic Devices and Circuits								
B.Tech-21UGCVLFT	21154OE74A	Additive Manufacturing								
B.Tech-21UGCVLFT	21154OE74B	Industrial safety								
B.Tech-21UGCVLFT	21153OE74A	Sensors								
B.Tech-21UGCVLFT	21153OE74B	Electrical, Electronic and Magnetic materials								
B.Tech-21UGCVLFT	21152OE75A	Wearable devices								
B.Tech-21UGCVLFT	21152OE77B	Medical Informatics								
B.Tech-21UGCVLFT	21155C75	Estimation, Costing and Valuation Engineering								
B.Tech-21UGCVLFT	21155C76	Irrigation Engineering and Drawing						✓		
B.Tech-21UGCVLFT	21160S77	Total Quality Management					✓			
B.Tech-21UGCVLFT	21155PW81	Project Work								

1.3.1 SUPPORTING DOCUMENTS

Courses which address the Gender Sensitization,HumanValues, Professional Ethics, Environment and sustainability.

SCHOOLOF ENGINEERINGAND TECHNOLOGY

DEPARTMENT OF CIVIL ENGINEERING

PROGRAM HAND BOOK

Gender Sensitization and Human Values	
Professional Ethics	..
HumanValues	
Environment and sustainability	
Professional Ethics & HumanValues	

COURSE STRUCTURE

B.TECH FT CIVIL R2021

I - VIII SEMESTERS CURRICULUM AND SYLLABI

B.TECH (FT) CIVIL [REGULATION 2020]

SEMESTER I

Sl.No	Course Code	CourseTitle	Periods PerWeek			Credit
			L	T	P	
1.	21147IP	Induction Programme				
THEORY						
2	21147S11	Professional English-I	3	0	0	3
3	21148S12	Matrices and Calculus	3	1	0	4
4	21149S13	Engineering Physics	3	0	0	3
5	21149S14	Engineering Chemistry	3	0	0	3
6	21150S15	Problem Solving and Python Programming	3	0	0	3
PRACTICALS						
7	21150L16	Problem Solving and Python Programming Laboratory	0	0	4	2
8	21149L17	Physics and Chemistry Laboratory	0	0	4	2
	TOTAL		**15**	**1**	**10**	**21**

SEMESTER II

SI. No	COURSE CODE	COURSETITLE	L	T	P	C
THEORY						
1.	21147S21	Professional English-II	3	0	0	3
2.	21148S22	Statistics and Numerical Methods	3	1	0	4
3.	21149S23E	Physics for Civil Engineering	3	0	0	3
4.	21154S24	Engineering Graphics	2	0	4	4
5.	21153S25C	Basic Electrical, Electronics and Instrumentation Engineering	3	0	0	3
PRACTICALS						
6.	21154L21	Engineering Practices Laboratory	0	0	4	2
7.	21153L22D	Basic Electrical, Electronics And Instrumentation Engineering Laboratory	0	0	4	2
	TOTAL		**14**	**1**	**16**	**23**

SEMESTER III

S. No	Sub.Code	Name ofthe Subject	L	T	P	C
THEORY						
1	21148S31D	Transforms and Partial Differential Equations	3	1	0	4
2	21154S32	Engineering Mechanics	3	0	0	3
3	21155C33	Fluid Mechanics	3	0	0	3
4	21155C34	Construction Materials and Technology	3	0	0	3
5	21155C35	Water Supply and Wastewater Engineering	4	0	0	4
6	21155C36	Surveying and Levelling	3	0	0	3
PRACTICALS						
7	21155L37	Surveying and Levelling Laboratory	0	0	4	2
8	21155L38	Water and Wastewater Analysis Laboratory	0	0	4	2
9	21155L39	Professional Development	0	0	2	1
		TOTAL	**19**	**1**	**10**	**25**

SEMESTERIV

S. No	Sub.Code	Name ofthe Subject	L	T	P	C
THEORY						
1	21155C41	Applied Hydraulics Engineering	3	1	0	4
2	21155C42	Strength of Materials	3	0	0	3
3	21155C43	Concrete Technology	3	0	0	3
4	21155C44	Soil Mechanics	3	0	0	3
5	21155C45	Highway and Railway Engineering	3	0	0	3
6	21149S46	Environmental Sciences and Sustainability	3	0	0	3
PRACTICALS						
7	21155L47	Hydraulic Engineering Laboratory	0	0	4	2
8	21155L48	Materials Testing Laboratory	0	0	4	2
9	21155L49	Soil Mechanics Laboratory	0	0	4	2
		TOTAL	**18**	**1**	**12**	**25**

SEMESTER– V

S.No	Sub.Code	Name ofthe Subject	L	T	P	C
		THEORY				
1	21155C51	Design of Reinforced Concrete Structural Elements	3	0	0	3
2	21155C52	Structural Analysis I	3	0	0	3
3	21155C53	Foundation Engineering	3	0	0	3
4	21155E54_	Elective I	3	0	0	3
5	21155E55_	ElectiveII	3	0	0	3
6	21155E56_	Elective III	3	0	0	3
7	21147MC51 _	Mandatory Course-I	3	0	0	0
		PRACTICALS				
8	21155L58	Highway Engineering Laboratory	0	0	4	2
9	21155L59	Survey Camp(2weeks)	0	0	0	1
		TOTAL	**21**	**0**	**4**	**21**

SEMESTER – VI

S.No	Sub.Code	Name ofthe Subject	L	T	P	C
		THEORY				
1	21150OE61_	Open Elective–I	3	0	0	3
2	21155C62	Design of Steel Structural Elements	3	0	0	3
3	21155C63	Structural Analysis II	3	0	0	3
4	21155C64	Hydrology and Water Resource Engineering	3	0	0	3
5	21155E65_	Elective IV	3	0	0	3
6	21155E66_	Elective V	3	0	0	3
7	21155E67_	Elective VI	3	0	0	3
8	21147MC61_	Mandatory Course-II	3	0	0	0
		PRACTICALS				
7	21155L69	Building Drawing and Detailing Laboratory	0	0	4	2
		TOTAL	**24**	**0**	**4**	**23**

SEMESTER –VII

S. No	Sub.Code	Name ofthe Subject	L	T	P	C
		THEORY				
1	21147S71	Human Values and Ethics	2	0	0	2
2	21150OE72_	Open Elective–II	3	0	0	3
3	211_ _OE73_	Open Elective–III	3	0	0	3
4	211_ _OE74_	Open Elective–IV	3	0	0	3

5	21155C75	Estimation, Costing and Valuation Engineering	3	0	0	3
6	21155C76	Irrigation Engineering and Drawing	3	0	0	3
7	21160S77	Total Quality Management	3	0	0	3
TOTAL			**20**	**0**	**0**	**20**

SEMESTER–VIII

S.No	Sub.Code	Name ofthe Subject	L	T	P	C
1	21155PW81	Project Work	0	0	20	10
		TOTAL	0	0	20	10

TOTAL CREDITS:168

MANDATORYCOURSES
I SEM V

S. No	Sub.Code	Name ofthe Subject	L	T	P	C
1	21147MC51A	Introduction to Women and Gender Studies	3	0	0	0
2	21147MC51B	Elements of Literature	3	0	0	0
3	21147MC51C	Film Appreciation	3	0	0	0
4	21147MC51D	Disaster Management	3	0	0	0

MANDATORY COURSES II
SEM VI

S. No	Sub.Code	Name ofthe Subject	L	T	P	C
1	21147MC61A	Well Being with Traditional Practices (Yoga, Ayurveda and Siddha)	3	0	0	0
2	21147MC61B	History of Science and Technology in India	3	0	0	0
3	21147MC61C	Political and Economic Thought for a Humane Society	3	0	0	0
4	21147MC61D	State, Nation Building And Politics in India	3	0	0	0
5	21147MC61E	Safety In Engineering Industries	3	0	0	0

LIST OF ELECTIVES
SEMESTER–V
ELECTIVE I

S.No	Sub.Code	Name of the Subject	L	T	P	C
1	21155E54A	Airports and Harbours	3	0	0	3
2	21155E54B	Concrete Structures	3	0	0	3
3	21155E54C	Groundwater Engineering	3	0	0	3
4	21155E54D	Dynamics and Earthquake Resistant Structures	3	0	0	3
5	21155E54E	Introduction to Finite Element Method	3	0	0	3
6	21155E54F	Steel Concrete Composite Structures	3	0	0	3
7	21155E54G	Environmental Quality Monitoring	3	0	0	3
8	21155E54H	Transport and Environment	3	0	0	3
9	21155E54I	Rainwater Harvesting	3	0	0	3
10	21155E54J	Marine Geotechnical Engineering	3	0	0	3

ELECTIVE II

S.No	Sub.Code	Name of the Subject	L	T	P	C
1	21155E55A	Steel Structures	3	0	0	3
2	21155E55B	Air and Noise Pollution Control Engineering	3	0	0	3
3	21155E55C	Rehabilitation/ Heritage Restoration	3	0	0	3
4	21155E55D	Formwork Engineering	3	0	0	3
5	21155E55E	Digitalized Construction Lab	3	0	0	3
6	21155E55F	Sustainable Construction And Lean Construction	3	0	0	3
7	21155E55G	Environmental Quality Monitoring	3	0	0	3
8	21155E55H	Coastal Engineering	3	0	0	3
9	21155E55I	Ocean Wave Dynamics	3	0	0	3

ELECTIVE III

S.No	Sub.Code	Name of the Subject	L	T	P	C
1	21155E56A	Water Quality and Management	3	0	0	3
2	21155E56B	Prefabricated Structures	3	0	0	3
3	21155E56C	Total Station and GPS Surveying	3	0	0	3
4	21155E56D	Rock Mechanics	3	0	0	3
5	21155E56E	Earth and Earth Retaining Structures	3	0	0	3

6	21155E56F	Tunneling Engineering	3	0	0	3
7	21155E56G	Soil Dynamics and Machine Foundations	3	0	0	3
8	21155E56H	Port and Harbour Engineering	3	0	0	3
9	21155E56I	Watershed Conservation and Management	3	0	0	3

SEMESTER – VI
ELECTIVE IV

S.No	Sub.Code	Name of the Subject	L	T	P	C
1	21155E65A	Prestressed Concrete Structures	3	0	0	3
2	21155E65B	Water Resources Systems Engineering	3	0	0	3
3	21155E65C	Remote Sensing Concepts	3	0	0	3
4	21155E65D	Satellite Image Processing	3	0	0	3
5	21155E65E	Cartography and GIS	3	0	0	3
6	21155E65F	Photogrammetry	3	0	0	3
7	21155E65G	Airborne and Terrestrial Laser Mapping	3	0	0	3
8	21155E65H	Hydrographic Surveying	3	0	0	3
9	21155E65I	Participatory Water Resources Management	3	0	0	3
10	21155E65J	Design of Plate and Shell Structures	3	0	0	3

ELECTIVE V

S. No	Sub.Code	Name of the Subject	L	T	P	C
1	21155E66A	Pile Foundation	3	0	0	3
2	21155E66B	Urban Planning and Development	3	0	0	3
3	21155E66C	Construction Equipment and Machinery	3	0	0	3
4	21155E66D	Smart Cities	3	0	0	3
5	21155E66E	Intelligent Transport Systems	3	0	0	3
6	21155E66F	Transportation Planning Process	3	0	0	3
7	21155E66G	Coastal Hazards and Mitigation	3	0	0	3
8	21155E66H	Solid and Hazardous Waste Management	3	0	0	3
9	21155E66I	Green Building Design	3	0	0	3
10	21155E66J	Power plant Structures	3	0	0	3

ELECTIVEVI

S. No	Sub.Code	Name of the Subject	L	T	P	C
1	21155E67A	Advanced Construction Techniques	3	0	0	3
2	21155E67B	Traffic Engineering and Management	3	0	0	3
3	21155E67C	Dynamics and Earthquake Resistant Structures	3	0	0	3
4	21155E67D	Climate Change Adaptation and Mitigation	3	0	0	3
5	21155E67E	Environmental Health and Safety	3	0	0	3
6	21155E67F	Industrial Wastewater Management	3	0	0	3
7	21155E67G	Coastal Zone Management and Remote Sensing	3	0	0	3
8	21155E67H	Computational Fluid Dynamics	3	0	0	3
9	21155E67I	Earth and Rockfill Dams	3	0	0	3
10	21155E67J	Finance for Engineers	3	0	0	3

SEMESTER VI

OPENELECTIVE-I

1	21150OE61A	IoT Concepts and Applications (CSE)	2	0	2	3
2	21150OE61B	Augmented and VirtualReality (CSE)	2	0	2	3

SEMESTER VII
OPENELECTIVE-II

1	21150OE72A	Data Science Fundamentals (CSE)	2	0	2		3
2	21150OE72B	Artificial Intelligence and MachineLearning Fundamentals	2	0	2		3

OPENELECTIVE-III

1	21147OE73A	English for Competitive Examinations	3	0	0	3
2	21153OE73A	Renewable EnergyTechnologies	3	0	0	3
3	21153OE73B	Electric and Hybrid Vehicle	3	0	0	3
4	21154OE73A	Introduction to non-Destructive testing	3	0	0	3
5	21154OE73B	Industrial Management	3	0	0	3
5	21152OE73A	Biomedical Instrumentation	3	0	0	3
6	21152OE73B	Fundamentals of Electronic Devices and Circuits	3	0	0	3

OPENELECTIVE-IV

1	21154OE74A	Additive Manufacturing	3	0	0	3
2	21154OE74B	Industrial safety	3	0	0	3
3	21153OE74A	Sensors	3	0	0	3
4	21153OE74B	Electrical, Electronic andMagnetic materials	3	0	0	3
5	21152OE75A	Wearable devices	3	0	0	3
6	21152OE77B	Medical Informatics	3	0	0	3

PRIST DEEMED TO BE UNIVERSITY

School of Engineering & Technology

Department of Mechanical Engineering

Mapping of Courses to Cross cutting Issues

B.Tech Mechanical Engineering (R - 2021)

Programme Name & Code	Course Code	Title of the Course	Cross cutting Issues				
			Gender Sensitization and Human Values	Professional Ethics and Human Values	Environment and Sustainability and Human Values	Human Values	Professional Ethics
B.Tech - 21UGMECHFT	21147S11	Professional English - I					✔
B.Tech - 21UGMECHFT	21148S12	Matrices and Calculus	-	-	-	-	-
B.Tech - 21UGMECHFT	21149S13	Engineering Physics	-	-	-	-	-
B.Tech - 21UGMECHFT	21149S14	Engineering Chemistry	-	-	-	-	-
B.Tech - 21UGMECHFT	21150S15	Problem Solving and Python Programming	-	-	-	-	-
B.Tech - 21UGMECHFT	21150L16	Problem Solving and Python Programming Laboratory	-	-	-	-	-
B.Tech - 21UGMECHFT	21149L17	Physics and Chemistry Laboratory	-	-	-	-	-
B.Tech - 21UGMECHFT	21147L18	Communication Laboratory- I					✔

B.Tech - 21UGMECHFT	21147S21	Professional English - II					✔
B.Tech - 21UGMECHFT	21148S22	Statistics and Numerical Methods	-	-	-	-	-
B.Tech - 21UGMECHFT	21149S23	Materials Science	-	-	-	-	-
B.Tech - 21UGMECHFT	21154S24	Engineering Graphics	-	-	-	-	-
B.Tech - 21UGMECHFT	21153S25	Basic Electrical and Electronics Engineering	-	-	-	-	-
B.Tech - 21UGMECHFT	21154L26	Engineering Practices Laboratory	-	-	-	-	-
B.Tech - 21UGMECHFT	21153L27	Basic Electrical and Electronics Engineering Laboratory	-	-	-	-	-
B.Tech - 21UGMECHFT	21147L28	Communication Laboratory - II					✔
B.Tech - 21UGMECHFT	21148S31 D	Transforms and Partial Differential Equations	-	-	-	-	-
B.Tech - 21UGMECHFT	21154C32	Engineering Mechanics	-	-	-	-	-
B.Tech - 21UGMECHFT	21154C33	Engineering Thermodynamics	-	-	-	-	-
B.Tech - 21UGMECHFT	21154C34	Fluid Mechanics and Machinery	-	-	-	-	-
B.Tech - 21UGMECHFT	21154C35	Engineering Materials and Metallurgy	-	-	-	-	-
B.Tech - 21UGMECHFT	21154C36	Manufacturing Processes	-	-	-	-	-

B.Tech - 21UGMECHFT	21154L37	Computer Aided Machine Drawing	-	-	-	-	-
B.Tech - 21UGMECHFT	21154L38	Manufacturing Technology Laboratory	-	-	-	-	-
B.Tech - 21UGMECHFT	21154L39	Professional Development					✔
B.Tech - 21UGMECHFT	21154C41	Theory of Machines	-	-	-	-	-
B.Tech - 21UGMECHFT	21154C42	Thermal Engineering	-	-	-	-	-
B.Tech - 21UGMECHFT	21154C43	Hydraulics and Pneumatics	-	-	-	-	-
B.Tech - 21UGMECHFT	21154C44	Manufacturing Technology	-	-	-	-	-
B.Tech - 21UGMECHFT	21154C45	Strength of Materials	-	-	-	-	-
B.Tech - 21UGMECHFT	21149S46	Environmental Sciences and Sustainability			✔		
B.Tech - 21UGMECHFT	21154L47	Strength of Materials and Fluid Machinery Laboratory	-	-	-	-	-
B.Tech - 21UGMECHFT	21154L48	Thermal Engineering Laboratory	-	-	-	-	-

PRIST
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THANJAVUR – 613 403 - TAMIL NADU

SCHOOL OF ENGINEERING AND TECHNOLOGY

DEPARTMENT OF MECHANICAL ENGINEERING

COURSE STRUCTURE

B.Tech – FULL TIME

[Regulation 2021]

(For Candidates admitted from 2022 onwards)

PROGRAM EDUCATIONAL OBJECTIVES (PEOs)

I. Effectuating success in careers by exploring with the design, digital and computational analysis of engineering systems, experimentation and testing, smart manufacturing, technical services, and research.

II. Amalgamating effectively with stakeholders to update and improve their core competencies and abilities to ethically compete in the ever-changing multicultural global enterprise.

III. To encourage multi-disciplinary research and development to foster advanced technology, and to nurture innovation and entrepreneurship in order to compete successfully in the global economy.

IV. To globally share and apply technical knowledge to create new opportunities that proactively advances our society through team efforts and to solve various challenging technical, environmental and societal problems.

V. To create world class mechanical engineers capable of practice engineering ethically with a solid vision to become great leaders in academia, industries and society.

PROGRAM OUTCOMES (POs)

PO	GRADUATE ATTRIBUTE
1	**Engineering knowledge**: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
2	**Problem analysis**: Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
3	**Design/development of solutions**: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
4	**Conduct investigations of complex problems**: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
5	**Modern tool usage**: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.
6	**The engineer and society**: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
7	**Environment and sustainability**: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
8	**Ethics**: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
9	**Individual and team work**: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
10	**Communication:** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
11	**Project management and finance:** Demonstrate knowledge and understanding of the engineering and management principles and apply these to one’s own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
12	**Life-long learning**: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

PROGRAM SPECIFIC OUTCOMES (PSOs)

On successful completion of the Mechanical Engineering Degree programme, the Graduates shall exhibit the following:

1. Apply the knowledge gained in Mechanical Engineering for design and development and manufacture of engineering systems.
2. Apply the knowledge acquired to investigate research-oriented problems in mechanical engineering with due consideration for environmental and social impacts.
3. Use the engineering analysis and data management tools for effective management of multidisciplinary projects.

PEO / PO MAPPING:

PEOs	POs												PSOs		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
I.	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
II.	3	2	2	2	2	1	1	1	3		2	1	2	3	3
III.	3	1	2	1	2	2	1		1	2		3	3	2	2
IV.	2	2	2	2	2		2				1	2	2	3	3
V.	3	2	2	2	1	3	2	2	2	1	1	3	3	2	2

Mapping of Course Outcome and Programme Outcome

Year	Semester	Course name	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
I	I	Professional English- I	1.6	2.2	1.8	2.2	1.5	3	3	3	1.6	3	3	3			
		Matrices and Calculus	3	3	1	1	0	0	0	0	2	0	2	3	-	-	-
		Engineering Physics	3	3	1.6	1.2	1.8	1	-	-	-	-	-	1	-	-	-
		Engineering Chemistry	2.8	1.3	1.6	1	-	1.5	1.8	-		-	-	1.5	-	-	-
		Problem Solving and Python Programming	2	3	3	3	2	-	-	-	-	-	2	2	3	3	-
		Problem Solving and Python Programming Laboratory	2	3	3	3	2	-	-	-	-	-	2	2	3	3	-
		Physics and Chemistry Laboratory	3	2.4	2.6	1	1	-	-	-	-	-	-	-	-	-	-
			2.6	1.3	1.6	1	1	1.4	1.8	-	-	-	-	1.3	-	-	-
		English Laboratory$	3	3	3	3	1	3	3	3	3	3	3	3	-	-	-
	II	Professional English- II	3	3	3	3	2.75	3	3	3	2.2	3	3	3	-	-	-
		Statistics and Numerical Methods	3	3	1	1	1	0	0	0	2	0	2	3	-	-	-
		Materials Science	3	2	1.6	1.4	1.8	1.2	1	-	-	-	-	1	-	-	-
		Basic Electrical and Electronics Engineering	2	1.8	1					1				2			1
		Engineering Graphics	3	1	2	-	2	-	-	-	-	3	-	2	2	2	-
		Engineering Practices Laboratory	3	2	-		1	1	1	-	-	-	-	2	2	1	1
		Basic Electrical and Electronics Engineering Laboratory	3	3	2	1	1	-	-	1.5	2	-	-	-	-	-	1
		Communication Laboratory / Foreign Language $	2.4	2.8	3	3	1.8	3	3	3	3	3	3	3	-	-	-
II	III	Transforms and Partial Differential Equations	3	3	2	2	1	-	-	- -	1	-	-	1	3	3	1
		Engineering Mechanics	3	2	3	1	2	-	-	-	-	-	-	2	3	1	2
		Engineering Thermodynamics	3	3	2			1			1		1	2	3	2	3
		Fluid Mechanics and Machinery	3	2	3	2	2	2	2	1	-	-	-	2	2	2	2
		Engineering Materials and Metallurgy	3	1	3	2	2	2	2	1	-	-	-	2	2	1	2
		Manufacturing Processes	3		2		2	2	2	1	1	-	-	1	3	1	2
		Professional Development	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	IV	Theory of Machines	3	2	2		2	-	-	1		-	-	1	3		1
		Thermal Engineering	3	2	1	1	-	-	-	-	-	-	-	1	2	1	1
		Hydraulics and Pneumatics	2	1	1	1	-	-	-	-	-	-	-	1	2	1	1
		Manufacturing Technology	3	3	3	1	1	1	3	-	-	3	-	-	3	2	2
		Strength of Materials	3	3	3	3	2	3	1	3	2	3	1	3	2	1	1

		Environmental Sciences and Sustainability	1	1	1	-	-	3	-	1	-	2	1	2	2	1	-
III	**V**	Design of Machine Elements	2	2	3	-	-	-	-	1	1	-	-	2	3	2	2
		Metrology and Measurements	3	2	2	2	-	-	-	-	1	-	-	1	3	2	1

	VI	Heat and Mass Transfer	3	3	3	2	-	-	-	-	1	-	-	1	3	2	1
IV	**VII**	Mechatronics and IoT	3	2	2	2	2.		1		1	-	-	2	1	2	3
		Computer Integrated Manufacturing	3	2	2	1	2	-	-	-	1	-	-	1	2	1	3
		Human Values and Ethics	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		Industrial Management	-	-	1	1	-	3	2	3	2	3	2	3	1	1	1

*Gender Sensitization and Human Values
*Human Values
*Professional Ethics
*Environment and Sustainability
*Professional Ethics& Human Values

SEMESTER I

S.NO.	COURSE CODE	COURSE TITLE	L	T	P	C
THEORY						
1.	21147IP	INDUCTION PROGRAM	2-WEEKS			
2.	21147S11	Professional English - I	3	0	0	3
3.	21148S12	Matrices and Calculus	3	1	0	4
4.	21149S13	Engineering Physics	3	0	0	3
5.	21149S14	Engineering Chemistry	3	0	0	3
6.	21150S15	Problem Solving and Python Programming	3	0	0	3
PRACTICAL						
7.	21150L16	Problem Solving and Python Programming Laboratory	0	0	4	2
8.	21149L17	Physics and Chemistry Laboratory	0	0	4	2
9	21147L18	Communication Laboratory- I	0	0	2	1
TOTAL			**15**	**1**	**10**	**21**

SEMESTER II

S.NO.	COURSE CODE	COURSE TITLE	L	T	P	C
		THEORY				
1.	21147S21	Professional English - II	3	0	0	3
2.	21148S22	Statistics and Numerical Methods	3	1	0	4
3	21149S23D	Materials Science	3	0	0	3
4.	21154S24	Engineering Graphics	2	0	4	4
5.	21153S25A	Basic Electrical and Electronics Engineering	3	0	0	3
		PRACTICAL				
6.	21154L27	Engineering Practices Laboratory	0	0	4	2
7.	21153L28C	Basic Electrical and Electronics Engineering Laboratory	0	0	4	2
8.	21147L29	Communication Laboratory - II	0	0	4	2
		TOTAL	**14**	**1**	**16**	**23**

SEMESTER III

S.NO.	COURSE CODE	COURSE TITLE	L	T	P	C
		THEORY				
1.	21148S31D	Transforms and Partial Differential Equations	3	1	0	4
2.	21154C32	Engineering Mechanics	3	0	0	3
3.	21154C33	Engineering Thermodynamics	3	0	0	3
4.	21154C34	Fluid Mechanics and Machinery	2	1	0	3
5.	21154C35	Engineering Materials and Metallurgy	3	0	0	3
6	21154C36	Manufacturing Processes	3	0	0	3

PRACTICAL						
7.	21154L37	Computer Aided Machine Drawing	0	0	4	2
8.	21154L38	Manufacturing Technology Laboratory	0	0	4	2
9.	21154L39	Professional Development	0	0	2	1
TOTAL			**17**	**2**	**10**	**24**

SEMESTER IV

S.NO.	COURSE CODE	COURSE TITLE	L	T	P	C
THEORY						
1.	21154C41	Theory of Machines	3	0	0	3
2.	21154C42	Thermal Engineering	3	1	0	4
3.	21154C43	Hydraulics and Pneumatics	3	0	0	3
4.	21154C44	Manufacturing Technology	3	0	0	3
5.	21154C45	Strength of Materials	3	0	0	3
6.	21149S46	Environmental Sciences and Sustainability	3	0	0	3
PRACTICAL						
7.	21154L47	Strength of Materials and Fluid Machinery Laboratory	0	0	4	2
8.	21154L48	Thermal Engineering Laboratory	0	0	4	2
TOTAL			**18**	**1**	**8**	**23**

SEMESTER V

S.NO.	COURSE CODE	COURSE TITLE	L	T	P	C
THEORY						
1.	21154C51	Design of Machine Elements	3	1	0	4
2.	21154C52	Metrology and Measurements	3	0	0	3
3.	21154E53--	Elective I	3	0	0	3
4.	21154E54--	Elective II	3	0	0	3
5.	21154E55-	Elective III	3	0	0	3
6	21147MC51--	Mandatory Course-I **(Internal Assessment Only)**	3	0	0	0
PRACTICAL						
6.	21154L57	Summer Internship (Company Certificate)	0	0	4	1
7.	21154L58	Metrology and Dynamics Laboratory	0	0	4	2
TOTAL			**18**	**1**	**8**	**19**

SEMESTER VI

S.NO.	COURSE CODE	COURSE TITLE	L	T	P	C
THEORY						
1.	2115--OE61--	Open Elective – I *	2	0	2	3
2.	21154C62	Heat and Mass Transfer	3	1	0	4
3.	21154E63--	Elective IV	3	0	0	3
4.	21154E64--	Elective V	3	0	0	3
5.	21154E65--	Elective VI	3	0	0	3
6.	21154E66--	Elective VII	3	0	0	3
7.	21147MC61--	Mandatory Course-II (Internal marks only)	3	0	0	0
PRACTICAL						
8.	21154L68	CAD / CAM Laboratory	0	0	4	2
9.	21154L69	Heat Transfer Laboratory	0	0	4	2
TOTAL			**20**	**1**	**10**	**23**

SEMESTER VII

S.NO.	COURSE CODE	COURSE TITLE	L	T	P	C
THEORY						
1.	21147S71	Human Values and Ethics	3	0	0	3
2.	2115--OE72--	Open Elective – II *	2	0	2	3
3.	2115--OE73--	Open Elective – III	3	0	0	3
4.	2115--OE74--	Open Elective – IV	3	0	0	3
5.	21154C75	Mechatronics and IoT	3	0	0	3
6.	21154C76	Computer Integrated Manufacturing	3	0	0	3
7.	21154C77	Industrial Management	3	0	0	3
PRACTICAL						
8.	21154L79	Mechatronics and IoT Laboratory	0	0	4	2
9.	21154L80	Summer Internship (Company Certificate)	0	0	0	1
TOTAL			**20**	**0**	**6**	24

SEMESTER VIII

S.No.	COURSE CODE	COURSE TITLE	L	T	P	C
THEORY						
1.	21154PW	Project Work / Internship	0	0	20	10
TOTAL			**0**	**0**	**20**	**10**

Mandatory courses I

S.NO.	COURSE CODE	COURSE TITLE	L	T	P	C
1.	21147MC51A	Introduction to Women and Gender Studies	3	0	0	0
2.	21147MC51B	Elements of Literature	3	0	0	0
3.	21147MC51C	Film Appreciation	3	0	0	0
4.	21147MC51D	Disaster Management	3	0	0	0

Mandatory courses II

S.NO.	COURSE CODE	COURSE TITLE	L	T	P	C
1.	21147MC61A	Well Being with traditional practices (Yoga, Ayurveda and Siddha)	3	0	0	0
2.	21147MC61B	History of Science and Technology in India	3	0	0	0
3.	21147MC61C	Political and Economic Thought for a Humane Society	3	0	0	0
4.	21147MC61D	State, Nation Building and Politics in India	3	0	0	0
5.	21147MC61E	Safety in Engineering Industry	3	0	0	0

.ELECTIVE – I (V SEMESTER)

S.NO.	COURSE CODE	COURSE TITLE	L	T	P	C
1.	21154E53A	CAD/CAM	3	0	0	3
2.	21154E53B	Value Engineering	3	0	0	3
3.	21154E53C	Product Life Cycle Management	3	0	0	3

ELECTIVE – II (V SEMESTER)

	COURSE CODE	COURSE TITLE	L	T	P	C
1.	21154E54A	Robotics	3	0	0	3
2.	21154E54B	Smart Mobility and Intelligent Vehicles	3	0	0	3
3.	21154E54C	Electrical Drives and Actuators	3	0	0	3

ELECTIVE – III (V SEMESTER)

SI. No	COURSE CODE	COURSE TITLE	L	T	P	C
1.	21154E55A	Automobile Engineering	3	0	0	3
2.	21154E55B	Design Concepts in Engineering	3	0	0	3

3.	21154E55C	Dynamics of Ground Vehicles	3	0	0	3

ELECTIVE – IV (VI SEMESTER)

SI. No	COURSE CODE	COURSE TITLE	L	T	P	C
1.	21154E63A	Design of Transmission System	3	0	0	3
2.	21154E63B	Thermal Power Engineering	3	0	0	3
3.	21154E63C	Turbo Machines	3	0	0	3

ELECTIVE – V (VI SEMESTER)

SI. No	COURSE CODE	COURSE TITLE	L	T	P	C
1.	21154E64A	Material Handling and solid processing Equipment	3	0	0	3
2.	21154E64B	Thermal and Fired Equipment design	3	0	0	3
3.	21154E64C	Design Codes and Standards	3	0	0	3
4.	21154E64D	Non-traditional Machining Processes	3	0	0	3

ELECTIVE – VI (VI SEMESTER)

SI. No	COURSE CODE	COURSE TITLE	L	T	P	C
1.	21154E65A	Power Plant Engineering	3	0	0	3
2.	21154E65B	Energy Conservation in Industries	3	0	0	3
3.	21154E65C	Bioenergy Conversion Technologies	3	0	0	3

ELECTIVE – VII (VI SEMESTER)

SI. No	COURSE CODE	COURSE TITLE	L	T	P	C
1.	21154E66A	Gas Dynamics and Jet Propulsion	3	0	0	3
2.	21154E66B	Operational Research	3	0	0	3
3.	21154E66C	Process Planning and Cost Estimation	3	0	0	3

OPEN ELECTIVE– I (SEMESTER VI)

Sl. No	COURSE CODE	COURSE TITLE	L	T	P	C
1.	21150OE61A	IoT Concepts and Applications	3	0	2	4
2.	21150OE61B	Augmented and Virtual Reality	3	0	2	4

OPEN ELECTIVE– II (SEMESTER VII)

Sl. No	COURSE CODE	COURSE TITLE	L	T	P	C
1.	21150OE72A	Artificial Intelligence and Machine Learning Fundamentals	3	0	2	4
2.	21150OE72B	Data Science Fundamentals	3	0	2	4

OPEN ELECTIVE– III

Sl. No	DEPT	COURSE CODE	COURSE TITLE	L	T	P	C
1.	ENGLISH	21148OE73A	English for Competitive Examinations	3	0	0	3
2.	ECE	21152OE73A	Biomedical Instrumentation	3	0	0	3
3.		21152OE73B	Space Engineering	3	0	0	3
4.	EEE	21153OE73A	Renewable Energy Technologies	3	0	0	3
5.		21153OE73B	Fundamentals of Electronic Devices and Circuits	3	0	0	3
6.	MECH **	21154OE73A	Introduction to NDT	3	0	0	3
7.		21154OE73B	Industrial Management	3	0	0	3
8.	CIVIL	21155OE73A	Remote Sensing Concepts	3	0	0	3
9.		21155OE73B	Drinking Water Supply and Treatment	3	0	0	3

** Offered for other department only

OPEN ELECTIVE– IV

Sl. No	DEPT	COURSE CODE	COURSE TITLE	L	T	P	C
1.	ECE	21152OE74A	Wearable devices	3	0	0	3
2.		21152OE74B	Medical Informatics	3	0	0	3
3.	EEE	21153OE74A	Electrical, Electronic and Magnetic materials	3	0	0	3
4.		21153OE74B	Energy Technology	3	0	0	3
5.	MECH **	21154OE74A	Industrial Safety	3	0	0	3
6.		21154OE74B	Additive Manufacturing	3	0	0	3
7.	CIVIL	21155OE74A	Basics of Integrated Water Resources Management	3	0	0	3
8.		21155OE74B	Geographical Information System	3	0	0	3

** Offered for other department only

CGPA CREDITS

Semester	Core	Elective	Open Elective	Practical	INTERN SHIP	Project	Total
I	16	-	-	05	-	-	21
II	17	-	-	06	-	-	23
III	19	-	-	05	-	-	24
IV	19	-	-	04	-	-	23
V	07	09	-	02	01	-	19
VI	04	12	03	04	-	-	23
VII	12	-	09	02	01	-	24
VIII	-	-	-	-	-	10	10
TOTAL							167

TOTAL **CGPA CREDITS : 167**

*NOTE: Theory & practical course mark allocation: L T P C
2 0 2 3

COMPONENT	MARKS
Theory	100
Practical	100
Total	200

200 convert to 70marks + internal 30mark=100Marks

If the candidate either fail or absent in any one of the component (Theory or Practical), He/She should be considering as fail. He/She has to reappear both (Theory and Practical) components.

HOD **DEAN / DIRECTOR**

DEAN (ACADEMIC AFFAIRS)

21147S11	PROFESSIONAL ENGLISH - I	L T P C 3 0 0 3

OBJECTIVES :

- To improve the communicative competence of learners
- To learn to use basic grammatic structures in suitable contexts
- To acquire lexical competence and use them appropriately in a sentence and understand their meaning in a text
- To help learners use language effectively in professional contexts
- To develop learners' ability to read and write complex texts, summaries, articles, blogs, definitions, essays and user manuals.

UNIT I INTRODUCTION TO EFFECTIVE COMMUNICATION 1

What is effective communication? (Explain using activities) Why is communication critical for excellence during study, research and work? What are the seven C's of effective communication? What are key language skills? What is effective listening? What does it involve? What is effective speaking? What does it mean to be an excellent reader? What should you be able to do? What is effective writing? How does one develop language and communication skills? What does the course focus on? How are communication and language skills going to be enhanced during this course? What do you as a learner need to do to enhance your English language and communication skills to get the best out of this course?

INTRODUCTION TO FUNDAMENTALS OF COMMUNICATION 8

Reading - Reading brochures (technical context), telephone messages / social media messages relevant to technical contexts and emails. Writing - Writing emails / letters introducing oneself. Grammar - Present Tense (simple and progressive); Question types: Why/ Yes or No/ and Tags. Vocabulary - Synonyms; One word substitution; Abbreviations & Acronyms (as used in technical contexts).

UNIT II NARRATION AND SUMMATION 9

Reading - Reading biographies, travelogues, newspaper reports, Excerpts from literature, and travel & technical blogs. Writing - Guided writing-- Paragraph writing Short Report on an event (field trip etc.) Grammar -Past tense (simple); Subject-Verb Agreement; and Prepositions. Vocabulary - Word forms (prefixes& suffixes); Synonyms and Antonyms. Phrasal verbs.

UNIT III DESCRIPTION OF A PROCESS / PRODUCT 9

Reading – Reading advertisements, gadget reviews; user manuals. Writing - Writing definitions; instructions; and Product /Process description. Grammar - Imperatives; Adjectives; Degrees of comparison; Present & Past Perfect Tenses. Vocabulary - Compound Nouns, Homonyms; and Homophones, discourse markers (connectives & sequence words).

UNIT IV CLASSIFICATION AND RECOMMENDATIONS 9

Reading - Newspaper articles; Journal reports -and Non Verbal Communication (tables, pie charts etc,). Writing – Note-making / Note-taking (*Study skills to be taught, not tested); Writing recommendations; Transferring information from non verbal (chart , graph etc, to verbal mode) Grammar - Articles; Pronouns - Possessive & Relative pronouns. Vocabulary - Collocations; Fixed / Semi fixed expressions.

UNIT V EXPRESSION 9

Reading - Reading editorials; and Opinion Blogs; Writing - Essay Writing (Descriptive or narrative). Grammar - Future Tenses, Punctuation; Negation (Statements & Questions); and Simple, Compound & Complex Sentences. Vocabulary - Cause & Effect Expressions - Content vs Function words.

TOTAL : 45 PERIODS

LEARNING OUTCOMES:

At the end of the course, learners will be able

- To use appropriate words in a professional context
- To gain understanding of basic grammatical structures and use them in right context.
- To read and infer the denotative and connotative meanings of technical texts
- To read and interpret information presented in tables, charts and other graphic forms
- To write definitions, descriptions, narrations and essays on various topics

TEXT BOOKS :

1. English for Engineers & Technologists Orient Blackswan Private Ltd. Department of English, Anna University, (2020 edition)
2. English for Science & Technology Cambridge University Press, 2021.
   Authored by Dr. Veena Selvam, Dr. Sujatha Priyadarshini, Dr. Deepa Mary Francis, Dr. KN. Shoba, and Dr. Lourdes Joevani, Department of English, Anna University.

REFERENCE BOOKS:

1. Technical Communication – Principles And Practices By Meenakshi Raman & Sangeeta Sharma, Oxford Univ. Press, 2016, New Delhi.
2. A Course Book On Technical English By Lakshminarayanan, Scitech Publications (India) Pvt. Ltd.
3. English For Technical Communication (With CD) By Aysha Viswamohan, Mcgraw Hill Education, ISBN : 0070264244.
4. Effective Communication Skill, Kulbhusan Kumar, RS Salaria, Khanna Publishing House.
5. Learning to Communicate - Dr. V. Chellammal, Allied Publishing House, New Delhi,2003.

ASSESSMENT PATTERN

Two internal assessments and an end semester examination to test students' reading and writing skills along with their grammatical and lexical competence.

CO-PO & PSO MAPPING

CO	PO												PSO		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	1	1	1	1	1	3	3	3	1	3	-	3	-	-	-
2	1	1	1	1	1	3	3	3	1	3	-	3	-	-	-
3	2	3	2	3	2	3	3	3	2	3	3	3	-	-	-
4	2	3	2	3	2	3	3	3	2	3	3	3	-	-	-
5	2	3	3	3	-	3	3	3	2	3	-	3	-	-	-
AVg.	**1.6**	**2.2**	**1.8**	**2.2**	**1.5**	**3**	**3**	**3**	**1.6**	**3**	**3**	**3**	**-**	**-**	**-**

- 1-low, 2-medium, 3-high, '-"- no correlation
- **Note:** The average value of this course to be used for program articulation matrix.

21148S12 **MATRICES AND CALCULUS**

L	T	P	C
3	1	0	4

COURSE OBJECTIVES:

- To develop the use of matrix algebra techniques that is needed by engineers for practical applications.
- To familiarize the students with differential calculus.
- To familiarize the student with functions of several variables. This is needed in many branches of engineering.
- To make the students understand various techniques of integration.
- To acquaint the student with mathematical tools needed in evaluating multiple integrals and their applications.

UNIT - I MATRICES 9 + 3

Eigenvalues and Eigenvectors of a real matrix – Characteristic equation – Properties of Eigenvalues and Eigenvectors – Cayley - Hamilton theorem – Diagonalization of matrices by orthogonal transformation – Reduction of a quadratic form to canonical form by orthogonal transformation – Nature of quadratic forms – Applications: Stretching of an elastic membrane.

UNIT - II DIFFERENTIAL CALCULUS 9 + 3

Representation of functions - Limit of a function - Continuity - Derivatives - Differentiation rules (sum, product, quotient, chain rules) - Implicit differentiation - Logarithmic differentiation - Applications : Maxima and Minima of functions of one variable.

UNIT - III FUNCTIONS OF SEVERAL VARIABLES 9 + 3

Partial differentiation – Homogeneous functions and Euler's theorem – Total derivative – Change of variables – Jacobians – Partial differentiation of implicit functions – Taylor's series for functions of two variables – Applications : Maxima and minima of functions of two variables and Lagrange's method of undetermined multipliers.

UNIT - IV INTEGRAL CALCULUS 9 + 3

Definite and Indefinite integrals - Substitution rule - Techniques of Integration: Integration by parts, Trigonometric integrals, Trigonometric substitutions, Integration of rational functions by partial fraction, Integration of irrational functions - Improper integrals - Applications: Hydrostatic force and pressure, moments and centres of mass.

UNIT - V MULTIPLE INTEGRALS 9 + 3

Double integrals – Change of order of integration – Double integrals in polar coordinates – Area enclosed by plane curves – Triple integrals – Volume of solids – Change of variables in double and triple integrals – Applications: Moments and centres of mass, moment of inertia.

TOTAL: 60 PERIODS

COURSE OUTCOMES:

At the end of the course the students will be able to

- Use the matrix algebra methods for solving practical problems.
- Apply differential calculus tools in solving various application problems.
- Able to use differential calculus ideas on several variable functions.
- Apply different methods of integration in solving practical problems.
- Apply multiple integral ideas in solving areas, volumes and other practical problems.

TEXT BOOKS:

1. Kreyszig.E, "Advanced Engineering Mathematics", John Wiley and Sons, 10th Edition, New Delhi, 2016.
2. Grewal.B.S., "Higher Engineering Mathematics", Khanna Publishers, New Delhi, 44th Edition, 2018.
3. James Stewart, "Calculus: Early Transcendentals", Cengage Learning, 8th Edition, New Delhi, 2015. [For Units II & IV - Sections 1.1, 2.2, 2.3, 2.5, 2.7 (Tangents problems only), 2.8, 3.1 to 3.6, 3.11, 4.1, 4.3, 5.1 (Area problems only), 5.2, 5.3, 5.4 (excluding net change theorem), 5.5, 7.1 - 7.4 and 7.8].

REFERENCES:

1. Anton. H, Bivens. I and Davis. S, " Calculus ", Wiley, 10th Edition, 2016
2. Bali. N., Goyal. M. and Watkins. C., “Advanced Engineering Mathematics”, Firewall Media (An imprint of Lakshmi Publications Pvt., Ltd.,), New Delhi, 7th Edition, 2009.
3. Jain. R.K. and Iyengar. S.R.K., “Advanced Engineering Mathematics”, Narosa Publications, New Delhi, 5th Edition, 2016.
4. Narayanan. S. and Manicavachagom Pillai. T. K., “Calculus" Volume I and II, S. Viswanathan Publishers Pvt. Ltd., Chennai, 2009.
5. Ramana. B.V., "Higher Engineering Mathematics", McGraw Hill Education Pvt. Ltd, New Delhi, 2016.
6. Srimantha Pal and Bhunia. S.C, "Engineering Mathematics” Oxford University Press, 2015.
7. Thomas. G. B., Hass. J, and Weir. M.D, "Thomas Calculus ", 14th Edition, Pearson India, 2018.

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	1	1	0	0	0	0	2	0	2	3	-	-	-
CO2	3	3	1	1	0	0	0	0	2	0	2	3	-	-	-
CO3	3	3	1	1	0	0	0	0	2	0	2	3	-	-	-
CO4	3	3	1	1	0	0	0	0	2	0	2	3	-	-	-
CO5	3	3	1	1	0	0	0	0	2	0	2	3	-	-	-
Avg	3	3	1	1	0	0	0	0	2	0	2	3	-	-	-

21147S13 **ENGINEERING PHYSICS** **L T P C**
3 0 0 3

COURSE OBJECTIVES

- To make the students effectively to achieve an understanding of mechanics.
- To enable the students to gain knowledge of electromagnetic waves and its applications.
- To introduce the basics of oscillations, optics and lasers.
- Equipping the students to be successfully understand the importance of quantum physics.
- To motivate the students towards the applications of quantum mechanics.

UNIT I MECHANICS 9

Multi-particle dynamics: Center of mass (CM) – CM of continuous bodies – motion of the CM – kinetic energy of system of particles. Rotation of rigid bodies: Rotational kinematics – rotational kinetic energy and moment of inertia - theorems of M .I –moment of inertia of continuous bodies – M.I of a diatomic molecule - torque – rotational dynamics of rigid bodies – conservation of angular momentum – rotational energy state of a rigid diatomic molecule - gyroscope - torsional pendulum – double pendulum –Introduction to nonlinear oscillations.

UNIT II ELECTROMAGNETIC WAVES 9

The Maxwell's equations - wave equation; Plane electromagnetic waves in vacuum, Conditions on the wave field - properties of electromagnetic waves: speed, amplitude, phase, orientation and waves in matter - polarization - Producing electromagnetic waves - Energy and momentum in EM waves: Intensity, waves from localized sources, momentum and radiation pressure - Cell-phone reception. Reflection and transmission of electromagnetic waves from a non-conducting medium-vacuum interface for normal incidence.

UNIT III OSCILLATIONS, OPTICS AND LASERS 9

Simple harmonic motion - resonance –analogy between electrical and mechanical oscillating systems - waves on a string - standing waves - traveling waves - Energy transfer of a wave - sound waves - Doppler effect. Reflection and refraction of light waves - total internal reflection - interference –Michelson interferometer –Theory of air wedge and experiment. Theory of laser - characteristics - Spontaneous and stimulated emission - Einstein's coefficients - population inversion - Nd-YAG laser, CO_2 laser, semiconductor laser –Basic applications of lasers in industry.

UNIT IV BASIC QUANTUM MECHANICS 9

Photons and light waves - Electrons and matter waves -Compton effect - The Schrodinger equation (Time dependent and time independent forms) - meaning of wave function - Normalization -Free particle - particle in a infinite potential well: 1D,2D and 3D Boxes- Normalization, probabilities and the correspondence principle.

UNIT V APPLIED QUANTUM MECHANICS 9

The harmonic oscillator(qualitative)- Barrier penetration and quantum tunneling(qualitative)- Tunneling microscope - Resonant diode - Finite potential wells (qualitative)- Bloch's theorem for particles in a periodic potential -Basics of Kronig-Penney model and origin of energy bands.

TOTAL : 45 PERIODS

COURSE OUTCOMES

After completion of this course, the students should be able to

- Understand the importance of mechanics.
- Express their knowledge in electromagnetic waves.
- Demonstrate a strong foundational knowledge in oscillations, optics and lasers.
- Understand the importance of quantum physics.
- Comprehend and apply quantum mechanical principles towards the formation of energy bands.

TEXT BOOKS:

1. D.Kleppner and R.Kolenkow. An Introduction to Mechanics. McGraw Hill Education (Indian Edition), 2017.
2. E.M.Purcell and D.J.Morin, Electricity and Magnetism, Cambridge Univ.Press, 2013.
3. Arthur Beiser, Shobhit Mahajan, S. Rai Choudhury, Concepts of Modern Physics, McGraw-Hill (Indian Edition), 2017.

REFERENCES:

1. R.Wolfson. Essential University Physics. Volume 1 & 2. Pearson Education (Indian Edition), 2009.
2. Paul A. Tipler, Physic - Volume 1 & 2, CBS, (Indian Edition), 2004.
3. K.Thyagarajan and A.Ghatak. Lasers: Fundamentals and Applications, Laxmi Publications, (Indian Edition), 2019.
4. D.Halliday, R.Resnick and J.Walker. Principles of Physics, Wiley (Indian Edition), 2015.
5. N.Garcia, A.Damask and S.Schwarz. Physics for Computer Science Students. Springer- Verlag, 2012.

CO's-PO's & PSO's MAPPING

CO's	PO's												PSO's		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	3	3	2	1	1	1	-	-	-	-	-	-	-	-	-
2	3	3	2	1	2	1	-	-	-	-	-	-	-	-	-
3	3	3	2	2	2	1	-	-	-	-	-	1	-	-	-
4	3	3	1	1	2	1	-	-	-	-	-	-	-	-	
5	3	3	1	1	2	1	-	-	-	-	-	-	-	-	-
AVG	3	3	1.6	1.2	1.8	1	-	-	-	-	-	1	-	-	-

1-Low,2-Medium,3-High,"-"-no correlation

Note: the average value of this course to be used for program articulation matrix.

21147S14 **ENGINEERING CHEMISTRY** **L T P C**
3 0 0 3

COURSE OBJECTIVES:

- To inculcate sound understanding of water quality parameters and water treatment techniques.
- To impart knowledge on the basic principles and preparatory methods of nanomaterials.
- To introduce the basic concepts and applications of phase rule and composites.
- To facilitate the understanding of different types of fuels, their preparation, properties and combustion characteristics.
- To familiarize the students with the operating principles, working processes and applications of energy conversion and storage devices.

UNIT I WATER AND ITS TREATMENT 9

Water: Sources and impurities, Water quality parameters: Definition and significance of-color, odour, turbidity, pH, hardness, alkalinity, TDS, COD and BOD, flouride and arsenic. Municipal water treatment: primary treatment and disinfection (UV, Ozonation, break-point chlorination). Desalination of brackish water: Reverse Osmosis. Boiler troubles: Scale and sludge, Boiler corrosion, Caustic embrittlement, Priming &foaming. Treatment of boiler feed water: Internal treatment (phosphate, colloidal, sodium aluminate and calgon conditioning) and External treatment - Ion exchange demineralization and zeolite process.

UNIT II NANOCHEMISTRY 9

Basics: Distinction between molecules, nanomaterials and bulk materials; Size-dependent properties (optical, electrical, mechanical and magnetic); Types of nanomaterials: Definition, properties and uses of – nanoparticle, nanocluster, nanorod, nanowire and nanotube. Preparation of nanomaterials: sol-gel, solvothermal, laser ablation, chemical vapour deposition, electrochemical deposition and electro spinning. Applications of nanomaterials in medicine, agriculture, energy, electronics and catalysis.

UNIT III PHASE RULE AND COMPOSITES 9

Phase rule: Introduction, definition of terms with examples. One component system - water system; Reduced phase rule; Construction of a simple eutectic phase diagram - Thermal analysis; Two component system: lead-silver system - Pattinson process.

Composites: Introduction: Definition & Need for composites; Constitution: Matrix materials (Polymer matrix, metal matrix and ceramic matrix) and Reinforcement (fiber, particulates, flakes and whiskers). Properties and applications of: Metal matrix composites (MMC), Ceramic matrix composites and Polymer matrix composites. Hybrid composites - definition and examples.

UNIT IV FUELS AND COMBUSTION 9

Fuels: Introduction: Classification of fuels; Coal and coke: Analysis of coal (proximate and ultimate), Carbonization, Manufacture of metallurgical coke (Otto Hoffmann method). Petroleum and Diesel: Manufacture of synthetic petrol (Bergius process), Knocking - octane number, diesel oil - cetane number; Power alcohol and biodiesel.

Combustion of fuels: Introduction: Calorific value - higher and lower calorific values, Theoretical calculation of calorific value; Ignition temperature: spontaneous ignition temperature, Explosive range; Flue gas analysis - ORSAT Method. CO_2 emission and carbon foot print.

UNIT V ENERGY SOURCES AND STORAGE DEVICES 9

Stability of nucleus: mass defect (problems), binding energy; Nuclear energy: light water nuclear power plant, breeder reactor. Solar energy conversion: Principle, working and applications of solar cells; Recent developments in solar cell materials. Wind energy; Geothermal energy; Batteries: Types of batteries, Primary battery - dry cell, Secondary battery - lead acid battery and lithium-ion-battery; Electric vehicles – working principles; Fuel cells: H_2-O_2 fuel cell, microbial fuel cell; Supercapacitors: Storage principle, types and examples.

TOTAL: 45 PERIODS

COURSE OUTCOMES

At the end of the course, the students will be able:

- To infer the quality of water from quality parameter data and propose suitable treatment methodologies to treat water.
- To identify and apply basic concepts of nanoscience and nanotechnology in designing the synthesis of nanomaterials for engineering and technology applications.
- To apply the knowledge of phase rule and composites for material selection requirements.
- To recommend suitable fuels for engineering processes and applications.
- To recognize different forms of energy resources and apply them for suitable applications in energy sectors.

TEXT BOOKS:

1. P. C. Jain and Monica Jain, “Engineering Chemistry”, 17^{th} Edition, Dhanpat Rai Publishing Company (P) Ltd, New Delhi, 2018.
2. Sivasankar B., “Engineering Chemistry”, Tata McGraw-Hill Publishing Company Ltd, New Delhi, 2008.
3. S.S. Dara, “A Text book of Engineering Chemistry”, S. Chand Publishing, 12^{th} Edition, 2018.

REFERENCES:

1. B. S. Murty, P. Shankar, Baldev Raj, B. B. Rath and James Murday, “Text book of nanoscience and nanotechnology”, Universities Press-IIM Series in Metallurgy and Materials Science, 2018.
2. O.G. Palanna, “Engineering Chemistry” McGraw Hill Education (India) Private Limited, 2^{nd} Edition, 2017.
3. Friedrich Emich, “Engineering Chemistry”, Scientific International PVT, LTD, New Delhi, 2014.
4. ShikhaAgarwal, “Engineering Chemistry-Fundamentals and Applications”, Cambridge University Press, Delhi, Second Edition, 2019.
5. O.V. Roussak and H.D. Gesser, Applied Chemistry-A Text Book for Engineers and Technologists, Springer Science Business Media, New York, 2nd Edition, 2013.

CO-PO & PSO MAPPING

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	3	2	2	1	-	1	1	-	-	-	-	1	-	-	-
2	2	-	-	1	-	2	2	-	-	-	-	-	-	-	-
3	3	1	-	-	-	-	-	-	-	-	-	-	-	-	-
4	3	1	1	-	-	1	2	-	-	-	-	-	-	-	-
5	3	1	2	1	-	2	2	-	-	-	-	2	-	-	-
Avg.	**2.8**	**1.3**	**1.6**	**1**	**-**	**1.5**	**1.8**	**-**		**-**	**-**	**1.5**	**-**	**-**	-

1-low, 2-medium, 3-high, ‘-“- no correlation

21147S15 PROBLEM SOLVING AND PYTHON PROGRAMMING **L T P C**
3 0 0 3

COURSE OBJECTIVES:

- To understand the basics of algorithmic problem solving.
- To learn to solve problems using Python conditionals and loops.
- To define Python functions and use function calls to solve problems.
- To use Python data structures - lists, tuples, dictionaries to represent complex data.
- To do input/output with files in Python.

UNIT I COMPUTATIONAL THINKING AND PROBLEM SOLVING 9

Fundamentals of Computing – Identification of Computational Problems -Algorithms, building blocks of algorithms (statements, state, control flow, functions), notation (pseudo code, flow chart, programming language), algorithmic problem solving, simple strategies for developing algorithms (iteration, recursion). Illustrative problems: find minimum in a list, insert a card in a list of sorted cards, guess an integer number in a range, Towers of Hanoi.

UNIT II DATA TYPES, EXPRESSIONS, STATEMENTS 9

Python interpreter and interactive mode, debugging; values and types: int, float, boolean, string, and list; variables, expressions, statements, tuple assignment, precedence of operators, comments; Illustrative programs: exchange the values of two variables, circulate the values of n variables, distance between two points.

UNIT III CONTROL FLOW, FUNCTIONS, STRINGS 9

Conditionals: Boolean values and operators, conditional (if), alternative (if-else), chained conditional (if-elif-else); Iteration: state, while, for, break, continue, pass; Fruitful functions: return values, parameters, local and global scope, function composition, recursion; Strings: string slices, immutability, string functions and methods, string module; Lists as arrays. Illustrative programs: square root, gcd, exponentiation, sum an array of numbers, linear search, binary search.

UNIT IV LISTS, TUPLES, DICTIONARIES 9

Lists: list operations, list slices, list methods, list loop, mutability, aliasing, cloning lists, list parameters; Tuples: tuple assignment, tuple as return value; Dictionaries: operations and methods; advanced list processing - list comprehension; Illustrative programs: simple sorting, histogram, Students marks statement, Retail bill preparation.

UNIT V FILES, MODULES, PACKAGES 9

Files and exception: text files, reading and writing files, format operator; command line arguments, errors and exceptions, handling exceptions, modules, packages; Illustrative programs: word count, copy file, Voter's age validation, Marks range validation (0-100).

TOTAL : 45 PERIODS

COURSE OUTCOMES:

Upon completion of the course, students will be able to

CO1: Develop algorithmic solutions to simple computational problems.
CO2: Develop and execute simple Python programs.
CO3: Write simple Python programs using conditionals and looping for solving problems.
CO4: Decompose a Python program into functions.
CO5: Represent compound data using Python lists, tuples, dictionaries etc.
CO6: Read and write data from/to files in Python programs.

TEXT BOOKS:

1. Allen B. Downey, "Think Python: How to Think like a Computer Scientist", 2nd Edition, O'Reilly Publishers, 2016.
2. Karl Beecher, "Computational Thinking: A Beginner's Guide to Problem Solving and programming", 1st Edition, BCS Learning & Development Limited, 2017.

REFERENCES:

1. Paul Deitel and Harvey Deitel, “Python for Programmers”, Pearson Education, 1st Edition, 2021.
2. G Venkatesh and Madhavan Mukund, “Computational Thinking: A Primer for Programmers and Data Scientists”, 1st Edition, Notion Press, 2021.
3. John V Guttag, "Introduction to Computation and Programming Using Python: With Applications to Computational Modeling and Understanding Data‘‘, Third Edition, MIT Press 2021
4. Eric Matthes, “Python Crash Course, A Hands - on Project Based Introduction to Programming”, 2nd Edition, No Starch Press, 2019.
   https://www.python.org/
6. Martin C. Brown, “Python: The Complete Reference”, 4th Edition, Mc-Graw Hill, 2018.

COs- PO’s & PSO’s MAPPING

CO’s	PO’s												PSO’s		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	3	3	3	3	2	-	-	-	-	-	2	2	3	3	-
2	3	3	3	3	2	-	-	-	-	-	2	2	3	-	-
3	3	3	3	3	2	-	-	-	-	-	2	-	3	-	-
4	2	2	-	2	2	-	-	-	-	-	1	-	3	-	-
5	1	2	-	-	1	-	-	-	-	-	1	-	2	-	-
AVg.	2	2	-	-	2	-	-	-	-	-	1	-	2	-	-

1 - low, 2 - medium, 3 - high, ‘-' - no correlation

21150L16 PROBLEM SOLVING AND PYTHON PROGRAMMING LABORATORY **L T P C**
0 0 4 2

COURSE OBJECTIVES:

- To understand the problem solving approaches.
- To learn the basic programming constructs in Python.
- To practice various computing strategies for Python-based solutions to real world problems.
- To use Python data structures - lists, tuples, dictionaries.
- To do input/output with files in Python.

EXPERIMENTS:

Note: The examples suggested in each experiment are only indicative. The lab instructor is expected to design other problems on similar lines. The Examination shall not be restricted to the sample experiments listed here.

1. Identification and solving of simple real life or scientific or technical problems, and developing flow charts for the same. (Electricity Billing, Retail shop billing, Sin series, weight of a motorbike, Weight of a steel bar, compute Electrical Current in Three Phase AC Circuit, etc.)
2. Python programming using simple statements and expressions (exchange the values of two variables, circulate the values of n variables, distance between two points).
3. Scientific problems using Conditionals and Iterative loops. (Number series, Number Patterns, pyramid pattern)
4. Implementing real-time/technical applications using Lists, Tuples. (Items present in a library/Components of a car/ Materials required for construction of a building –operations of list & tuples)
5. Implementing real-time/technical applications using Sets, Dictionaries. (Language, components of an automobile, Elements of a civil structure, etc.- operations of Sets & Dictionaries)
6. Implementing programs using Functions. (Factorial, largest number in a list, area of shape)
7. Implementing programs using Strings. (reverse, palindrome, character count, replacing characters)
8. Implementing programs using written modules and Python Standard Libraries (pandas, numpy. Matplotlib, scipy)
9. Implementing real-time/technical applications using File handling. (copy from one file to another, word count, longest word)
10. Implementing real-time/technical applications using Exception handling. (divide by zero error, voter’s age validity, student mark range validation)
11. Exploring Pygame tool.
12. Developing a game activity using Pygame like bouncing ball, car race etc.

TOTAL: 60 PERIODS

COURSE OUTCOMES:

On completion of the course, students will be able to:
CO1: Develop algorithmic solutions to simple computational problems
CO2: Develop and execute simple Python programs.
CO3: Implement programs in Python using conditionals and loops for solving problems.
CO4: Deploy functions to decompose a Python program.
CO5: Process compound data using Python data structures.
CO6: Utilize Python packages in developing software applications.

TEXT BOOKS:

1. Allen B. Downey, “Think Python : How to Think like a Computer Scientist”, 2nd Edition, O’Reilly Publishers, 2016.
2. Karl Beecher, “Computational Thinking: A Beginner's Guide to Problem Solving and Programming”, 1st Edition, BCS Learning & Development Limited, 2017.

REFERENCES:

1. Paul Deitel and Harvey Deitel, “Python for Programmers”, Pearson Education, 1st Edition, 2021.
2. G Venkatesh and Madhavan Mukund, “Computational Thinking: A Primer for Programmers and Data Scientists”, 1st Edition, Notion Press, 2021.
3. John V Guttag, "Introduction to Computation and Programming Using Python: With Applications to Computational Modeling and Understanding Data‘‘, Third Edition, MIT Press, 2021
4. Eric Matthes, “Python Crash Course, A Hands - on Project Based Introduction to Programming”, 2nd Edition, No Starch Press, 2019.
5. https://www.python.org/
6. Martin C. Brown, “Python: The Complete Reference”, 4th Edition, Mc-Graw Hill, 2018.

COs- PO’s & PSO’s MAPPING

CO’s	PO’s												PSO’s	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
1	3	3	3	3	3	-	-	-	-	-	3	2	3	3
2	3	3	3	3	3	-	-	-	-	-	3	2	3	-
3	3	3	3	3	2	-	-	-	-	-	2	-	3	-
4	3	2	-	2	2	-	-	-	-	-	1	-	3	-
5	1	2	-	-	1	-	-	-	-	-	1	-	2	-
6	2	-	-	-	2	-	-	-	-	-	1	-	2	-
AVg.	**2**	**3**	**3**	**3**	**2**	-	-	-	-	-	**2**	**2**	**3**	**3**

1 - low, 2 - medium, 3 - high, ‘-' - no correlation

21149L17 PHYSICS AND CHEMISTRY LABORATORY

L	T	P	C
0	0	4	2

PHYSICS LABORATORY: (Any Seven Experiments)

COURSE OBJECTIVES:

- To learn the proper use of various kinds of physics laboratory equipment.
- To learn how data can be collected, presented and interpreted in a clear and concise manner.
- To learn problem solving skills related to physics principles and interpretation of experimental data.
- To determine error in experimental measurements and techniques used to minimize such error.
- To make the student as an active participant in each part of all lab exercises.

1. Torsional pendulum - Determination of rigidity modulus of wire and moment of inertia of regular and irregular objects.
2. Simple harmonic oscillations of cantilever.
3. Non-uniform bending - Determination of Young's modulus
4. Uniform bending – Determination of Young's modulus
5. Laser- Determination of the wave length of the laser using grating
6. Air wedge - Determination of thickness of a thin sheet/wire
7. a) Optical fibre -Determination of Numerical Aperture and acceptance angle
   b) Compact disc- Determination of width of the groove using laser.
8. Acoustic grating- Determination of velocity of ultrasonic waves in liquids.
9. Ultrasonic interferometer – determination of the velocity of sound and compressibility of liquids
10. Post office box -Determination of Band gap of a semiconductor.
11. Photoelectric effect
12. Michelson Interferometer.
13. Melde's string experiment
14. Experiment with lattice dynamics kit.

TOTAL: 30 PERIODS

COURSE OUTCOMES:

Upon completion of the course, the students should be able to

- Understand the functioning of various physics laboratory equipment.
- Use graphical models to analyze laboratory data.
- Use mathematical models as a medium for quantitative reasoning and describing physical reality.
- Access, process and analyze scientific information.
- Solve problems individually and collaboratively.

CO's-PO's & PSO's MAPPING

CO's	PO's												PSO's		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	3	2	3	1	1	-	-	-	-	-	-	-	-	-	-
2	3	3	2	1	1	-	-	-	-	-	-	-	-	-	-
3	3	2	3	1	1	-	-	-	-	-	-	-	-	-	-
4	3	3	2	1	1	-	-	-	-	-	-	-	-	-	-
5	3	2	3	1	1	-	-	-	-	-	-	-	-	-	-
AVG	3	2.4	2.6	1	1										

- **1-Low,2-Medium,3-High,"-"-no correlation**
- **Note: the average value of this course to be used for program articulation matrix.**

CHEMISTRY LABORATORY: (Any seven experiments to be conducted)

COURSE OBJECTIVES:

- To inculcate experimental skills to test basic understanding of water quality parameters, such as, acidity, alkalinity, hardness, DO, chloride and copper.
- To induce the students to familiarize with electroanalytical techniques such as, pH metry, potentiometry and conductometry in the determination of impurities in aqueous solutions.
- To demonstrate the analysis of metals and alloys.
- To demonstrate the synthesis of nanoparticles

1. Preparation of Na_2CO_3 as a primary standard and estimation of acidity of a water sample using the primary standard
2. Determination of types and amount of alkalinity in water sample.
   - Split the first experiment into two
3. Determination of total, temporary & permanent hardness of water by EDTA method.
4. Determination of DO content of water sample by Winkler's method.
5. Determination of chloride content of water sample by Argentometric method.
6. Estimation of copper content of the given solution by Iodometry.
7. Estimation of TDS of a water sample by gravimetry.
8. Determination of strength of given hydrochloric acid using pH meter.
9. Determination of strength of acids in a mixture of acids using conductivity meter.
10. Conductometric titration of barium chloride against sodium sulphate (precipitation titration)
11. Estimation of iron content of the given solution using potentiometer.
12. Estimation of sodium /potassium present in water using flame photometer.
13. Preparation of nanoparticles (TiO_2/ZnO/CuO) by Sol-Gel method.
14. Estimation of Nickel in steel
15. Proximate analysis of Coal

TOTAL : 30 PERIODS

COURSE OUTCOMES:

- To analyse the quality of water samples with respect to their acidity, alkalinity, hardness and DO.
- To determine the amount of metal ions through volumetric and spectroscopic techniques
- To analyse and determine the composition of alloys.
- To learn simple method of synthesis of nanoparticles

- To quantitatively analyse the impurities in solution by electroanalytical techniques

TEXT BOOK:

1. J. Mendham, R. C. Denney, J.D. Barnes, M. Thomas and B. Sivasankar, Vogel's Textbook of Quantitative Chemical Analysis (2009).

CO-PO & PSO MAPPING

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	3	-	1	-	-	2	2	-	-	-	-	2	-	-	-
2	3	1	2	-	-	1	2	-	-	-	-	1	-	-	-
3	3	2	1	1	-	-	1	-	-	-	-	-	-	-	-
4	2	1	2	-	-	2	2	-	-	-	-	-	-	-	-
5	2	1	2	-	1	2	2	-	-	-	-	1	-	-	-
Avg.	2.6	1.3	1.6	1	1	1.4	1.8	-	-	-	-	1.3	-	-	-

- **1-low, 2-medium, 3-high, '-"- no correlation**

21147L18 **COMMUNICATION LABORATORY I** **L T P C**
0 0 2 1

OBJECTIVES :

- To improve the communicative competence of learners
- To help learners use language effectively in academic /work contexts
- To develop various listening strategies to comprehend various types of audio materials like lectures, discussions, videos etc.
- To build on students' English language skills by engaging them in listening, speaking and grammar learning activities that are relevant to authentic contexts.
- To use language efficiently in expressing their opinions via various media.

UNIT I INTRODUCTION TO FUNDAMENTALS OF COMMUNICATION 6

Listening for general information-specific details- conversation: Introduction to classmates - Audio / video (formal & informal); Telephone conversation; Listening to voicemail & messages; Listening and filling a form. Speaking - making telephone calls-Self Introduction; Introducing a friend; - politeness strategies- making polite requests, making polite offers, replying to polite requests and offers- understanding basic instructions(filling out a bank application for example).

UNIT II NARRATION AND SUMMATION 6

Listening - Listening to podcasts, anecdotes / stories / event narration; documentaries and interviews with celebrities. Speaking - Narrating personal experiences / events-Talking about current and temporary situations & permanent and regular situations* - describing experiences and feelings- engaging in small talk- describing requirements and abilities.

UNIT III DESCRIPTION OF A PROCESS / PRODUCT 6

Listening - Listen to product and process descriptions; a classroom lecture; and advertisements about products. Speaking – Picture description- describing locations in workplaces- Giving instruction to use the product- explaining uses and purposes- Presenting a product- describing shapes and sizes and weights- talking about quantities(large & small)-talking about precautions.

UNIT IV CLASSIFICATION AND RECOMMENDATIONS 6

Listening – Listening to TED Talks; Listening to lectures - and educational videos. Speaking – Small Talk; discussing and making plans-talking about tasks-talking about progress- talking about positions and directions of movement-talking about travel preparations- talking about transportation-

UNIT V EXPRESSION 6

Listening - Listening to debates/ discussions; different viewpoints on an issue; and panel discussions. Speaking -making predictions- talking about a given topic-giving opinions- understanding a website- describing processes

TOTAL : 30 PERIODS

LEARNING OUTCOMES:

At the end of the course, learners will be able

- To listen to and comprehend general as well as complex academic information
- To listen to and understand different points of view in a discussion
- To speak fluently and accurately in formal and informal communicative contexts
- To describe products and processes and explain their uses and purposes clearly and accurately
- To express their opinions effectively in both formal and informal discussions

ASSESSMENT PATTERN

- One online / app based assessment to test listening /speaking
- End Semester **ONLY** listening and speaking will be conducted online.
- Proficiency certification is given on successful completion of listening and speaking internal test and end semester exam.

CO-PO & PSO MAPPING

CO's	PO's												PSO's		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	3	3	3	3	1	3	3	3	3	3	3	3	-	-	-
2	3	3	3	3	1	3	3	3	3	3	3	3	-	-	-
3	3	3	3	3	1	3	3	3	3	3	3	3	-	-	-
4	3	3	3	3	1	3	3	3	3	3	3	3	-	-	-
5	3	3	3	3	1	3	3	3	3	3	3	3	-	-	-
AVg.	**3**	**3**	**3**	**3**	**1**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	-	-	-

1-low, 2-medium, 3-high, '-"- no correlation

Note: The average value of this course to be used for program articulation matrix.

21147S21 PROFESSIONAL ENGLISH - II **L T P C**
3 0 0 3

OBJECTIVES:

- To engage learners in meaningful language activities to improve their reading and writing skills
- To learn various reading strategies and apply in comprehending documents in professional context.
- To help learners understand the purpose, audience, contexts of different types of writing
- To develop analytical thinking skills for problem solving in communicative contexts
- To demonstrate an understanding of job applications and interviews for internship and placements

UNIT I MAKING COMPARISONS 6

Reading - Reading advertisements, user manuals, brochures; Writing - Professional emails, Email etiquette - Compare and Contrast Essay; Grammar – Mixed Tenses, Prepositional phrases

UNIT II EXPRESSING CAUSAL RELATIONS IN SPEAKING AND WRITING 6

Reading - Reading longer technical texts- Cause and Effect Essays, and Letters / emails of complaint, Writing - Writing responses to complaints. Grammar - Active Passive Voice transformations, Infinitive and Gerunds

UNIT III PROBLEM SOLVING 6

Reading - Case Studies, excerpts from literary texts, news reports etc. Writing - Letter to the Editor, Checklists, Problem solution essay / Argumentative Essay. Grammar - Error correction; If conditional sentences

UNIT IV REPORTING OF EVENTS AND RESEARCH 6

Reading -Newspaper articles; Writing - Recommendations, Transcoding, Accident Report, Survey Report Grammar – Reported Speech, Modals Vocabulary – Conjunctions- use of prepositions

UNIT V THE ABILITY TO PUT IDEAS OR INFORMATION COGENTLY 6

Reading - Company profiles, Statement of Purpose, (SOP), an excerpt of interview with professionals; Writing - Job / Internship application - Cover letter & Resume; Grammar - Numerical adjectives, Relative Clauses.

TOTAL : 30 PERIODS

OUTCOMES:

At the end of the course, learners will be able

- To compare and contrast products and ideas in technical texts.
- To identify and report cause and effects in events, industrial processes through technical texts
- To analyse problems in order to arrive at feasible solutions and communicate them in the written format.
- To present their ideas and opinions in a planned and logical manner
- To draft effective resumes in the context of job search.

TEXT BOOKS :

1. English for Engineers & Technologists (2020 edition) Orient Blackswan Private Ltd. Department of English, Anna University.
2. English for Science & Technology Cambridge University Press 2021.
3. Authored by Dr. Veena Selvam, Dr. Sujatha Priyadarshini, Dr. Deepa Mary Francis, Dr. KN. Shoba, and Dr. Lourdes Joevani, Department of English, Anna University.

REFERENCES:

1. Raman. Meenakshi, Sharma. Sangeeta (2019). Professional English. Oxford university press. New Delhi.
2. Improve Your Writing ed. V.N. Arora and Laxmi Chandra, Oxford Univ. Press, 2001, NewDelhi.
3. Learning to Communicate – Dr. V. Chellammal. Allied Publishers, New Delhi, 2003
4. Business Correspondence and Report Writing by Prof. R.C. Sharma & Krishna Mohan, Tata McGraw Hill & Co. Ltd., 2001, New Delhi.
5. Developing Communication Skills by Krishna Mohan, Meera Bannerji- Macmillan India Ltd. 1990, Delhi

CO-PO & PSO MAPPING

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	3	3	3	3	3	3	3	3	2	3	3	3	-	-	-
2	3	3	3	3	3	3	3	3	2	3	3	3	-	-	-
3	3	3	3	3	3	3	3	3	2	3	3	3	-	-	-
4	3	3	3	3	2	3	3	3	2	3	3	3	-	-	-
5	-	-	-	-	-	-	-	-	3	3	3	3	-	-	-
AVg.	3	3	3	3	2.75	3	3	3	2.2	3	3	3	-	-	-

- 1-low, 2-medium, 3-high, '-"- no correlation
- **Note:** The average value of this course to be used for program articulation matrix.

6. .

21148S22 **STATISTICS AND NUMERICAL METHODS** **L T P C**

3 1 0 4

COURSE OBJECTIVES:

- This course aims at providing the necessary basic concepts of a few statistical and numerical methods and give procedures for solving numerically different kinds of problems occurring in engineering and technology.
- To acquaint the knowledge of testing of hypothesis for small and large samples which plays an important role in real life problems.
- To introduce the basic concepts of solving algebraic and transcendental equations.
- To introduce the numerical techniques of interpolation in various intervals and numerical techniques of differentiation and integration which plays an important role in engineering and technology disciplines.
- To acquaint the knowledge of various techniques and methods of solving ordinary differential equations.

UNIT I TESTING OF HYPOTHESIS 9+3

Sampling distributions - Tests for single mean, proportion and difference of means (Large and small samples) – Tests for single variance and equality of variances – Chi square test for goodness of fit – Independence of attributes.

UNIT II DESIGN OF EXPERIMENTS 9+3

One way and two way classifications - Completely randomized design – Randomized block design – Latin square design - 2^2 factorial design.

UNIT III SOLUTION OF EQUATIONS AND EIGENVALUE PROBLEMS 9+3

Solution of algebraic and transcendental equations - Fixed point iteration method – Newton Raphson method- Solution of linear system of equations - Gauss elimination method – Pivoting - Gauss Jordan method – Iterative methods of Gauss Jacobi and Gauss Seidel - Eigenvalues of a matrix by Power method and Jacobi's method for symmetric matrices.

UNIT IV INTERPOLATION, NUMERICAL DIFFERENTIATION AND NUMERICAL INTEGRATION 9+3

Lagrange's and Newton's divided difference interpolations – Newton's forward and backward difference interpolation – Approximation of derivates using interpolation polynomials – Numerical single and double integrations using Trapezoidal and Simpson's 1/3 rules.

UNIT V NUMERICAL SOLUTION OF ORDINARY DIFFERENTIAL EQUATIONS 9+3

Single step methods: Taylor's series method - Euler's method - Modified Euler's method - Fourth order Runge-Kutta method for solving first order differential equations - Multi step methods: Milne's and Adams - Bash forth predictor corrector methods for solving first order differential equations.

TOTAL: 60 PERIODS

COURSE OUTCOMES:

Upon successful completion of the course, students will be able to:

- Apply the concept of testing of hypothesis for small and large samples in real life problems.
- Apply the basic concepts of classifications of design of experiments in the field of agriculture.
- Appreciate the numerical techniques of interpolation in various intervals and apply the numerical techniques of differentiation and integration for engineering problems.
- Understand the knowledge of various techniques and methods for solving first and second order ordinary differential equations.
- Solve the partial and ordinary differential equations with initial and boundary conditions by using certain techniques with engineering applications.

TEXT BOOKS:

1. Grewal, B.S., and Grewal, J.S., "Numerical Methods in Engineering and Science", Khanna Publishers, 10th Edition, New Delhi, 2015.
2. Johnson, R.A., Miller, I and Freund J., "Miller and Freund's Probability and Statistics for Engineers", Pearson Education, Asia, 8th Edition, 2015.

REFERENCES:

1. Burden, R.L and Faires, J.D, "Numerical Analysis", 9th Edition, Cengage Learning, 2016.
2. Devore. J.L., "Probability and Statistics for Engineering and the Sciences", Cengage Learning, New Delhi, 8th Edition, 2014.
3. Gerald. C.F. and Wheatley. P.O. "Applied Numerical Analysis" Pearson Education, Asia, New Delhi, 7th Edition, 2007.
4. Gupta S.C. and Kapoor V. K., "Fundamentals of Mathematical Statistics", Sultan Chand & Sons, New Delhi, 12th Edition, 2020.
5. Spiegel. M.R., Schiller. J. and Srinivasan. R.A., "Schaum's Outlines on Probability and Statistics ", Tata McGraw Hill Edition, 4th Edition, 2012.
6. Walpole. R.E., Myers. R.H., Myers. S.L. and Ye. K., "Probability and Statistics for Engineers and Scientists", 9th Edition, Pearson Education, Asia, 2010.

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	1	1	1	0	0	0	2	0	2	3	-	-	-
CO2	3	3	1	1	1	0	0	0	2	0	2	3	-	-	-
CO3	3	3	1	1	1	0	0	0	2	0	2	3	-	-	-
CO4	3	3	1	1	1	0	0	0	2	0	2	3	-	-	-
CO5	3	3	1	1	1	0	0	0	2	0	2	3	-	-	-
Avg	3	3	1	1	1	0	0	0	2	0	2	3	-	-	-

21149S23D **MATERIALS SCIENCE** **L T P C**

3 0 0 3

COURSE OBJECTIVES:

- To make the students to understand the basics of crystallography and its importance in studying materials properties.
- To understand the electrical properties of materials including free electron theory, applications of quantum mechanics and magnetic materials.
- To instil knowledge on physics of semiconductors, determination of charge carriers and device applications
- To establish a sound grasp of knowledge on different optical properties of materials, optical displays and applications
- To inculcate an idea of significance of nano structures, quantum confinement and ensuing nano device applications.

UNIT I CRYSTALLOGRAPHY 9

Crystal structures: BCC, FCC and HCP – directions and planes - linear and planar densities – crystal imperfections- edge and screw dislocations – grain and twin boundaries - Burgers vector and elastic strain energy- Slip systems, plastic deformation of materials - Polymorphism – phase changes – nucleation and growth – homogeneous and heterogeneous nucleation.

UNIT II ELECTRICAL AND MAGNETIC PROPERTIES OF MATERIALS 9

Classical free electron theory - Expression for electrical conductivity – Thermal conductivity, expression - Quantum free electron theory :Tunneling - degenerate states – Fermi- Dirac statistics – Density of energy states – Electron in periodic potential – Energy bands in solids – tight binding approximation - Electron effective mass – concept of hole. Magnetic materials: Dia, para and ferromagnetic effects – paramagnetism in the conduction electrons in metals – exchange interaction and ferromagnetism – quantum interference devices – GMR devices.

UNIT III SEMICONDUCTORS AND TRANSPORT PHYSICS 9

Intrinsic Semiconductors – Energy band diagram – direct and indirect band gap semiconductors – Carrier concentration in intrinsic semiconductors – extrinsic semiconductors - Carrier concentration in N-type & P-type semiconductors – Variation of carrier concentration with temperature – Carrier transport in Semiconductors: Drift, mobility and diffusion – Hall effect and devices – Ohmic contacts – Schottky diode.

UNIT IV OPTICAL PROPERTIES OF MATERIALS 9

Classification of optical materials – Optical processes in semiconductors: optical absorption and emission, charge injection and recombination, optical absorption, loss and gain. Optical processes in quantum wells – Optoelectronic devices: light detectors and solar cells – light emitting diode – laser diode - optical processes in organic semiconductor devices –excitonic state – Electro-optics and nonlinear optics: Modulators and switching devices – plasmonics.

UNIT V NANOELECTRONIC DEVICES 9

Quantum confinement – Quantum structures – quantum wells, wires and dots – Zener-Bloch oscillations – Resonant tunneling – quantum interference effects - mesoscopic structures - Single electron phenomena - Single electron Transistor. Semiconductor photonic structures – 1D, 2D and 3D photonic crystal. Active and passive optoelectronic devices – photo processes – spintronics – carbon nanotubes: Properties and applications.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of the course, the students should be able to

- know basics of crystallography and its importance for varied materials properties
- gain knowledge on the electrical and magnetic properties of materials and their applications
- understand clearly of semiconductor physics and functioning of semiconductor devices
- understand the optical properties of materials and working principles of various optical devices
- appreciate the importance of functional nanoelectronic devices.

TEXT BOOKS:

1. V.Raghavan. Materials Science and Engineering: A First Course, Prentice Hall India Learning Private Limited, 2015.
2. S.O. Kasap, Principles of Electronic Materials and Devices, Mc-Graw Hill, 2018.
3. Jasprit Singh, Semiconductor Devices: Basic Principles, Wiley (India), 2007.
4. Jasprit Singh, Semiconductor Optoelectronics: Physics and Technology, Mc-Graw Hill India (2019)
5. G.W.Hanson. Fundamentals of Nanoelectronics. Pearson Education (Indian Edition), 2009.

REFERENCES:

1. R.Balasubramaniam, Callister's Materials Science and Engineering. Wiley (Indian Edition), 2014.
2. Wendelin Wright and Donald Askeland, Essentials of Materials Science and Engineering, CL Engineering, 2013.
3. Robert F.Pierret, Semiconductor Device Fundamentals, Pearson, 2006
4. Pallab Bhattacharya, Semiconductor Optoelectronic Devices, Pearson, 2017
5. Ben Rogers, Jesse Adams and Sumita Pennathur, Nanotechnology: Understanding Small Systems, CRC Press, 2017.

CO's-PO's & PSO's MAPPING

CO's	PO's												PSO's		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	3	2	1	2	1	1	-	-	-	-	-	-	-	-	-
2	3	2	1	1	2	1	1	-	-	-	-	-	-	-	-
3	3	2	2	2	2	1	-	-	-	-	-	-	-	-	-
4	3	2	2	1	2	2	-	-	-	-	-	1	-	-	-
5	3	2	2	1	2	1	-	-	-	-	-	-	-	-	-
AVG	3	2	1.6	1.4	1.8	1.2	1	-	-	-	-	1	-	-	-

1- Low,2-Medium,3-High,"-"-no correlation

Note: the average value of this course to be used for program articulation matrix.

21153S25A BASIC ELECTRICAL AND ELECTRONICS ENGINEERING

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

- To introduce the basics of electric circuits and analysis
- To impart knowledge in the basics of working principles and application of electrical machines
- To introduce analog devices and their characteristics
- To educate on the fundamental concepts of digital electronics
- To introduce the functional elements and working of measuring instruments

UNIT I ELECTRICAL CIRCUITS 9

DC Circuits: Circuit Components: Conductor, Resistor, Inductor, Capacitor – Ohm's Law - Kirchhoff's Laws –Independent and Dependent Sources – Simple problems- Nodal Analysis, Mesh analysis with Independent sources only (Steady state)
Introduction to AC Circuits and Parameters: Waveforms, Average value, RMS Value, Instantaneous power, real power, reactive power and apparent power, power factor – Steady state analysis of RLC circuits (Simple problems only)

UNIT II ELECTRICAL MACHINES 9

Construction and Working principle- DC Separately and Self excited Generators, EMF equation, Types and Applications. Working Principle of DC motors, Torque Equation, Types and Applications. Construction, Working principle and Applications of Transformer, Three phase Alternator, Synchronous motor and Three Phase Induction Motor.

UNIT III ANALOG ELECTRONICS 9

Resistor, Inductor and Capacitor in Electronic Circuits- Semiconductor Materials: Silicon &Germanium – PN Junction Diodes, Zener Diode –Characteristics Applications – Bipolar Junction Transistor-Biasing, JFET, SCR, MOSFET, IGBT – Types, I-V Characteristics and Applications, Rectifier and Inverters

UNIT IV DIGITAL ELECTRONICS 9

Review of number systems, binary codes, error detection and correction codes, Combinational logic - representation of logic functions-SOP and POS forms, K-map representations - minimization using K maps (Simple Problems only)

UNIT V MEASUREMENTS AND INSTRUMENTATION 9

Functional elements of an instrument, Standards and calibration, Operating Principle, types -Moving Coil and Moving Iron meters, Measurement of three phase power, Energy Meter, Instrument Transformers-CT and PT, DSO- Block diagram- Data acquisition.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

After completing this course, the students will be able to

1. Compute the electric circuit parameters for simple problems
2. Explain the working principle and applications of electrical machines
3. Analyze the characteristics of analog electronic devices
4. Explain the basic concepts of digital electronics
5. Explain the operating principles of measuring instruments

TEXT BOOKS:

1. Kothari DP and I.J Nagrath, "Basic Electrical and Electronics Engineering", Second Edition, McGraw Hill Education, 2020
2. S.K. Bhattacharya "Basic Electrical and Electronics Engineering", Pearson Education, Second Edition, 2017.
3. Sedha R.S., "A text book book of Applied Electronics", S. Chand & Co., 2008
4. James A. Svoboda, Richard C. Dorf, "Dorf's Introduction to Electric Circuits", Wiley, 2018.
5. A.K. Sawhney, Puneet Sawhney 'A Course in Electrical & Electronic Measurements & Instrumentation', Dhanpat Rai and Co, 2015.

REFERENCES:

1. Kothari DP and I.J Nagrath, "Basic Electrical Engineering", Fourth Edition, McGraw Hill

Education, 2019.
2. Thomas L. Floyd, ‘Digital Fundamentals’, 11th Edition, Pearson Education, 2017.
3. Albert Malvino, David Bates, ‘Electronic Principles, McGraw Hill Education; 7th edition, 2017.
4. Mahmood Nahvi and Joseph A. Edminister, “Electric Circuits”, Schaum’ Outline Series, McGraw Hill, 2002.
5. H.S. Kalsi, ‘Electronic Instrumentation’, Tata McGraw-Hill, New Delhi, 2010

Mapping of COs with POs and PSOs															
COs/POs&PSOs	**POs**												**PSOs**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
CO1	2	2	1					1				2			1
CO2	2	2	1					1				2			1
CO3	2	1	1					1				2			1
CO4	2	2	1					1				2			1
CO5	2	2	1					1				2			1
CO/PO & PSO Average	2	1.8	1					1				2			1
1 – Slight, 2 – Moderate, 3 – Substantial															

21154S24 **ENGINEERING GRAPHICS** **L T P C**
2 0 4 4

COURSE OBJECTIVES:

The main learning objective of this course is to prepare the students for:

1. Drawing engineering curves.
2. Drawing freehand sketch of simple objects.
3. Drawing orthographic projection of solids and section of solids.
4. Drawing development of solids
5. Drawing isometric and perspective projections of simple solids.

CONCEPTS AND CONVENTIONS (Not for Examination)

Importance of graphics in engineering applications - Use of drafting instruments - BIS conventions and specifications — Size, layout and folding of drawing sheets — Lettering and dimensioning.

UNIT I PLANE CURVES 6+12

Basic Geometrical constructions, Curves used in engineering practices: Conics — Construction of ellipse, parabola and hyperbola by eccentricity method — Construction of cycloid — construction of involutes of square and circle — Drawing of tangents and normal to the above curves.

UNIT II PROJECTION OF POINTS, LINES AND PLANE SURFACE 6+12

Orthographic projection- principles-Principal planes-First angle projection-projection of points. Projection of straight lines (only First angle projections) inclined to both the principal planes - Determination of true lengths and true inclinations by rotating line method and traces. Projection of planes (polygonal and circular surfaces) inclined to both the principal planes by rotating object method.

UNIT III PROJECTION OF SOLIDS AND FREEHAND SKETCHING 6+12

Projection of simple solids like prisms, pyramids, cylinder, cone and truncated solids when the axis is inclined to one of the principal planes and parallel to the other by rotating object method. Visualization concepts and Free Hand sketching: Visualization principles –Representation of Three Dimensional objects – Layout of views- Freehand sketching of multiple views from pictorial views of objects.
Practicing three dimensional modeling of simple objects by CAD Software (Not for examination)

UNIT IV PROJECTION OF SECTIONED SOLIDS AND DEVELOPMENT OF SURFACES 6 +12

Sectioning of above solids in simple vertical position when the cutting plane is inclined to the one of the principal planes and perpendicular to the other — obtaining true shape of section. Development of lateral surfaces of simple and sectioned solids — Prisms, pyramids cylinders and cones.
Practicing three dimensional modeling of simple objects by CAD Software (Not for examination)

UNIT V ISOMETRIC AND PERSPECTIVE PROJECTIONS 6+12

Principles of isometric projection — isometric scale - Isometric projections of simple solids and truncated solids - Prisms, pyramids, cylinders, cones- combination of two solid objects in simple vertical positions - Perspective projection of simple solids-Prisms, pyramids and cylinders by visual ray method.
Practicing three dimensional modeling of isometric projection of simple objects by CAD Software (Not for examination)

TOTAL: (L=30; P=60) 90 PERIODS

OUTCOMES:

On successful completion of this course, the student will be able to

- Use BIS conventions and specifications for engineering drawing.
- Construct the conic curves, involutes and cycloid.
- Solve practical problems involving projection of lines.
- Draw the orthographic, isometric and perspective projections of simple solids.
- Draw the development of simple solids.

TEXT BOOK:

1. Bhatt N.D. and Panchal V.M., "Engineering Drawing", Charotar Publishing House, 53rd Edition, 2019.
2. Natrajan K.V., "A Text Book of Engineering Graphics", Dhanalakshmi Publishers, Chennai, 2018.
3. Parthasarathy, N. S. and Vela Murali, "Engineering Drawing", Oxford University Press, 2015

REFERENCES:

1. Basant Agarwal and Agarwal C.M., "Engineering Drawing", McGraw Hill, 2nd Edition, 2019.
2. Gopalakrishna K.R., "Engineering Drawing" (Vol. I&II combined), Subhas Publications, Bangalore, 27th Edition, 2017.
3. Luzzader, Warren.J. and Duff, John M., "Fundamentals of Engineering Drawing with an introduction to Interactive Computer Graphics for Design and Production, Eastern Economy Edition, Prentice Hall of India Pvt. Ltd, New Delhi, 2005.
4. Parthasarathy N. S. and Vela Murali, "Engineering Graphics", Oxford University, Press, New Delhi, 2015.
5. Shah M.B., and Rana B.C., "Engineering Drawing", Pearson Education India, 2nd Edition, 2009.
6. Venugopal K. and Prabhu Raja V., "Engineering Graphics", New Age International (P) Limited, 2008.

Publication of Bureau of Indian Standards:

1. IS 10711 – 2001: Technical products Documentation – Size and lay out of drawing sheets.
2. IS 9609 (Parts 0 & 1) – 2001: Technical products Documentation – Lettering.
3. IS 10714 (Part 20) – 2001 & SP 46 – 2003: Lines for technical drawings.
4. IS 11669 – 1986 & SP 46 –2003: Dimensioning of Technical Drawings.
5. IS 15021 (Parts 1 to 4) – 2001: Technical drawings – Projection Methods.

Special points applicable to University Examinations on Engineering Graphics:

1. There will be five questions, each of either or type covering all units of the syllabus.
2. All questions will carry equal marks of 20 each making a total of 100.
3. The answer paper shall consist of drawing sheets of A3 size only. The students will be permitted to use appropriate scale to fit solution within A3 size.
4. The examination will be conducted in appropriate sessions on the same day

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	3	1	2		2					3		2	2	2	
2	3	1	2		2					3		2	2	2	
3	3	1	2		2					3		2	2	2	
4	3	1	2		2					3		2	2	2	
5	3	1	2		2					3		2	2	2	
Avg.	3	1	2		2					3		2	2	2	
Low (1) ; Medium (2) ; High (3)															

21154L26 ENGINEERING PRACTICES LABORATORY

L T P C
0 0 4 2

COURSE OBJECTIVES:

The main learning objective of this course is to provide hands on training to the students in:

1. Drawing pipe line plan; laying and connecting various pipe fittings used in common household plumbing work; Sawing; planing; making joints in wood materials used in commonhousehold wood work.
2. Wiring various electrical joints in common household electrical wire work.
3. Welding various joints in steel plates using arc welding work; Machining various simple processes like turning, drilling, tapping in parts; Assembling simple mechanical assembly of common household equipments; Making a tray out of metal sheet using sheet metal work.
4. Soldering and testing simple electronic circuits; Assembling and testing simple electronic components on PCB.

GROUP – A (CIVIL & ELECTRICAL)

PART I CIVIL ENGINEERING PRACTICES 15

PLUMBING WORK:

a) Connecting various basic pipe fittings like valves, taps, coupling, unions, reducers, elbows and other components which are commonly used in household.
b) Preparing plumbing line sketches.
c) Laying pipe connection to the suction side of a pump
d) Laying pipe connection to the delivery side of a pump.
e) Connecting pipes of different materials: Metal, plastic and flexible pipes used inhousehold appliances.

WOOD WORK:

a) Sawing,
b) Planing and
c) Making joints like T-Joint, Mortise joint and Tenon joint and Dovetail joint.

Wood Work Study:

a) Studying joints in door panels and wooden furniture
b) Studying common industrial trusses using models.

PART II ELECTRICAL ENGINEERING PRACTICES 15

a) Introduction to switches, fuses, indicators and lamps - Basic switch board wiring with lamp, fan and three pin socket
b) Staircase wiring
c) Fluorescent Lamp wiring with introduction to CFL and LED types.
d) Energy meter wiring and related calculations/ calibration
e) Study of Iron Box wiring and assembly
f) Study of Fan Regulator (Resistor type and Electronic type using Diac/Triac/quadrac)
g) Study of emergency lamp wiring/Water heater

GROUP – B (MECHANICAL AND ELECTRONICS)

PART III MECHANICAL ENGINEERING PRACTICES 15

WELDING WORK:

a) Welding of Butt Joints, Lap Joints, and Tee Joints using arc welding.
b) Practicing gas welding.

BASIC MACHINING WORK:

a) (simple)Turning.
b) (simple)Drilling.
c) (simple)Tapping.

ASSEMBLY WORK:

a) Assembling a centrifugal pump.
b) Assembling a household mixer.
c) Assembling an airconditioner.

SHEET METAL WORK:

a) Making of a square tray

FOUNDRY WORK:

a) Demonstrating basic foundry operations.

PART IV ELECTRONIC ENGINEERING PRACTICES 15

SOLDERING WORK:

a) Soldering simple electronic circuits and checking continuity.

ELECTRONIC ASSEMBLY AND TESTING WORK:

a) Assembling and testing electronic components on a small PCB.

ELECTRONIC EQUIPMENT STUDY:

a) Study an elements of smart phone.
b) Assembly and dismantle of LED TV.
c) Assembly and dismantle of computer/ laptop

TOTAL = 60 PERIODS

COURSE OUTCOMES:

Upon completion of this course, the students will be able to:

1. Draw pipe line plan; lay and connect various pipe fittings used in common household plumbing work; Saw; plan; make joints in wood materials used in common household wood work.
2. Wire various electrical joints in common household electrical wire work.
3. Weld various joints in steel plates using arc welding work; Machine various simple processeslike turning, drilling, tapping in parts; Assemble simple mechanical assembly of common household equipments; Make a tray out of metal sheet using sheet metal work.
4. Solder and test simple electronic circuits; Assemble and test simple electronic components on PCB.

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	3	2			1	1	1					2	2	1	1
2	3	2			1	1	1					2	2	1	1
3	3	2			1	1	1					2	2	1	1
Avg.	3	2			1	1	1					2	2	1	1
Low (1) ; Medium (2) ; High (3)															

21153L27 BASIC ELECTRICAL AND ELECTRONICS ENGINEERING LABORATORY

L T P C
0 0 4 2

COURSE OBJECTIVES:

- To train the students in conducting load tests on electrical machines
- To gain practical experience in characterizing electronic devices
- To train the students to use DSO for measurements.

LIST OF EXPERIMENTS

1. Verification of ohms and Kirchhoff's Laws.
2. Load test on DC Shunt Motor.
3. Load test on Self Excited DC Generator
4. Load test on Single phase Transformer
5. Load Test on Induction Motor
6. Characteristics of PN and Zener Diodes
7. Characteristics of BJT, SCR and MOSFET
8. Half wave and Full Wave rectifiers
9. Study of Logic Gates
10. Implementation of Binary Adder and Subtractor
11. Study of DSO

TOTAL: 60 PERIODS

COURSE OUTCOMES:

After completing this course, the students will be able to

1. Use experimental methods to verify the Ohm's and Kirchhoff's Laws.
2. Analyze experimentally the load characteristics of electrical machines
3. Analyze the characteristics of basic electronic devices
4. Use DSO to measure the various parameters

Mapping of COs with POs and PSOs															
COs/POs&PSOs	**POs**												**PSOs**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
CO1	3	3	2	1	1			1.5	2						1
CO2	3	3	2	1	1			1.5	2						1
CO3	3	3	2	1	1			1.5	2						1
CO4	3	3	2	1	1			1.5	2						1
CO5	3	3	2	1	1			1.5	2						1
CO/PO & PSO Average	3	3	2	1	1			1.5	2						1
1 - Slight, 2 - Moderate, 3 - Substantial															

21147L28 **COMMUNICATION LABORATORY II** **L T P C**
0 0 4 2

OBJECTIVES

- To identify varied group discussion skills and apply them to take part in effective discussions in a professional context.
- To analyse concepts and problems and make effective presentations explaining them clearly and precisely.
- To be able to communicate effectively through formal and informal writing.
- To be able to use appropriate language structures to write emails, reports and essays
- To give instructions and recommendations that are clear and relevant to the context

UNIT I **12**

Speaking-Role Play Exercises Based on Workplace Contexts, - talking about competition-discussing progress toward goals-talking about experiences- talking about events in life- discussing past events-Writing: writing emails (formal & semi-formal).

UNIT II **12**

Speaking: discussing news stories-talking about frequency-talking about travel problems-discussing travel procedures- talking about travel problems- making arrangements-describing arrangements-discussing plans and decisions- discussing purposes and reasons- understanding common technology terms-Writing: - writing different types of emails.

UNIT III **12**

Speaking: discussing predictions-describing the climate-discussing forecasts and scenarios- talking about purchasing-discussing advantages and disadvantages- making comparisons- discussing likes and dislikes- discussing feelings about experiences-discussing imaginary scenarios Writing: short essays and reports-formal/semi-formal letters.

UNIT IV **12**

Speaking: discussing the natural environment-describing systems-describing position and movement- explaining rules-(example- discussing rental arrangements)- understanding technical instructions-Writing: writing instructions-writing a short article.

UNIT V **12**

Speaking: describing things relatively-describing clothing-discussing safety issues (making recommendations) talking about electrical devices-describing controlling actions- Writing: job application (Cover letter + Curriculum vitae)-writing recommendations.

TOTAL: 60 PERIODS

LEARNING OUTCOMES

At the end of the course, learners will be able

- Speak effectively in group discussions held in ~~a~~ formal/semi formal contexts.
- Discuss, analyse and present concepts and problems from various perspectives to arrive at suitable solutions
- Write emails, letters and effective job applications.
- Write critical reports to convey data and information with clarity and precision
- Give appropriate instructions and recommendations for safe execution of tasks

Assessment Pattern

- One online / app based assessment to test speaking and writing skills
- Proficiency certification is given on successful completion of speaking and writing.

CO-PO & PSO MAPPING

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	2	3	3	3	1	3	3	3	3	3	3	3	-	-	-
2	2	3	3	3	1	3	3	3	3	3	3	3	-	-	-
3	2	2	3	3	1	3	3	3	3	3	3	3	-	-	-
4	3	3	3	3	3	3	3	3	3	3	3	3	-	-	-
5	3	3	3	3	3	3	3	3	3	3	3	3	-	-	-
AVg.	2.4	2.8	3	3	1.8	3	3	3	3	3	3	3	-	-	-

21148S31D TRANSFORMS AND PARTIAL DIFFERENTIAL EQUATIONS **L T P C**
3 1 0 4

COURSE OBJECTIVES:

- To introduce the basic concepts of PDE for solving standard partial differential equations.
- To introduce Fourier series analysis which is central to many applications in engineering apart from its use in solving boundary value problems.
- To acquaint the student with Fourier series techniques in solving heat flow problems used in various situations.
- To acquaint the student with Fourier, transform techniques used in wide variety of situations.
- To introduce the effective mathematical tools for the solutions of partial differential equations that model several physical processes and to develop Z transform techniques for discrete time systems.

UNIT I PARTIAL DIFFERENTIAL EQUATIONS 9+3
Formation of partial differential equations –Solutions of standard types of first order partial differential equations - First order partial differential equations reducible to standard types- Lagrange's linear equation - Linear partial differential equations of second and higher order with constant coefficients of both homogeneous and non-homogeneous types.

UNIT II FOURIER SERIES 9+3
Dirichlet's conditions – General Fourier series – Odd and even functions – Half range sine series and cosine series – Root mean square value – Parseval's identity – Harmonic analysis.

UNIT III APPLICATIONS OF PARTIAL DIFFERENTIAL EQUATIONS 9+3
Classification of PDE – Method of separation of variables - Fourier series solutions of one-dimensional wave equation - One dimensional equation of heat conduction - Steady state solution of two-dimensional equation of heat conduction (Cartesian coordinates only).

UNIT IV FOURIER TRANSFORMS 9+3
Statement of Fourier integral theorem– Fourier transform pair – Fourier sine and cosine transforms - Properties - Transforms of simple functions - Convolution theorem - Parseval's identity.

UNIT V Z - TRANSFORMS AND DIFFERENCE EQUATIONS 9+3
Z-transforms - Elementary properties – Convergence of Z-transforms - – Initial and final value theorems - Inverse Z-transform using partial fraction and convolution theorem - Formation of difference equations – Solution of difference equations using Z - transforms.

TOTAL: 60 PERIODS

OUTCOMES:
Upon successful completion of the course, students should be able to:

1. Understand how to solve the given standard partial differential equations.
2. Solve differential equations using Fourier series analysis which plays a vital role in engineering applications.
3. Appreciate the physical significance of Fourier series techniques in solving one- and two-dimensional heat flow problems and one-dimensional wave equations.
4. Understand the mathematical principles on transforms and partial differential equations would provide them the ability to formulate and solve some of the physical problems of engineering.
5. Use the effective mathematical tools for the solutions of partial differential equations by using Z transform techniques for discrete time systems

TEXT BOOKS:

1. Grewal B.S., "Higher Engineering Mathematics", 44^{th}Edition, Khanna Publishers, New Delhi, 2018.
2. Kreyszig E, "Advanced Engineering Mathematics ", 10^{th} Edition, John Wiley, New Delhi, India, 2018.

REFERENCES:

1. Andrews. L.C and Shivamoggi. B, "Integral Transforms for Engineers" SPIE Press, 1999.
2. Bali. N.P and Manish Goyal, "A Textbook of Engineering Mathematics", 10th Edition, Laxmi Publications Pvt. Ltd, 2021.
3. James. G., "Advanced Modern Engineering Mathematics", 4thEdition, Pearson Education, New Delhi, 2016.
4. Narayanan. S., Manicavachagom Pillay.T.K and Ramanaiah.G "Advanced Mathematics for Engineering Students", Vol. II & III, S.Viswanathan Publishers Pvt. Ltd, Chennai, 1998.
5. Ramana. B.V., "Higher Engineering Mathematics", McGraw Hill Education Pvt. Ltd, New Delhi, 2018.
6. Wylie. R.C. and Barrett. L.C., “Advanced Engineering Mathematics “Tata McGraw Hill Education Pvt. Ltd, 6th Edition, New Delhi, 2012.

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	1	1	0	0	0	0	2	0	0	3	-	-	-
CO2	3	3	1	1	0	0	0	0	2	0	0	3	-	-	-
CO3	3	3	1	1	0	0	0	0	2	0	0	3	-	-	-
CO4	3	3	1	1	0	0	0	0	2	0	0	3	-	-	-
CO5	3	3	1	1	0	0	0	0	2	0	0	3	-	-	-
Avg	3	3	1	1	0	0	0	0	2	0	0	3	-	-	-

21154C32	ENGINEERING MECHANICS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

1 To Learn the use scalar and vector analytical techniques for analysing forces in statically determinate structures
2 To introduce the equilibrium of rigid bodies, vector methods and free body diagram
3 To study and understand the distributed forces, surface, loading on beam and intensity.
4 To learn the principles of friction, forces and to determine the apply the concepts of frictional forces at the contact surfaces of various engineering systems.
5 To develop basic dynamics concepts – force, momentum, work and energy;

UNIT I STATICS OF PARTICLES 9

Fundamental Concepts and Principles, Systems of Units, Method of Problem Solutions, Statics of Particles -Forces in a Plane, Resultant of Forces, Resolution of a Force into Components, Rectangular Components of a Force, Unit Vectors. Equilibrium of a Particle- Newton's First Law of Motion, Space and Free-Body Diagrams, Forces in Space, Equilibrium of a Particle in Space.

UNIT II EQUILIBRIUM OF RIGID BODIES 9

Principle of Transmissibility, Equivalent Forces, Vector Product of Two Vectors, Moment of a Force about a Point, Varignon's Theorem, Rectangular Components of the Moment of a Force, Scalar Product of Two Vectors, Mixed Triple Product of Three Vectors, Moment of a Force about an Axis, Couple - Moment of a Couple, Equivalent Couples, Addition of Couples, Resolution of a Given Force into a Force -Couple system, Further Reduction of a System of Forces, Equilibrium in Two and Three Dimensions - Reactions at Supports and Connections.

UNIT III DISTRIBUTED FORCES 9

Centroids of lines and areas – symmetrical and unsymmetrical shapes, Determination of Centroids by Integration, Theorems of Pappus-Guldinus, Distributed Loads on Beams, Centre of Gravity of a Three-Dimensional Body, Centroid of a Volume, Composite Bodies, Determination of Centroids of Volumes by Integration. Moments of Inertia of Areas and Mass - Determination of the Moment of Inertia of an Area by Integration, Polar Moment of Inertia, Radius of Gyration of an Area, Parallel-Axis Theorem, Moments of Inertia of Composite Areas, Moments of Inertia of a Mass - Moments of Inertia of Thin Plates, Determination of the Moment of Inertia of a Three-Dimensional Body by Integration.

UNIT IV FRICTION 9

The Laws of Dry Friction, Coefficients of Friction, Angles of Friction, Wedge friction, Wheel Friction, Rolling Resistance, Ladder friction.

UNIT V DYNAMICS OF PARTICLES 9

Kinematics - Rectilinear Motion and Curvilinear Motion of Particles. Kinetics- Newton's Second Law of Motion -Equations of Motions, Dynamic Equilibrium, Energy and Momentum Methods - Work of a Force, Kinetic Energy of a Particle, Principle of Work and Energy, Principle of Impulse and Momentum, Impact of bodies.

TOTAL: 45 PERIODS

OUTCOMES:

At the end of the course the students would be able to

- Illustrate the vector and scalar representation of forces and moments
- Analyse the rigid body in equilibrium
- Evaluate the properties of distributed forces
- Determine the friction and the effects by the laws of friction
- Calculate dynamic forces exerted in rigid body

TEXT BOOKS:

Beer Ferdinand P, Russel Johnston Jr., David F Mazurek, Philip J Cornwell, Sanjeev Sanghi, Vector Mechanics for Engineers: Statics and Dynamics, McGraw Higher Education., 12thEdition, 2019.

Vela Murali, “Engineering Mechanics-Statics and Dynamics”, Oxford University Press, 2018.

REFERENCES:

1 Boresi P and Schmidt J, Engineering Mechanics: Statics and Dynamics, 1/e, Cengage learning, 2008.
2 Hibbeller, R.C., Engineering Mechanics: Statics, and Engineering Mechanics: Dynamics, 13th edition, Prentice Hall, 2013.
3 Irving H. Shames, Krishna Mohana Rao G, Engineering Mechanics - Statics and Dynamics, 4thEdition, Pearson Education Asia Pvt. Ltd., 2005.
4 Meriam J L and Kraige L G, Engineering Mechanics: Statics and Engineering Mechanics: Dynamics, 7th edition, Wiley student edition, 2013.
5 Timoshenko S, Young D H, Rao J V and SukumarPati, Engineering Mechanics, 5thEdition, McGraw Hill Higher Education, 2013.

CO	**PO**												**PSO**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	3	2	2	1	2							2	3	1	1
2	3	2	2	1	2							2	3	1	1
3	3	2	3	1	2							2	3	1	2
4	3	2	3	1	2							2	3	1	2
5	3	2	3	1	2							2	3	1	2
Low (1); Medium (2); High (3)															

21154C33 **ENGINEERING THERMODYNAMICS**

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

1. Impart knowledge on the basics and application of zeroth and first law of thermodynamics.
2. Impart knowledge on the second law of thermodynamics in analysing the performance of thermal devices.
3. Impart knowledge on availability and applications of second law of thermodynamics
4. Teach the various properties of steam through steam tables and Mollier chart.
5. Impart knowledge on the macroscopic properties of ideal and real gases.

UNIT I BASICS, ZEROTH AND FIRST LAW 9

Review of Basics – Thermodynamic systems, Properties and processes Thermodynamic Equilibrium - Displacement work - P-V diagram. Thermal equilibrium - Zeroth law – Concept of temperature and Temperature Scales. First law – application to closed and open systems – steady and unsteady flow processes.

UNIT II SECOND LAW AND ENTROPY 9

Heat Engine – Refrigerator - Heat pump. Statements of second law and their equivalence & corollaries. Carnot cycle - Reversed Carnot cycle - Performance - Clausius inequality. Concept of entropy - T-s diagram - Tds Equations - Entropy change for a pure substance.

UNIT III AVAILABILITY AND APPLICATIONS OF II LAW 9

Ideal gases undergoing different processes - principle of increase in entropy. Applications of II Law. High- and low-grade energy. Availability and Irreversibility for open and closed system processes - I and II law Efficiency

UNIT IV PROPERTIES OF PURE SUBSTANCES 9

Steam - formation and its thermodynamic properties - p-v, p-T, T-v, T-s, h-s diagrams. PVT surface. Determination of dryness fraction. Calculation of work done and heat transfer in non-flow and flow processes using Steam Table and Mollier Chart.

UNIT V GAS MIXTURES AND THERMODYNAMIC RELATIONS 9

Properties of Ideal gas, real gas - comparison. Equations of state for ideal and real gases. vander Waal's relation - Reduced properties - Compressibility factor - Principle of Corresponding states - Generalized Compressibility Chart. Maxwell relations - TdS Equations - heat capacities relations - Energy equation, Joule-Thomson experiment - Clausius-Clapeyron equation.

TOTAL: 45 PERIODS

OUTCOMES:

At the end of the course the students would be able to

1. Apply the zeroth and first law of thermodynamics by formulating temperature scales and calculating the property changes in closed and open engineering systems.
2. Apply the second law of thermodynamics in analysing the performance of thermal devices through energy and entropy calculations.
3. Apply the second law of thermodynamics in evaluating the various properties of steam through steam tables and Mollier chart
4. Apply the properties of pure substance in computing the macroscopic properties of ideal and real gases using gas laws and appropriate thermodynamic relations.
5. Apply the properties of gas mixtures in calculating the properties of gas mixtures and applying various thermodynamic relations to calculate property changes.

TEXTBOOKS:

1. Nag.P.K., "Engineering Thermodynamics", 6th Edition, Tata McGraw Hill (2017), New Delhi.
2. Natarajan, E., "Engineering Thermodynamics: Fundamentals and Applications", 2nd Edition (2014), Anuragam Publications, Chennai.

REFERENCES:

1. Cengel, Y and M. Boles, Thermodynamics - An Engineering Approach, Tata McGraw Hill,9th Edition, 2019.
2. Chattopadhyay, P, “Engineering Thermodynamics”, 2nd Edition Oxford University Press, 2016.
3. Rathakrishnan, E., “Fundamentals of Engineering Thermodynamics”, 2nd Edition, Prentice Hall of India Pvt. Ltd, 2006.
4. Claus Borgnakke and Richard E. Sonntag, “Fundamentals of Thermodynamics”, 10th Edition, Wiley Eastern, 2019.
5. Venkatesh. A, “Basic Engineering Thermodynamics”, Universities Press (India) Limited, 2007

CO	PO												PSO		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	3	3	2	1								2			
2	3	3	2	1								2			
3	3	3	2	1					1		1	2	3		3
4	3	3	2	1		1			2		1	2	3	2	
5	3	3	2	1		1			2		1	2	3	2	3
Low (1) Medium (2) ; High (3)															

21154C34 **FLUID MECHANICS AND MACHINERY** **L T P C**
3 1 0 4

COURSE OBJECTIVES:

1. To introduce the students about properties of the fluids, behaviour of fluids under static conditions.
2. To impart basic knowledge of the dynamics of fluids and boundary layer concept.
3. To expose to the applications of the conservation laws to a) flow measurements b) flow through pipes (both laminar and turbulent) and c) forces on pipe bends.
4. To exposure to the significance of boundary layer theory and its thicknesses.
5. To expose the students to basic principles of working of hydraulic machineries and to design Pelton wheel, Francis and Kaplan turbine, centrifugal and reciprocating pumps.

UNIT I FLUID PROPERTIES AND FLOW CHARACTERISTICS 10+3

Properties of fluids – Fluid statics - Pressure Measurements - Buoyancy and floatation - Flow characteristics - Eulerian and Lagrangian approach - Concept of control volume and system - Reynold's transportation theorem - Continuity equation, energy equation and momentum equation - Applications.

UNIT II FLOW THROUGH PIPES AND BOUNDARY LAYER 9+3

Reynold's Experiment - Laminar flow through circular conduits - Darcy Weisbach equation - friction factor - Moody diagram - Major and minor losses - Hydraulic and energy gradient lines - Pipes in series and parallel - Boundary layer concepts - Types of boundary layer thickness.

UNIT III DIMENSIONAL ANALYSIS AND MODEL STUDIES 8+3

Fundamental dimensions - Dimensional homogeneity - Rayleigh's method and Buckingham Pi theorem - Dimensionless parameters - Similitude and model studies - Distorted and undistorted models.

UNIT IV TURBINES 9+3

Impact of jets - Velocity triangles - Theory of rotodynamic machines - Classification of turbines - Working principles - Pelton wheel - Modern Francis turbine - Kaplan turbine - Work done - Efficiencies - Draft tube - Specific speed - Performance curves for turbines - Governing of turbines.

UNIT V PUMPS 9+3

Classification of pumps - Centrifugal pumps - Working principle - Heads and efficiencies– Velocity triangles - Work done by the impeller - Performance curves - Reciprocating pump working principle - Indicator diagram and it's variations - Work saved by fitting air vessels - Rotary pumps.

TOTAL: 60 PERIODS

OUTCOMES:

On completion of the course, the student is expected to be able to

1. Understand the properties and behaviour in static conditions. Also, to understand the conservation laws applicable to fluids and its application through fluid kinematics and dynamics
2. Estimate losses in pipelines for both laminar and turbulent conditions and analysis of pipes connected in series and parallel. Also, to understand the concept of boundary layer and its thickness on the flat solid surface.
3. Formulate the relationship among the parameters involved in the given fluid phenomenon and to predict the performances of prototype by model studies
4. Explain the working principles of various turbines and design the various types of turbines.
5. Explain the working principles of centrifugal, reciprocating and rotary pumps and design the centrifugal and reciprocating pumps

TEXT BOOKS:

1. Modi P.N. and Seth, S.M. Hydraulics and Fluid Mechanics, Standard Book House, New Delhi, 22nd edition (2019)
2. Jain A. K. Fluid Mechanics including Hydraulic Machines, Khanna Publishers, New Delhi, 2014.
3. Kumar K. L., Engineering Fluid Mechanics, Eurasia Publishing House(p) Ltd. New Delhi, 2016.

REFERENCES:

1. Fox W.R. and McDonald A.T., Introduction to Fluid Mechanics John-Wiley and Sons, Singapore, 2011.
2. Pani B S, Fluid Mechanics: A Concise Introduction, Prentice Hall of India Private Ltd, 2016.
3. Cengel Y A and Cimbala J M, Fluid Mechanics, McGraw Hill Education Pvt. Ltd., 2014.
4. S K Som; Gautam Biswas and S Chakraborty, Introduction to Fluid Mechanics and Fluid Machines, Tata McGraw Hill Education Pvt. Ltd., 2012.
5. Streeter, V. L. and Wylie E. B., Fluid Mechanics, McGraw Hill Publishing Co., 2010.

CO	PO												PSO		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
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2	3	3	3	2	1	2	2	1	2	1	1	2	3	2	3
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5	3	3	3	3	1	2	2	1	2	1	1	3	3	2	2
Low (1); Medium (2) ; High (3)															

21154C35 ENGINEERING MATERIALS AND METALLURGY

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

1 To learn the constructing the phase diagram and using of iron-iron carbide phase diagram for microstructure formation.

2 To learn selecting and applying various heat treatment processes and its microstructure formation.

3 To illustrate the different types of ferrous and non-ferrous alloys and their uses in engineering field.

4 To illustrate the different polymer, ceramics and composites and their uses in engineering field.

5 To learn the various testing procedures and failure mechanism in engineering field.

UNIT I CONSTITUTION OF ALLOYS AND PHASE DIAGRAMS 9

Constitution of alloys – Solid solutions, substitutional and interstitial – phase diagrams, Isomorphous, eutectic, eutectoid, peritectic, and peritectoid reactions, Iron – Iron carbide equilibrium diagram. Classification of steel and cast-Iron microstructure, properties and application.

UNIT II HEAT TREATMENT 9

Definition – Full annealing, stress relief, recrystallisation and spheroidising -normalizing, hardening and tempering of steel. Isothermal transformation diagrams – cooling curves superimposed on I.T. diagram – continuous cooling Transformation (CCT) diagram – Austempering, Martempering – Hardenability, Jominy end quench test -case hardening, carburizing, Nitriding, cyaniding, carbonitriding - Flame and Induction hardening – Vacuum and Plasma hardening – Thermo-mechanical treatments- elementary ideas on sintering.

UNIT III FERROUS AND NON-FERROUS METALS 9

Effect of alloying additions on steel (Mn, Si, Cr, Mo, Ni, V,Ti& W) – stainless and tool steels – HSLA - Maraging steels – Grey, white, malleable, spheroidal – alloy cast irons, Copper and its alloys – Brass, Bronze and Cupronickel – Aluminium and its alloys; Al-Cu – precipitation strengthening treatment – Titanium alloys, Mg-alloys, Ni-based super alloys – shape memory alloys- Properties and Applications- overview of materials standards

UNIT IV NON-METALLIC MATERIALS 9

Polymers – types of polymers, commodity and engineering polymers – Properties and applications of PE, PP, PS, PVC, PMMA, PET, PC, PA, ABS, PAI, PPO, PPS, PEEK, PTFE, Thermoset polymers – Urea and Phenol formaldehydes -Nylon, Engineering Ceramics – Properties and applications of Al2O3, SiC, Si3N4, PSZ and SIALON – intermetallics- Composites- Matrix and reinforcement Materials- applications of Composites - Nano composites.

UNIT V MECHANICAL PROPERTIES AND DEFORMATION MECHANISMS 9

Mechanisms of plastic deformation, slip and twinning – Types of fracture – fracture mechanics- Griffith's theory- Testing of materials under tension, compression and shear loads – Hardness tests (Brinell, Vickers and Rockwell), Micro and nano-hardness tests, Impact test Izod and charpy, fatigue and creep failure mechanisms.

TOTAL: 45 PERIODS

OUTCOMES:

At the end of the course the students would be able to

1. Explain alloys and phase diagram, Iron-Iron carbon diagram and steel classification.
2. Explain isothermal transformation, continuous cooling diagrams and different heat treatment processes.
3. Clarify the effect of alloying elements on ferrous and non-ferrous metals.
4. Summarize the properties and applications of non-metallic materials.
5. Explain the testing of mechanical properties.

TEXT BOOKS:

1. Kenneth G.Budinski and Michael K. Budinski, “Engineering Materials”, Prentice Hall of India Private Limited, 9th edition ,2018.
2. Sydney H.Avner, “Introduction to Physical Metallurgy”, McGraw Hill Book Company, 1994

REFERENCES:

1. A. Alavudeen, N. Venkateshwaran, and J. T.WinowlinJappes, A Textbook of Engineering Materials and Metallurgy, Laxmi Publications, 2006.
2. Amandeep Singh Wadhwa, andHarvinder Singh Dhaliwal, A Textbook of Engineering Material and Metallurgy, University Sciences Press, 2008.
3. G.S. Upadhyay and Anish Upadhyay, “Materials Science and Engineering”, Viva Books Pvt.Ltd, New Delhi, 2020.
4. Raghavan.V, “Materials Science and Engineering”, Prentice Hall of India Pvt.Ltd. 6th edition, 2019.
5. Williams D Callister, “Material Science and Engineering” Wiley India Pvt Ltd, 2nd edition Re print 2019.

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3	3	1	3									2	2	1	2
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Low (1) ; Medium (2) ; High (3)															

21154C36 **MANUFACTURING PROCESSES**

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

1. To illustrate the working principles of various metal casting processes.
2. To learn and apply the working principles of various metal joining processes.
3. To analyse the working principles of bulk deformation of metals.
4. To learn the working principles of sheet metal forming process.
5. To study and practice the working principles of plastics molding.

UNIT – I METAL CASTING PROCESSES 9

Sand Casting – Sand Mould – Type of patterns - Pattern Materials – Pattern allowances – Molding sand Properties and testing – Cores –Types and applications – Molding machines – Types and applications– Melting furnaces - Principle of special casting processes- Shell, investment – Ceramic mould – Pressure die casting - low pressure, gravity- Tilt pouring, high pressure die casting- Centrifugal Casting - CO2 casting -- Defects in Sand casting process-remedies

UNIT II METAL JOINING PROCESSES 9

Fusion welding processes - Oxy fuel welding - Filler and Flux materials--Arc welding, Electrodes, Coating and specifications – Gas Tungsten arc welding –Gas metal arc welding - Submerged arc welding – Electro slag welding– Plasma arc welding — Resistance welding Processes -Electron beam welding -Laser beam Welding Friction welding – Friction stir welding – Diffusion welding – Thermit Welding, Weld defects – inspection &remedies – Brazing – soldering – Adhesive bonding.

UNIT III BULK DEFORMATION PROCESSES 9

Hot working and cold working of metals – Forging processes – Open, impression and closed die forging – cold forging- Characteristics of the processes – Typical forging operations – rolling of metals – Types of Rolling – Flat strip rolling – shape rolling operations – Defects in rolled parts – Principle of rod and wire drawing – Tube drawing – Principles of Extrusion – Types – Hot and Cold extrusion. Introduction to shaping operations.

UNIT IV SHEET METAL PROCESSES 9

Sheet metal characteristics – Typical shearing, bending and drawing operations – Stretch forming operations — Formability of sheet metal – Test methods –special forming processes - Working principle and applications — Hydro forming – Rubber pad forming – Metal spinning – Introduction of Explosive forming, magnetic pulse forming, peen forming, Super plastic forming – Micro forming – Incremental forming.

UNIT V MANUFACTURE OF PLASTIC COMPONENTS 9

Types and characteristics of plastics – Molding of thermoplastics & Thermosetting polymers– working principles and typical applications - injection molding – Plunger and screw machines – Compression molding, Transfer Molding – Typical industrial applications – introduction to blow molding – Rotational molding – Film blowing – Extrusion – Thermoforming – Bonding of Thermoplastics- duff moulding.

TOTAL :45 PERIODS

OUTCOMES:

At the end of the course the students would be able to

1. Explain the principle of different metal casting processes.
2. Describe the various metal joining processes.
3. Illustrate the different bulk deformation processes.
4. Apply the various sheet metal forming process.
5. Apply suitable molding technique for manufacturing of plastics components.

TEXT BOOKS:

1. Kalpakjian. S, “Manufacturing Engineering and Technology”, Pearson Education India,4th Edition, 2013
2. P.N.Rao Manufacturing Technology Volume 1 Mc Grawhill Education 5th edition,2018.

REFERENCES:

1. Roy. A. Lindberg, Processes and materials of manufacture, PHI / Pearson education, 2006.
2. S. Gowri P. Hariharan, A.Suresh Babu, Manufacturing Technology I, Pearson Education, 2008.
3. Paul Degarma E, Black J.T and Ronald A. Kosher, Eligth Edition, Materials and Processes, in Manufacturing, Eight Edition, Prentice – Hall of India, 1997.
4. Hajra Chouldhary S.K and Hajra Choudhury. AK., Elements of workshop Technology, volume I and II, Media promoters and Publishers Private Limited, Mumbai, 1997
5. Sharma, P.C., A Text book of production Technology, S.Chand and Co. Ltd., 2004

CO	PO												PSO		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
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3	3		2			2	2	1	1	-	-	1	3	1	2
4	3		2			2	2	1	1	-	-	1	3	1	2
5	3		2		2	2	2	1	1	-	-	1	3	1	2
Low (1) ; Medium (2) ; High (3)															

21154L37 **COMPUTER AIDED MACHINE DRAWING**

L	T	P	C
0	0	4	2

COURSE OBJECTIVES:

1 To acquaint the skills and practical experience in handling 2D drafting and 3D modelling software systems, standard drawing practices using fits and tolerances.
2 To prepare assembly drawings both manually and using standard CAD packages.
3 To Preparing standard drawing layout for modeled parts, assemblies with BoM.

PART I DRAWING STANDARDS & FITS AND TOLERANCES 12

Code of practice for Engineering Drawing, BIS specifications – Welding symbols, riveted joints, keys, fasteners - Reference to hand book for the selection of standard components like bolts, nuts, screws, keys etc. - Limits, Fits – Tolerancing of individual dimensions IS919- Specification of Fits – Preparation of production drawings and reading of part and assembly drawings, basic principles of Geometric Dimensioning &Tolerancing.

PART II 2D DRAFTING 48

Drawing, Editing, Dimensioning, Layering, Hatching, Block, Array, Detailing, Detailed Drawing.
1. Bearings – Bush Bearing,
2. Valves - Safety and Non-return Valves.
3. Couplings - Flange, Oldham's, Muff, Gear couplings.
4. Joints - Universal, Knuckle, Gib& Cotter, Strap, Sleeve &Cotter joints.
5. Engine parts – Piston, Connecting Rod, Crosshead (vertical and horizontal), Stuffing box, multi-plate clutch.
6. Machine Components - Screw Jack, Machine Vice, LatheTail Stock, Lathe Chuck, Plummer Block, Vane and Gear pumps.

Total: 20% of classes for theory classes and 80% of classes for practice
Note: 25% of assembly drawings must be done manually and remaining 75% of assembly drawings must be done by using any CAD software. The above tasks can be performed manually and using standard commercial 2D CAD software.

TOTAL:60 PERIODS

OUTCOMES: At the end of the course the students would be able to

1. Prepare standard drawing layout for modelled assemblies with BoM.
2. Model orthogonal views of machine components.
3. Prepare standard drawing layout for modelled parts

TEXT BOOKS:

1. Gopalakrishna K.R., "Machine Drawing", 17th Edition, Subhas Stores Books Corner, Bangalore,2003.
2. N. D. Bhatt and V.M. Panchal, "Machine Drawing", 51st Edition, Charator Publishers,2022.

REFERENCES:

1. K. L Narayana, P.Kannaiah, K.Venkata Reddy, Machine Drawing , 15 Edition , New Age International Publication
2. Goutam Pohit and Goutam Ghosh, "Machine Drawing with AutoCAD", 1st Edition,Pearson Education, 2004
3. Junnarkar, N.D., "Machine Drawing", 1st Edition, Pearson Education, 2004
4. N. Siddeshwar, P. Kanniah, V.V.S. Sastri," Machine Drawing" , published by Tata McGrawHill,2006
5. S. Trymbaka Murthy, "A Text Book of Computer Aided Machine Drawing", CBS Publishers, New Delhi, 2007

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
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2	1	2			3				3	2		3	2	2	2
3	1	2			3				3	2		3	2	2	2
Low (1) ; Medium (2) ; High (3)															

21154L38 **MANUFACTURING TECHNOLOGY LABORATORY**

L	T	P	C
0	0	4	2

COURSE OBJECTIVES:

1 To Selecting appropriate tools, equipment's and machines to complete a given job.
2 To Performing various welding process using GMAW and fabricating gears using gear making machines.
3 To Performing various machining process such as rolling, drawing, turning, shaping, drilling, milling and analysing the defects in the cast and machined components.

LIST OF EXPERIMENTS

1. Fabricating simple structural shapes using Gas Metal Arc Welding machine.
2. Preparing green sand moulds with cast patterns.
3. Taper Turning and Eccentric Turning on circular parts using lathe machine.
4. Knurling, external and internal thread cutting on circular parts using lathe machine.
5. Shaping – Square and Hexagonal Heads on circular parts using shaper machine.
6. Drilling and Reaming using vertical drilling machine.
7. Milling contours on plates using vertical milling machine.
8. Cutting spur and helical gear using milling machine.
9. Generating gears using gear hobbing machine.
10. Generating gears using gear shaping machine.
11. Grinding components using cylindrical and centerless grinding machine.
12. Grinding components using surface grinding machine.
13. Cutting force calculation using dynamometer in milling machine
14. Cutting force calculation using dynamometer in lathe machine

TOTAL:60 PERIODS

OUTCOMES: At the end of the course the students would be able to

1. Demonstrate the safety precautions exercised in the mechanical workshop and join two metals using GMAW.
2. The students able to make the work piece as per given shape and size using machining process such as rolling, drawing, turning, shaping, drilling and milling.
3. The students become make the gears using gear making machines and analyze the defects in the cast and machined components

CO	PO												PSO		
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1	3						1		2			1	1	2	2
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3	3						1		2			1	1	2	2
Low (1) ; Medium (2) ; High (3)															

21154L39	PROFESSIONAL DEVELOPMENT	L T P C
		0 0 2 1

OBJECTIVES:

To be proficient in important Microsoft Office tools: MS WORD, EXCEL, POWERPOINT.

- To be proficient in using MS WORD to create quality technical documents, by using standard templates, widely acceptable styles and formats, variety of features to enhance the presentability and overall utility value of content.
- To be proficient in using MS EXCEL for all data manipulation tasks including the common statistical, logical, mathematical etc., operations, conversion, analytics, search and explore, visualize, interlink, and utilizing many more critical features offered
- To be able to create and share quality presentations by using the features of MS PowerPoint, including: organization of content, presentability, aesthetics, using media elements and enhance the overall quality of presentations.

MS WORD: **10 Hours**

Create and format a document
Working with tables
Working with Bullets and Lists
Working with styles, shapes, smart art, charts
Inserting objects, charts and importing objects from other office tools
Creating and Using document templates
Inserting equations, symbols and special characters
Working with Table of contents and References, citations
Insert and review comments
Create bookmarks, hyperlinks, endnotes footnote
Viewing document in different modes
Working with document protection and security
Inspect document for accessibility

MS EXCEL: **10 Hours**

Create worksheets, insert and format data
Work with different types of data: text, currency, date, numeric etc.
Split, validate, consolidate, Convert data
Sort and filter data

Perform calculations and use functions: (Statistical, Logical, Mathematical, date, Time etc.,)
Work with Lookup and reference formulae
Create and Work with different types of charts
Use pivot tables to summarize and analyse data
Perform data analysis using own formulae and functions
Combine data from multiple worksheets using own formulae and built-in functions to generate results
Export data and sheets to other file formats
Working with macros
Protecting data and Securing the workbook

MS POWERPOINT: **10 Hours**

Select slide templates, layout and themes
Formatting slide content and using bullets and numbering
Insert and format images, smart art, tables, charts
Using Slide master, notes and handout master
Working with animation and transitions
Organize and Group slides
Import or create and use media objects: audio, video, animation
Perform slideshow recording and Record narration and create presentable videos

TOTAL: 30 PERIODS

OUTCOMES:

On successful completion the students will be able to

- Use MS Word to create quality documents, by structuring and organizing content for their day to day technical and academic requirements
- Use MS EXCEL to perform data operations and analytics, record, retrieve data as per requirements and visualize data for ease of understanding
- Use MS PowerPoint to create high quality academic presentations by including common tables, charts, graphs, interlinking other elements, and using media objects.

21154C41	THEORY OF MACHINES	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

1. To study the basic components of mechanisms, analyzing the assembly with respect to the displacement, velocity, and acceleration at any point in a link of a mechanism and design cammechanisms for specified output motions.
2. To study the basic concepts of toothed gearing and kinematics of gear trains
3. To Analyzing the effects of friction in machine elements
4. To Analyzing the force-motion relationship in components subjected to external forces and analyzing of standard mechanisms.
5. To Analyzing the undesirable effects of unbalances resulting from prescribed motions in mechanismand the effect of dynamics of undesirable vibrations.

UNIT – I KINEMATICS OF MECHANISMS 9

Mechanisms - Terminology and definitions - kinematics inversions of 4 bar and slide crank chain - kinematicsanalysis in simple mechanisms - velocity and acceleration polygons- Analytical methods - computer approach - cams - classifications - displacement diagrams - layout of plate cam profiles - derivatives of followers motion - circular arc and tangent cams.

UNIT – II GEARS AND GEAR TRAINS 9

Spur gear - law of toothed gearing - involute gearing - Interchangeable gears - Gear tooth action interference and undercutting – nonstandard teeth – gear trains – parallel axis gears trains – epicyclic gear trains – automotive transmission gear trains.

UNIT – III FRICTION IN MACHINE ELEMENTS 9

Surface contacts - Sliding and Rolling friction - Friction drives - Friction in screw threads - Bearings and lubrication - Friction clutches - Belt and rope drives - Friction aspects in brakes- Friction in vehicle propulsion and braking.

UNIT – IV FORCE ANALYSIS 9

Applied and Constrained Forces - Free body diagrams - static Equilibrium conditions - Two, Three and four members - Static Force analysis in simple machine members - Dynamic Force Analysis - Inertia Forces and Inertia Torque - D'Alembert's principle - superposition principle - dynamic Force Analysis in simple machine members

UNIT – V BALANCING AND VIBRATION 9

Static and Dynamic balancing – Balancing of revolving and reciprocating masses – Balancing machines – free vibrations – Equations of motion - natural Frequency – Damped Vibration – bending critical speed of simple shaft – Torsional vibration – Forced vibration – harmonic Forcing – Vibration isolation. (Gyroscopic principles)

TOTAL: 45 PERIODS

OUTCOMES: At the end of the course the students would be able to

1. Discuss the basics of mechanism.
2. Solve problems on gears and gear trains.
3. Examine friction in machine elements.
4. Calculate static and dynamic forces of mechanisms.
5. Calculate the balancing masses and their locations of reciprocating and rotating masses. Computing the frequency of free vibration, forced vibration and damping coefficient.

TEXT BOOKS:

1. Uicker, J.J., Pennock G.R and Shigley, J.E., "Theory of Machines and Mechanisms", Oxford University Press, 2017.
2. Ramamurthi. V, "Mechanics of Machines", Narosa Publishing House, 3rd edition 2019.

REFERENCES:

1. AmitabhaGhosh and Asok Kumar Mallik, "Theory of Mechanisms and Machines", Affiliated East-West

Pvt. Ltd., 1988.
2. Rao.J.S. and Dukkipati.R.V. “Mechanism and Machine Theory”, New Age International Pvt. Ltd., 2nd edition,2014.
3. Rattan, S.S, “Theory of Machines”, McGraw-Hill Education Pvt. Ltd., 5th edition 2019.
4. Robert L. Norton, Kinematics and Dynamics of Machinery, Tata McGraw-Hill, 2013.
5. Wilson and Sadler, Kinematics and Dynamics of Machinery, Pearson, 2008.

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3	3	2	2		2			1				1	3		1
4	3	2	2		2			1				1	3		1
5	3	2	2		2			1				1	3		1
Low (1) ; Medium (2) ; High (3)															

21154C42	THERMAL ENGINEERING	L	T	P	C
		4	0	0	4

COURSE OBJECTIVES:

1. To learn the concepts and laws of thermodynamics to predict the operation of thermodynamic cycles and performance of Internal Combustion(IC) engines and Gas Turbines.
2. To analyzing the performance of steam nozzle, calculate critical pressure ratio
3. To Evaluating the performance of steam turbines through velocity triangles, understand the need for governing and compounding of turbines
4. To analyzing the working of IC engines and various auxiliary systems present in IC engines
5. To evaluating the various performance parameters of IC engines

UNIT I THERMODYNAMIC CYCLES 12

Air Standard Cycles – Carnot, Otto, Diesel, Dual, Brayton – Cycle Analysis, Performance and Comparison, Basic Rankine Cycle, modified, reheat and regenerative cycles.

UNIT II STEAM NOZZLES AND INJECTOR 12

Types and Shapes of nozzles, Flow of steam through nozzles, Critical pressure ratio, Variation of mass flow rate with pressure ratio. Effect of friction. Metastable flow.

UNIT III STEAM AND GAS TURBINES 12

Types, Impulse and reaction principles, Velocity diagrams, Work done and efficiency – optimal operating conditions. Multi-staging, compounding and governing. Gas turbine cycle analysis - open and closed cycle. Performance and its improvement - Regenerative, Intercooled, Reheated cycles and their combination.

UNIT IV INTERNAL COMBUSTION ENGINES – FEATURES AND COMBUSTION 12

IC engine - Classification, working, components and their functions. Ideal and actual : Valve and port timing diagrams, p-v diagrams- two stroke & four stroke, and SI & CI engines - comparison. Geometric, operating, and performance comparison of SI and CI engines. Desirable properties and qualities of fuels. Air-fuel ratio calculation - lean and rich mixtures. Combustion in SI & CI Engines - Knocking - phenomena and control.

UNIT V INTERNAL COMBUSTION ENGINE PERFORMANCE AND AUXILIARY SYSTEMS 12

Performance and Emission Testing, Performance parameters and calculations. Morse and Heat Balance tests. Multipoint Fuel Injection system and Common rail direct injection systems. Ignition systems – Magneto, Battery and Electronic. Lubrication and Cooling systems. Concepts of Supercharging and Turbocharging – Emission Norms

TOTAL :60 PERIODS

OUTCOMES: At the end of the course the students would be able to

1. Apply thermodynamic concepts to different air standard cycles and solve problems.
2. To solve problems in steam nozzle and calculate critical pressure ratio.
3. Explain the flow in steam turbines, draw velocity diagrams, flow in Gas turbines and solve problems.
4. Explain the functioning and features of IC engine, components and auxiliaries.
5. Calculate the various performance parameters of IC engines

TEXT BOOKS:

1. Mahesh. M. Rathore, “Thermal Engineering”, 1st Edition, Tata McGraw Hill, 2010.
2. Ganesan.V, " Internal Combustion Engines" 4th Edition, Tata McGraw Hill, 2012.

REFERENCES:

1. Ballaney. P, “Thermal Engineering”, 25th Edition, Khanna Publishers, 2017.
2. Domkundwar, Kothandaraman, &Domkundwar, “A Course in Thermal Engineering”, 6th Edition, DhanpatRai& Sons, 2011.
3. Gupta H.N, “Fundamentals of Internal Combustion Engines”, 2nd Edition Prentice Hall of India, 2013.
4. Mathur M.L and Mehta F.S., “Thermal Science and Engineering”, 3rd Edition, Jain Brothers Pvt. Ltd, 2017.
5. Soman. K, “Thermal Engineering”, 2nd Edition, Prentice Hall of India, 2011.

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	3	2	1	1								1	2	1	
2	3	2	2	1								1	2	1	
3	3	2	2	1								1	2	1	
4	3	2	1	1								1	2	1	
5	3	2	1	1								1	2	1	
Low (1) ; Medium (2) ; High (3)															

21154C43 **HYDRAULICS AND PNEUMATICS**

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

1. To provide the knowledge on the working principles of fluid power systems.
2. To study the fluids and components used in modern industrial fluid power system.
3. To develop the design, construction and operation of fluid power circuits.
4. To learn the working principles of pneumatic power system and its components.
5. To provide the knowledge of trouble shooting methods in fluid power systems.

UNIT I FLUID POWER PRINICIPLES AND HYDRAULIC PUMPS 9

Introduction to Fluid power – Advantages and Applications – Fluid power systems – Types of fluids - Properties of fluids and selection – Basics of Hydraulics – Pascal's Law – Principles of flow - Friction loss – Work, Power and Torque- Problems, Sources of Hydraulic power: Pumping Theory–- Pump Classification - Construction, Working, Design, Advantages, Disadvantages, Performance, Selection criteria of pumps - Fixed and Variable displacement pumps – Problems

UNIT – II HYDRAULIC ACTUATORS AND CONTROL COMPONENTS 9

Hydraulic Actuators: Cylinders – Types and construction, Application, Hydraulic cushioning – Rotary Actuators-Hydraulic motors - Control Components: Direction Control, Flow control and pressure control valves – Types, Construction and Operation – Accessories: Reservoirs, Pressure Switches – Filters –types and selection- Applications – Fluid Power ANSI Symbols – Problems

UNIT – III HYDRAULIC CIRCUITS AND SYSTEMS 9

Accumulators, Intensifiers, Industrial hydraulic circuits – Regenerative, Pump Unloading, Double-Pump, Pressure Intensifier, Air-over oil, Sequence, Reciprocation, Synchronization, Fail-Safe, Speed Control, Deceleration circuits, Sizing of hydraulic systems, Hydrostatic transmission, Electro hydraulic circuits, –Servo and Proportional valves – Applications- Mechanical, hydraulic servo systems.

UNIT – IV PNEUMATIC AND ELECTRO PNEUMATIC SYSTEMS 9

Properties of air –Air preparation and distribution – Filters, Regulator, Lubricator, Muffler, Air control Valves, Quick Exhaust Valves, Pneumatic actuators, Design of Pneumatic circuit –classification- single cylinder and multi cylinder circuits-Cascade method –Integration of fringe circuits, Electro Pneumatic System – Elements – Ladder diagram – timer circuits-Problems, Introduction to fluidics and pneumatic logic circuits

UNIT – V TROUBLE SHOOTING AND APPLICATIONS 9

Installation, Selection, Maintenance, Trouble Shooting and Remedies in Hydraulic and Pneumatic systems, Conditioning of hydraulic fluids Design of hydraulic circuits for Drilling, Planning, Shaping, Surface grinding, Press and Forklift applications- mobile hydraulics; Design of Pneumatic circuits for metal working, handling, clamping counter and timer circuits. – Low-cost Automation – Hydraulic and Pneumatic power packs, IOT in Hydraulics and pneumatics
Note: (Use of standard Design Data Book is permitted in the University examination)

TOTAL: 45 PERIODS

OUTCOMES: At the end of the course the students would be able to

1. Apply the working principles of fluid power systems and hydraulic pumps.
2. Apply the working principles of hydraulic actuators and control components.
3. Design and develop hydraulic circuits and systems.
4. Apply the working principles of pneumatic circuits and power system and its components.
5. Identify various troubles shooting methods in fluid power systems.

TEXT BOOKS:

1. Anthony Esposito, "Fluid Power with Applications", Prentice Hall, 2009.
2. James A. Sullivan, "Fluid Power Theory and Applications", Fourth Edition, Prentice Hall, 1997

REFERENCES:

1. Jagadeesha. T., "Pneumatics Concepts, Design and Applications ", Universities Press, 2015.
2. Joshi.P., Pneumatic Control", Wiley India, 2008.
3. Majumdar, S.R., "Oil Hydraulics Systems – Principles and Maintenance",TataMcGraw Hill, 2001.
4. Shanmugasundaram.K., "Hydraulic and Pneumatic Controls". Chand & Co, 2006.
5. Srinivasan.R., "Hydraulic and Pneumatic Controls", Vijay Nicole Imprints, 3rd edition,2019.

CO	PO												PSO		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	2	1	1	1								1	2	1	1
2	2	1	1	1								1	2	1	1
3	2	1	1	1								1	2	1	1
4	2	1	1	1								1	2	1	1
5	2	1	1	1								1	2	1	1
Low (1) ; Medium (2) ; High (3)															

21154C44 **MANUFACTURING TECHNOLOGY**

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

1 To study the concepts and basic mechanics of metal cutting and the factors affecting machinability
2 To learn working of basic and advanced turning machines.
3 To teach the basics of machine tools with reciprocating and rotating motions and abrasive finishing processes.
4 To study the basic concepts of CNC of machine tools and constructional features of CNC.
5 To learn the basics of CNC programming concepts to develop the part programme for Machine centre and turning centre

UNIT – I MECHANICS OF METAL CUTTING 9

Mechanics of chip formation, forces in machining, Types of chip, cutting tools – single point cutting tool nomenclature, orthogonal and oblique metal cutting, thermal aspects, cutting tool materials, tool wear, tool life, surface finish, cutting fluids and Machinability.

UNIT – II TURNING MACHINES 9

Centre lathe, constructional features, specification, operations – taper turning methods, thread cutting methods, special attachments, surface roughness in turning, machining time and power estimation. Special lathes - Capstan and turret lathes- tool layout – automatic lathes: semi-automatic – single spindle: Swiss type, automatic screw type – multi spindle

UNIT – III RECIPROCATING MACHINE TOOLS 9

Reciprocating machine tools: shaper, planer, slotter: Types and operations- Hole making: Drilling, reaming, boring, tapping, type of milling operations-attachments- types of milling cutters- machining time calculation - Gear cutting, gear hobbing and gear shaping – gear finishing methods Abrasive processes: grinding wheel – specifications and selection, types of grinding process – cylindrical grinding, surface grinding, centreless grinding, internal grinding - micro finishing methods

UNIT – IV CNC MACHINES 9

Computer Numerical Control (CNC) machine tools, constructional details, special features – Drives, Recirculating ball screws, tool changers; CNC Control systems – Open/closed, point-to-point/continuous - Turning and machining centres – Work holding methods in Turning and machining centres, Coolant systems, Safety features.

UNIT – V PROGRAMMING OF CNC MACHINE TOOLS 9

Coordinates, axis and motion, Absolute vs Incremental, Interpolators, Polar coordinates, Program planning, G and M codes, Manual part programming for CNC machining centers and Turning centers – Fixed cycles, Loops and subroutines, Setting up a CNC machine for machining.

TOTAL 45 PERIODS

OUTCOMES: At the end of the course the students would be able to

1. Apply the mechanism of metal removal process and to identify the factors involved in improving machinability.
2. Describe the constructional and operational features of centre lathe and other special purpose lathes.
3. Describe the constructional and operational features of reciprocating machine tools.
4. Apply the constructional features and working principles of CNC machine tools.
5. Demonstrate the Program CNC machine tools through planning, writing codes and setting up CNC machine tools to manufacture a given component.

TEXT BOOKS:

1. Kalpakjian. S, "Manufacturing Engineering and Technology", Pearson Education India,7th Edition, 2018.
2. Michael Fitzpatrick, Machining and CNC Technology, McGraw-Hill Education; 4th edition, 2018.

REFERENCES:

1. Roy. A. Lindberg, Processes and materials of manufacture, PHI / Pearson education, 2006.
2. Geofrey Boothroyd, "Fundamentals of Metal Machining and Machine Tools", McGraw Hill, 1984.

3. Rao. P.N "Manufacturing Technology," Metal Cutting and Machine Tools, Tata McGraw- Hill, New Delhi, 2009.
4. A. B. Chattopadhyay, Machining and Machine Tools, Wiley, 2nd edition, 2017.
5. Peter Smid, CNC Programming Handbook, Industrial Press Inc.;Third edition, 2007.

CO	**PO**												**PSO**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	3	3	3	1	1	1	3			3		2	3	3	2
2	3	3	3	1	1	1	3			3		2	3	2	2
3	3	3	3	1	1	1	3			3		2	3	2	2
4	3	3	2	1	1	1	3			3		2	3	2	2
5	3	3	3	1	1	1	3			3		2	3	2	3
Low (1) ; Medium (2) ; High (3)															

21154C45 **STRENGTH OF MATERIALS**

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

- To understand the concepts of stress, strain, principal stresses and principal planes.
- To study the concept of shearing force and bending moment due to external loads in determinate beams and their effect on stresses.
- To determine stresses and deformation in circular shafts and helical spring due to torsion.
- To compute slopes and deflections in determinate beams by various methods.
- To study the stresses and deformations induced in thin and thick shells.

UNIT I STRESS, STRAIN AND DEFORMATION OF SOLIDS 9

Rigid bodies and deformable solids – Tension, Compression and Shear Stresses - Deformation of simple and compound bars - Thermal stresses - Elastic constants - Volumertric strains - Stresses on inclined planes – Principal stresses and principal planes – Mohr's circle of stress.

UNIT II TRANSVERSE LOADING ON BEAMS AND STRESSES IN BEAM 9

Beams – Types - Transverse loading on beams – Shear force and Bending moment in beams – Cantilever, Simply supported and over hanging beams. Theory of simple bending - Bending stress distribution - Load carrying capacity - Proportioning of sections - Flitched beams - Shear stress distribution.

UNIT III TORSION 9

Theory of Torsion - Stresses and Deformations in Solid and Hollow Circular Shafts - Combined bending moment and torsion of shafts - Power transmitted to shaft – Shaft in series and parallel – Closed and Open Coiled helical springs – springs in series and parallel.

UNIT IV DEFLECTION OF BEAMS 9

Elastic curve - Governing differential equation - Double integration method - Macaulay's method - Area moment method - Conjugate beam method for computation of slope and deflection of determinant beams.

UNIT V THIN CYLINDERS, SPHERES AND THICK CYLINDERS 9

Stresses in thin cylindrical shell due to internal pressure - circumferential and longitudinal stresses - Deformation in thin cylinders - Spherical shells subjected to internal pressure - Deformation in spherical shells – Thick cylinders - Lame's theory.

TOTAL: 45 PERIODS

OUTCOMES:

At the end of the course the students would be able to

1. Understand the concepts of stress and strain in simple and compound bars, the importan of principal stresses and principal planes.
2. Understand the load transferring mechanism in beams and stress distribution due shearing force and bending moment.
3. Apply basic equation of torsion in designing of shafts and helical springs
4. Calculate slope and deflection in beams using different methods.
5. Analyze thin and thick shells for applied pressures.

TEXT BOOK

1. Rajput R.K. "Strength of Materials (Mechanics of Solids)", S.Chand & company Ltd., New Delhi, 7th edition, 2018.
2. Rattan S.S., "Strength of Materials", Tata McGraw Hill Education Pvt .Ltd., New Delhi, 2017.

REFERENCES:

1. Singh. D.K., "Strength of Materials", Ane Books Pvt Ltd., New Delhi, 2021.
2. Egor P Popov, "Engineering Mechanics of Solids", 2nd edition, PHI Learning Pvt. Ltd., New Delhi, 2015.
3. Beer. F.P. & Johnston. E.R. "Mechanics of Materials", Tata McGraw Hill, 8th Edition, New Delhi 2019.
4. Vazirani. V.N, Ratwani. M.M, Duggal .S.K "Analysis of Structures: Analysis, Design and Detailing of Structures-Vol.1", Khanna Publishers, New Delhi 2014.

CO	**PO**												**PSO**		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	3	3	3	3	2	3	1	3	2	3	1	3	3	2	3
2	3	3	3	3	2	3	1	3	2	3	1	3	3	2	3
3	3	3	3	3	2	3	1	3	2	3	1	3	3	2	3
4	3	3	3	3	2	3	1	3	2	3	1	3	3	2	3
5	3	3	3	3	2	3	1	3	2	3	1	3	3	2	3
Low (1) ; Medium (2) ; High (3)															

21149S46 ENVIRONMENTAL SCIENCES AND SUSTAINABILITY **L T P C**
3 1 0 3

OBJECTIVES:

- To introduce the basic concepts of environment, ecosystems and biodiversity and emphasize on the biodiversity of India and its conservation.
- To impart knowledge on the causes, effects and control or prevention measures of environmental pollution and natural disasters.
- To facilitate the understanding of global and Indian scenario of renewable and nonrenewable resources, causes of their degradation and measures to preserve them.
- To familiarize the concept of sustainable development goals and appreciate the interdependence of economic and social aspects of sustainability, recognize and analyze climate changes, concept of carbon credit and the challenges of environmental management.
- To inculcate and embrace sustainability practices and develop a broader understanding on green materials, energy cycles and analyze the role of sustainable urbanization.

UNIT I ENVIRONMENT AND BIODIVERSITY 6

Definition, scope and importance of environment – need for public awareness. Eco-system and Energy flow- ecological succession. Types of biodiversity: genetic, species and ecosystem diversity- values of biodiversity, India as a mega-diversity nation - hot-spots of biodiversity - threats to biodiversity: habitat loss, poaching of wildlife, man-wildlife conflicts - endangered and endemic species of India – conservation of biodiversity: In-situ and ex-situ.

UNIT II ENVIRONMENTAL POLLUTION 6

Causes, Effects and Preventive measures of Water, Soil, Air and Noise Pollutions. Solid, Hazardous and E-Waste management. Case studies on Occupational Health and Safety Management system (OHASMS). Environmental protection, Environmental protection acts.

UNIT III RENEWABLE SOURCES OF ENERGY 6

Energy management and conservation, New Energy Sources: Need of new sources. Different types new energy sources. Applications of- Hydrogen energy, Ocean energy resources, Tidal energy conversion. Concept, origin and power plants of geothermal energy.

UNIT IV SUSTAINABILITY AND MANAGEMENT 6

Development, GDP, Sustainability- concept, needs and challenges-economic, social and aspects of sustainability-from unsustainability to sustainability-millennium development goals, and protocols-Sustainable Development Goals-targets, indicators and intervention areas Climate change- Global, Regional and local environmental issues and possible solutions-case studies. Concept of Carbon Credit, Carbon Footprint. Environmental management in industry-A case study.

UNIT V SUSTAINABILITY PRACTICES 6

Zero waste and R concept, Circular economy, ISO 14000 Series, Material Life cycle assessment, Environmental Impact Assessment. Sustainable habitat: Green buildings, Green materials, Energy efficiency, Sustainable transports. Sustainable energy: Non-conventional Sources, Energy Cycles-carbon cycle, emission and sequestration, Green Engineering: Sustainable urbanization- Socio-economical and technological change.

TOTAL : 30 PERIODS

OUTCOMES:

- To recognize and understand the functions of environment, ecosystems and biodiversity and their conservation.
- To identify the causes, effects of environmental pollution and natural disasters and contribute to the preventive measures in the society.
- To identify and apply the understanding of renewable and non-renewable resources and contribute to the sustainable measures to preserve them for future generations.
- To recognize the different goals of sustainable development and apply them for suitable technological advancement and societal development.
- To demonstrate the knowledge of sustainability practices and identify green materials, energy cycles and the role of sustainable urbanization.

TEXT BOOKS:

1. Anubha Kaushik and C. P. Kaushik's “Perspectives in Environmental Studies”, 6th Edition, New Age International Publishers ,2018.
2. Benny Joseph, ‘Environmental Science and Engineering’, Tata McGraw-Hill, New Delhi, 2016.
3. Gilbert M.Masters, ‘Introduction to Environmental Engineering and Science’, 2nd edition, Pearson Education, 2004.
4. Allen, D. T. and Shonnard, D. R., Sustainability Engineering: Concepts, Design and Case Studies, Prentice Hall.
5. Bradley. A.S; Adebayo, A.O., Maria, P. Engineering applications in sustainable design and development, Cengage learning.
6. Environment Impact Assessment Guidelines, Notification of Government of India, 2006.
7. Mackenthun, K.M., Basic Concepts in Environmental Management, Lewis Publication, London, 1998.

REFERENCES :

1. R.K. Trivedi, ‘Handbook of Environmental Laws, Rules, Guidelines, Compliances and Standards’, Vol. I and II, Enviro Media. 38 . Edition 2010.
2. Cunningham, W.P. Cooper, T.H. Gorhani, ‘Environmental Encyclopedia’, Jaico Publ., House, Mumbai, 2001.
3. Dharmendra S. Sengar, ‘Environmental law’, Prentice hall of India PVT. LTD, New Delhi, 2007.
4. Rajagopalan, R, ‘Environmental Studies-From Crisis to Cure’, Oxford University Press, Third Edition, 2015.
5. Erach Bharucha “Textbook of Environmental Studies for Undergraduate Courses” Orient Blackswan Pvt. Ltd. 2013.

CO-PO & PSO MAPPING

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	2	1	-	-	-	2	3	-	-	-	-	2	-	-	-
2	3	2	-	-	-	3	3	-	-	-	-	2	-	-	-
3	3	-	1	-	-	2	2	-	-	-	-	2	-	-	-
4	3	2	1	1	-	2	2	-	-	-	-	2	-	-	-
5	3	2	1	-	-	2	2	-	-	-	-	1	-	-	-
Avg.	**2.8**	**1.8**	**1**	**1**	**-**	**2.2**	**2.4**	**-**	**-**	**-**	**-**	**1.8**	-	-	-

1-low, 2-medium, 3-high, ‘-“- no correlation

21154L47 STRENGTH OF MATERIALS AND FLUID MACHINERY LABORATORY **L T P C**
0 0 3 2

COURSE OBJECTIVE:
1. To study the mechanical properties of metals, wood and spring by testing in laboratory.
2. To verify the principles studied in fluid mechanics and machinery theory by performing experiments in laboratory.

UNIT – I STRENGTH OF MATERIALS **30**
LIST OF EXPERIMENTS
1. Tension test on mild steel rod
2. Torsion test on mild steel rod
3. Hardness test on metal (Rockwell and Brinell Hardness)
4. Compression test on helical spring
5. Deflection test on carriage spring

UNIT – II FLUID MECHANICS AND MACHINES LABORATORY **30**
LIST OF EXPERIMENTS
1. (a) Determination of coefficient of discharge of a venturimeter
   (b) Determination of friction factor for flow through pipes
2. (a) Determination of metacentric height
   (b) Determination of forces due to impact of jet on a fixed plate
3. Characteristics of centrifugal pumps
4. Characteristics of reciprocating pump
5. Characteristics of Pelton wheel turbine

TOTAL: 60 PERIODS

OUTCOMES: On completion of the course, the student is expected to be able to
1. Determine the tensile, torsion and hardness properties of metals by testing
2. Determine the stiffness properties of helical and carriage spring
3. Apply the conservation laws to determine the coefficient of discharge of a venturimeter and finding the friction factor of given pipe
4. Apply the fluid static and momentum principles to determine the metacentric height and forces due to impact of jet
5. Determine the performance characteristics of turbine, rotodynamic pump and positive displacement pump.

CO	**PO**												**PSO**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	3	2	1	3	3	1	1	1	3	1	1	2	2	2	1
2	3	2	1	3	3	1	1	1	3	1	1	2	3	2	1
3	3	3	2	3	2	1	1	1	3	1	1	2	3	2	1
Low (1) ; Medium (2) ; High (3)															

21154L48 THERMAL ENGINEERING LABORATORY

L	T	P	C
0	0	3	2

COURSE OBJECTIVES

1 To study the valve and port timing diagram and performance characteristics of IC engines
2 To study the Performance of refrigeration cycle / components
3 To study the Performance and Energy Balance Test on a Steam Generator.

45

PART I IC ENGINES LABORATORY

List of Experiments

1. Valve Timing and Port Timing diagrams.
2. Actual p-v diagrams of IC engines.
3. Performance Test on four - stroke Diesel Engine.
4. Heat Balance Test on 4 - stroke Diesel Engine.
5. Morse Test on Multi-Cylinder Petrol Engine.
6. Retardation Test on a Diesel Engine.
7. Determination of p-θ diagram and heat release characteristics of an IC engine.
8. Determination of Flash Point and Fire Point of various fuels / lubricants
9. Performance test on a two stage Reciprocating Air compressor
10. Determination of COP of a Refrigeration system

15

PART II STEAM LABORATORY

List of Experiments:

1. Study of Steam Generators and Turbines.
2. Performance and Energy Balance Test on a Steam Generator.
3. Performance and Energy Balance Test on Steam Turbine.

TOTAL:60 PERIODS

OUTCOMES:

At the end of the course the students would be able to

1. Conduct tests to evaluate performance characteristics of IC engines
2. Conduct tests to evaluate the performance of refrigeration cycle
3. Conduct tests to evaluate Performance and Energy Balance on a Steam Generator.

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	2	2	1	1					1			1	1	1	1
2	2	2	1	1					1			1	1	1	1
3	2	2	1	1					1			1	1	1	1
Low (1) ; Medium (2) ; High (3)															

21154C51	DESIGN OF MACHINE ELEMENTS	L	T	P	C
		3	1	0	4

COURSE OBJECTIVES

1. To learn the various steps involved in the Design Process.
2. To Learn designing shafts and couplings for various applications.
3. To Learn the design of temporary and permanent Joints.
4. To Learn designing helical, leaf springs, flywheels, connecting rods and crank shafts for variousapplications.
5. To Learn designing and select sliding and rolling contact bearings, seals and gaskets.

(Use of PSG Design Data book is permitted)

UNIT – I FUNDAMENTAL CONCEPTS IN DESIGN 12

Introduction to the design process - factors influencing machine design, selection of materials based on mechanical properties - Preferred numbers- Direct, Bending and torsional loading- Modes of failure - Factor of safety – Combined loads – Principal stresses – Eccentric loading – curved beams – crane hook and 'C' frame- theories of failure – Design based on strength and stiffness – stress concentration – Fluctuating stresses - Endurance limit -Design for finite and infinite life under variable loading - Exposure to standards.

UNIT – II DESIGN OF SHAFTS AND COUPLINGS 12

Shafts and Axles - Design of solid and hollow shafts based on strength, rigidity and critical speed – Keys and splines – Rigid and flexible couplings.

UNIT – III DESIGN OF TEMPORARY AND PERMANENT JOINTS 12

Threaded fasteners - Bolted joints including eccentric loading, Knuckle joints, Cotter joints – Welded joints-Butt, Fillet and parallel transverse fillet welds – welded joints subjected to bending, torsional and eccentric loads, riveted joints for structures - theory of bonded joints.

UNIT – IV DESIGN OF ENERGY STORING ELEMENTS AND ENGINE COMPONENTS 12

Types of springs, design of helical and concentric springs-surge in springs, Design of laminated springs - rubber springs - Flywheels considering stresses in rims and arms for engines and punching machines-- Solid and Rimmed flywheels- connecting rods and crank shafts

UNIT – V DESIGN OF BEARINGS AND MISCELLANEOUS ELEMENTS 12

Sliding contact and rolling contact bearings - Hydrodynamic journal bearings, Sommerfeld Number, Raimondi & Boyd graphs, -- Selection of Rolling Contact bearings -Design of Seals and Gaskets.

TOTAL: 60 PERIODS

OUTCOMES: At the end of the course the students would be able to

1. Explain the design machine members subjected to static and variable loads.
2. Apply the concepts design to shafts, key and couplings.
3. Apply the concepts of design to bolted, Knuckle, Cotter, riveted and welded joints.
4. Apply the concept of design helical, leaf springs, flywheels, connecting rods and crank shafts.
5. Apply the concepts of design and select sliding and rolling contact bearings, seals and gaskets.

TEXT BOOKS:

1. Bhandari V B, "Design of Machine Elements", 4th Edition , Tata McGraw-Hill Book Co, 2016
2. Joseph Shigley, Richard G. Budynas and J. Keith Nisbett "Mechanical Engineering Design", 10th Edition, Tata McGraw-Hill , 2015.

REFERENCES:

1. Ansel C Ugural, "Mechanical Design – An Integral Approach", 1st Edition, Tata McGraw-Hill Book Co, 2004.
2. Merhyle Franklin Spotts, Terry E. Shoup, and Lee EmreyHornberger, "Design of Machine Elements" 8th Edition, Printice Hall, 2004.
3. Robert C. Juvinall and Kurt M. Marshek, "Fundamentals of Machine component Design",6th Edition, Wiley, 2017.
4. Sundararajamoorthy T. V. and Shanmugam .N, "Machine Design", Anuradha Publications, Chennai, 2003.
5. Design of Machine Elements | SI Edition | Eighth Edition | By Pearson by M. F. Spotts, Terry E. Shoup, et al. | 25 March 2019

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	2	2	3					1	1			2	3	2	2
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3	2	2	3					1	1			2	3	2	2
4	2	2	3					1	1			2	3	2	2
5	2	2	3					1	1			2	3	2	2
Low (1) ; Medium (2) ; High (3)															

21154C52 **METROLOGY AND MEASUREMENTS**

L	T	P	C
3	1	0	3

COURSE OBJECTIVES

1 To learn basic concepts of the metrology and importance of measurements.
2 To teach measurement of linear and angular dimensions assembly and transmission elements.
3 To study the tolerance analysis in manufacturing.
4 To develop the fundamentals of GD & T and surface metrology.
5 To provide the knowledge of the advanced measurements for quality control in manufacturing industries.

UNIT – I BASICS OF METROLOGY **9**

Measurement - Need, Process, Role in quality control; Factors affecting measurement - SWIPE; Errors in Measurements - Types - Control - Measurement uncertainty - Types, Estimation, Problems on Estimation of Uncertainty, Statistical analysis of measurement data, Measurement system analysis, Calibration of measuring instruments, Principle of air gauging- ISO standards.

UNIT – II MEASUREMENT OF LINEAR, ANGULAR DIMENSIONS, ASSEMBLY AND TRANSMISSION ELEMENTS **9**

Linear Measuring Instruments – Vernier caliper, Micrometer, Vernier height gauge, Depth Micrometer, Bore gauge, Telescoping gauge; Gauge blocks – Use and precautions, Comparators – Working and advantages; Opto-mechanical measurements using measuring microscope and Profile projector - Angular measuring instruments – Bevel protractor, Clinometer, Angle gauges, Precision level, Sine bar, Autocollimator, Angle dekkor, Alignment telescope. Measurement of Screw threads - Single element measurements – Pitch Diameter, Lead, Pitch. Measurement of Gears – purpose – Analytical measurement – Runout, Pitch variation, Tooth profile, Tooth thickness, Lead – Functional checking – Rolling gear test.

UNIT – III TOLERANCE ANALYSIS **9**

Tolerancing- Interchangeability, Selective assembly, Tolerance representation, Terminology, Limits and Fits, Problems (using tables IS919); Design of Limit gauges, Problems. Tolerance analysis in manufacturing, Process capability, tolerance stackup, tolerance charting.

UNIT – IV METROLOGY OF SURFACES **9**

Fundamentals of GD & T- Conventional vs Geometric tolerance, Datums, Inspection of geometric deviations like straightness, flatness, roundness deviations; Simple problems – Measurement of Surface finish – Functionality of surfaces, Parameters, Comparative, Stylus based and Optical Measurement techniques, Filters, Introduction to 3D surface metrology- Parameters.

UNIT – V ADVANCES IN METROLOGY **9**

Lasers in metrology - Advantages of lasers – Laser scan micrometers; Laser interferometers – Applications – Straightness, Alignment; Ball bar tests, Computer Aided Metrology - Basic concept of CMM – Types of CMM – Constructional features – Probes – Accessories – Software – Applications – Multi-sensor CMMs.

Machine Vision - Basic concepts of Machine Vision System – Elements – Applications - On-line and in-process monitoring in production - Computed tomography – White light Scanners.

TOTAL: 45 PERIODS

OUTCOMES: At the end of the course the students would be able to

1. Discuss the concepts of measurements to apply in various metrological instruments.
2. Apply the principle and applications of linear and angular measuring instruments, assembly and transmission elements.
3. Apply the tolerance symbols and tolerance analysis for industrial applications.
4. Apply the principles and methods of form and surface metrology.
5. Apply the advances in measurements for quality control in manufacturing Industries.

TEXT BOOKS:

1 Dotson Connie, “Dimensional Metrology”, Cengage Learning, First edition, 2012.
2 Mark Curtis, Francis T. Farago, “Handbook of Dimensional Measurement”, Industrial Press, Fifth edition, 2013.

REFERENCES:

1. AmmarGrous, J “Applied Metrology for Manufacturing Engineering”, Wiley-ISTE, 2011.
2. Galyer, J.F.W. Charles Reginald Shotbolt, “Metrology for Engineers”, Cengage Learning EMEA; 5th revised edition, 1990.
3. National Physical LaboratoryGuideNo. 40, No. 41, No. 42, No. 43, No. 80, No. 118, No. 130, No. 131. http://www.npl.co.uk.
4. Raghavendra N.V. and Krishnamurthy. L., Engineering Metrology and Measurements, Oxford University Press, 2013.
5. Venkateshan, S. P., “Mechanical Measurements”, Second edition, John Wiley &Sons, 2015.

CO	**PO**												**PSO**		
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4	3	2	2	2					1			1	3	2	1
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Low (1) ; Medium (2) ; High (3)															

21154L58 METROLOGY AND DYNAMICS LABORATORY

L	T	P	C
0	0	3	2

COURSE OBJECTIVES

1 To study the different measurement equipment and use of this industry for quality inspection.
2 To supplements the principles learnt in dynamics of machinery.
3 To understand how certain measuring devices are used for dynamic testing.

UNIT – I METROLOGY 30

LIST OF EXPERIMENTS

1. Calibration and use of linear measuring instruments – Vernier caliper, micrometer, Vernier height gauge, depth micrometer, bore gauge, telescopic gauge, Comparators.
2. Measurement of angles using bevel protractor, sine bar, autocollimator, precision level.
3. Measurement of assembly and transmission elements - screw thread parameters – Screw thread Micrometers, Three wire method, Toolmaker's microscope.
4. Measurement of gear parameters - Micrometers, Vernier caliper, Gear tester.
5. Measurement of features in a prismatic component using Coordinate Measuring Machine (CMM), Programming of CNC Coordinate Measuring Machines for repeated measurements of identical components.
6. Non-contact (Optical) measurement using Measuring microscope / Profile projector and Video measurement system.
7. Surface metrology - Measurement of form parameters - Straightness, Flatness, Roundness, Cylindricity, Perpendicularity, Runout, Concentricity – in the given component using Roundness tester.
8. Measurement of Surface finish in components manufactured using various processes (turning, milling, grinding, etc.,) using stylus based instruments.

UNIT – II DYNAMICS LABORATORY 30

List of Experiments:

1. Study of gear parameters.
2. Epicycle gear Train.
3. Determination of moment of inertia of flywheel and axle system.
4. Determination of mass moment of inertia of a body about its axis of symmetry.
5. Undamped free vibrations of a single degree freedom spring-mass system.
6. Torsional Vibration (Undamped) of single rotor shaft system.
7. Dynamic analysis of cam mechanism.
8. Experiment on Watts Governor.
9. Experiment on Porter Governor.
10. Experiment on Proell Governor.
11. Experiment on motorized gyroscope.
12. Determination of critical speed of shafts.

TOTAL:60 PERIODS

OUTCOMES: At the end of the course the students would be able to

1. The students able to measure the gear tooth dimensions, angle using sine bar, straightness.
2. Determine mass moment of inertia of mechanical element, governor effort and range of sensitivity.
3. Determine the natural frequency and damping coefficient, critical speeds of shafts,

CO	PO												PSO		
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2		2	2	3		2	2		1	2	2		2	2	2
3		2	2	3		2	2		1	2	2		3	2	2
Avg	-	2	2	3	-	2	2	-	1	2	2	-	2.6	2	2
Low (1) ; Medium (2) ; High (3)															

21154C62 **HEAT AND MASS TRANSFER**

L	T	P	C
3	1	0	4

COURSE OBJECTIVES

1. To Learn the principal mechanism of heat transfer under steady state and transient conditions.
2. To learn the fundamental concept and principles in convective heat transfer.
3. To learn the theory of phase change heat transfer and design of heat exchangers.
4. To study the fundamental concept and principles in radiation heat transfer.
5. To develop the basic concept and diffusion, convective di mass transfer.

UNIT – I CONDUCTION **12**

General Differential equation - Cartesian, Cylindrical and Spherical Coordinates - One Dimensional Steady State Heat Conduction — plane and Composite Systems - Conduction with Internal Heat Generation - Extended Surfaces – Unsteady Heat Conduction – Lumped Analysis – Semi Infinite and Infinite Solids –Use of Heisler's charts – Methods of enhanced thermal conduction

UNIT – II CONVECTION **12**

Conservation Equations, Boundary Layer Concept – Forced Convection: External Flow – Flow over Plates, Cylinders Spheres and Bank of tubes. Internal Flow - Entrance effects. Free Convection - Flow over Vertical Plate, Horizontal Plate, Inclined Plate, Cylinders and Spheres. Mixed Convection.

UNIT – III PHASE CHANGE HEAT TRANSFER AND HEAT EXCHANGERS **12**

Nusselt's theory of condensation- Regimes of Pool boiling and Flow boiling - Correlations in boiling and condensation. Heat Exchanger Types – TEMA Standards - Overall Heat Transfer Coefficient – Fouling Factors. LMTD and NTU methods. Fundamentals of Heat Pipes and its applications.

UNIT – IV RADIATION **12**

Introduction to Thermal Radiation - Radiation laws and Radiative properties - Black Body and Gray body Radiation - Radiosity - View Factor Relations. Electrical Analogy. Radiation Shields.

UNIT – V MASS TRANSFER **12**

Basic Concepts – Diffusion Mass Transfer – Fick's Law of Diffusion – Steady state and Transient Diffusion - Stefan flow –Convective Mass Transfer – Momentum, Heat and Mass Transfer Analogy – Convective Mass Transfer Correlations.

TOTAL: 60 PERIODS

OUTCOMES: At the end of the course the students would be able to

1. Apply heat conduction equations to different surface configurations under steady state and transient conditions and solve problems.
2. Apply free and forced convective heat transfer correlations to internal and external flows through/over various surface configurations and solve problems.
3. Explain the phenomena of boiling and condensation, apply LMTD and NTU methods of thermal analysis to different types of heat exchanger configurations and solve problems.
4. Explain basic laws for Radiation and apply these principles to radiative heat transfer between different types of surfaces to solve problems.
5. Apply diffusive and convective mass transfer equations and correlations to solve problems for different applications.

TEXT BOOKS:

1. R.C. Sachdeva, "Fundamentals of Engineering Heat & Mass transfer", New Age International Publishers, 2009
2. Yunus A. Cengel, "Heat Transfer A Practical Approach" - Tata McGraw Hill, 5thEdition - 2013

REFERENCES:

1. Frank P. Incropera and David P. Dewitt, "Fundamentals of Heat and Mass Transfer", John Wiley & Sons, 7th Edition, 2014.
2. Holman, J.P., "Heat and Mass Transfer", Tata McGraw Hill, 2010
3. Kothandaraman, C.P., "Fundamentals of Heat and Mass Transfer", New Age International, New Delhi, 2012
4. Ozisik, M.N., "Heat Transfer", McGraw Hill Book Co., 1994.
5. S.P. Venkateshan, "Heat Transfer", Ane Books, New Delhi, 2014

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3	3	3	3	2					1			1	3	2	1
4	3	3	3	2					1			1	3	2	1
5	3	3	3	2					1			1	3	2	1
Low (1) ; Medium (2) ; High (3)															

21154L68 **CAD/CAM LABORATORY**

L	T	P	C
0	0	4	2

COURSE OBJECTIVES

1 To gain practical experience in handling 2D drafting and 3Dmodelling software systems
2 Designing 3 Dimensional geometric model of parts, sub-assemblies, assemblies and exporting it to drawing
3 Programming G & M Code programming and simulate the CNC program and Generating part programming data through CAM software

3D GEOMETRIC MODELLING **30**

1. CAD Introduction
   Sketch:
   Solid modeling: Extrude, Revolve, Sweep, Variational sweep and Loft.
   Surface modeling: Extrude, Sweep, Trim, Mesh of curves and Free form.
   Feature manipulation: Copy, Edit, Pattern, Suppress, History operations.
   Assembly: Constraints, Exploded Views, Interference check
   Drafting: Layouts, Standard & Sectional Views, Detailing & Plotting
2. Creation of 3D assembly model of following machine elements using 3D Modelling software
   1. Flange Coupling
   2. Plummer Block
   3. Screw Jack
   4. Lathe Tailstock
   5. Universal Joint
   6. Machine Vice
   7. Stuffing box
   8. Crosshead
   9. Safety Valves
   10. Non-return valves
   11. Connecting rod
   12. Piston
   13. Crankshaft

* Students may also be trained in manual drawing of some of the above components (specify the number - progressive arrangement of 3D)

30

MANUAL PART PROGRAMMING

1. CNC Machining Centre
   i) Linear Cutting.
   ii) Circular cutting.
   iii) Cutter Radius Compensation.
   iv) Canned Cycle Operations.

2. CNC Turning Centre
   i) Straight, Taper and Radial Turning.
   ii) Thread Cutting.
   iii) Rough and Finish Turning Cycle.
   iv) Drilling and Tapping Cycle.

3. COMPUTER AIDED PART PROGRAMMING
   i) Generate CL Data and Post process data using CAM packages for Machining and Turning Centre.
   ii) Application of CAPP in Machining and Turning

TOTAL:60 PERIODS

OUTCOMES: At the end of the course the students would be able to

1. Design experience in handling 2D drafting and 3D modelling software systems
2. Design 3 Dimensional geometric model of parts, sub-assemblies, assemblies and export it to drawing
3. Demonstrate manual part programming and simulate the CNC program and Generate part programming using G and M code through CAM software.

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	2	2	2	2	3				2			1	3	3	1
2	2	2	2	2	3				2			1	3	3	1
3	2	2	2	2	3				2			1	3	3	1
Low (1) ; Medium (2) ; High (3)															

21154L69 **HEAT TRANSFER LABORATORY**

L	T	P	C
0	0	4	2

COURSE OBJECTIVES

1 To gain experimental knowledge of Predicting the thermal conductivity of solids and liquids.
2 To gain experimental knowledge of Estimating the heat transfer coefficient values of various fluids.
3 To gain experimental knowledge of Testing the performance of tubes in tube heat exchangers

LIST OF EXPERIMENTS:

1. Thermal conductivity measurement of pipe insulation using lagged pipe apparatus.
2. Determination of thermal conductivity of a composite wall, insulating powder, oils, and water.
3. Determination of heat transfer coefficient of air under natural convection and forced convection.
4. Heat transfer from pin-fin under natural and forced convection.
5. Determination of heat flux under pool boiling and flow boiling in various regimes.
6. Determination of heat transfer coefficient in film-wise and drop-wise condensation.
7. Determination of friction factor, heat transfer coefficient of cold/hot fluid and effectiveness of a tube-in-tube heat exchanger.
8. Determination of Stefan - Boltzmann constant.
9. Determination of emissivity of a grey surface.
10. Calibration of thermocouples / RTDs at standard reference temperatures.

TOTAL : 60 PERIODS

OUTCOMES: At the end of the course the students would be able to

1. Conduct experiment on Predict the thermal conductivity of solids and liquids
2. Conduct experiment on Estimate the heat transfer coefficient values of various fluids.
3. Conduct experiment on Test the performance of tubes in tube heat exchangers

CO	PO												PSO		
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1	1	1	3	2					1			1	2	2	3
2	1	1	3	2					1			1	2	2	3
3	1	1	3	2					1			1	2	2	3
Low (1) ; Medium (2) ; High (3)															

21154C71 **MECHATRONICS AND IoT**

L	T	P	C
3	0	0	3

COURSE OBJECTIVES

1 To make students get acquainted with the sensors and the actuators, which are commonly used in mechatronics systems.
2 To provide insight into the signal conditioning circuits, and also to develop competency in PLC programming and control
3 To make students familiarize with the fundamentals of IoT and Embedded systems.
4 To impart knowledge about the Arduino and the Raspberry Pi.
5 To inculcate skills in the design and development of mechatronics and IoT based systems.

UNIT – I SENSORS AND ACTUATORS 9

Introduction to Mechatronics - Modular Approach, Sensors and Transducers: Static and Dynamic Characteristics, Transducers - Resistive, Capacitive, Inductive and Resonant, Optical Sensors – Photodetectors - Vision Systems – Laser - Fibre optic - Non-fibre Optic, Solid State Sensors, Piezoelectric and Ultrasonic Sensors. Actuators - Brushless Permanent Magnet DC Motor - PM, VR and Hybrid Stepper motors – DC and AC Servo Motors

UNIT – II SIGNAL CONDITIONING CIRCUITS AND PLC 9

Operational Amplifiers – Inverting and Non-Inverting Amplifier – Wheatstone bridge Amplifier – Instrumentation Amplifier – PID Controller, Protection Circuits, Filtering Circuits, Multiplexer, Data Logger and Data Acquisition System –, Switching Loads by Power Semiconductor Devices Circuits - Thyristors - TRIAC – Darlington Pair –MOSFET and Relays.
PLC – Architecture – Input / Output Processing – Logic Ladder Programming – Functional Block Programming using Timers and Counters – Applications.

UNIT – III FUNDAMENTALS OF IoT AND EMBEDDED SYSTEMS 9

The Internet of Things (IoT) - Introduction to the IoT Framework – IoT Enabling Technologies- The Effective Implementation of IoT: The Detailed Procedure. Embedded Systems: An Introduction - Single-Chip Microcontroller Systems - Single-Board Microcontroller Systems - Single-Board Computer Systems - Embedded Systems: Peripherals - Software Considerations

UNIT – IV CONTROLLERS 9

Foundation topics: Programming Languages: C++ and Python - The Linux Operating System. Arduino: The Arduino Boards - Arduino Peripherals- Arduino IDE – ESP8266 Wi-Fi module. Raspberry Pi: The Raspberry Pi Boards - The Raspberry Pi Peripherals - The Raspberry Pi Operating System. (typical peripherals) Interfacing and Controlling I/O devices by Arduino and Raspberry Pi: LEDs - Push buttons - Light intensity sensor - Ultrasonic distance sensor – Temperature sensor- Humidity sensor - Sensor and Actuator interactions

UNIT – V MECHATRONICS AND IoT CASE STUDIES 9

Mechatronics systems: Drone actuation and Control -Autonomous Robot with Vision System, Automotive Mechatronics: Electronic Ignition System - ABS - EBD - Adaptive Cruise Control. IoT case studies: Remote Monitoring Systems- Remotely Operated Autonomous Systems - Centralized Water Management System - IoT Enabled Robotic Camera Dolly - Portable, Wireless, Interactive IoT Sensors for Agriculture - IoT Vehicle Management System with Network Selection.

TOTAL:45 PERIODS

OUTCOMES: At the end of the course the students would be able to

1. Explain Select suitable sensors and actuators to develop mechatronics systems.
2. Discuss Devise proper signal conditioning circuit for mechatronics systems, and also able to implement PLC as a controller for an automated system.
3. Elucidate the fundamentals ofIot and Embedded Systems
4. Discuss Control I/O devices through Arduino and Raspberry Pi.
5. Design and develop an apt mechatronics/IoT based system for the given real-time application.

TEXT BOOKS:

1. Bradley D.A., Burd N.C., Dawson D., Loader A.J., "Mechatronics: Electronics in Products and Processes", Routledge, 2017.
2. Sami S.H and Kisheen Rao G "The Internet of Mechanical Things: The IoT Framework for Mechanical Engineers", CRC Press, 2022.

REFERENCES:

1. John Billingsley, "Essentials of Mechatronics", Wiley, 2006
2. David H., Gonzalo S., Patrick G.,Rob B. and Jerome H.,"IoT Fundamentals: Networking Technologies, Protocols, and Use Cases for the Internet of Things", Pearson Education, 2018.
3. Nitin G and Sharad S, "Internet of Things: Robotic and Drone Technology", CRC Press, 2022
4. Newton C. Braga, "Mechatronics for The Evil Genius", McGrawHill, 2005.
5. Bell C., "Beginning Sensor Networks with Arduino and Raspberry Pi", Apress, 2013

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	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
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3	3	1	2	1	2	-	2	-	-	-	-	-	1	2	3
4	3	3	3	3	3	-	-	-	3	-	-	3	1	2	3
5	3	3	3	3	3	-	2	-	3	-	-	3	1	2	3
Low (1) ; Medium (2) ; High (3)															

21154C72 COMPUTER INTEGRATED MANUFACTURING

L	T	P	C
3	0	0	3

COURSE OBJECTIVES

1. To provide the overview of evolution of automation, CIM and its principles.
2. To learn the various Automation tools, include various material handling system.
3. To train students to apply group technology and FMS.
4. To familiarize the computer aided process planning in manufacturing.
5. To introduce to basics of data transaction, information integration and control of CIM.

UNIT – I INTRODUCTION 9

Introduction to CAD, CAM, CAD/CAM and CIM - Evolution of CIM – CIM wheel and cycle – Production concepts and mathematical models - Simple problems in production models - CIM hardware and software – Major elements of CIM system – Three step process for implementation of CIM – Computers in CIM – Computer networks for manufacturing – The future automated factory – Management of CIM – safety aspects of CIM– advances in CIM

UNIT – II AUTOMATED MANUFACTURING SYSTEMS 9

Automated production line - system configurations, work part transfer mechanisms – Fundamentals of Automated assembly system – System configuration, Part delivery at workstations – Design for automated assembly - Overview of material handling equipments – Consideration in material handling system design – The 10 principles of Material handling. Conveyor systems – Types of conveyors – Operations and features. Automated Guided Vehicle system – Types &applications – Vehicle guidance technology – Vehicle management and safety. Storage system performance – storage location strategies – Conventional storage methods and equipments – Automated storage/Retrieval system and Carousel storage system Deadlocks in Automated manufacturing systems – Petrinet models – Applications in Dead lock avoidance – smart manufacturing – Industry 4.0 – Digital manufacturing – Virtual manufacturing

UNIT – III GROUP TECHNOLOGY AND FMS 9

Part families – Visual – Parts classification and coding – Production flow analysis – Grouping of parts and Machines by rank order clustering method – Benefits of GT – Case studies. FMS – Components – workstations – FMS layout configurations – Computer control systems – FMS planning and implementation issues – Architecture of FMS – flow chart showing various operations in FMS – Machine cell design – Composite part concept, Holier method, Key machine concept – Quantitative analysis of FMS – Bottleneck model – Simple and complicated problems – Extended Bottleneck model - sizing the FMS — FMS applications, Benefits.

UNIT – IV PROCESS PLANNING 9

Process planning – Activities in process planning, Informations required. From design to process planning – classification of manufacturing processes – Selection of primary manufacturing processes – Sequencing of operations according to Anteriorities – various examples – forming of Matrix of Anteriorities – case study. Typical process sheet – case studies in Manual process planning. Computer Aided Process Planning – Process planning module and data base – Variant process planning – Two stages in VPP – Generative process planning – Flow chart showing various activities in generative PP - Semi generative process planning- Comparison of CAPP and Manual PP.

UNIT – V PROCESS CONTROL AND DATA ANALYSIS 9

Introduction to process model formulation – linear feedback control systems – Optimal control – Adaptive control –Sequence control and PLC& SCADA. Computer process control – Computer process interface – Interface hardware – Computer process monitoring – Direct digital control and Supervisory computer control - Overview of Automatic identification methods – Bar code technology –Automatic data capture technologies.- Quality management (SPC) and automated inspection

TOTAL :45 PERIODS

OUTCOMES: At the end of the course the students would be able to

1. Discuss the basics of computer aided engineering.
2. Choose appropriate automotive tools and material handling systems.
3. Discuss the overview of group technology, FMS and automation identification methods.
4. Design using computer aided process planning for manufacturing of various components
5. Acquire knowledge in computer process control techniques.

TEXT BOOKS:

1. Shivanand H K, Benal M M and Koti V, Flexible Manufacturing System, New Age, 2016.
2. CIM: Computer Integrated Manufacturing: Computer Steered Industry Book by August-Wilhelm Scheer

REFERENCES:

1. Alavudeen and Venkateshwaran, Computer Integrated Manufacturing‖, PHI Learning Pvt. Ltd., New Delhi, 2013.
2. Gideon Halevi and Ronald D. Weill, Principles of Process Planning‖, Chapman Hall, 1995.
3. James A. Retrg, Herry W. Kraebber, Computer Integrated Manufacturing‖, Pearson Education, Asia,3rdEdition,2004.
4. Mikell P. Groover, Automation, Production system and Computer integrated Manufacturing, Prentice Hall of India Pvt. Ltd., 4thEdition, 2014.
5. Radhakrishnan P, Subramanian S and Raju V, CAD/CAM/CIM, New Age International Publishers, 3rd Edition, 2008.

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3	3	2	2	1	2				1			1	2	1	3
4	3	2	2	1	2				1			1	2	1	3
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Low (1) ; Medium (2) ; High (3)

21154C73 PROFESSIONAL ETHICS IN ENGINEERING LT P C
3 0 0 3

OBJECTIVES: • To enable the students to create an awareness on Engineering Ethics and Human Values, to instill Moral and Social Values and Loyalty and to appreciate the rights of others.

UNIT I HUMAN VALUES 10 Morals, values and Ethics – Integrity – Work ethic – Service learning – Civic virtue – Respect for others – Living peacefully – Caring – Sharing – Honesty – Courage – Valuing time – Cooperation – Commitment – Empathy – Self confidence – Character – Spirituality – Introduction to Yoga and meditation for professional excellence and stress management.

UNIT II ENGINEERING ETHICS 9
Senses of 'Engineering Ethics' – Variety of moral issues – Types of inquiry – Moral dilemmas – Moral Autonomy – Kohlberg's theory – Gilligan's theory – Consensus and Controversy – Models of professional roles - Theories about right action – Self-interest – Customs and Religion – Uses of Ethical Theories.

UNIT III ENGINEERING AS SOCIAL EXPERIMENTATION 9
Engineering as Experimentation – Engineers as responsible Experimenters – Codes of Ethics – A Balanced Outlook on Law.

UNIT IV SAFETY, RESPONSIBILITIES AND RIGHTS 9 Safety and Risk – Assessment of Safety and Risk – Risk Benefit Analysis and Reducing Risk - Respect for Authority – Collective Bargaining – Confidentiality – Conflicts of Interest – Occupational Crime – Professional Rights – Employee Rights – Intellectual Property Rights (IPR) – Discrimination.

UNIT V GLOBAL ISSUES 8 Multinational Corporations – Environmental Ethics – Computer Ethics – Weapons Development – Engineers as Managers – Consulting Engineers – Engineers as Expert Witnesses and Advisors – Moral Leadership –Code of Conduct – Corporate Social Responsibility.

TOTAL: 45 PERIODS

OUTCOMES: • Upon completion of the course, the student should be able to apply ethics in society, discuss the ethical issues related to engineering and realize the responsibilities and rights in the society.

TEXT BOOKS:

1. Mike W. Martin and Roland Schinzinger, "Ethics in Engineering", Tata McGraw Hill, New Delhi, 2003.
2. Govindarajan M, Natarajan S, Senthil Kumar V. S, "Engineering Ethics", Prentice Hall of India, New Delhi, 2004.

REFERENCES:

1. Charles B. Fleddermann, "Engineering Ethics", Pearson Prentice Hall, New Jersey, 2004.
2. Charles E. Harris, Michael S. Pritchard and Michael J. Rabins, "Engineering Ethics – Concepts and Cases", Cengage Learning, 2009.

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3			1	1		3	2	3	2	3	2	3	1	1	1
4			1	1		3	2	3	2	3	2	3	1	1	1
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Low (1) ; Medium (2) ; High (3)

21154C74 **INDUSTRIAL MANAGEMENT** **L T**
3 0

COURSE OBJECTIVES

1	To study the basic concepts of management; approaches to management; Contributors tomanagement studies; various forms of business organization and trade unions function in professional organizations.
2	To study the planning; organizing and staffing functions of management in professional organization.
3	To study the leading; controlling and decision making functions of management in professionalorganization.
4	To learn the organizational theory in professional organization.
5	To learn the principles of productivity and modern concepts in management in professional organization.

UNIT – I INTRODUCTION TO MANAGEMENT

Management: Introduction; Definition and Functions - Approaches to the study of Management - Mintzberg's Ten Managerial Roles - Principles of Taylor; Fayol; Weber; Parker - Forms of Organization: Sole Proprietorship; Partnership; Company (Private and Public); Cooperative - Public Sector Vs Private Sector Organization - Business Environment: Economic; Social; Political; Legal - Trade Union: Definition; Functions; Merits & Demerits.

UNIT – II FUNCTIONS OF MANAGEMENT - I

Planning: Characteristics; Nature; Importance; Steps; Limitation; Planning Premises; Strategic Planning; Vision & Mission statement in Planning- Organizing: Organizing Theory; Principles; Types; Departmentalization; Centralization and Decentralization; Authority & Responsibility – Staffing: Systems Approach; Recruiting and Selection Process; Human Resource Development (HRD) Concept and Design.

UNIT – III FUNCTIONS OF MANAGEMENT - II

Directing (Leading): Leadership Traits; Style; Morale; Managerial Grids (Blake-Mounton, Reddin) - Communication: Purpose; Model; Barriers – Controlling: Process; Types; Levels; Guidelines; Audit (External, Internal, Merits); Preventive Control - Decision Making: Elements; Characteristics; Nature; Process; Classifications.

UNIT – IV ORGANIZATION THEORY

Organizational Conflict: Positive Aspects; Individual; Role; Interpersonal; Intra Group; Inter Group; Conflict Management – Maslow's hierarchy of needs theory; Herzberg's motivation-hygiene theory; McClelland's three needs motivation theory; Vroom's valence-expectancy theory – Change Management: Concept of Change; Lewin's Process of Change Model; Sources of Resistance; Overcoming Resistance; Guidelines to managing Conflict.

UNIT – V PRODUCTIVITY AND MODERN TOPICS

Productivity: Concept; Measurements; Affecting Factors; Methods to Improve – Modern Topics (concept, feature/characteristics, procedure, merits and demerits): Business Process Reengineering (BPR); Benchmarking; SWOT/SWOC Analysis; Total Productive Maintenance; Enterprise Resource Planning (ERP); Management of Information Systems (MIS), Industry 4.0.

TOTAL:45 PERIODS

OUTCOMES: At the end of the course the students would be able to

1. Discuss basic concepts of management; approaches to management; contributors to managementstudies; various forms of business organization and trade unions function in professional organizations.
2. Discuss the planning; organizing and staffing functions of management in professional organization.
3. Apply the leading; controlling and decision making functions of management in professional organization.
4. Discuss the organizational theory in professional organization.
5. Apply principles of productivity and modern concepts in management in professional organization.

TEXT BOOKS:

1. M. Govindarajan and S. Natarajan, "Principles of Management", Prentice Hall of India, New Delhi, 2009.
2. Koontz. H. and Weihrich. H., "Essentials of Management: An International Perspective", 8th Edition, TataMcGrawhill, New Delhi, 2010.

REFERENCES:

1. Joseph J, Massie, "Essentials of Management", 4th Edition, Pearson Education, 1987.
2. Saxena, P. K., "Principles of Management: A Modern Approach", Global India Publications, 2009.
3. S.Chandran, "Organizational Behaviours", Vikas Publishing House Pvt. Ltd., 1994.
4. Richard L. Daft, "Organization Theory and Design", South Western College Publishing, 11th Edition, 2012.
5. S. TrevisCerto, "Modern Management Concepts and Skills", Pearson Education, 2018.

CO	PO												PSO		
										10	11	12	1	2	3
1										3	2	3	1	1	[illegible]
2										3	2	3	1	1	[illegible]
3										3	2	3	1	1	[illegible]
4										3	2	3	1	1	[illegible]
5										3	2	3	1	1	[illegible]

Low (1) ; Medium (2) ; High (3)

21154L79 **MECHATRONICS AND IoT LABORATORY**

L	*T*	*P*	*C*
0	*0*	*3*	*2*

Course Objectives

1. To study the concept of mechatronics to design, modelling and analysis of basic electrical hydraulic systems.
2. To provide the hands on-training in the control of linear and rotary actuators.
3. To study the concepts and fundamentals of IoT, sensors, actuators and IoT boards

MECHATRONICS

LIST OF EXPERIMENTS:

1. Measurement of Linear/Angular of Position, Direction and Speed using Transducers.
2. Measurement of Pressure, Temperature and Force using Transducers.
3. Speed and Direction control of DC Servomotor, AC Servomotor and Induction motors.
4. Addition, Subtraction and Multiplication Programming in 8051.
5. Programming and Interfacing of Stepper motor and DC motor using 8051/PLC.
6. Programming and Interfacing of Traffic Light Interface using 8051.
7. Sequencing of Hydraulic and Pneumatic circuits.
8. Sequencing of Hydraulic, Pneumatic and Electro-pneumatic circuits using Software.
9. Electro-pneumatic/hydraulic control using PLC.
10. Vision based image acquisition and processing technique for inspection and classification.

INTERNET OF THINGS

1. Familiarization with concept of IoT and its open source microcontroller/SBC.
2. Write a program to turn ON/OFF motor using microcontroller/SBC through internet.
3. Write a program to interface sensors to display the data on the screen through internet.
4. Interface the sensors with microcontroller/SBC and write a program to turn ON/OFF Solenoid valve through internet when sensor data is detected.
5. To interface sensor with microcontroller/SBC and write a program to turn ON/OFF Linear/Rotary Actuator through IoT when sensor data is detected.
6. To interface Bluetooth/Wifi with microcontroller/SBC and write a program to send sensor data to smart phone using Bluetooth/wifi.

TOTAL : 60 PERIODS

OUTCOMES: At the end of the course the students would be able to

1. Demonstrate the functioning of mechatronics systems with various pneumatic, hydraulic and electrical systems.
2. Demonstrate the microcontroller and PLC as controllers in automation systems by executing proper interfacing of I/O devices and programming
3. Demonstrate of IoT based Home automation, CNC router, Robotic arm.

					PO							PSO
3	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	1	3	-	-	-	3	-	-	3	1	1	3
1	1	3	-	-	-	3	-	-	3	1	1	3
3	3	3	-	-	-	3	-	-	3	3	3	3
Low (1) ; Medium (2) ; High (3)												

21154E53A	CAD/CAM	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

1 To Introduce and understand the Basic of Design.
2 To study the two dimensional drafting and bill of material creation.
3 To learn three dimensional modelling and its advantages.
4 To study the basic and purpose of assembling modeling.
5 To study the basics of computer aided machining and part programming.

UNIT – I BASICS OF DESIGNS 9

Understanding of Projections, Scales, units, GD & T; its 14 symbols, Special characteristics & Title Block readings. Revision / ECN status of drawings – Customer Specific requirements – Drawing Grid reading

UNIT – II 2D DRAFTING 9

Projection views – Orthographic view, Axillary view, Full & Half Section views, Broken Section view, Offset Section view - Title Block creation - BOM Creation - Notes creation - Ballooning of 2D drawing and its features for Inspection reporting

UNIT – III 3D MODELING 9

Conversion of Views – 2D to 3D & 3D to 2D – Parametric and Non-Parametric Modeling – Tree features of 3D Modeling and its advantages – Surface Modeling – BIW (Body In White) – Solid Modeling, Boolean operations like Unites, Subtraction, Intersect, etc.

UNIT – IV ASSEMBLY MODELING 9

Basics of Assembly modeling, Purpose of Assembly modeling & amp; its advantages - Top to Down & BottomUp modeling approaches - Analysis of Clearances - Undercuts - Interferences - Stack up analysis -Cumulative effect of Tolerances in after assembly conditions.- motion analysis

UNIT – V CAM 9

Basics of CNC Machining – 3, 4 & 5 Axis machines - CNC and Part Programing, CAM programing 2D & 3D. Elements of CAM Orientation, Boundary Creation, Cutter Path Selection, Cutter Compensation -Machining Stocks, Roughing, Re-roughing, Semi Finishing & Finishing - Tool Path Generation, Isl and Milling Programing. Machining program simulation, integration of program with machine; Estimation of CNC Cycle time. – Post Process NC Code conversion and Setup Sheet Preparation.

TOTAL : 45 PERIODS

OUTCOMES: At the end of the course the students would be able to

1. Discuss the basics of the design and concepts.
2. Develop the two dimensional drafting and projection views.
3. Discuss the three dimensional modeling, parametric and Non-parametric modeling
4. Discuss the assembly modeling and top down, bottom up approaches.
5. Develop the computer aided machining and wirting part programming.

TEXT BOOKS:

1. Computer Aided Design & Manufacturing - Jacob Moses & Ruchi Agarwal
2. CAD / CAM Principles & Application - J. Srinivas

REFERENCES:

1. CAD / CAM - Ibrahim Zaid (Text & Reference Book)
2. CAD / CAM – Chandandeep Grewal
3. CAD CAM & Automation - FarazdakHaideri (Text & Reference Book)
4. Computer Aided Design & Manufacturing – Anup Goel
5. CAD / CAM – PN Rao

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	3	2	2	2	2				1			1	3	3	2
2	3	2	2	2	2				1			1	3	3	2
3	3	2	2	2	2				1			1	3	3	2
4	3	2	2	2	2				1			1	3	3	2
5	3	2	2	2	2				1			1	3	3	2
Low (1) ; Medium (2) ; High (3)															

21154E53B VALUE EGNINEERING L T P C
3 0 0 3

COURSE OBJECTIVES

1. To study the value engineering process and able to identify its functions within the process.
2. To determine the appropriate value engineering methodology for a given project and proposeappropriate training to centralized and decentralized modes.
3. To learn various decision-making processes and cost evaluation models and apply them inappropriately in the product development life-cycle.
4. To explore in-depth understanding of various value engineering applications in humanresources, manufacturing and marketing.
5. To demonstrate to implement value engineering solutions and propose to perfect them.

UNIT – I VALUE ENGINEERING BASICS 9

Origin of value engineering - Meaning of value engineering - Definition of value engineering and Value analysis- Value Management - Value Analysis Versus Value Engineering - Value Analysis versus Traditional cost reduction techniques - Types of Value function – Basic and Secondary functions - concept of cost and worth - creativity In Value Engineering - uses, applications, advantages and limitations of Value analysis.

UNIT – II VALUE ENGINEERING JOB PLAN AND PROCESS 9

Seven phases of job plan - FAST Diagramming as Value Engineering Tool - Behavioral and organizational aspects of Value Engineering - Ten principles of Value analysis - Benefits of Value Engineering.

UNIT – III VALUE ENGINEERING TECHNIQUES 9

Creativity - Brain storming - Gordon technique - Morphological Analysis - ABC Analysis- Probabilistic approach - Make or Buy decisions – Function cost worth analysis (FCWA) - Function Analysis System technique (FAST) - Break Even Analysis - Life cycle cost(LCC)

UNIT – IV WORKSHEETS AND GUIDELINES 9

Preparation of worksheets - general and information phase - Function Classification, relationship and summary - Meaningful costs - Cost analysis - idea listing and comparison - Feasibility ranking - Investigator phase, study summary - guidelines for writing value engineering proposal - Financial aspects - List cycle cost analysis - Oral presentation - Audit - Case studies and Discussion.

UNIT – V VERSATILITY OF VALUE ENGINEERING 9

Value engineering operation in maintenance and repair activities - value engineering in non hardware projects - Initiating a value engineering programme Introduction - training plan - career development for value engineering specialties.

Total :45 Periods

OUTCOMES: At the end of the course the students would be able to

1. Estimate a product cost based on value engineering principles in terms of its values, functions and worthiness.
2. Discuss the product and articulate it in various phases of value engineering
3. Discuss and select appropriate methods, standards and apply them on value engineering project and propose appropriate training
4. Apply querying theory and FAST to prefect a value engineering project implementation.
5. Develop various case studies related to value engineering project implementation.

TEXT BOOKS:

1. Iyer. S.S., “Value Engineering”, New Age International (P) Limited, 9th Edition, 2009 3Ed”, , 2009.
2. Anil Kumar. and Mukhopadhyaya., “Value Engineering: Concepts Techniques and applications”, SAGE Publications, 1st Edition, 2003.

REFERENCES:

1. Del L. Younker., “Value Engineering: analysis and methodology”, CRC Press, 2003.
2. Richard Park., “Value Engineering A Plan for Invention”, CRC Press, 1998.
3. Arthur E. Mudge., “Value Engineering :A systematic approach", McGraw Hill, 1989.
4. Alphonse Dell'Isola., “Value Engineering: Practical Applications...for Design, Construction, Maintenance and Operations”, R.S. Means Company, 1997.
5. Lawrence D. Miles., “Techniques of Value Analysis and Engineering”, Lawrence D. Miles Value Foundation, 3rd Edition, 2015.

CO	PO												PSO		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	1			1			1	2	1		3	1	1	2	1
2	1			1			1	2	1		3	1	1	2	1
3	1			1			1	2	1		3	1	1	2	1
4	1			1			1	2	1		3	1	1	2	1
5	1			1			1	2	1		3	1	1	2	1
Low (1) ; Medium (2) ; High (3)															

21154E53C	PRODUCT LIFE CYCLE MANAGEMENT	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

1 To study about the history, concepts and terminology in PLM
2 To learn the functions and features of PLM/PDM
3 To develop different modules offered in commercial PLM/PDM tools
4 To demonstrate PLM/PDM approaches for industrial applications
5 To use PLM/PDM with legacy data bases, Coax& ERP systems

UNIT – I HISTORY, CONCEPTS AND TERMINOLOGY OF PLM 9

Introduction to PLM, Need for PLM, opportunities of PLM, Different views of PLM - Engineering Data Management (EDM), Product Data Management (PDM), Collaborative Product Definition Management (cPDm), Collaborative Product Commerce (CPC), Product Lifecycle Management (PLM). PLM/PDM Infrastructure – Network and Communications, Data Management, Heterogeneous data sources and applications

UNIT – II PLM/PDM FUNCTIONS AND FEATURES 9

User Functions - Data Vault and Document Management, Workflow and Process Management, Product Structure Management, Product Classification and Programme Management. Utility Functions – Communication and Notification, data transport, data translation, image services, system administration and application integration

UNIT – III DETAILS OF MODULES IN A PDM/PLM SOFTWARE 9

Case studies based on top few commercial PLM/PDM tools – Teamcenter, Windchill, ENOVIA, Aras PLM, SAP PLM, Arena, Oracle Agile PLM and Autodesk Vault.- Architecture of PLM software- selection criterion of software for particular application - Brand name to be removed

UNIT – IV ROLE OF PLM IN INDUSTRIES 9

Case studies on PLM selection and implementation (like auto, aero, electronic) - other possible sectors, PLM visioning, PLM strategy, PLM feasibility study, change management for PLM, financial justification of PLM, barriers to PLM implementation, ten step approach to PLM, benefits of PLM for–business, organisation, users, product or service, process performance- process compliance and process automation

UNIT – V BASICS ON CUSTOMISATION/INTEGRATION OF PDM/PLM SOFTWARE 9

PLM Customization, use of EAI technology (Middleware), Integration with legacy data base, CAD, SLMand ERP

TOTAL: 45 PERIODS

OUTCOMES: At the end of the course the students would be able to

1. Summarize the history, concepts and terminology of PLM
2. Develop the functions and features of PLM/PDM
3. Discuss different modules offered in commercial PLM/PDM tools.
4. Interpret the implement PLM/PDM approaches for industrial applications.
5. Integrate PLM/PDM with legacy data bases, CAx& ERP systems

TEXT BOOKS:

1. Product Lifecycle Management for a Global Market, Springer; 2014 edition (29 September2016),ISBN-10 : 3662516330
2. Product Life Cycles and Product Management, Praeger Publishers Inc (27 March 1989)ISBN-10 :0899303196

REFERENCES:
1. AnttiSaaksvuori and AnselmiImmonen, “Product Lifecycle Management”, Springer Publisher, 2008 (3rd Edition)
2. IvicaCrnkovic, Ulf Asklund and AnnitaPerssonDahlqvist, “Implementing and Integrating Product Data Management and Software Configuration Management”, Artech House Publishers, 2003.
3. John Stark, “Global Product: Strategy, Product Lifecycle Management and the Billion Customer Question”, Springer Publisher, 2007
4. John Stark, “Product Lifecycle Management: 21st Century Paradigm for Product Realisation”, Springer Publisher, 2011 (2nd Edition).
5. Michael Grieves, “Product Life Cycle Management”, Tata McGraw Hill, 2006.

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	1	1	3	1				1	1			1	1	3	3
2	1	1	3	1				1	1			1	1	3	3
3	1	1	3	1				1	1			1	1	3	3
4	1	1	3	1				1	1			1	1	3	3
5	1	1	3	1				1	1			1	1	3	3

Low (1) ; Medium (2) ; High (3)

21154E54A	ROBOTICS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

1. To learn about basics of robots and their classifications
2. To understand the robot kinematics in various planar mechanisms
3. To learn about the concepts in robot dynamics
4. To understand the concepts in trajectory planning and programming
5. To know about the various applications of robots

UNIT – I BASICS OF ROBOTICS 8

Introduction- Basic components of robot-Laws of robotics- classification of robot- robot architecture, work space-accuracy-resolution -repeatability of robot.

UNIT – II ROBOT KINMEATICS 11

Robot kinematics: Introduction- Matrix representation- rigid motion & homogeneous transformation- D-H, forward & inverse kinematics of 2DOF and 3 DOF planar and spatial mechanisms

UNIT – III ROBOT DYNAMICS 9

Introduction - Manipulator dynamics – Lagrange - Euler formulation- Newton - Euler formulation

UNIT – IV TRAJECTORY, PATH PLANNING AND PROGRAMMING 8

Trajectory Planning- Joint space and Cartesian space technique, Introduction to robot control, Robot programming and Languages- Introduction to ROS

UNIT – V ROBOT AND ROBOT APPLICATIONS 9

Sensors and Actuators for Robots, Power transmission systems, Rotary to rotary motion, Rotary to linear motion, Harmonics drives – gear system - belt drives. Robot end effectors & Grippers: Introduction- types & classification- Mechanical gripper- gripper force analysis- other types & special purpose grippers. Robot Applications: pick and place, manufacturing, automotive, medical, space and underwater.

TOTAL: 45 PERIODS

COURSE OUTCOMES

Upon completion of this course, the students can able to
CO1: State the basic concepts and terminologies of robots
CO2:Know the Procedures for Forward and Inverse Kinematics, Dynamics for Various Robots
CO3: Derive the Forward and Inverse Kinematics, Dynamics for Various Robots
CO4:Apply the various programming techniques in industrial applications
CO5: Analyze the use of various types of robots in different applications

Mapping of COs with POs and PSOs

COs/POs&PSOs	POs												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	3	2	3	1	2							1	2	1	3
CO2	3	2	3	1	2							1	2	1	3
CO3	3	2	3	1	2							1	2	1	3
CO4	3	2	3	1	2							1	2	2	3
CO5	3	2	3	1	3							1	2	2	3
CO/PO & PSO Average	3	2	3	1	2.2							1	2	1.4	3
1 – Slight, 2 – Moderate, 3 – Substantial															

TEXT BOOKS:

1. John.J.Craig, " Introduction to Robotics: Mechanics & control", Pearson Publication, Fourth edition, 2018.
2. K.S.Fu, R.C.Gonzalez, C.S.G.Lee, "Robotics: Sensing, Vision & Intelligence", Tata McGraw-Hill Publication, First Edition, 1987.

REFERENCES:

1. M.P.Groover, M.Weiss ,R.N. Nagal, N.G.Odrey, "Industrial Robotics - Technology, programming and Applications" Tata , McGraw-Hill Education Pvt Limited 2ndEdition, 2012.
2. Jazar, "Theory of Applied Robotics: Kinematics, Dynamics and Control", Springer, 2ndEdition, 2010
3. S K Saha, Introduction to Robotics, Tata McGraw-Hill, ISBN: 9789332902800, Second Edition, 9789332902800
4. Sathya Ranjan Deb, "Robotics Technology & flexible Automation" Second edition, Tata McGraw-Hill Publication, 2009.

21154E54B	SMART MOBILITY AND INTELLIGENT VEHICLES	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

The objectives of the course are:

1. To introduce students to the various technologies and systems used to implement smart mobility and intelligent vehicles.
2. To learn Basics of Radar Technology and Systems, Ultrasonic Sonar Systems, LIDAR Sensor Technology and Systems and other sensors for automobile vision system.
3. To learn Basic Control System Theory applied to Autonomous Automobiles.
4. To produce overall impact of automating like various driving functions, connecting the automobile to sources of information that assist with a task
5. To allow the automobile to make autonomous intelligent decisions concerning future actions of the vehicle that potentially impact the safety of the occupants through connected car & autonomous vehicle technology.

UNIT – I INTRODUCTION TO AUTOMATED, CONNECTED, AND INTELLIGENTVEHICLES 9

Concept of Automotive Electronics, Electronics Overview, History & Evolution, Infotainment, Body, Chassis, and Powertrain Electronics, Introduction to Automated, Connected, and Intelligent Vehicles. Case studies: Automated, Connected, and Intelligent Vehicles

UNIT – II SENSOR TECHNOLOGY FOR SMART MOBILITY 9

Basics of Radar Technology and Systems, Ultrasonic Sonar Systems, Lidar Sensor Technology and Systems, Camera Technology, Night Vision Technology, Other Sensors, Use of Sensor Data Fusion, Integration of Sensor Data to On-Board Control Systems

UNIT – III CONNECTED AUTONOMOUS VEHICLE 9

Basic Control System Theory applied to Automobiles, Overview of the Operation of ECUs, Basic Cyber-Physical System Theory and Autonomous Vehicles, Role of Surroundings Sensing Systems and Autonomy, Role of Wireless Data Networks and Autonomy

UNIT – IV VEHICLE WIRELESS TECHNOLOGY & NETWORKING 9

Wireless System Block Diagram and Overview of Components, Transmission Systems – Modulation/Encoding, Receiver System Concepts- Demodulation/Decoding, Wireless Networking and Applications to Vehicle Autonomy, Basics of Computer Networking – the Internet of Things, Wireless Networking Fundamentals, Integration of Wireless Networking and On-Board Vehicle Networks

UNIT – V CONNECTED CAR & AUTONOMOUS VEHICLE TECHNOLOGY 9

Connectivity Fundamentals, Navigation and Other Applications, Vehicle-to-Vehicle Technology and Applications, Vehicle-to-Roadside and Vehicle-to-Infrastructure Applications, Autonomous Vehicles - Driverless Car Technology, Moral, Legal, Roadblock Issues, Technical Issues, Security Issues

TOTAL: 45 PERIODS

COURSE OUTCOMES

Upon successful completion of the course, students should be able to:

CO1: Recognize the concept of cyber-physical control systems and their application to collision avoidance and autonomous vehicles

CO2: Select the concept of remote sensing and the types of sensor technology needed to implement remote sensing

CO3: Familiar with the concept of fully autonomous vehicles

CO4: Apply the basic concepts of wireless communications and wireless data networks

CO 5: Analyze the concept of the connected vehicle and its role in automated vehicles

Mapping of COs with POs and PSOs															
COs/POs &PSOs	**POs**												**PSOs**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
CO1	3	2	1	1		1						1	2	1	1
CO2	3	2	1	1		1						1	2	1	1
CO3	3	2	1	1		1						1	2	1	1
CO4	3	2	1	1		1						1	2	1	1
CO5	3	2	1	1		1						1	2	1	1
CO/PO & PSO Average	3	2	1	1		1						1	2	1	1
1 – Slight, 2 – Moderate, 3 – Substantial															

TEXT BOOKS

1. "Intelligent Transportation Systems and Connected and Automated Vehicles", 2016, Transportation Research Board
2. Radovan Miucic, "Connected Vehicles: Intelligent Transportation Systems", 2019, Springer

REFERENCE:

1. Tom Denton, "Automobile Electrical and Electronic systems, Roultedge", Taylor & Francis Group,5th Edition,2018.

21154E54C ELECTRICAL DRIVES AND ACTUATORS

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

1. To familiarize a relay and power semiconductor devices
2. To get a knowledge on drive characteristics
3. To obtain the knowledge on DC motors and drives.
4. To obtain the knowledge on AC motors and drives.
5. To obtain the knowledge on Stepper and Servo motor.

UNIT – I RELAY AND POWER SEMI-CONDUCTOR DEVICES 9

Study of Switching Devices – Relay and Types, Switching characteristics -BJT, SCR, TRIAC, GTO, MOSFET, IGBT and IGCT-: SCR, MOSFET and IGBT - Triggering and commutation circuit - Introduction to Driver and snubber circuits

UNIT – II DRIVE CHARACTERISTICS 9

Electric drive – Equations governing motor load dynamics – steady state stability – multi quadrant Dynamics: acceleration, deceleration, torque, and Direction starting & stopping – Selection of motor.

UNIT – III DC MOTORS AND DRIVES 9

DC Servomotor - Types of PMDC & BLDC motors - principle of operation- emf and torque equations - characteristics and control – Drives- H bridge - Single and Three Phases – 4 quadrant operation – Applications

UNIT – IV AC MOTORS AND DRIVES 9

Introduction - Induction motor drives - Speed control of 3-phase induction motor - Stator voltage control - Stator frequency control - Stator voltage and frequency control - Stator current control - Static rotor resistance control - Slip power recovery control.

UNIT – V STEPPER AND SERVO MOTOR 9

Stepper Motor: Classifications- Construction and Principle of Operation - Modes of Excitation-Drive System-Logic Sequencer - Applications. Servo Mechanism - DC Servo motor-AC Servo motor – Applications.

TOTAL: 45 PERIODS

COURSE OUTCOMES

At the end of the course, the student able to:

CO 1: Recognize the principles and working of relays, drives and motors.
CO 2: Explain the working and characteristics of various drives and motors.
CO 3: Apply the solid state switching circuits to operate various types of Motors and Drivers
CO 4: Interpret the performance of Motors and Drives.
CO 5: Suggest the Motors and Drivers for given applications.

Mapping of COs with POs and PSOs

COs/Pos&PSOs	POs												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	3	1	1	2	1							1	1		3
CO2	3	1	2	2	1							1	1		3
CO3	3	1	2	2	1							1	1		3
CO4	3	1	1	2	2							1	1		3
CO5	3	1	1	2	2							1	1		3
CO/PO & PSO Average	3	1	1.4	2	1.4							1	1		3
1 – Slight, 2 – Moderate, 3 – Substantial															

21154E55A	AUTOMOBILE ENGINEERING	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

1 To study the construction and working principle of various parts of an automobile.
2 To study the practice for assembling and dismantling of engine parts and transmission system
3 To study various transmission systems of automobile.
4 To study about steering, brakes and suspension systems
5 To study alternative energy sources

UNIT – I VEHICLE STRUCTURE AND ENGINES 9

Types of automobiles vehicle construction and different layouts, chassis, frame and body, Vehicle aerodynamics (various resistances and moments involved), IC engines – components-functions and materials, variable valve timing (VVT).

UNIT – II ENGINE AUXILIARY SYSTEMS 9

Electronically controlled gasoline injection system for SI engines, Electronically controlled diesel injection system (Unit injector system, Rotary distributor type and common rail direct injection system), Electronic ignition system (Transistorized coil ignition system, capacitive discharge ignition system), Turbo chargers (WGT, VGT), Engine emission control by three way catalytic converter system, Emission norms (Euro and BS).

UNIT – III TRANSMISSION SYSTEMS 9

Clutch-types and construction, gear boxes- manual and automatic, gear shift mechanisms, Overdrive, transfer box, fluid flywheel, torque converter, propeller shaft, slip joints, universal joints, Differential and rear axle, Hotchkiss Drive and Torque Tube Drive.

UNIT – IV STEERING, BRAKES AND SUSPENSION SYSTEMS 9

Steering geometry and types of steering gear box-Power Steering, Types of Front Axle, Types of Suspension Systems, Pneumatic and Hydraulic Braking Systems, Antilock Braking System (ABS),electronicbrake force distribution (EBD) and Traction Control.

UNIT – V ALTERNATIVE ENERGY SOURCES 9

Use of Natural Gas, Liquefied Petroleum Gas, Bio-diesel, Bio-ethanol, Gasohol and Hydrogen in Automobiles-Engine modifications required -Performance, Combustion and Emission Characteristics of SI and CI engineswith these alternate fuels - Electric and Hybrid Vehicles, Fuel Cell Note: Practical Training in dismantling and
assembling of Engine parts and Transmission Systems should be given to the students.

TOTAL:45 PERIODS

OUTCOMES: At the end of the course the students would be able to

1. Recognize the various parts of the automobile and their functions and materials.
2. Discuss the engine auxiliary systems and engine emission control.
3. Distinguish the working of different types of transmission systems.
4. Explain the Steering, Brakes and Suspension Systems.
5. Predict possible alternate sources of energy for IC Engines.

TEXT BOOKS:

1 Jain K.K. and Asthana .R.B, “Automobile Engineering” Tata McGraw Hill Publishers, New Delhi, 2002.

REFERENCES:

1. Ganesan V. “Internal Combustion Engines”, Third Edition, Tata McGraw-Hill, 2012.
2. Heinz Heisler, “Advanced Engine Technology,” SAE International Publications USA, 1998.
3. Joseph Heitner, “Automotive Mechanics,” Second Edition, East-West Press, 1999.
4. Martin W, Stockel and Martin T Stockle , “Automotive Mechanics Fundamentals,” The Good heart - Will Cox Company Inc, USA ,1978.
5. Newton, Steeds and Garet, “Motor Vehicles”, Butterworth Publishers,1989.

21154E55B	DESIGN CONCEPTS IN ENGINEERING	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

1. To study the various design requirements and get acquainted with the processes involvedin product development.
2. To study the design processes to develop a successful product.
3. To learn scientific approaches to provide design solutions.
4. Designing solution through relate the human needs and provide a solution.
5. To study the principles of material selection, costing and manufacturing in design.

UNIT – I DESIGN TERMINOLOGY 9

Definition-various methods and forms of design-importance of product design-static and dynamic products-various design projects-morphology of design-requirements of a good design-concurrent engineering-computer aided engineering-codes and standards-product and process cycles-bench marking.

UNIT – II INTRODUCTION TO DESIGN PROCESSES 9

Basic modules in design process-scientific method and design method-Need identification, importance of problem definition-structured problem, real life problem- information gathering -customer requirements- Quality Function Deployment (QFD)- product design specifications-generation of alternative solutions- Analysis and selection-Detail design and drawings-Prototype, modeling, simulation, testing and evaluation

UNIT – III CREATIVITY IN DESIGN 9

Creativity and problem solving-vertical and lateral thinking-invention-psychological view, mental blocks- Creativity methods-brainstorming, synectics, force fitting methods, mind map, concept map-Theory of innovative problem solving (TRIZ) - conceptual decomposition creating design concepts.

UNIT – IV HUMAN AND SOCIETAL ASPECTS IN PRODUCT DEVELOPMENT 9

Human factors in design, ergonomics, user friendly design-Aesthetics and visual aspects environmentalaspects-marketing aspects-team aspects-legal aspects-presentation aspects

UNIT – V MATERIAL AND PROCESSES IN DESIGN 9

Material selection for performance characteristics of materials-selection for new design substitution for existing design-economics of materials-selection methods-recycling and material selection-types of manufacturing process, process systems- Design for Manufacturability (DFM) - Design for Assembly (DFA).

Total:45 periods

OUTCOMES: At the end of the course the students would be able to

1. Analyze the various design requirements and get acquainted with the processes involved in product development.
2. Apply the design processes to develop a successful product.
3. Apply scientific approaches to provide design solutions.
4. Design solution through relate the human needs and provide a solution.
5. Apply the principles of material selection, costing and manufacturing in design.

TEXT BOOKS:

1. Dieter. G. N., Linda C. Schmidt, "Engineering Design", McGraw Hill, 2013..

2. Horenstein, M. N., Design Concepts for Engineers, Prentice Hall, 2010.

REFERENCES:

1. Dhillon, B. S., Advanced Design Concepts for Engineers, Technomic Publishing Co., 1998.
2. Edward B. Magrab, Satyandra K. Gupta, F. Patrick McCluskey and Peter A. Sandborn, “Integrated Product and Process Design and Development”, CRC Press, 2009.
3. James Garratt, “Design and Technology”, Cambridge University Press, 1996.
4. Joseph E. Shigley, Charles R.Mische, and Richard G. Budynas, “Mechanical Engineering Design”, McGraw Hill Professional, 2003.
5. Sumesh Krishnan and MukulSukla, Concepts in Engineering Design, Notion Press, 2016.

CO	**PO**												**PSO**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	2	2	2	2					1			1	2	1	1
2	2	2	2	2					1			1	2	1	1
3	2	2	2	2					1			1	2	1	1
4	2	2	2	2					1			1	2	1	1
5	2	2	2	2					1			1	2	1	1
Low (1) ; Medium (2) ; High (3)															

21154E55C **DYNAMICS OF GROUND VEHICLES** **L T P C**
3 0 0 3

COURSE OBJECTIVES:

The objective of this course is to make the students to Develop physical and mathematical models to predict the dynamic response of vehicles

UNIT I CONCEPT OF VIBRATION 9

Definitions, Modeling and Simulation, Global and Vehicle Coordinate System, Free, Forced, Undamped and Damped Vibration, Response Analysis of Single DOF, Two DOF, Multi DOF, Magnification factor, Transmissibility ratio, Base excitation. Vibration absorber, Vibration measuring instruments, Torsional vibration, Critical speed

UNIT II TYRES 9

Tyre axis system, tyre forces and moments, tyre marking, tyre structure, hydroplaning, wheel and rim. Rolling resistance, factors affecting rolling resistance, Longitudinal and Lateral force at various slip angles, Tractive and cornering property of tire. Performance of tire on wet surface. Ride property of tyres. Various test carried on a tyre.

UNIT III VERTICAL DYNAMICS 9

Human response to vibration, Sources of Vibration. Suspension requirements – types. State Space Representation. Design and analysis of Passive, Semi active and Active suspension using Quarter car, Bicycle Model, half car and full car vibrating model. Influence of suspension stiffness, suspension damping, and tire stiffness. Control law. Suspension optimization techniques. Air suspension system and their properties.

UNIT IV LONGITUDINAL DYNAMICS AND CONTROL 9

Aerodynamic forces and moments. Equation of motion. Load distribution for three-wheeler and four-wheeler. Calculation of maximum acceleration, tractive effort and reaction forces for different drive vehicles. Power limited acceleration and traction limited acceleration. Estimation of CG location. Stability of vehicles resting on slope. Driveline dynamics. Braking and Driving torque. Prediction of Vehicle performance. ABS, stability control, Traction control.

UNIT V LATERAL DYNAMICS 9

Steady state handling characteristics. Steady state response to steering input – Yaw velocity gain, Lateral acceleration gain, curvature response gain. Testing of handling characteristics. Transient response characteristics. Steering dynamics. Direction control of vehicles. Roll center, Roll axis. Stability of vehicle on banked road, during turn. Effect of suspension on cornering. Minuro Plot for Lateral Transient Response.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of the course, the students can able to

1. Develop physical and mathematical models to predict the dynamic response of vehicles
2. Apply vehicle design performance criteria and how to use the criteria to evaluate vehicle dynamic response
3. Use dynamic analyses in the design of vehicles.
4. Understand the principle behind the lateral dynamics.
5. Evaluate the longitudinal dynamics and control in an automobile

TEXT BOOKS:

1. J. Y. Wong, "Theory of Ground Vehicles", Fourth Edition, Wiley-Interscience, 2008
2. Singiresu S. Rao, "Mechanical Vibrations," Fifth Edition, Prentice Hall, 2010
3. Thomas D. Gillespie, "Fundamentals of Vehicle Dynamics," Society of Automotive Engineers Inc, 2014

REFERENCES:

1. Dean Karnopp, "Vehicle Dynamics, Stability, and Control", Second Edition, CRC Press, 2013
2. Hans B Pacejka, "Tyre and Vehicle Dynamics," Second edition, SAE International, 2005
3. John C. Dixon, "Tyres, Suspension, and Handling, " Second Edition, Society of Automotive Engineers Inc, 1996
4. Michael Blundell & Damian Harty, "The Multibody Systems Approach to Vehicle

Dynamics",Elsevier Limited, 2004
5. R. Nakhaie Jazar, "Vehicle Dynamics: Theory and Application", Second edition, Springer, 2013

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	3	3	3	3	3	3		2	2	3		3	2	2	2
2	3	3	3	3	3	3		2	2	3		3	2	2	2
3	3	3	3	3	3	3		2	2	3		3	2	3	3
4	3	2	2	2	2	2		2	1	3		3	2	3	3
5	3	3	3	3	3	3		2	2	3		3	2	3	3
Avg.	3	2.8	2.8	2.8	2.8	2.8		2	1.8	3		3	2	3	3

21154E63A **DESIGN OF TRANSMISSION SYSTEM**

L	T	P	C
3	0	0	3

COURSE OBJECTIVES

1. To gain knowledge on the principles and procedure for the design of Mechanical power Transmission components.
2. To understand the standard procedure available for Design of Transmission of Mechanical elements spur gears and parallel axis helical gears.
3. To learn the design bevel, worm and cross helical gears of Transmission system.
4. To learn the concepts of design multi and variable speed gear box for machine tool applications.
5. To learn the concepts of design to cams, brakes and clutches

(Use of P S G Design Data Book permitted)

UNIT – I DESIGN OF FLEXIBLE ELEMENTS 9

Design of Flat belts and pulleys - Selection of V belts and pulleys – Selection of hoisting wire ropes and pulleys – Design of Transmission chains and Sprockets.

UNIT – II SPUR GEARS AND PARALLEL AXIS HELICAL GEARS 9

Speed ratios and number of teeth-Force analysis -Tooth stresses - Dynamic effects – Fatigue strength - Factor of safety - Gear materials – Design of straight tooth spur & helical gears based on strength and wear considerations – Pressure angle in the normal and transverse plane-Equivalent number of teeth-forces for helical gears.

UNIT – III BEVEL, WORM AND CROSS HELICAL GEARS 9

Straight bevel gear: Tooth terminology, tooth forces and stresses, equivalent number of teeth. Estimating the dimensions of pair of straight bevel gears. Worm Gear: Merits and demerits terminology. Thermal capacity, materials-forces and stresses, efficiency, estimating the size of the worm gear pair. Cross helical: Terminology-helix angles-Estimating the size of the pair of cross helical gears.

UNIT – IV GEAR BOXES 9

Geometric progression - Standard step ratio - Ray diagram, kinematics layout -Design of sliding mesh gear box - Design of multi speed gear box for machine tool applications - Constant mesh gear box - Speed reducer unit. – Variable speed gear box, Fluid Couplings, Torque Converters for automotive applications.

UNIT – V CAMS, CLUTCHES AND BRAKES 9

Cam Design: Types-pressure angle and under cutting base circle determination-forces and surface stresses. Design of plate clutches –axial clutches-cone clutches-internal expanding rim clutches-Electromagnetic clutches. Band and Block brakes - external shoe brakes – Internal expanding shoe brake.

Total:45 periods

OUTCOMES: At the end of the course the students would be able to

1. Apply the concepts of design to belts, chains and rope drives.
2. Apply the concepts of design to spur, helical gears.
3. Apply the concepts of design to worm and bevel gears.
4. Apply the concepts of design to gear boxes.
5. Apply the concepts of design to cams, brakes and clutches

TEXT BOOKS:

1. Bhandari V, “Design of Machine Elements”, 4th Edition, Tata McGraw-Hill Book Co, 2016.
2. Joseph Shigley, Charles Mischke, Richard Budynas and Keith Nisbett “Mechanical Engineering Design”, 8th Edition, Tata McGraw-Hill, 2008.

REFERENCES:
1. Merhyle F. Spotts, Terry E. Shoup and Lee E. Hornberger, “Design of Machine Elements” 8th Edition, Printice Hall, 2003.
2. Orthwein W, “Machine Component Design”, Jaico Publishing Co, 2003.
3. Prabhu. T.J., “Design of Transmission Elements”, Mani Offset, Chennai, 2000.
4. Robert C. Juvinall and Kurt M. Marshek, “Fundamentals of Machine Design”, 4th Edition, Wiley,2005
5. Sundararajamoorthy T. V, Shanmugam .N, “Machine Design”, Anuradha Publications,Chennai, 2003.

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	3	2	3	1					1			1	2	3	2
2	3	2	3	1					1			1	2	3	2
3	3	2	3	1					1			1	2	3	2
4	3	2	3	1					1			1	2	3	2
5	3	2	3	1					1			1	2	3	2
Low (1) ; Medium (2) ; High (3)															

21154E63B **THERMAL POWER ENGINEERING**

L	T	P	C
3	0	0	3

Course Objectives

1. To study the fuel properties and arrive at proximate and ultimate analysis of fuels.
2. To study the different types of boilers and compute their performance parameters.
3. To study the performance parameters of an air compressor
4. To study the working principles of various refrigeration systems and perform cop calculations
5. To study the psychrometric properties and how they are utilized in arriving at calculations todetermine heating loads

UNIT – I FUELS AND COMBUSTION **9**

Fuels - Types and Characteristics of Fuels - Determination of Properties of Fuels – Fuels Analysis - Proximate and Ultimate Analysis – Moisture Determination – Calorific Value -Gross & Net Calorific Values

UNIT – II BOILERS **9**

Types and comparison, Mountings and Accessories. Performance calculations, Boiler trial.

UNIT – III AIR COMPRESSORS **9**

Classification and comparison, working principle, work of compression - with and without clearance, Volumetric efficiency, Isothermal efficiency and Isentropic efficiency. Multistage air compressor with Intercooling. Working principle and comparison of Rotary compressors with reciprocating air compressors

UNIT – IV REFRIGERATION SYSTEMS **9**

Vapour compression refrigeration cycle, Effect of Superheat and Sub-cooling, Performance calculations, Working principle of air cycle, vapour absorption system, and Thermoelectric refrigeration.

UNIT – V PSYCHROMETRY AND AIR-CONDITIONING **9**

Psychrometric properties – Property calculations using Psychrometric chart and expressions. Psychrometric processes – adiabatic saturation, sensible heating and cooling, humidification, dehumidification, evaporative cooling and adiabatic mixing Air conditioning systems, concept of RSHF, GSHF and ESHF, Cooling load calculations. Cooling towers – concept and types.

TOTAL:45 PERIODS

OUTCOMES: At the end of the course the students would be able to

1. Evaluate the fuel properties and arrive at proximate and ultimate analysis of fuels.
2. Analyze different types of boilers and compute their performance parameters.
3. Evaluate the performance parameters of an air compressor
4. Apply the working principles of various refrigeration systems and perform cop calculations
5. Analyze the psychrometric properties and how they are utilized in arriving at calculations todetermine heating loads.

TEXT BOOKS:

1. Mahesh. M. Rathore, “Thermal Engineering”, 1st Edition, Tata McGraw Hill, 2010.
2. Ballaney. P, “ Thermal Engineering”, 25th Edition, Khanna Publishers, 2017

REFERENCES:

1. Ananthanarayanan P.N, “ Basic Refrigeration and Air-Conditioning”, 4th Edition, Tata McGraw Hill, 2013.
2. Arora, “ Refrigeration and Air-Conditioning”, 2nd Edition, Prentice Hall of India, 2010.
3. Mathur M.L and Mehta F.S., “Thermal Science and Engineering”, 3rd Edition, Jain Brothers Pvt. Ltd, 2017.
4. Nag P.K, “ Basic and Applied Thermodynamics”, 2nd Edition, Tata McGraw Hill, 2010
5. Soman. K, “Thermal Engineering”, 2nd Edition, Prentice Hall of India, 2011

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	3	1	1	1					1			1	2	1	1
2	3	2	1	1					1			1	2	1	1

3	3	1	1	1					1			1	2	1	1
4	3	2	1	1					1			1	2	1	1
5	3	1	1	1					1			1	2	1	1

Low (1) ; Medium (2) ; High (3)

21154E63C	**TURBO MACHINES**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

COURSE OBJECTIVES

1. To study the energy transfer in rotor and stator parts of the turbo machines.
2. To study the function of various elements of centrifugal fans and blowers.
3. To evaluating the working and performance of centrifugal compressor
4. To analyzing flow behavior and flow losses in axial flow compressor.
5. To study the types and working of axial and radial flow turbines.

UNIT – I WORKING PRINCIPLES 9

Classification of Turbomachines. Energy transfer between fluid and rotor - Euler equation and its interpretation. Velocity triangles. Efficiencies in Compressor and Turbine stages. Degree of reaction. Dimensionless parameters for Turbomachines.

UNIT – II CENTRIFUGAL FANS AND BLOWERS 9

Types – components – working. Flow analysis in impeller blades-volute and diffusers. Velocity triangles - h-s diagram. Stage parameters in fans and blowers. Performance characteristic curves - various losses. Fan - bearings, drives and noise.

UNIT – III CENTRIFUGAL COMPRESSOR 9

Components - blade types. Velocity triangles - h-s diagram, stage work. Slip factor and Degree of Reaction. Performance characteristics and various losses. Geometry and performance calculation.

UNIT – IV AXIAL FLOW COMPRESSOR 9

Construction details. Work done factor. Velocity triangles - h-s diagram, stage work. Work done factor. Performance characteristics, efficiency and stage losses – Stalling and Surging. Free and Forced vortex flow.

UNIT – V AXIAL AND RADIAL FLOW TURBINES 9

Axial flow turbines - Types – Elements - Stage velocity diagrams - h-s diagram, stage work - impulse and reaction stages. Compounding of turbines. Performance coefficients and losses. Radial flow turbines: Types – Elements - Stage velocity diagrams - h-s diagram, stage work Performance coefficients and losses.

TOTAL : 45 PERIODS

OUTCOMES: At the end of the course the students would be able to

1. Explain the energy transfer in rotor and stator parts of the turbo machines.
2. Explain the function of various elements of centrifugal fans and blowers
3. Evaluate the working and performance of centrifugal compressor.
4. Analyze flow behavior and flow losses in axial flow compressor.
5. Explain the types and working of axial and radial flow turbines

TEXT BOOKS:

1. Ganesan, V., “Gas Turbines”, 3rd Edition, Tata McGraw Hill, 2011. .
2. Yahya, S.M., “Turbines, Compressor and Fans”, 4th Edition, Tata McGraw Hill, 2011.

REFERENCES:

1. Dixon, S.L., “Fluid Mechanics and Thermodynamics of Turbomachinery”, 7th Edition, Butterworth-Heinemann, 2014.
2. Gopalakrishnan. G and Prithvi Raj. D,” A Treatise on Turbomachines”, Scitech Publications (India) Pvt. Ltd., 2nd Edition, 2008.
3. Lewis, R.I., “Turbomachinery Performance Analysis” 1st Edition, Arnold Publisher, 1996.
4. Saravanamutto, Rogers, Cohen, Straznicky., “Gas Turbine Theory” 6th Edition, Pearson Education Ltd, 2009.
5. Venkanna, B.K., “Fundamentals of Turbomachinery”, PHI Learning Pvt. Ltd., 2009.

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	2	1	1	1					1			1	3	2	1
2	2	1	1	1					1			1	3	2	1
3	2	1	1	1					1			1	3	2	1
4	2	1	1	1					1			1	3	2	1
5	2	1	1	1					1			1	3	2	1
Low (1) ; Medium (2) ; High (3)															

21154E64A MATERIAL HANDLING AND SOLID PROCESSING EQUIPMENT

L	T	P	C
3	0	0	3

COURSE OBJECTIVES

1. To provide knowledge on materials handling equipment.
2. To provide knowledge on Industrial Vehicles
3. To provide knowledge on conveyor equipment.
4. To provide knowledge on Auxiliary Equipment and Hoisting Equipment.
5. To provide knowledge on Bulk Handling Equipment and Systems

UNIT – I INTRODUCTION TO MATERIALS HANDLING 9

Basic principles &objectives in material handling and its benefits - Classification of material handling equipment - selection of material handling equipments - guidelines for effective utilisation of material handling equipments -unit load concept

UNIT – II INDUSTRIAL VEHICLES 9

Introduction and types - Hand trucks - Two wheel Hand Trucks - Multiple wheel Hand Trucks - Hand Lift Trucks - Power Trucks - Fixed Platform Truck - Platform Lift Truck - Pallet Lift Truck - Walkie Truck - Straddle Carrier - Fork Lift Trucks - Specifications of FLT - FLT Attachments - Tractors - Industrial Tractor-Trailer-Self-propelled trucks and fork trucks - Automated guided vehicles Theory

UNIT – III CONVEYORS 9

Classification of conveyors- Definition - Description - General Characteristics - types and uses of belt Conveyors - Roller conveyors - Haulage Conveyors - Screw Conveyors - Bucket Conveyors - Chain Conveyors - Cable Conveyors - Pneumatic and Hydraulic conveyors - Computer controlled conveyor system.

UNIT – IV AUXILIARY EQUIPMENTAND HOISTING EQUIPMENT 9

Hoppers - Gates- Feeders- Chutes-positioners- Ball Table- Weighing and Control Equipment- Pallet loaders and unloaders -applications and advancements. - Hoisting Equipment - parts of hoisting equipment - Description and uses of hoists - Description and uses of ropes - description and purpose of crane hooks - Elevators - Cranes - Derricks - and its types

UNIT – V BULK HANDLING EQUIPMENT AND SYSTEMS 9

Storage of bulk solids - bulk handling equipment - Robotic handling - Materials handling at the workplace - Robots and their classification - Major components of a robot - classification of Robotic manipulators - Robotic handling applications

TOTAL:45 PERIODS

OUTCOMES: At the end of the course the students would be able to

1. Discuss the basic concepts of material handling equipment.
2. Explain the basic working principles of various industrial Vehicles.
3. Develop the basic working principles of various conveyors.
4. Elabrate the basic working principles of various Auxiliary Equipment and Hoisting Equipment.
5. Explain the basic working principles of various Bulk Handling Equipment and Systems.

TEXT BOOKS:

1. Allegri (Sr.), T.H., Material Handling – Principles and Practices, CBS Publishers and Distributors,Delhi, 1987.
2. Siddharta Ray, Introduction to Materials Handling, New Age International Publishers

REFERENCES:

1. Bolz, H. A and Hagemann, G. E (ed.), ''Materials Handling Handbook'', Ronald Press
2. 8005:1976, Classification of Unit Loads, Bureau of Indian Standards.
3. Apple, J.A., ''Material Handling System Design'', John Wiley & Sons
4. Theodore H., Allegre Sr., Material Handling Principles and Practice, CBS Publishers and Distributors
5. Immer J. R., Material Handling, Tata McGraw Hill Publication.

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	2	1	1	1	1				1			1	1	2	2
2	2	1	1	1	1				1			1	1	2	2
3	2	1	1	1	1				1			1	1	2	2
4	2	1	1	1	1				1			1	1	2	2
5	2	1	1	1	1				1			1	1	2	2
Low (1) ; Medium (2) ; High (3)															

21154E64B THERMAL AND FIRED EQUIPMENT DESIGN

L	T	P	C
3	0	0	3

COURSE OBJECTIVES

1. To introduce the concepts of thermal and fired equipment.
2. To study the basis, design and construction of boilers.
3. To study of typical fuel firing systems in the boiler.
4. To study of materials requirements for pressure parts.
5. To study of various boiler auxiliaries system.

UNIT – I INTRODUCTION 9

Principal equipment in Thermal Power Plant, Historical developments of Boiler, Utility, Industrial boilers, Morden trends in boiler design , Basic knowledge of different types of Thermal Fired Equipment ,sub critical and super critical boilers - Coal , Oil ,Gas , Pulverised fuel cyclone, FBC, CFBC , MSW , and Stoker firing, Boiler efficiency , auxiliary power consumption , Performance data , Performance Correction Curves

UNIT – II BASIS OF BOILERS AND DESIGN 9

Codes- Design and Construction, IBR, ISO, ASME, BS, Heat balance diagram, Boiler parameters, Fuel analysis and variations, Site conditions, Furnace heat loadings, FOT, Plan area loading, Volumetric loading Balanced Draft and Pressurised Furnace, Natural / Controlled Circulation, Constant and Sliding Pressure, Boiler heat transfer surfaces, Flue gas velocities, boiler auxiliaries, Boiler schemes, Boiler Layouts

UNIT – III FIRING SYSTEM- FUEL AND MILLING 9

Coal / Oil / Natural Gas in any combination, Lignite, Blast Furnace Gas / Coke Oven Gas / Corex Gas Carbon Monoxide / Tail gas, Asphalt, Black Liquor, Bagasse, Rice Husk, Washery Rejects, Wheat / Rice straw MSW, wind box, Burner, Type of Stokers, Pulverisers - Bowl mill, Tube mill, Direct firing, Indirect firing, Wall firing (Turbulent / Vortex Burners), Tangential firing (Jet Burners), Fire Ball.

UNIT – IV PRESSURE PARTS AND DESIGN AND MATERIALS 9

Economiser, Drums , Water Walls , Headers , Links , Super Hater , Super Heaters , Reheaters, Tubes , Spiral Tubes , Surface area , Free Gas Area , Metal temperature , LMTD , Acid Due Point Temperature , Carbon steel , Low alloy steel , Titanium alloy steel

UNIT – V BOILER AUXILIARIES 9

Air preheaters (APH) - bi sector APH , Tri sector APH, Cold PA System, Hot PA System, Tubular APH, Steam coil Air preheater , FANS - Axial, Radial, Performance curves, MILLS- Tube , Vertical mills , Air quality Control systems ,DustCollection System - Mechanical Precipitator, Electrostatic Precipitator, FGD , SCR , SNCR

TOTAL:45 PERIODS

OUTCOMES: At the end of the course the students would be able to

1. Explain the concepts of thermal and fired equipment.
2. Discuss the basis, design and construction of boilers.
3. Describe of typical fuel firing systems in the boiler.
4. Discuss the materials requirements for pressure parts.
5. Discuss of various boiler auxiliaries system.

TEXT BOOKS:

1. A Course in Power Plant Engineering; Dhanapat Rai and Sons - Domkundwar
2. Power Plant Engineering by B. Vijaya Ramnath C. Elanchezhian, L. Saravanakumar

REFERENCES:

1. Elwakil M, Power Plant Technology, McGraw Hill, New York, 1964
2. Steam Generators and Waste Heat Boilers: For Process and Plant Engineers (Mechanical Engineering) by V. Ganapathy
3. Steam Generators: Description and Design by Donatello Annaratone
4. An Introduction to Coal and Wood Firing Steam Generators (Power Plants Engineering) by JPaul Guyer
5. Advances in Power Boilers (JSME Series in Thermal and Nuclear

Power Generation)by Mamoru Ozawa and Hitoshi Asano | 28 January 2021

CO	PO												PSO		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	2	1	3	1					1			1	2	3	2
2	2	1	3	1					1			1	2	3	2
3	2	1	3	1					1			1	2	3	2
4	2	1	3	1					1			1	2	3	2
5	2	1	3	1					1			1	2	3	2
Low (1) ; Medium (2) ; High (3)															

21154E64C **DESIGN CODES AND STANDARDS**

L	T	P	C
3	0	0	3

COURSE OBJECTIVES

1. To study the Codes and Standards and Need for them in the Industry
2. To know the different sources and the bodies that publish Codes and Standards
3. To familiarize the Government Regulations and its applicability
4. To familiarize with different codes used in Different Industry
5. To familiarize the Codes and Standards used in Process Industry

UNIT – I INTRODUCTION 9

Introduction to Codes and Standards. What is code? What is Standard?Need for codes and standards. Objective of Codes and Standards. Codes, Standards and Good Engineering Practices.

UNIT – II CODES 9

Codes and Standards used in Different Industry. Material, Design, Inspection and Construction Codes. Process Industry Codes. Machinery Design codes. Codes used in Oil and Gas Industry. Welding Codes. Machine Design. Automotive. HVAC. Performance Test Codes. Other Discipline codes

UNIT – III STANDARDS 9

Sources of Codes and Standards. Who publishes Codes and Standards? International Societies and Professional Bodies. Process of Standardisation and Code publishing in Professional Bodies and Companies. Interdisciplinary Codes.

UNIT – IV REGULATIONS 9

Government and Federal Regulations. Need for them. Indian and International Regulations. Standards organisations. Weather and Climatic codes. IS, ISO, IBR, OISD. Certification Bodies. Authorities and Engineers to certify. PE, Chartered Engineers

UNIT – V DESIGN CODES 9

Codes and Standards applicable in Process Industry Equipment Design. Pressure Vessel Design Codes. Heat Exchanger Design Codes. Wind and Seismic Codes. Machinery Codes. Package Equipment Design Codes. Performance Test Codes. ASTM, ASME, API, AWS, ANSI, ISO, ASHRAE.

TOTAL:45 PERIODS

OUTCOMES: At the end of the course the students would be able to

1. Explain the need for codes and Standards in Industry.
2. Discuss the different codes and standards used in different industry.
3. Discuss the sources of different codes and standards and the societies that publish them and how these are evolved
4. Explain need for Government regulations and Certification authorities and familiar with common regulations in India and International
5. Discuss knowledge of codes and standards used in Process equipment design for Oil and Gas Industry.

TEXT BOOKS:

1. Mechanical Engg. Handbook. ASME. ASTM.API
2. Perrys Chemical Engg Handbook

REFERENCES:

1. ASME
2. API
3. ISO, IBR, OISD
4. AWS
5. ISHRAE

CO	PO												PSO		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	2	1	3						1			1	1	2	2
2	2	1	3						1			1	1	2	2
3	2	1	3						1			1	1	2	2
4	2	1	3						1			1	1	2	2
5	2	1	3						1			1	1	2	2
Low (1) ; Medium (2) ; High (3)															

21154E64D	NON-TRADITIONAL MACHINING PROCESSES	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

1. To classify non-traditional machining processes and describe mechanical energy based non-traditional machining processes.
2. To differentiate chemical and electro chemical energy-based processes.
3. To describe thermo-electric energy-based processes
4. To explain nano finishing processes.
5. To introduce hybrid non-traditional machining processes and differentiate hybrid non-traditional machining processes

UNIT – I INTRODUCTION AND MECHANICAL ENERGY BASED PROCESSES **9**

ntroduction - Need for non-traditional machining processes - Classification of non-traditional machining processes - Applications, advantages and limitations of non-traditional machining processes - Abrasive jet nachining, Abrasive water jet machining, Ultrasonic machining their principles, equipment, effect of process parameters, applications, advantages and limitations.

UNIT – II CHEMICAL AND ELECTRO CHEMICAL ENERGY BASED PROCESSES **9**

Principles, equipments, effect of process parameters, applications, advantages and limitations of Chemical nachining, Electro-chemical machining, Electro-chemical honing, Electro-chemical grinding, Electro chemical leburring.

UNIT – III THERMO-ELECTRIC ENERGY BASED PROCESSES **9**

Principles, equipments, effect of process parameters, applications, advantages and limitations of Electric lischarge machining, Wire electric discharge machining, Laser beam machining, Plasma arc machining, Electron beam machining, Ion beam machining.

UNIT – IV NANO FINISHING PROCESSES **9**

Principles, equipments, effect of process parameters, applications, advantages and limitations of Abrasive low machining – Chemo mechanical polishing, Magnetic abrasive finishing, Magnetorheological finishing, Magneto rheological abrasive flow finishing.

UNIT – V HYBRID NON-TRADITIONAL MACHINING PROCESSES **9**

ntroduction - Various hybrid non-traditional machining processes, their working principles, equipments, effect of process parameters, applications, advantages and limitations. Selection and comparison of different non-traditional machining processes.

TOTAL:45 PERIODS

OUTCOMES: At the end of the course the students would be able to

1. Formulate different types of non-traditional machining processes and evaluate mechanical energy based non-traditional machining processes.
2. Illustrate chemical and electro chemical energy based processes.
3. Evaluate thermo-electric energy based processes.
4. Interpret nano finishing processes.
5. Analyse hybrid non-traditional machining processes and differentiate non- traditional machining processes.

TEXT BOOKS:

1. Adit han. M., “Unconventional Machining Processes”, Atlantic, New Delhi, India, 2009. ISBN 13: 9788126910458
2. Ana nd Pandey, “Modern Machining Processes”, Ane Books Pvt. Ltd., New Delhi, India, 2019.

REFERENCES:

1. Benedict, G.F., “Non-traditional Manufacturing Processes”, Marcel Dekker Inc., New York 1987. ISBN-13: 978-0824773526.

2. Carl Sommer, “Non-Traditional Machining Handbook”, Advance Publishing., United States, 2000, ISBN-13: 978-1575373256.
3. Golam Kibria, Bhattacharyya B. and Paulo Davim J., “Non-traditional Micromachining Processes: Fundamentals and Applications”, Springer International Publishing., Switzerland, 2017, ISBN:978-3-319-52008-7.
4. Jagadeesha T., “Non-Traditional Machining Processes”, I.K. International Publishing House Pvt. Ltd., New Delhi, India, 2017, ISBN-13: 978-9385909122.
5. Kapil Gupta, Neelesh K. Jain and Laubscher R.F., “Hybrid Machining Processes: Perspectives on Machining and Finishing”, 1st edition, Springer International Publishing., Switzerland, 2016, ISBN-13: 978-3319259208.

CO	**PO**												**PSO**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	3		1		1		1		1	1		1	2	2	2
2	3		1		1		1		1	1		1	2	2	2
3	3		1		1		1		1	1		1	2	2	2
4	3		2		1		1		1	1		1	2	2	2
5	3		3		3		1		1	1		1	3	3	3
Low (1) ; Medium (2) ; High (3)															

21154E65A	POWER PLANT ENGINEERING	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

1. To study the coal based thermal power plants.
2. To study the diesel, gas turbine and combined cycle power plants.
3. To learn the basic of nuclear engineering and power plants.
4. To learn the power from renewable energy
5. To study energy, economic and environmental issues of power plants

UNIT – I COAL BASED THERMAL POWER PLANTS 9

Rankine cycle - improvisations, Layout of modern coal power plant, Super Critical Boilers, FBC Boilers, Turbines, Condensers, Steam & Heat rate, Subsystems of thermal power plants – Fuel and ash handling, Draught system, Feed water treatment. Binary Cycles and Cogeneration systems.

UNIT – II DIESEL, GAS TURBINE AND COMBINED CYCLE POWER PLANTS 9

Otto, Diesel, Dual & Brayton Cycle - Analysis & Optimisation. Components of Diesel and Gas Turbine power plants. Combined Cycle Power Plants. Integrated Gasifier based Combined Cycle systems.

UNIT – III NUCLEAR POWER PLANTS 9

Basics of Nuclear Engineering, Layout and subsystems of Nuclear Power Plants, Working of Nuclear Reactors : Boiling Water Reactor (BWR), Pressurized Water Reactor (PWR), CANada Deuterium- Uranium reactor (CANDU), Breeder, Gas Cooled and Liquid Metal Cooled Reactors. Safety measures for Nuclear Power plants.

UNIT – IV POWER FROM RENEWABLE ENERGY 9

Hydro Electric Power Plants – Classification, Typical Layout and associated components including Turbines. Principle, Construction and working of Wind, Tidal, Solar Photo Voltaic (SPV), Solar Thermal, Geo Thermal, Biogas and Fuel Cell power systems.

UNIT – V ENERGY, ECONOMIC AND ENVIRONMENTAL ISSUES OF POWER PLANTS 9

Power tariff types, Load distribution parameters, load curve, Comparison of site selection criteria, relative merits & demerits, Capital & Operating Cost of different power plants. Pollution control technologies including Waste Disposal Options for Coal and Nuclear Power Plants.

TOTAL:45 PERIODS

OUTCOMES: At the end of the course the students would be able to

1. Explain the layout, construction and working of the components inside a thermal power plant.
2. Explain the layout, construction and working of the components inside a Diesel, Gas and Combined cycle power plants.
3. Explain the layout, construction and working of the components inside nuclear power plants.
4. Explain the layout, construction and working of the components inside Renewable energy power plants
5. Explain the applications of power plants while extend their knowledge to power plant economics and environmental hazards and estimate the costs of electrical energy production.

TEXT BOOKS:

1. Nag. P.K., "Power Plant Engineering", Third Edition, Tata McGraw – Hill Publishing Company Ltd., 2008.
2. A Textbook of Power Plant Engineeringby R.K. Rajput | 1 January 2016

REFERENCES:

1. El-Wakil. M.M., "Power Plant Technology", Tata McGraw – Hill Publishing Company Ltd., 2010.
2. Godfrey Boyle, "Renewable energy", Open University, Oxford University Press in association with the Open University, 2004.
3. Thomas C. Elliott, Kao Chen and Robert C. Swanekamp, "Power Plant Engineering", Second Edition, Standard Handbook of McGraw – Hill, 1998.
4. Power Plant Engineeringby B. Vijaya Ramnath C. Elanchezhian, L. Saravanakumar | 1 November 2016

5. Power Plant Engineering, As per AICTE: Theory and Practice by Dipak Kumar Mandal, Somnath Chakrabarti, et al. | 1 January 2019

CO	PO												PSO		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	3	1	1	1		1	3			1		1	2	2	1
2	3	1	1	1		1	3			1		1	2	2	1
3	3	1	1	1		1	3			1		1	2	2	1
4	3	1	1	1		1	3			1		1	2	2	1
5	3	1	1	1		1	3			1		1	2	2	1
Low (1) ; Medium (2) ; High (3)															

21154E65B	ENERGY CONSERVATION IN INDUSTRIES	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

1. To learn Quantifying the energy demand and energy supply scenario of nation and explaining the need for energy auditing for becoming environmentally benign
2. To Analyzing factors behind energy billing and applying the concept of demand side management for lowering energy costs
3. To learn Computing the stoichiometric air requirement for any given fuel and quantifying the energy losses associated with thermal utilities of industries
4. To Diagnosing the causes for under performance of various electrical utilities and suggesting remedies for improving their efficiency
5. To Applying CUSUM and other financial evaluation techniques to estimating the accruable energy savings/monetary benefits for any energy efficiency project

UNIT – I INTRODUCTION 9

Energy scenario of World, India and TN - Environmental aspects of Energy Generation – Material and Energy balancing - Energy Auditing: Need, Types, Methodology and Barriers. Role of Energy Managers. Basic instruments for Energy Auditing.

UNIT – II ELECTRICAL SUPPLY SYSTEMS 9

Electricity Tariff structures – Typical Billing - Demand Side Management - HT and LT supply - Power Factor - Energy conservation in Transformers – Harmonics

UNIT – III ENERGY CONSERVATION IN MAJOR THERMAL UTILITIES 9

Stoichiometry - Combustion principles. Energy conservation in: Boilers - Steam Distribution Systems - Furnaces - Thermic Fluid Heaters – Cooling Towers – D.G. sets. Insulation and Refractories - Waste Heat Recovery Devices.

UNIT – IV ENERGY CONSERVATION IN MAJOR ELECTRICAL UTILITIES 9

Energy conservation in: Motors - Pumps - Fans - Blowers - Compressed Air Systems - Refrigeration and Air Conditioning Systems - Illumination systems

UNIT – V ENERGY MONITORING, TARGETING, LABELLING AND ECONOMICS 9

Elements of Monitoring & Targeting System – CUSUM - Energy / Cost index diagram – Energy Labelling - Energy Economics – Cost of production and Life Cycle Costing - Economic evaluation techniques – Discounting and Non-Discounting - ESCO concept – PAT scheme

TOTAL :45 PERIODS

OUTCOMES: At the end of the course the students would be able to

1. Discuss Quantify the energy demand and energy supply scenario of nation and appreciate the need for energy auditing for becoming environmentally benign
2. Analyse factors behind energy billing and apply the concept of demand side management for lowering energy costs
3. Compute the stoichiometric air requirement for any given fuel and quantify the energy losses associated with thermal utilities of industries
4. Diagnose the causes for under performance of various electrical utilities and suggest remedies for improving their efficiency
5. Apply CUSUM and other financial evaluation techniques to estimate the accruable energy savings/monetary benefits for any energy efficiency project

TEXT BOOKS:

1. Guide book for National Certification Examination for “Energy Managers and Energy Auditors” (4 Volumes). Available at http://www.em-ea.org/gbook1.asp. This website is administered by Bureau of Energy Efficiency (BEE), a statutory body under Ministry of Power, Government of India.
2. K. Nagabhushan Raju, Industrial Energy Conservation Techniques: (concepts, Applications and Case Studies), Atlantic Publishers &Dist, 2007.

REFERENCES:

1. Abbi Y P, Shashank Jain., Handbook on Energy Audit and Environment Management, TERI Press, 2006.
2. Albert Thumann and Paul Mehta D, “Handbook of Energy Engineering”, 7thEdition, The Fairmont Press, 2013.
3. Murphy.W.R. and McKay.G, “Energy Management”, Butterworth, London 1982.
4. Paul W.O'Callaghan, Design and management for energy conservation: A handbook for energy managers, plant engineers, and designers, Pergamon Press, 1981.
5. Steve Doty, Wayne Turner C, Energy Management Handbook 7th Edition, The Fairmont Press, 2009.

CO	PO												PSO	
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**
1	2	2	1				3		1			1	2	2
2	2	2	1				3		1			1	2	2
3	2	2	1				3		1			1	2	2
4	2	2	1				3		1			1	2	2
5	2	2	1				3		1			1	2	2

Low (1) ; Medium (2) ; High (3)

21154E65C	BIOENERGY CONVERSION TECHNOLOGIES	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

1. To elucidate on biomass, types, availability, and characteristics
2. To study the bio-methanation process.
3. To impart knowledge on combustion of biofuels
4. To describe on the significance of equivalence ratio on thermochemical conversion ofbiomass
5. To provide insight to the possibilities of producing liquid fuels from biomass

UNIT – I INTRODUCTION 9

Biomass: types – advantages and drawbacks – typical characteristics – proximate & ultimate analysis - comparison with coal - Indian scenario - carbon neutrality – biomass assessment studies - typical conversion mechanisms - densification technologies

UNIT – II BIOMETHANATION 9

Biomethenation process – influencing parameters – typical feed stocks – Biogas plants: types and design, Biogas appliances – burner, luminaries and power generation systems – Industrial effluent based biogas plants.

UNIT – III COMBUSTION 9

Perfect, complete and incomplete combustion - stoichiometric air requirement for biofuels - equivalence ratio – fixed Bed and fluid Bed combustion

UNIT – IV GASIFICATION, PYROLYSIS AND CARBONISATION 9

Chemistry of gasification - types - comparison - typical application - performance evaluation - economics. Pyrolysis - Classification - process governing parameters - Typical yield rates. Carbonization – merits of carbonized fuels – techniques adopted for carbonisation

UNIT – V LIQUIFIED BIOFUELS 9

Straight Vegetable Oil (SVO) as fuel - Biodiesel production from oil seeds, waste oils and algae - Process and chemistry - Biodiesel Vs. Diesel – comparison on emission and performance fronts. Production of alcoholic fuels (methanol and ethanol) from biomass - engine modifications

TOTAL:45 PERIODS

OUTCOMES: At the end of the course the students would be able to

1. Estimate the surplus biomass availability of any given area.
2. Design a biogas plant for a variety of biofuels.
3. Determine and compare the cost of steam generation from biofuels with that of coal and petroleum fuels.

4. Analyse the influence of process governing parameters in thermochemical conversion of biomass.
5. Synthesize liquid biofuels for power generation from biomass.

TEXT BOOKS:

1. Biomass for Bioenergy and Biomaterials, by Nidhi Adlakha, Rakesh Bhatnagar , Syed Shams Yazdani, CRC Press; 1st edition (22 October 2021), ISBN-10 : 0367745550
2. Bioenergy and Biochemical Processing Technologies, by Augustine O. Ayeni, Samuel EshorameSanni , Solomon U. Oranusi, Springer (30 June 2022).

REFERENCES:

1. David Boyles, Bio Energy Technology Thermodynamics and costs, Ellis HoknoodChichester,1984.
2. Iyer PVR et al, Thermochemical Characterization of Biomass, M N E S
3. Khandelwal KC, Mahdi SS, Biogas Technology - A Practical Handbook, Tata McGraw Hill, 1986
4. Mahaeswari, R.C. Bio Energy for Rural Energisation, Concepts Publication,1997
5. Tom B Reed, Biomass Gasification - Principles and Technology, Noyce Data Corporation, 1981

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	2				2		3		1			2	3		
2	2	2	3			2	2				2	2	3		
3	2	2	3	2			1				2	2	3	2	
4	2	2	3	2			1				2	2	3	1	
5	2	2	3	2			1				2	2	3	1	
Low (1) ; Medium (2) ; High (3)															

21154E65A **GAS DYNAMICS AND JET PROPULSION**

L	T	P	C
3	0	0	3

COURSE OBJECTIVES

1 To study the fundamentals of compressible flow concepts and the use of gas tables.
2 To learn the compressible flow behaviour in constant area ducts.
3 To study the development of shock waves and its effects.
4 To study the types of jet engines and their performance parameters.
5 To learn the types of rocket engines and their performance parameters.

UNIT – I BASIC CONCEPTS AND ISENTROPIC FLOWS 9

Energy and momentum equations of compressible fluid flows, Concepts of compressible flow - Mach waves and Mach cone. Flow regimes, effect of Mach number on compressibility. Stagnation, static, critical properties and their interrelationship. Isentropic flow and its relations. Isentropic flow through variable area ducts – nozzles and diffusers. Use of Gas tables.

UNIT – II COMPRESSIBLE FLOW THROUGH DUCTS 9

Flows through constant area ducts with heat transfer (Rayleigh flow) and Friction (Fanno flow) - variation of flow properties. Choking. Isothermal flow with friction. Use of Gas tables.

UNIT – III NORMAL AND OBLIQUE SHOCKS 9

Governing equations - Rankine-Hugoniot Relation. Variation of flow parameters across the normal and oblique shocks. Prandtl – Meyer expansion and relation. Use of Gas tables.

UNIT – IV JET PROPULSION 9

Theory of jet propulsion - thrust equation - Performance parameters - thrust, power and efficiency. Operation, cycle analysis and performance of ram jet, turbojet, turbofan, turbo prop and pulse jet engines.

UNIT – V SPACE PROPULSION 9

Types of rocket engines and propellants. Characteristic velocity – thrust equation. Theory of single and multistage rocket propulsion. Liquid fuel feeding systems. Solid propellant geometries. Orbital and escape velocity. Rocket performance calculations.

TOTAL:45 PERIODS

OUTCOMES: At the end of the course the students would be able to

1. Apply the fundamentals of compressible flow concepts and the use of gas tables.
2. Analyze the compressible flow behaviour in constant area ducts.
3. Analyze the development of shock waves and its effects.
4. Explain the types of jet engines and their performance parameters.
5. Explain the types of rocket engines and their performance parameters.

TEXT BOOKS:

1. Anderson, J.D., "Modern Compressible flow", Third Edition, McGraw Hill, 2003.
2. S.M. Yahya, "Fundamentals of Compressible Flow with Aircraft and Rocket propulsion", New Age International (P) Limited, 4th Edition, 2012.

REFERENCES:

1. R. D. Zucker and O Biblarz, "Fundamentals of Gas Dynamics", 2nd edition, Wiley, 2011.
2. Balachandran, P., "Fundamentals of Compressible Fluid Dynamics", Prentice-Hall of India, 2007.
3. Radhakrishnan, E., "Gas Dynamics", Printice Hall of India, 2006.
4. Hill and Peterson, "Mechanics and Thermodynamics of Propulsion", Addison – Wesley, 1965.
5. Babu, V., "Fundamentals of Compressible Flow", CRC Press, 1st Edition, 2008.

CO	PO												PSO		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	3	2	1	1					1			1	3	1	2
2	3	2	1	1					1			1	3	1	2
3	3	2	1	1					1			1	3	1	2
4	3	2	1	1					1			1	3	1	2
5	3	2	1	1					1			1	3	1	2

Low (1) ; Medium (2) ; High (3)

21154E65B	OPERATIONAL RESEARCH	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

The main learning objective of this course is to prepare the students for:

1. To learn Selecting the constraints on the availability of resources and developing a model andrendering an optimal solution for the given circumstances.
2. To study Appraising the challenges in the transportation and production problems and
   furnishing a rational solution to maximize the benefits.
3. To learn Planning the purchase/ manufacturing policies, managing the spares/ stocks and
   meeting the customer demands.
4. To Analysing the queue discipline and exploring the avenues for better customer service.
5. To Investigating the nature of the project and offering methodical assistance towards decision
   making in maintenance.

UNIT – I INTRODUCTION TO OPERATIONS RESEARCH AND LINEAR PROGRAMMING 9

Operation Research: Definition – Models – Steps – Important topics – Scope - Tools. Linear Programing (LP): Introduction - Concept (Problem mix, Assumption, Properties) -Development (Problem formulation) - Problems in: Graphical method, Simplex methods, Big M method.

UNIT – II TRANSPORTATION, ASSIGNMENT AND PRODUCTION SCHEDULING PROBLEMS 9

Transportation problems: Introduction, Model, Types – Problems in: Initial Basic (feasible) solution: Northwest Corner Cell method; Least Cost Cell method; Vogel's Approximation method and Optimal solution MODI (U-V) method. Assignment problems: Introduction,Types, Problems in Hungarian method. Production Scheduling problems: Introduction -Problems in Single Machine Scheduling: SPT; WSPT, EDD methods – Problems inJohnson's Algorithm: n job 2 machines, n job 3 machines.

UNIT – III INVENTORY CONTROL MODELS & SYSTEMS 9

Inventory Control: Introduction, Models - Problems in Purchase and Production(Manufacturing) models with and without shortages - Theory on types of inventory control systems: P& Q, ABC, VED, FNS, XYZ, SDE and HML.

UNIT – IV QUEUING THEORY 9

Queuing Theory: Introduction; Applications; Terminology, Poisson process and exponential distribution - Problems in Single Server and Multi Server Queuing Models -Case study on simulation using Monte Carlo technique.

UNIT – V PROJECT MANAGEMENT AND REPLACEMENT MODELS 9

Project Management: Introduction; Guidelines for Networking AOA Diagrams - Problems in Critical Path Method (CPM) & Program Evaluation Review Technique (PERT) - Differences of CPM & PERT. Replacement Problems: Types - Problems in: Determination of Economic Life of an Asset - Problems in: Individual and Group Replacement Policies , Apply OR software

TOTAL :45 PERIODS

OUTCOMES: At the end of the course the students would be able to

1. Discuss the selection of the constraints on the availability of resources, develop a model and render an optimal solution for the given circumstances.
2. Explain the appraise the challenges in the transportation and production problems and furnish a rational solution to maximize the benefits.
3. Explain plan the purchase/ manufacturing policies, manage the spares/ stocks, and meet the customer demands.
4. Analyze the queue discipline and explore the avenues for better customer service.

5. Investigate the nature of the project and offer methodical assistance towards decision making in maintenance.

TEXT BOOKS:

1. Pannerselvam R, "Operations Research", 2nd Edition, PHI, 2009.
2. Hamdy A. Taha, "Operations Research an Introduction", 10th Edition, PHI/Pearson Education, 2017.

REFERENCES:

1. Ravindran, Phillips and Solberg, "Operations Research Principles and Practice", 2nd Edition, Wiley India, 2007.
2. Srinivasan G, "Operations Research Principles and Applications", 3 rd Edition EEEPHI, 2017.
3. Sharma J K, "Operations Research Theory and Applications",5th Edition, Macmillan India, 2013.
4. Premkumar Gupta and D.S.Hira, "Problems in Operations Research", S.Chand,2009.
5. Wayne L. Winston, "Operations Research Applications and Algorithms", 4th Edition, Cengage Learning, 2004.

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	2	3	3	2	2	1	1	1	1	1	2	2	2	2	2
2	2	3	3	2	2	1	1	1	1	1	2	2	2	2	2
3	2	3	3	2	2	1	1	1	1	1	2	2	2	2	2
4	2	3	3	2	2	1	1	1	1	1	2	2	2	2	2
5	2	3	3	2	2	1	1	1	1	1	2	2	2	2	2
Low (1) ; Medium (2) ; High (3)															

21154E66C PROCESS PLANNING AND COST ESTIMATION

L	T	P	C
3	0	0	3

COURSE OBJECTIVES

1. To introduce the process planning concepts to make cost estimation for various products after process planning
2. To Learn the various Process Planning Activities
3. To provide the knowledge of importance of costing and estimation.
4. To provide the knowledge of estimation of production costing.
5. To learn the knowledge of various Machining time calculations

UNIT – I INTRODUCTION TO PROCESS PLANNING 9

Introduction- methods of process planning-Drawing Interpretation-Material evaluation – steps in process selection-. Production equipment and tooling selection

UNIT – II PROCESS PLANNING ACTIVITIES 9

Process parameters calculation for various production processes-Selection jigs and fixture selection of quality assurance methods - Set of documents for process planning-Economics of process planning- case studies

UNIT – III INTRODUCTION TO COST ESTIMATION 9

Importance of costing and estimation –methods of costing-elements of cost estimation –Types of estimates - Estimating procedure- Estimation labor cost, material cost- allocation of overhead charges- Calculation of depreciation cost

UNIT – IV PRODUCTION COST ESTIMATION 9

Estimation of Different Types of Jobs - Estimation of Forging Shop, Estimation of Welding Shop,Estimation of Foundry Shop

UNIT – V MACHINING TIME CALCULATION 9

Estimation of Machining Time - Importance of Machine Time Calculation- Calculation of Machining Time for Different Lathe Operations, Drilling and Boring - Machining Time Calculation for Milling,Shaping and Planning -Machining Time Calculation for Grinding.

Total:45 periods

OUTCOMES: At the end of the course the students would be able to

1. Discus select the process, equipment and tools for various industrial products.
2. Explain the prepare process planning activity chart.
3. Explain the concept of cost estimation.
4. Compute the job order cost for different type of shop floor.
5. Calculate the machining time for various machining operations.

TEXT BOOKS:

1. Peter scalon, “Process planning, Design/Manufacture Interface”, Elsevier science technology Books, Dec 2002.
2. Sinha B.P, “Mechanical Estimating and Costing”, Tata-McGraw Hill publishing co, 1995.

REFERENCES:

1. Chitale A.V. and Gupta R.C., “Product Design and Manufacturing”, 2nd Edition, PHI, 2002.
2. Ostwalal P.F. and Munez J., “Manufacturing Processes and systems”, 9th Edition, John Wiley,1998.
3. Russell R.S and Tailor B.W, “Operations Management”, 4th Edition, PHI, 2003.
4. Mikell P. Groover, “Automation, Production, Systems and Computer Integrated Manufacturing”,Pearson Education 2001.
5. K.C. Jain & L.N. Aggarwal, “Production Planning Control and Industrial Management”, KhannaPublishers 1990.

CO	PO												PSO		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	3	2	2	2					1		1	1	2	1	1
2	3	3	2	1					1		1	1	2	1	1
3	3	3	2	2					1		1	1	2	1	1
4	3	3	2	2					1		1	1	2	1	1
5	3	3	2	2					1		1	1	2	1	1
Low (1) ; Medium (2) ; High (3)															

MANDATORY COURSES I

21147MC51A INTRODUCTION TO WOMEN AND GENDER STUDIES **L T P C**
3 0 0 0

COURSE OUTLINE

UNIT I CONCEPTS
Sex vs. Gender, masculinity, femininity, socialization, patriarchy, public/ private, essentialism, binaryism, power, hegemony, hierarchy, stereotype, gender roles, gender relation, deconstruction, resistance, sexual division of labour.

UNIT II FEMINIST THEORY
Liberal, Marxist, Socialist, Radical, Psychoanalytic, postmodernist, ecofeminist.

UNIT III WOMEN'S MOVEMENTS: GLOBAL, NATIONAL AND LOCAL
Rise of Feminism in Europe and America.
Women's Movement in India.

UNIT IV GENDER AND LANGUAGE
Linguistic Forms and Gender.
Gender and narratives.

UNIT V GENDER AND REPRESENTATION
Advertising and popular visual media.

Gender and Representation in Alternative Media.
Gender and social media.

TOTAL : 45 PERIODS

21147MC51B DISASTER MANAGEMENT **L T P C**
3 0 0 0

COURSE OBJECTIVE

- To impart knowledge on concepts related to disaster, disaster risk reduction, disaster management
- To acquaint with the skills for planning and organizing disaster response

UNIT I HAZRADS, VULNERABILITY AND DISASTER RISKS 9

Definition: Disaster, Hazard, Vulnerability, Resilience, Risks - Types of Disasters: Natural, Human induced, Climate change induced -Earthquake, Landslide, Flood, Drought, Fire etc - Technological disasters- Structural collapse, Industrial accidents, oil spills -Causes, Impacts including social, Economic, political, environmental, health, psychosocial, etc.- Disaster vulnerability profile of India and Tamil Nadu - Global trends in disasters: urban disasters, pandemics, Complex emergencies, --, Inter relations between Disasters and Sustainable development Goals

UNIT II DISASTER RISK REDUCTION (DRR) 9

Sendai Framework for Disaster Risk Reduction**,** Disaster cycle - Phases, Culture of safety, prevention, mitigation and preparedness community Based DRR, Structural- nonstructural measures, Roles and responsibilities of- community, Panchayati Raj Institutions / Urban Local Bodies (PRIs/ULBs), States, Centre, and other stakeholders- Early Warning System – Advisories from Appropriate Agencies.- Relevance of indigenous Knowledge, appropriate technology and Local resources.

UNIT III DISASTER MANAGEMENT 9

Components of Disaster Management – Preparedness of rescue and relief, mitigation, rehabilitation and reconstruction- Disaster Risk Management and post disaster management - Compensation and Insurance- Disaster Management Act (2005) and Policy - Other related policies, plans, programmers and legislation - Institutional Processes and Framework at State and Central Level- (NDMA –SDMA-DDMA-NRDF- Civic Volunteers)

UNIT IV TOOLS AND TECHNOLOGY FOR DISASTER MANAGEMENT 9

Early warning systems -Components of Disaster Relief: Water, Food, Sanitation, Shelter, Health, Waste Management, Institutional arrangements (Mitigation, Response and Preparedness, – Role of GIS and Information Technology Components in Preparedness, Risk Assessment, Response and Recovery Phases of Disaster – Disaster Damage Assessment. - Elements of Climate Resilient Development -Standard operation Procedure for disaster response – Financial planning for disaster Management

UNIT V DISASTER MANAGEMENT: CASE STUDIES 9

Discussion on selected case studies to analyse the potential impacts and actions in the contest of disasters-Landslide Hazard Zonation: Earthquake Vulnerability Assessment of Buildings and Infrastructure: Case Studies, Drought Assessment: Case Studies, Coastal Flooding: Storm Surge Assessment, Floods: Fluvial and Pluvial Flooding: Case Studies; Forest Fire: Case Studies, Man Made disasters: Case Studies, Space Based Inputs for Disaster Mitigation and Management and field works related to disaster management.- Field work-Mock drill -

TOTAL : 45 PERIODS

TEXT BOOKS:

1 Taimpo (2016), Disaster Management and Preparedness, CRC Publications
2 Singh R (2017), Disaster Management Guidelines for earthquakes, Landslides, Avalanches and tsunami, Horizon Press Publications
3 Singhal J.P. “Disaster Management”, Laxmi Publications, 2010. ISBN-10: 9380386427 ISBN-13: 978-9380386423
4 Tushar Bhattacharya, “Disaster Science and Management”, McGraw Hill India Education Pvt. Ltd., 2012. **ISBN-10:** 1259007367, **ISBN-13:** 978-1259007361]

REFERENCES

1. Govt. of India: Disaster Management Act, Government of India, New Delhi, 2005.
2. Government of India, National Disaster Management Policy, 2009.
3. Shaw R (2016), Community based Disaster risk reduction, Oxford University Press

COURSE OUTCOME:

CO1: To impart knowledge on the concepts of Disaster, Vulnerability and Disaster Risk reduction (DRR)

CO2: To enhance understanding on Hazards, Vulnerability and Disaster Risk Assessment prevention and risk reduction

CO3: To develop disaster response skills by adopting relevant tools and technology

CO4: Enhance awareness of institutional processes for Disaster response in the country and

CO5: Develop rudimentary ability to respond to their surroundings with potential Disaster response in areas where they live, with due sensitivity

CO’s – PO’s & PSO’s MAPPING

CO’s	PO’s												PSO’s		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	3	3	2	3	-	-	2	2	-	-	2	-	2	-	1
2	3	3	3	3	-	-	2	1	-	-	2	-	2	-	1
3	3	3	3	3	-	-	2	2	-	-	-	-	2	-	1
4	3	3	2	3	-	-	2	1	-	-	2	-	2	-	1
5	3	3	2	3	-	-	2	2	-	-	2	-	3	-	1
AVG	3	3	3	3	-	-	2	2	-	-	2	-	2	-	1

MANDATORY COURSES II

21147MC61A WELL-BEING WITH TRADITIONAL PRACTICES-YOGA, AYURVEDA AND SIDDHA

L	T	P	C
3	0	0	0

COURSE OBJECTIVES:

- To enjoy life happily with fun filled new style activities that help to maintain health also
- To adapt a few lifestyle changes that will prevent many health disorders
- To be cool and handbill every emotion very smoothly in every walk of life
- To learn to eat cost effective but healthy foods that are rich in essential nutrients
- To develop immunity naturally that will improve resistance against many health disorders

UNIT I HEALTH AND ITS IMPORTANCE 2+4

Health: Definition - Importance of maintaining health - More importance on prevention than treatment

Ten types of health one has to maintain - Physical health - Mental health - Social health - Financial health - Emotional health - Spiritual health - Intellectual health - Relationship health - Environmental health - Occupational/Professional heath.

Present health status - The life expectancy-present status - mortality rate - dreadful diseases - Non-communicable diseases (NCDs) the leading cause of death - 60% - heart disease – cancer – diabetes - chronic pulmonary diseases - risk factors – tobacco – alcohol - unhealthy diet - lack of physical activities.

Types of diseases and disorders - Lifestyle disorders – Obesity – Diabetes - Cardiovascular diseases – Cancer – Strokes – COPD - Arthritis - Mental health issues.

Causes of the above diseases / disorders - Importance of prevention of illness - Takes care of health - Improves quality of life - Reduces absenteeism - Increase satisfaction - Saves time

Simple lifestyle modifications to maintain health - Healthy Eating habits (Balanced diet according to age) Physical Activities (Stretching exercise, aerobics, resisting exercise) - Maintaining BMI-Importance and actions to be taken

UNIT II DIET 4+6

Role of diet in maintaining health - energy one needs to keep active throughout the day - nutrients one needs for growth and repair - helps one to stay strong and healthy - helps to prevent diet-related illness, such as some cancers - keeps active and - helps one to maintain a healthy weight - helps to reduce risk of developing lifestyle disorders like diabetes – arthritis – hypertension – PCOD – infertility – ADHD – sleeplessness -helps to reduce the risk of heart diseases - keeps the teeth and bones strong.

Balanced Diet and its 7 Components - Carbohydrates – Proteins – Fats – Vitamins – Minerals - Fibre and Water.

Food additives and their merits & demerits - Effects of food additives - Types of food additives - Food additives and processed foods - Food additives and their reactions

Definition of BMI and maintaining it with diet

Importance - Consequences of not maintaining BMI - different steps to maintain optimal BM

Common cooking mistakes

Different cooking methods, merits and demerits of each method

UNIT III ROLE OF AYURVEDA & SIDDHA SYSTEMS IN MAINTAINING HEALTH 4+4

AYUSH systems and their role in maintaining health - preventive aspect of AYUSH - AYUSH as a soft therapy.

Secrets of traditional healthy living - Traditional Diet and Nutrition - Regimen of Personal and Social Hygiene - Daily routine (Dinacharya) - Seasonal regimens (Ritucharya) - basic sanitation and healthy living environment - Sadvritta (good conduct) - for conducive social life.

Principles of Siddha & Ayurveda systems - Macrocosm and Microcosm theory - Pancheekarana Theory / **(**Five Element Theory) 96 fundamental Principles - Uyir Thathukkal **(**Tri-Dosha Theory) - Udal Thathukkal

Prevention of illness with our traditional system of medicine
Primary Prevention - To decrease the number of new cases of a disorder or illness - Health promotion/education, and - Specific protective measures - Secondary Prevention - To lower the rate of established cases of a disorder or illness in the population (prevalence) - Tertiary Prevention - To decrease the amount of disability associated with an existing disorder.

UNIT IV MENTAL WELLNESS 3+4

Emotional health - Definition and types - Three key elements: the subjective experience - the physiological response - the behavioral response - Importance of maintaining emotional health - Role of emotions in daily life -Short term and long term effects of emotional disturbances - Leading a healthy life with emotions - Practices for emotional health - Recognize how thoughts influence emotions - Cultivate positive thoughts - Practice self-compassion - Expressing a full range of emotions.

Stress management - Stress definition - Stress in daily life - How stress affects one's life - Identifying the cause of stress - Symptoms of stress - Managing stress (habits, tools, training, professional help) - Complications of stress mismanagement.

Sleep - Sleep and its importance for mental wellness - Sleep and digestion.
Immunity - Types and importance - Ways to develop immunity

UNIT V YOGA 2+12

Definition and importance of yoga - Types of yoga - How to Choose the Right Kind for individuals according to their age - The Eight Limbs of Yoga - Simple yogasanas for cure and prevention of health disorders - What yoga can bring to our life.

TOTAL : 45 PERIODS

TEXT BOOKS:

1. Nutrition and Dietetics - Ashley Martin, Published by White Word Publications, New York, NY 10001, USA
2. Yoga for Beginners_ 35 Simple Yoga Poses to Calm Your Mind and Strengthen Your Body,
   by Cory Martin, Copyright © 2015 by Althea Press, Berkeley, California

REFERENCES:

1. WHAT WE KNOW ABOUT EMOTIONAL INTELLIGENCE How It Affects Learning, Work, Relationships, and Our Mental Health, by Moshe Zeidner, Gerald Matthews, and Richard D. Roberts
   A Bradford Book, The MIT Press, Cambridge, Massachusetts, London, England
2. The Mindful Self-Compassion Workbook, Kristin Neff, Ph.D Christopher Germer, Ph.D, Published by The Guilford Press A Division of Guilford Publications, Inc.370 Seventh Avenue, Suite 1200, New York, NY 10001

1. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4799645/
2. **Simple lifestyle modifications to maintain health** https://www.niddk.nih.gov/health-information/diet-nutrition/changing-habits-better-health#:~:text=Make%20your%20new%20healthy%20habit,t%20have%20time%20to%20cook.
3. **Read more**: https://www.legit.ng/1163909-classes-food-examples-functions.html
4. https://www.yaclass.in/p/science-state-board/class-9/nutrition-and-health-5926
5. **Benefits of healthy eating** https://www.cdc.gov/nutrition/resources-publications/benefits-of-healthy-eating.html
6. **Food additives** https://www.betterhealth.vic.gov.au/health/conditionsandtreatments/food-additives
7. **BMI** https://www.hsph.harvard.edu/nutritionsource/healthy-weight/
   https://www.who.int/europe/news-room/fact-sheets/item/a-healthy-lifestyle---who-recommendations
8. **Yoga** https://www.healthifyme.com/blog/types-of-yoga/
   https://yogamedicine.com/guide-types-yoga-styles/
   Ayurveda : https://vikaspedia.in/health/ayush/ayurveda-1/concept-of-healthy-living-in-ayurveda
9. **Siddha** : http://www.tkdl.res.in/tkdl/langdefault/Siddha/Sid_Siddha_Concepts.asp
10. **CAM :** https://www.hindawi.com/journals/ecam/2013/376327/
11. **Preventive** herbs : https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3847409/

COURSE OUTCOMES:

After completing the course, the students will be able to:

- Learn the importance of different components of health
- Gain confidence to lead a healthy life
- Learn new techniques to prevent lifestyle health disorders
- Understand the importance of diet and workouts in maintaining health

21147MC61B **Safety in Engineering Industry** **L T P C**
3 0 0 0

OBJECTIVES

- To Understand the Introduction and basic Terminologies safety.
- To enable the students to learn about the Important Statutory Regulations and standards.
- To enable students to Conduct and participate the various Safety activities in the Industry.
- To have knowledge about Workplace Exposures and Hazards.
- To assess the various Hazards and consequences through various Risk Assessment Techniques.

UNIT I SAFETY TERMINOLOGIES

Hazard-Types of Hazard- Risk-Hierarchy of Hazards Control Measures-Lead indicators- lag Indicators-Flammability- Toxicity Time-weighted Average (TWA) - Threshold LimitValue (TLV) - Short Term Exposure Limit (STEL)- Immediately dangerous to life or health (IDLH)- acute and chronic Effects- Routes of Chemical Entry-Personnel Protective Equipment- Health and Safety Policy-Material Safety Data Sheet MSDS

UNIT II STANDARDS AND REGULATIONS

Indian Factories Act-1948- Health- Safety- Hazardous materials and Welfare- ISO 45001:2018 occupational health and safety (OH&S) - Occupational Safety and Health Audit IS14489:1998- Hazard Identification and Risk Analysis- code of practice IS 15656:2006

UNIT III SAFETY ACTIVITIES

Toolbox Talk- Role of safety Committee- Responsibilities of Safety Officers and Safety Representatives- Safety Training and Safety Incentives- Mock Drills- On-site Emergency Action Plan- Off-site Emergency Action Plan- Safety poster and Display- Human Error Assessment

UNIT IV WORKPLACE HEALTH AND SAFETY

Noise hazard- Particulate matter- musculoskeletal disorder improper sitting poster and lifting Ergonomics RULE & REBA- Unsafe act & Unsafe Condition- Electrical Hazards- Crane Safety-Toxic gas Release

UNIT V HAZARD IDENTIFICATION TECHNIQUES

Job Safety Analysis-Preliminary Hazard Analysis-Failure mode and Effects Analysis- Hazard and Operability- Fault Tree Analysis- Event Tree Analysis Qualitative and Quantitative Risk Assessment-Checklist Analysis- Root cause analysis- What-If Analysis- and Hazard Identification and Risk Assessment

Course outcomes on completion of this course the student will be able:

- Understand the basic concept of safety.
- Obtain knowledge of Statutory Regulations and standards.
- Know about the safety Activities of the Working Place.
- Analyze on the impact of Occupational Exposures and their Remedies
- Obtain knowledge of Risk Assessment Techniques.

TEXTBOOKS

1. R.K. Jain and Prof. Sunil S. Rao Industrial Safety, Health and Environment Management Systems KHANNA PUBLISHER
2. L. M. Deshmukh Industrial Safety Management: Hazard Identification and Risk Control McGraw-Hill Education

REFERENCES

1. Frank Lees (2012) ‘Lees’ Loss Prevention in Process Industries.Butterworth-Heinemann publications, UK, 4th Edition.
2. John Ridley & John Channing (2008)Safety at Work: Routledge, 7th Edition.
3. Dan Petersen (2003) Techniques of Safety Management: A System Approach.
4. Alan Waring.(1996).Safety management system: Chapman &Hall,England
5. Society of Safety Engineers, USA

ONLINE RESOURCES

ISO 45001:2018 occupational health and safety (OH&S) International Organization for Standardization https://www.iso.org/standard/63787.html

Indian Standard code of practice on occupational safety and health audit https://law.resource.org/pub/in/bis/S02/is.14489.1998.pdf

Indian Standard code of practice on Hazard Identification and Risk Analysis IS 15656:2006 https://law.resource.org/pub/in/bis/S02/is.15656.2006.pdf

Course Outcomes	Statement	Program Outcome														
		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
CO1	Understand the basic concept of safety.	3	3	3	1	1	3	2	2	3	3	1	3	3	3	3
CO2	Obtain knowledge of Statutory Regulations and standards.	2	3	2	2	1	3	2	3	3	2	1	3	3	3	3
CO3	Know about the safety Activities of the Working Place.	2	2	2	2	1	2	2	2	3	2	1	2	3	3	3
CO4	Analyze on the impact of Occupational Exposures and their Remedies	3	3	3	2	2	3	2	2	3	2	1	3	3	3	3
CO5	Obtain knowledge of Risk Assessment Techniques.	3	2	3	2	2	3	2	2	3	2	2	3	3	3	3
Industrial safety		3	3	3	2	1	3	2	2	3	2	1	3	3	3	3

OPEN ELECTIVE I AND II

21150OE72A ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING FUNDAMENTALS L T P C
2 0 2 3

OBJECTIVES:
The main objectives of this course are to:
1. Understand the importance, principles, and search methods of AI
2. Provide knowledge on predicate logic and Prolog.
3. Introduce machine learning fundamentals
4. Study of supervised learning algorithms.
5. Study about unsupervised learning algorithms.

UNIT I INTELLIGENT AGENT AND UNINFORMED SEARCH 6
Introduction - Foundations of AI - History of AI - The state of the art - Risks and Benefits of AI - **Intelligent Agents** - Nature of Environment - Structure of Agent - Problem Solving Agents - Formulating Problems - **Uninformed Search** - Breadth First Search - Dijkstra's algorithm or uniform-cost search - Depth First Search - Depth Limited Search

UNIT II PROBLEM SOLVING WITH SEARCH TECHNIQUES 6
Informed Search - Greedy Best First - A* algorithm - Adversarial Game and Search - **Game theory** - Optimal decisions in game - Min Max Search algorithm - Alpha-beta pruning - **Constraint Satisfaction Problems (CSP)** - Examples - Map Coloring - Job Scheduling - Backtracking Search for CSP

UNIT III LEARNING 6
Machine Learning: Definitions – Classification - Regression - approaches of machine learning models - Types of learning - Probability - Basics - Linear Algebra - Hypothesis space and inductive bias, Evaluation. Training and test sets, cross validation, Concept of over fitting, under fitting, Bias and Variance - **Regression**: Linear Regression - Logistic Regression

UNIT IV SUPERVISED LEARNING 6
Neural Network: Introduction, Perceptron Networks – Adaline - Back propagation networks - **Decision Tree:** Entropy – Information gain - Gini Impurity - classification algorithm - Rule based Classification - **Naïve Bayesian classification** - **Support Vector Machines** (SVM)

UNIT V UNSUPERVISED LEARNING 6
Unsupervised Learning – Principle Component Analysis - **Neural Network**: Fixed Weight Competitive Nets - Kohonen Self-Organizing Feature Maps – **Clustering**: Definition - Types of Clustering – Hierarchical clustering algorithms – k-means algorithm

TOTAL : 30 PERIODS

PRACTICAL EXERCISES: 30 PERIODS
Programs for Problem solving with Search
1. Implement breadth first search
2. Implement depth first search
3. Analysis of breadth first and depth first search in terms of time and space
4. Implement and compare Greedy and A* algorithms.

Supervised learning

5. Implement the non-parametric locally weighted regression algorithm in order to fit data points. Select appropriate data set for your experiment and draw graphs
6. Write a program to demonstrate the working of the decision tree based algorithm.
7. Build an artificial neural network by implementing the back propagation algorithm and test the same using appropriate data sets.
8. Write a program to implement the naïve Bayesian classifier.

Unsupervised learning

9. Implementing neural network using self-organizing maps
10. Implementing k-Means algorithm to cluster a set of data.
11. Implementing hierarchical clustering algorithm.

Note:

- Installation of gnu-prolog, Study of Prolog (gnu-prolog).
- The programs can be implemented in using C++/JAVA/ Python or appropriate tools can be used by designing good user interface
- Data sets can be taken from standard repositories (https://archive.ics.uci.edu/ml/datasets.html) or constructed by the students.

OUTCOMES:

CO1: Understand the foundations of AI and the structure of Intelligent Agents
CO2: Use appropriate search algorithms for any AI problem
CO3: Study of learning methods
CO4: Solving problem using Supervised learning
CO5: Solving problem using Unsupervised learning

TOTAL: 60 PERIODS

TEXT BOOKS:

1. S. Russell and P. Norvig, “Artificial Intelligence: A Modern Approach”, Prentice Hall, Fourth Edition, 2021
2. S.N.Sivanandam and S.N.Deepa, Principles of soft computing-Wiley India.3 rd ed,

REFERENCES

1. Machine Learning. Tom Mitchell. First Edition, McGraw- Hill, 1997.
2. I. Bratko, “Prolog: Programming for Artificial Intelligence‖, Fourth edition, Addison-Wesley Educational Publishers Inc., 2011.
3. C. Muller & Sarah Alpaydin, Ethem. Introduction to machine learning. MIT press, 2020.

21150OE61A **IOT CONCEPTS AND APPLICATIONS** **L T P C**
2 0 2 3

OBJECTIVES:

- To apprise students with basic knowledge of IoT that paves a platform to understand physical and logical design of IOT
- To teach a student how to analyse requirements of various communication models and protocols for cost-effective design of IoT applications on different IoT platforms.
- To introduce the technologies behind Internet of Things(IoT).
- To explain the students how to code for an IoT application using Arduino/Raspberry Pi open platform.
- To apply the concept of Internet of Things in real world scenario.

UNIT I INTRODUCTION TO INTERNET OF THINGS 5

Evolution of Internet of Things – Enabling Technologies – IoT Architectures: oneM2M, IoT World Forum (IoTWF) and Alternative IoT Models – Simplified IoT Architecture and Core IoT Functional Stack – Fog, Edge and Cloud in IoT

UNIT II COMPONENTS IN INTERNET OF THINGS 5

Functional Blocks of an IoT Ecosystem – Sensors, Actuators, and Smart Objects – Control Units - Communication modules (Bluetooth, Zigbee,Wifi, GPS, GSM Modules)

UNIT III PROTOCOLS AND TECHNOLOGIES BEHIND IOT 6

IOT Protocols - IPv6, 6LoWPAN, MQTT, CoAP - RFID, Wireless Sensor Networks, BigData Analytics, Cloud Computing, Embedded Systems.

UNIT IV OPEN PLATFORMS AND PROGRAMMING 7

IOT deployment for Raspberry Pi /Arduino platform-Architecture -Programming – Interfacing – Accessing GPIO Pins – Sending and Receiving Signals Using GPIO Pins – Connecting to the Cloud.

UNIT V IOT APPLICATIONS 7

Business models for the internet of things, Smart city, Smart mobility and transport, Industrial IoT, Smart health, Environment monitoring and surveillance - Home Automation - Smart Agriculture

30 PERIODS

PRACTICAL EXERCISES: 30 PERIODS
1. Introduction to Arduino platform and programming
2. Interfacing Arduino to Zigbee module
3. Interfacing Arduino to GSM module
4. Interfacing Arduino to Bluetooth Module
5 Introduction to Raspberry PI platform and python programming
6. Interfacing sensors to Raspberry PI
7. Communicate between Arduino and Raspberry PI using any wireless medium
8. Setup a cloud platform to log the data
9. Log Data using Raspberry PI and upload to the cloud platform
10.Design an IOT based system

OUTCOMES:
CO 1: Explain the concept of IoT.
CO 2: Understand the communication models and various protocols for IoT.
CO 3: Design portable IoT using Arduino/Raspberry Pi /open platform
CO 4: Apply data analytics and use cloud offerings related to IoT.
CO 5: Analyze applications of IoT in real time scenario.

TOTAL:60 PERIODS

TEXTBOOKS

1. Robert Barton, Patrick Grossetete, David Hanes, Jerome Henry, Gonzalo Salgueiro, “IoT Fundamentals: Networking Technologies, Protocols, and Use Cases for the Internet of Things”, CISCO Press, 2017
2. Samuel Greengard, The Internet of Things, The MIT Press, 2015

REFERENCES

1. Perry Lea, “Internet of things for architects”, Packt, 2018
2. Olivier Hersent, David Boswarthick, Omar Elloumi , “The Internet of Things – Key applications and Protocols”, Wiley, 2012
3. IOT (Internet of Things) Programming: A Simple and Fast Way of Learning, IOT Kindle Edition.
4. Dieter Uckelmann, Mark Harrison, Michahelles, Florian (Eds), “Architecting the Internet of Things”, Springer, 2011.
5. ArshdeepBahga, Vijay Madisetti, “Internet of Things – A hands-on approach”, Universities Press, 2015
6. https://www.arduino.cc/
   https://www.ibm.com/smarterplanet/us/en/?ca=v_smarterplanet

211500E75B **DATA SCIENCE FUNDAMENTALS** **L T P C**
2 0 2 3

COURSE OBJECTIVES:

- Familiarize students with the data science process.
- Understand the data manipulation functions in Numpy and Pandas.
- Explore different types of machine learning approaches.
- Understand and practice visualization techniques using tools.
- Learn to handle large volumes of data with case studies.

UNIT I INTRODUCTION 6

Data Science: Benefits and uses – facets of data - Data Science Process: Overview – Defining research goals – Retrieving data – data preparation - Exploratory Data analysis – build the model – presenting findings and building applications - Data Mining - Data Warehousing - Basic statistical descriptions of Data

UNIT II DATA MANIPULATION 9

Python Shell - Jupyter Notebook - IPython Magic Commands - NumPy Arrays-Universal Functions – Aggregations – Computation on Arrays – Fancy Indexing – Sorting arrays – Structured data – Data manipulation with Pandas – Data Indexing and Selection – Handling missing data – Hierarchical indexing – Combining datasets – Aggregation and Grouping – String operations – Working with time series – High performance

UNIT III MACHINE LEARNING 5

The modeling process - Types of machine learning - Supervised learning - Unsupervised learning - Semi-supervised learning- Classification, regression - Clustering – Outliers and Outlier Analysis

UNIT IV DATA VISUALIZATION 5

Importing Matplotlib – Simple line plots – Simple scatter plots – visualizing errors – density and contour plots – Histograms – legends – colors – subplots – text and annotation – customization – three dimensional plotting - Geographic Data with Basemap - Visualization with Seaborn

UNIT V HANDLING LARGE DATA 5

Problems - techniques for handling large volumes of data - programming tips for dealing with large data sets- Case studies: Predicting malicious URLs, Building a recommender system - Tools and techniques needed - Research question - Data preparation - Model building – Presentation and automation.

30 PERIODS

P r e s s , 2 0 1 4 .

PRACTICAL EXERCISES: 30 PERIODS

LAB EXERCISES

1. Download, install and explore the features of Python for data analytics.
2. Working with Numpy arrays
3. Working with Pandas data frames
4. Basic plots using Matplotlib
5. Statistical and Probability measures
   a) Frequency distributions
   b) Mean, Mode, Standard Deviation
   c) Variability
   d) Normal curves
   e) Correlation and scatter plots
   f) Correlation coefficient
   g) Regression

Note: Example data sets like: UCI, Iris, Pima Indians Diabetes etc.

6. Use the standard benchmark data set for performing the following:
a) Univariate Analysis: Frequency, Mean, Median, Mode, Variance, Standard Deviation,Skewness and Kurtosis.
b) Bivariate Analysis: Linear and logistic regression modelling.
7. Apply supervised learning algorithms and unsupervised learning algorithms on any data set.
8. Apply and explore various plotting functions on any data set.

TOTAL:60 PERIODS

COURSE OUTCOMES:

At the end of this course, the students will be able to:

CO1: Gain knowledge on data science process.
CO2: Perform data manipulation functions using Numpy and Pandas.
CO3 Understand different types of machine learning approaches.
CO4: Perform data visualization using tools.
CO5: Handle large volumes of data in practical scenarios.

TEXT BOOKS

1. Manning Publications, 2016.
2. Jake VanderPlas, “Python Data Science Handbook”, O’Reilly, 2016.

REFERENCES

1. Robert S. Witte and John S. Witte, “Statistics”, Eleventh Edition, Wiley Publications, 2017.
2. Allen B. Downey, “Think Stats: Exploratory Data Analysis in Python”, Green Tea

21150OE66B **AUGMENTED REALITY /VIRTUAL REALITY** **L T P C**
3 0 0 3

OBJECTIVES:

- To impart the fundamental aspects and principles of AR/VR technologies.
- To know the internals of the hardware and software components involved in the development of AR/VR enabled applications.
- To learn about the graphical processing units and their architectures.
- To gain knowledge about AR/VR application development.
- To know the technologies involved in the development of AR/VR based applications.

UNIT I INTRODUCTION 7

Introduction to Virtual Reality and Augmented Reality - Definition - Introduction to Trajectories and Hybrid Space-Three I's of Virtual Reality – Virtual Reality Vs 3D Computer Graphics – Benefits of Virtual Reality - Components of VR System - Introduction to AR-AR Technologies-Input Devices - 3D Position Trackers - Types of Trackers - Navigation and Manipulation Interfaces - Gesture Interfaces – Types of Gesture Input Devices – Output Devices – Graphics Display – Human Visual System - Personal Graphics Displays - Large Volume Displays - Sound Displays - Human Auditory System.

UNIT II VR MODELING 6

Modeling – Geometric Modeling – Virtual Object Shape – Object Visual Appearance – Kinematics Modeling - Transformation Matrices - Object Position - Transformation Invariants -Object Hierarchies – Viewing the 3D World – Physical Modeling – Collision Detection – Surface Deformation – Force Computation – Force Smoothing and Mapping – Behavior Modeling – Model Management.

UNIT III VR PROGRAMMING 6

VR Programming – Toolkits and Scene Graphs – World ToolKit – Java 3D – Comparison of World ToolKit and Java 3D

UNIT IV APPLICATIONS 6

Human Factors in VR - Methodology and Terminology - VR Health and Safety Issues – VR and Society-Medical Applications of VR - Education, Arts and Entertainment - Military VR Applications – Emerging Applications of VR - VR Applications in Manufacturing - Applications of VR in Robotics - Information Visualization – VR in Business – VR in Entertainment – VR in Education.

UNIT V AUGMENTED REALITY 5

Introduction to Augmented Reality-Computer vision for AR-Interaction-Modelling and Annotation-Navigation-Wearable devices

30 PERIODS

PRACTICAL EXERCISES: 30 PERIODS

1. Study of tools like Unity, Maya, 3DS MAX, AR toolkit, Vuforia and Blender.
2. Use the primitive objects and apply various projection types by handling camera.
3. Download objects from asset store and apply various lighting and shading effects.
4. Model three dimensional objects using various modelling techniques and apply textures over them.
5. Create three dimensional realistic scenes and develop simple virtual reality enabled mobile applications which have limited interactivity.
6. Add audio and text special effects to the developed application.
7. Develop VR enabled applications using motion trackers and sensors incorporating full haptic interactivity.
8. Develop AR enabled applications with interactivity like E learning environment, Virtual walkthroughs and visualization of historic places.
9. Develop AR enabled simple applications like human anatomy visualization, DNA/RNA structure visualization and surgery simulation.
10. Develop simple MR enabled gaming applications.

TOTAL:60 PERIODS

OUTCOMES:

On completion of the course, the students will be able to:

CO1: Understand the basic concepts of AR and VR
CO2: Understand the tools and technologies related to AR/VR
CO3: Know the working principle of AR/VR related Sensor devices
CO4: Design of various models using modeling techniques
CO5: Develop AR/VR applications in different domains

TEXTBOOKS:

1. Charles Palmer, John Williamson, “Virtual Reality Blueprints: Create compelling VR experiences for mobile”, Packt Publisher, 2018
2. Dieter Schmalstieg, Tobias Hollerer, “Augmented Reality: Principles & Practice”, Addison Wesley, 2016
3. John Vince, “Introduction to Virtual Reality”, Springer-Verlag, 2004.
4. William R. Sherman, Alan B. Craig: Understanding Virtual Reality – Interface, Application, Design”, Morgan Kaufmann, 2003

OPEN ELCTIVE III

21150E76A ENGLISH FOR COMPETITIVE EXAMINATIONS L T P C
3 0 0 3

COURSE DESCRIPTION:
Students aspiring to take up competitive exams of which the English language is a vital component will find this course useful. Designed for students in the higher semesters, the course will help students to familiarise themselves with those aspects of English that are tested in these examinations.

Objectives:
- To train the students in the language components essential to face competitive examinations both at the national (UPSC, Banking, Railway, Defence) and the international level (GRE, TOEFL, IELTS).
- To enhance an awareness of the specific patterns in language testing and the respective skills to tackle verbal reasoning and verbal ability tests.
- To inculcate effective practices in language-learning in order to improve accuracy in usage of grammar and coherence in writing.
- To improve students' confidence to express their ideas and opinions in formal contexts
- To create awareness of accuracy and precision in communication

UNIT I 9
Orientation on different formats of competitive exams - Vocabulary - Verbal ability - Verbal reasoning - Exploring the world of words - Essential words - Meaning and their usage - Synonyms-antonyms - Word substitution - Word analogy - Idioms and phrases - Commonly confused words – Spellings - Word expansion - New words in use.

UNIT II 9
Grammar - Sentence improvement -Sentence completion - Rearranging phrases into sentences - Error identification -Tenses - Prepositions - Adjectives - Adverbs - Subject-verb agreement - Voice - Reported speech - Articles - Clauses - Speech patterns.

UNIT III 9
Reading - Specific information and detail - Identifying main and supporting ideas - Speed reading techniques - Improving global reading skills - Linking ideas - Summarising - Understanding argument - Identifying opinion/attitude and making inferences - Critical reading.

UNIT IV 9
Writing - Pre-writing techniques - Mindmap - Describing pictures and facts - Paragraph structure - organising points - Rhetoric writing - Improving an answer - Drafting, writing and developing an argument - Focus on cohesion - Using cohesive devices -Analytic writing - Structure and types of essay – Mind maps – Structure of drafts, letters, memos, emails – Statements of Purpose – Structure, Content and Style.

UNIT V 9
Listening and Speaking - Contextual listening - Listening to instructions - Listening for specific information - Identifying detail, main ideas - Following signpost words - Stress, rhythm and intonation - Speaking to respond and elicit ideas - Guided speaking - Opening phrases - Interactive communication - Dysfluency -Sentence stress - Speaking on a topic - Giving opinions - Giving an oral presentation - Telling a story or a personal anecdote - Talking about oneself - Utterance - Speech acts- Brainstorming ideas - Group discussion.

TOTAL: 45 PERIODS

LEARNING OUTCOMES:
At the end of the course, learners will be able
- Expand their vocabulary and gain practical techniques to read and comprehend a wide range of texts with the emphasis required

- Identify errors with precision and write with clarity and coherence
- Understand the importance of task fulfilment and the usage of task-appropriate vocabulary
- Communicate effectively in group discussions, presentations and interviews
- Write topic based essays with precision and accuracy

CO-PO & PSO MAPPING

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	1	3	3	1	3	3	3	3	1	3	1	3	-	-	-
2	2	3	3	2	3	3	3	3	1	3	3	3	-	-	-
3	3	3	3	3	3	3	3	3	3	3	3	3	-	-	-
4	2	2	2	2	2	2	2	2	3	3	3	3	-	-	-
5	2	2	2	2	2	2	2	2	2	3	2	3	-	-	-
AVg.	**2**	**2.6**	**2.6**	**2**	**2.6**	**2.6**	**2.6**	**2.6**	**2**	**3**	**2.4**	**3**	**-**	**-**	**-**

1-low, 2-medium, 3-high, '-"- no correlation

Note: The average value of this course to be used for program articulation matrix.

Teaching Methods:
Instructional methods will involve discussions, taking mock tests on various question papers – Objective, multiple-choice and descriptive. Peer evaluation, self-check on improvement and peer feedback - Practice sessions on speaking assessments, interview and discussion – Using multimedia.

Evaluative Pattern:
Internal Tests – 50%
End Semester Exam - 50%

TEXTBOOKS:

1. R.P.Bhatnagar - *General English for Competitive Examinations.* Macmillan India Limited, 2009.

REFERENCES:

1. Educational Testing Service - The Official Guide to the GRE Revised General Test, Tata McGraw Hill, 2010.
2. The Official Guide to the TOEFL Test, Tata McGraw Hill, 2010.
3. R Rajagopalan- General English for Competitive Examinations, McGraw Hill Education (India) Private Limited, 2008.

Websites
http://www.examenglish.com/, http://www.ets.org/ , http://www.bankxams.com/
http://civilservicesmentor.com/, http://www.educationobserver.com
http://www.cambridgeenglish.org/in/

21152OE73B **SPACE ENGINEERING** **L T P C**
3 0 0 3

OBJECTIVES:

- Use the standard atmosphere tables and equations.
- Find lift and drag coefficient data from NACA plots.
- Apply the concept of static stability to flight vehicles.
- Describe the concepts of stress, strain, Young's modulus, Poisson's ratio, yield strength.
- Demonstrate a basic knowledge of dynamics relevant to orbital mechanics.

UNIT I STANDARD ATMOSPHERE 6

History of aviation – standard atmosphere - pressure, temperature and density altitude.

UNIT II AERODYNAMICS 10

Aerodynamic forces – Lift generation Viscosity and its implications - Shear stress in a velocity profile - Lagrangian and Eulerian flow field - Concept of a streamline – Aircraft terminology and geometry - Aircraft types - Lift and drag coefficients using NACA data.

UNIT III PERFORMANCE AND PROPULSION 9

Viscous and pressure drag - flow separation - aerodynamic drag - thrust calculations -thrust/power available and thrust/power required.

UNIT IV AIRCRAFT STABILITY AND STRUCTURAL THEORY 10

Degrees of freedom of aircraft motions - stable, unstable and neutral stability - concept of static stability - Hooke's Law- brittle and ductile materials - moment of inertia - section modulus.

UNIT V SPACE APPLICATIONS 10

History of space research - spacecraft trajectories and basic orbital manoeuvres - six orbital elements - Kepler's laws of orbits - Newtons law of gravitation.

TOTAL: 45 PERIODS

OUTCOMES:

- Illustrate the history of aviation & developments over the years
- Ability to identify the types & classifications of components and control systems
- Explain the basic concepts of flight & Physical properties of Atmosphere
- Identify the types of fuselage and constructions.
- Distinguish the types of Engines and explain the principles of Rocket

TEXT BOOKS:

1. John D. Anderson, Introduction to Flight, 8 th Ed., McGraw-Hill Education, New York,2015.
2. E Rathakrishnan, "Introduction to Aerospace Engineering: Basic Principles of Flight", John Wiley, NJ, 2021.
3. Stephen. A. Brandt, " Introduction to Aeronautics: A design perspective " American Institute of Aeronautics & Astronautics,1997.

REFERENCE:

1. Kermode, A.C., "Mechanics of Flight", Himalayan Book, 1997.

21154OE73B **INDUSTRIAL MANAGEMENT** **L T P C**

3 0 0 3

COURSE OBJECTIVES:

- To introduce fundamental concepts of industrial management
- To understand the approaches to the study of Management
- To learn about Decision Making, Organizing and leadership
- To analyze the Managerial Role and functions
- To know about the Supply Chain Management'

UNIT 1 INTRODUCTION 9

Technology Management - Definition - Functions - Evolution of Modern Management - Scientific Management Development of Management Thought. Approaches to the study of Management, Forms of Organization -Individual Ownership - Partnership - Joint Stock Companies - Co-operative Enterprises - Public Sector Undertakings, Corporate Frame Work- Share Holders - Board of Directors - Committees - Chief Executive Line and Functional Managers,-Financial-Legal-Trade Union

UNIT 2 FUNCTIONS OF MANAGEMENT 9

Planning - Nature and Purpose - Objectives - Strategies – Policies and Planning Premises - Decision Making - Organizing - Nature and Process - Premises - Departmentalization - Line and staff - Decentralization -Organizational culture, Staffing - selection and training .Placement - Performance appraisal - Career Strategy – Organizational Development. Leading - Managing human factor - Leadership .Communication, Controlling - Process of Controlling - Controlling techniques, productivity and operations management - Preventive control, Industrial Safety.

UNIT 3 ORGANIZATIONAL BEHAVIOUR 9

Definition - Organization - Managerial Role and functions -Organizational approaches, Individual behaviour - causes - Environmental Effect - Behaviour and Performance, Perception - Organizational Implications. Personality - Contributing factors - Dimension – Need Theories - Process Theories - Job Satisfaction, Learning and Behaviour-Learning Curves, Work Design and appaches.

UNIT 4 GROUPDYNAMICS 9

Group Behaviour - Groups - Contributing factors - Group Norms, Communication - Process - Barriers to communication - Effective communication, leadership - formal and informal characteristics – Managerial Grid - Leadership styles - Group Decision Making - Leadership Role in Group Decision, Group Conflicts - Types -Causes - Conflict Resolution -Inter group relations and conflict, Organization centralization and decentralization - Formal and informal - Organizational Structures Organizational Change and Development -Change Process – Resistance to Change - Culture and Ethics.

UNIT 5 MODERN CONCEPTS 9

Management by Objectives (MBO) - Management by Exception (MBE),Strategic Management - Planning for Future direction - SWOT Analysis -Evolving development strategies, information technology in management Decisions support system-Management Games Business Process Re-engineering(BPR) -Enterprises Resource Planning (ERP) - Supply Chain Management (SCM) - Activity Based Management (AM) - Global Perspective - Principles and Steps Advantages and disadvantage

TOTAL: 45 PERIODS

COURSE OUTCOMES:

CO1: Understand the basic concepts of industrial management

CO2: Identify the group conflicts and its causes.

CO3: Perform swot analysis

CO4 : Analyze the learning curves

CO5 : Understand the placement and performance appraisal

REFERENCES:

Maynard H.B, "Industrial Engineering Hand book", McGraw-Hill, sixth 2008

CO's – PO's & PSO's MAPPING

CO's	PO's												PSO's		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	2	1											2	1	
2		3	2	3											2
3	2	3	2	3									1	2	3
4	2	2	3	3										3	3
5	2	2											2		
AVg.	2	2.2	2.3	3									1.8	2	2.6

21154OE73A INTRODUCTION TO NON-DESTRUCTIVE TESTING L T P C
3 0 0 3

COURSE OBJECTIVES:

The main learning objective of this course is to prepare the students for:

- Understanding the basic importance of NDT in quality assurance.
- Imbibing the basic principles of various NDT techniques, its applications, limitations, codes and standards.
- Equipping themselves to locate a flaw in various materials, products.
- Applying apply the testing methods for inspecting materials in accordance with industry specifications and standards.
- Acquiring the knowledge on the selection of the suitable NDT technique for a given application

UNIT I INTRODUCTION TO NDT & VISUAL TESTING 9

Concepts of Non-destructive testing-relative merits and limitations-NDT Versus mechanical testing, Fundamentals of Visual Testing - vision, lighting, material attributes, environmental factors, visual perception, direct and indirect methods – mirrors, magnifiers, boroscopes and fibroscopes – light sources and special lighting.

UNIT II LIQUID PENETRANT & MAGNETIC PARTICLE TESTING 9

Liquid Penetrant Inspection: principle, applications, advantages and limitations, dyes, developers and cleaners, Methods & Interpretation.

Magnetic Particle Inspection: Principles, applications, magnetization methods, magnetic particles, Testing Procedure, demagnetization, advantages and limitations, - Interpretation and evaluation of test indications.

UNIT III EDDY CURRENT TESTING & THERMOGRAPHY 9

Eddy Current Testing: Generation of eddy currents- properties- eddy current sensing elements, probes, Instrumentation, Types of arrangement, applications, advantages, limitations – Factors affecting sensing elements and coil impedance, calibration, Interpretation/Evaluation.

Thermography- Principle, Contact & Non-Contact inspection methods, Active & Passive methods, Liquid Crystal - Concept, example, advantages & limitations. Electromagnetic spectrum, infrared thermography- approaches, IR detectors, Instrumentation and methods, applications.

UNIT IV ULTRASONIC TESTING & AET 9

Ultrasonic Testing: Types of ultrasonic waves, characteristics, attenuation, couplants, probes, EMAT. Inspection methods-pulse echo, transmission and phased array techniques, types of scanning and displays, angle beam inspection of welds, time of flight diffraction (TOFD) technique, Thickness determination by ultrasonic method, Study of A, B and C scan presentations, calibration.

Acoustic Emission Technique – Introduction, Types of AE signal, AE wave propagation, Source location, Kaiser effect, AE transducers, Principle, AE parameters, AE instrumentation, Advantages & Limitations, Interpretation of Results, Applications.

UNIT V RADIOGRAPHY TESTING 9

Sources-X-rays and Gamma rays and their characteristics-absorption, scattering. Filters and screens, Imaging modalities-film radiography and digital radiography (Computed, Direct, Real Time, CT scan). Problems in shadow formation, exposure factors, inverse square law, exposure charts, Penetrameters, safety in radiography.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

After completion of this course, the students will be able to

1. Realize the importance of NDT in various engineering fields.
2. Have a basic knowledge of surface NDE techniques which enables to carry out variousinspection in accordance with the established procedures.
3. Calibrate the instrument and inspect for in-service damage in the components by means ofEddy current testing as well as Thermography testing.
4. Differentiate various techniques of UT and AET and select appropriate NDT methods forbetter evaluation.
5. Interpret the results of Radiography testing and also have the ability to analyse the influenceof various parameters on the testing.

TEXT BOOKS:

1. Baldev Raj, T. Jayakumar and M. Thavasimuthu, Practical Non Destructive Testing, AlphaScience International Limited, 3rd edition, 2002.
2. J. Prasad and C. G. K. Nair, Non-Destructive Test and Evaluation of Materials, Tata McGraw-Hill Education, 2nd edition, 2011.
3. Ravi Prakash, “Non-Destructive Testing Techniques”, 1st revised edition, New AgeInternational Publishers, 2010.

REFERENCES:

1. ASM Metals Handbook, V-17, "Nondestructive Evaluation and Quality Control", AmericanSociety of Metals, USA, 2001.
2. Barry Hull and Vernon John,"Nondestructive Testing", Macmillan, 1989.
3. Chuck Hellier, “Handbook of Nondestructive Evaluation”, Mc Graw Hill, 2012.
4. Louis Cartz, "Nondestructive Testing", ASM International, USA, 1995.

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO 1	PSO 2	PSO 3
C01	2	2	2	3			2	2				2	1	2	
C02	3	1	2	2			2	2				2	2	2	1
C03	3	2	1	2			2	2				2	2	2	
CO4	3	1	2	2			2	2				2	2	2	2
CO5	3	2	2	2			2	2				2	2	2	1
Avg	2.8	1.6	1.8	2.2			2	2				2	1.8	2	1.3

21152OE73A **BIOMEDICAL INSTRUMENTATION** **L T P C**

3 0 0 3

COURSE OBJECTIVE:

- To Introduce Fundamentals of Biomedical Engineering
- To study the communication mechanics in a biomedical system with few examples
- To study measurement of certain important electrical and non-electrical parameters
- To understand the basic principles in imaging techniques
- To have a basic knowledge in life assisting and therapeutic devices

UNIT I FUNDAMENTALS OF BIOMEDICAL ENGINEERING 9

Cell and its structure – Resting and Action Potential – Nervous system and its fundamentals - Basic components of a biomedical system- Cardiovascular systems- Respiratory systems - Kidney and blood flow - Biomechanics of bone - Biomechanics of soft tissues -Physiological signals and transducers - Transducers – selection criteria – Piezo electric, ultrasonic transducers - Temperature measurements - Fibre optic temperature sensors.

UNIT II NON ELECTRICAL PARAMETERS MEASUREMENT AND DIAGNOSTIC PROCEDURES 9

Measurement of blood pressure - Cardiac output - Heart rate - Heart sound - Pulmonary function measurements – spirometer – Photo Plethysmography, Body Plethysmography – Blood Gas analysers, pH of blood –measurement of blood pCO2, pO2, finger-tip oxymeter - ESR, GSR measurements. Infectious Disease – Awareness, Causative agent, Prevention and control - Cholera, Dengu, Malaria, Diarrhea, Tuberculosis, Typhoid, Covid, HIV.

UNIT III ELECTRICAL PARAMETERS ACQUISITION AND ANALYSIS 9

Electrodes – Limb electrodes –floating electrodes – pregelled disposable electrodes - Micro, needle and surface electrodes – Amplifiers, Preamplifiers, differential amplifiers, chopper amplifiers – Isolation amplifier - ECG – EEG – EMG – ERG – Lead systems and recording methods – Typical waveforms - Electrical safety in medical environment, shock hazards – leakage current-Instruments for checking safety parameters of biomedical equipment.

UNIT IV IMAGING MODALITIES AND ANALYSIS 9

Radio graphic and fluoroscopic techniques – Computer tomography – MRI – Ultrasonography – Endoscopy – Thermography –Different types of biotelemetry systems - Retinal Imaging - Imaging application in Biometric systems.

UNIT V LIFE ASSISTING, THERAPEUTIC AND ROBOTIC DEVICES 9

Pacemakers – Defibrillators – Ventilators – Nerve and muscle stimulators – Diathermy – Heart – Lung machine – Audio meters – Dialysers – Lithotripsy - ICCU patient monitoring system - Nano Robots - Robotic surgery –Orthopedic prostheses fixation

TOTAL : 45 PERIODS

OUTCOMES: At the end of the course students will have the

- Ability to understand the philosophy of the heart, lung, blood circulation and respiration system.
- Ability to provide latest ideas on devices of non-electrical devices.
- Ability to gain knowledge on various sensing and measurement devices of electrical origin.
- Ability to understand the analysis systems of various organ types.
- Ability to bring out the important and modern methods of imaging techniques and their analysis.
- Ability to explain the medical assistance/techniques, robotic and therapeutic equipments.

TEXT BOOKS:

1. Leslie Cromwell, “Biomedical Instrumentation and Measurement”, Prentice Hall of India, New Delhi, 2007.
2. Khandpur R.S, Handbook of Biomedical Instrumentation, Tata McGraw-Hill, New Delhi,2nd edition, 2003
3. Joseph J Carr and John M.Brown, Introduction to Biomedical Equipment Technology, John Wiley and sons, New York, 4th edition, 2012

REFERENCES

1. John G. Webster, Medical Instrumentation Application and Design, John Wiley and sons, New York, 1998.
2. Duane Knudson, Fundamentals of Biomechanics, Springer, 2nd Edition, 2007.
3. Suh, Sang, Gurupur, Varadraj P., Tanik, Murat M., Health Care Systems, Technology and Techniques, Springer, 1st Edition, 2011.
4. Ed. Joseph D. Bronzino, The Biomedical Engineering Hand Book, Third Edition, Boca Raton, CRC Press LLC, 2006.
5. M.Arumugam, ‘Bio-Medical Instrumentation’, Anuradha Agencies, 2003.

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO	PSO	PSO3
C01	3	2	2	3								2	2	2	1
C02	3	1	2	2								2	2	2	1
C03	3	2	1	2								2	2	2	1
CO4	3	2	1	2								2	2	2	2
CO5	3	2	2	2								2	2	2	1
Avg	3	1.8	1.6	2.2								2	2	2	1.2

21155OE73A REMOTE SENSING CONCEPTS L T P C3 0 0 3

OBJECTIVES:

- To introduce the concepts of remote sensing processes and its components.
- To expose the various remote sensing platforms and sensors and to introduce the elements ofdata interpretation

UNIT I REMOTE SENSING AND ELECTROMAGNETIC RADIATION 9

Definition – components of RS – History of Remote Sensing – Merits and demerits of data collation between conventional and remote sensing methods - Electromagnetic Spectrum – Radiation principles - Wave theory, Planck's law, Wien's Displacement Law, Stefan's Boltzmann law, Kirchoff's law – Radiation sources: active & passive - Radiation Quantities

UNIT II EMR INTERACTION WITH ATMOSPHERE AND EARTH MATERIAL 9

Standard atmospheric profile – main atmospheric regions and its characteristics – interaction of radiation with atmosphere – Scattering, absorption and refraction – Atmospheric windows - Energy balance equation – Specular and diffuse reflectors – Spectral reflectance & emittance – Spectroradiometer - Spectral Signature concepts – Typical spectral reflectance curves for vegetation, soil and water – solid surface scattering in microwave region.

UNIT III ORBITS AND PLATFORMS 9

Motions of planets and satellites – Newton's law of gravitation - Gravitational field and potential -Escape velocity - Kepler's law of planetary motion - Orbit elements and types – Orbital perturbations and maneuvers – Types of remote sensing platforms - Ground based, Airborne platforms and Spaceborne platforms – Classification of satellites – Sun synchronous and Geosynchronous satellites –Lagrange Orbit.

UNIT IV SENSING TECHNIQUES 9

Classification of remote sensors – Resolution concept : spatial, spectral, radiometric and temporal resolutions - Scanners - Along and across track scanners – Optical-infrared sensors – Thermal sensors – microwave sensors – Calibration of sensors - High Resolution Sensors - LIDAR , UAV –Orbital and sensor characteristics of live Indian earth observation satellites

UNIT V DATA PRODUCTS AND INTERPRETATION 9

Photographic and digital products – Types, levels and open source satellite data products –– selection and procurement of data- Visual interpretation: basic elements and interpretation keys - Digital interpretation - Concepts of Image rectification, Image enhancement and Image classification

TOTAL:45 PERIODS

COURSE OUTCOMES:

On completion of the course, the student is expected to

CO 1 Understand the concepts and laws related to remote sensing
CO 2 Understand the interaction of electromagnetic radiation with atmosphere and earth material
CO 3 Acquire knowledge about satellite orbits and different types of satellites
CO 4 Understand the different types of remote sensors
CO 5 Gain knowledge about the concepts of interpretation of satellite imagery

TEXTBOOKS:

1. Thomas M.Lillesand, Ralph W. Kiefer and Jonathan W. Chipman, Remote Sensing andImage interpretation, John Wiley and Sons, Inc, New York,2015.
2. George Joseph and C Jeganathan, Fundamentals of Remote Sensing,Third EditionUniversities Press (India) Private limited, Hyderabad, 2018

REFERENCES:

1. Janza, F.Z., Blue H.M. and Johnson,J.E. Manual of Remote Sensing. Vol.1, AmericanSocietyof Photogrametry, Virginia, USA, 2002.
2. Verbyla, David, Satellite Remote Sensing of Natural Resources. CRC Press, 1995
3. Paul Curran P.J. Principles of Remote Sensing. Longman, RLBS, 1988.

4. Introduction to Physics and Techniques of Remote Sensing , Charles Elachi and JacobVan Zyl, 2006 Edition II, Wiley Publication.
5. Basudeb Bhatta, Remote Sensing and GIS, Oxford University Press, 2011

CO-PO MAPPING

PO	Graduate Attribute	Course Outcome					Average
		CO1	CO2	CO3	CO4	CO5	
PO1	Engineering Knowledge	3	3	3	3	3	3
PO2	Problem Analysis				3	3	3
PO3	Design/Development of Solutions				3	3	3
PO4	Conduct Investigations of Complex Problems				3	3	3
PO5	Modern Tool Usage				3	3	3
PO6	The Engineer and Society						
PO 7	Environment and Sustainability						
PO 8	Ethics						
PO 9	Individual and Team Work						
PO 10	Communication						
PO 11	Project Management and Finance						
PO 12	Life-long Learning	3		3	3	3	3
PSO 1	Knowledge of Geoinformatics discipline	3	3	3	3	3	3
PSO 2	Critical analysis of Geoinformatics Engineering problems and innovations	3	3	3	3	3	3
PSO 3	Conceptualization and evaluation of Design solutions	3	3	3	3	3	3

21155OE73B DRINKING WATER SUPPLY AND TREATMENT L T P C

3 0 0 3

OBJECTIVE:

- To equip the students with the principles and design of water treatment units and distribution system.

UNIT I SOURCES OF WATER 9

Public water supply system – Planning, Objectives, Design period, Population forecasting; Water demand - Sources of water and their characteristics, Surface and Groundwater - Impounding Reservoir - Development and selection of source - Source Water quality - Characterization - Significance – Drinking Water quality standards.

UNIT II CONVEYANCE FROM THE SOURCE 9

Water supply – intake structures – Functions; Pipes and conduits for water – Pipe materials – Hydraulics of flow in pipes - Transmission main design - Laying, jointing and testing of pipes - appurtenances – Types and capacity of pumps – Selection of pumps and pipe materials.

UNIT III WATER TREATMENT 9

Objectives – Unit operations and processes – Principles, functions, and design of water treatment plant units, aerators of flash mixers, Coagulation and flocculation –- sand filters - Disinfection –- Construction, Operation and Maintenance aspects.

UNIT IV ADVANCED WATER TREATMENT 9

Water softening – Desalination- R.O. Plant – demineralization – Adsorption - Ion exchange- Membrane Systems - Iron and Manganese removal - Defluoridation - Construction and Operation and Maintenance aspects

UNIT V WATER DISTRIBUTION AND SUPPLY 9

Requirements of water distribution - Components - Selection of pipe material - Service reservoirs - Functions – Network design – Economics - Computer applications – Appurtenances – Leak detection - Principles of design of water supply in buildings – House service connection - Fixtures and fittings, systems of plumbing and types of plumbing.

TOTAL: 45 PERIODS

OUTCOMES

CO1: An understanding of water quality criteria and standards, and their relation to public health

CO2: The ability to design the water conveyance system

CO3: The knowledge in various unit operations and processes in water treatment

CO4: An ability to understand the various systems for advanced water treatment

CO5: An insight into the structure of drinking water distribution system

TEXT BOOKS :

1. Garg. S.K., "Water Supply Engineering", Khanna Publishers, Delhi, September 2008.
2. Punmia B.C, Arun K.Jain, Ashok K.Jain, " Water supply Engineering" Lakshmi publication private limited, New Delhi, 2016.
3. Rangwala "Water Supply and Sanitary Engineering", February 2022
4. Birdie.G.S., "Water Supply and Sanitary Engineering", Dhanpat Rai and sons, 2018.

REFERENCES :

1. Fair. G.M., Geyer.J.C., "Water Supply and Wastewater Disposal", John Wiley and Sons,1954

2. abbit.H.E, and Donald.J.J, "Water Supply Engineering" , McGraw Hill book Co, 1984.
3. Steel. E.W.et al., "Water Supply Engineering" , Mc Graw Hill International book Co, 1984.
4. Duggal. K.N., "Elememts of public Health Engineering", S.Chand and Company Ltd, New Delhi, 1998.

CO's- PO's & PSO's MAPPING

CO's	PO's												PSO's		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1		3						3		3			3		
2		3		2		2				3			3		
3				2		2				3			3		
4			3	2				3	2	3			3		
5			3	2			1		2	3		1			
Avg.		3	3	2		2	1	3	2	3		1	3		

1. **low, 2-medium, 3-high, '-"- no correlation**

Note: The average value of this course to be used for program articulation matrix.

21153OE73A	RENEWABLE ENERGY TECHNOLOGIES	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

1 To know the Indian and global energy scenario
2 To learn the various solar energy technologies and its applications.
3 To educate the various wind energy technologies.
4 To explore the various bio-energy technologies.
5 To study the ocean and geothermal technologies.

UNIT – I ENERGY SCENARIO 9

Indian energy scenario in various sectors – domestic, industrial, commercial, agriculture, transportation and others - Present conventional energy status - Present renewable energy status-Potential of various renewable energy sources-Global energy status-Per capita energy consumption - Future energy plans

UNIT – II SOLAR ENERGY 9

Solar radiation – Measurements of solar radiation and sunshine – Solar spectrum - Solar thermal collectors – Flat plate and concentrating collectors – Solar thermal applications – Solar thermal energy storage – Fundamentals of solar photo voltaic conversion – Solar cells – Solar PV Systems – Solar PV applications.

UNIT – III WIND ENERGY 9

Wind data and energy estimation – Betz limit - Site selection for windfarms – characteristics - Wind resource assessment - Horizontal axis wind turbine – components - Vertical axis wind turbine – Wind turbine generators and its performance – Hybrid systems - Environmental issues - Applications.

UNIT – IV BIO-ENERGY 9

Bio resources – Biomass direct combustion – thermochemical conversion - biochemical conversion-mechanical conversion - Biomass gasifier - Types of biomass gasifiers - Cogeneration –- Carbonisation – Pyrolysis - Biogas plants – Digesters –Biodiesel production – Ethanol production - Applications.

UNIT – V OCEAN AND GEOTHERMAL ENERGY 9

Small hydro - Tidal energy – Wave energy – Open and closed OTEC Cycles – Limitations – Geothermal energy – Geothermal energy sources - Types of geothermal power plants – Applications - Environmental impact.

TOTAL:45 PERIODS

OUTCOMES: At the end of the course the students would be able to

1. Discuss the Indian and global energy scenario.
2. Describe the various solar energy technologies and its applications.
3. Explain the various wind energy technologies.
4. Explore the various bio-energy technologies.
5. Discuss the ocean and geothermal technologies.

TEXT BOOKS:

1. Fundamentals and Applications of Renewable Energy | Indian Edition, by Mehmet Kanoglu, Yunus A. Cengel, John M. Cimbala, cGraw Hill; First edition (10 December 2020), ISBN-10 : 9390385636
2. Renewable Energy Sources and Emerging Technologies, by Kothari, Prentice Hall IndiaLearning Private Limited; 2nd edition (1 January 2011), ISBN-10 : 8120344707

REFERENCES:

1. Godfrey Boyle, “Renewable Energy, Power for a Sustainable Future”, Oxford UniversityPress, U.K., 2012.
2. Rai.G.D., “Non-Conventional Energy Sources”, Khanna Publishers, New Delhi, 2014.
3. Sukhatme.S.P., “Solar Energy: Principles of Thermal Collection and Storage”, Tata McGraw Hill Publishing Company Ltd., New Delhi, 2009.
4. Tiwari G.N., “Solar Energy – Fundamentals Design, Modelling and applications”, Alpha Science Intl Ltd, 2015.
5. Twidell, J.W. & Weir A., “Renewable Energy Resources”, EFNSpon Ltd., UK, 2015.

CO	**PO**												**PSO**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	1	1	1	1	1	2	3	2	2	1	1	3	2	1	2
2	3	2	2	1	1	1	3	1	1	1	2	3	2	1	2
3	3	2	3	1	2	1	3	1	1	1	1	3	1	1	2
4	2	2	2	1	2	1	3	1	1	1	2	3	2	2	2
5	2	1	2	1	2	1	3	1	1	1	1	3	2	1	2
Low (1) ; Medium (2) ; High (3)															

21153OE73B FUNDAMENTALS Of ELECTRONIC DEVICES AND CIRCUITS **L T P C**
3 0 0 3

COURSE OBJECTIVES :

- To give a comprehensive exposure to all types of devices and circuits constructed with discrete components. This helps to develop a strong basis for building linear and digital integrated circuits
- To analyze the frequency response of small signal amplifiers
- To design and analyze single stage and multistage amplifier circuits
- To study about feedback amplifiers and oscillators principles
- To understand the analysis and design of multi vibrators

UNIT I SEMICONDUCTOR DEVICES **9**

PN junction diode, Zener diode, BJT, MOSFET, UJT –structure, operation and V-I characteristics, Rectifiers – Half Wave and Full Wave Rectifier, Zener as regulator

UNIT II AMPLIFIERS **9**

Load line, operating point, biasing methods for BJT and MOSFET**,** BJT small signal model – Analysis of CE, CB, CC amplifiers- Gain and frequency response –Analysis of CS and Source follower – Gain and frequency response- High frequency analysis.

UNIT III MULTISTAGE AMPLIFIERS AND DIFFERENTIAL AMPLIFIER **9**

Cascode amplifier, Differential amplifier – Common mode and Difference mode analysis – Tuned amplifiers – Gain and frequency response – Neutralization methods.

UNIT IV FEEDBACK AMPLIFIERS AND OSCILLATORS **9**

Advantages of negative feedback – Analysis of Voltage / Current, Series , Shunt feedback Amplifiers – positive feedback-Condition for oscillations, phase shift – Wien bridge, Hartley, Colpitts and Crystal oscillators.

UNIT V POWER AMPLIFIERS AND DC/DC CONVERTERS **9**

Power amplifiers- class A-Class B-Class AB-Class C-Temperature Effect- Class AB Power amplifier using MOSFET –DC/DC convertors – Buck, Boost, Buck-Boost analysis and design.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of the course the students will be able to
CO1: Explain the structure and working operation of basic electronic devices.
CO2: Design and analyze amplifiers.
CO3: Analyze frequency response of BJT and MOSFET amplifiers
CO4: Design and analyze feedback amplifiers and oscillator principles.
CO5: Design and analyze power amplifiers and supply circuits

TEXT BOOKS:

1. David A. Bell, "Electronic Devices and Circuits", Oxford Higher Education press, 5 th Edition, 2010.
2. Robert L. Boylestad and Louis Nasheresky, “Electronic Devices and Circuit Theory”, 10th Edition, Pearson Education / PHI, 2008.
3. Adel .S. Sedra, Kenneth C. Smith, "Micro Electronic Circuits", Oxford University Press, 7 th Edition, 2014.

REFERENCES:

1. Donald.A. Neamen, "Electronic Circuit Analysis and Design", Tata McGraw Hill, 3 rd Edition, 2010.
2. D.Schilling and C.Belove, "Electronic Circuits", McGraw Hill, 3 rd Edition, 1989
3. Muhammad H.Rashid, "Power Electronics", Pearson Education / PHI , 2004.

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO	PSO	PSO3
1	3	3	3	3	2	1	-	-	-	-	-	1	2	1	1
2	3	2	2	3	2	2	-	-	-	-	-	1	2	1	1
3	3	3	3	2	1	2	-	-	-	-	-	1	2	1	1
4	3	3	2	3	2	2	-	-	-	-	-	1	2	1	1
5	3	2	3	2	2	1	-	-	-	-	-	1	2	1	1
CO	**3**	**3**	**3**	**3**	**2**	**2**	-	-	-	-	-	**1**	**2**	**1**	**1**

OPEN ELECTIVE IV

21155OE74A BASICS OF INTEGRATED WATER RESOURCES MANAGEMENT **L T P C**
3 0 0 3

OBJECTIVES

- To introduce the interdisciplinary approach of water management.
- To develop knowledge base and capacity building on IWRM.

UNIT I OVERVIEW OF IWRM 9

Facts about water - Definition – Key challenges - Paradigm shift - Water management Principles - Social equity - Ecological sustainability - Economic efficiency - SDGs - World Water Forums.

UNIT II WATER USE SECTORS: IMPACTS AND SOLUTION 9

Water users: People, Agriculture, ecosystem and others - Impacts of the water use sectors on water resources - Securing water for people, food production, ecosystems and other uses - IWRM relevance in water resources management.

UNIT III WATER ECONOMICS 9

Economic characteristics of water good and services – Economic instruments – Private sector involvement in water resources management - PPP experiences through case studies.

UNIT IV RECENT TREANDS IN WATER MANAGEMENT 9

River basin management - Ecosystem Regeneration – 5 Rs - WASH - Sustainable livelihood - Water management in the context of climate change.

UNIT V IMPLEMENTATION OF IWRM 9

Barriers to implementing IWRM - Policy and legal framework - Bureaucratic reforms and inclusive development - Institutional Transformation - Capacity building - Case studies on conceptual framework of IWRM.

TOTAL: 45 PERIODS

OUTCOMES

On completion of the course, the student will be able to apply appropriate management techniques towards managing the water resources.

CO1 Describe the context and principles of IWRM; Compare the conventional and integrated ways of water management.
CO2 Discuss on the different water uses; how it is impacted and ways to tackle these impacts.
CO3 Explain the economic aspects of water and choose the best economic option among the alternatives; illustrate the pros and cons of PPP through case studies.
CO4 Illustrate the recent trends in water management.
CO5 Understand the implementation hitches and the institutional frameworks.

TEXT BOOKS

1. Cech Thomas V., Principles of water resources: history, development, management and policy. John Wiley and Sons Inc., New York. 2003.
2. Mollinga P. *et al.* "Integrated Water Resources Management", Water in South Asia Volume I, Sage Publications, 2006.

REFERENCES

1. Technical Advisory Committee, Background Papers No: 1, 4 and 7, Stockholm, Sweden. 2002.
2. IWRM Guidelines at River Basin Level (UNESCO, 2008).
3. Tutorial on Basic Principles of Integrated Water Resources Management ,CAP-NET. http://www.pacificwater.org/userfiles/file/IWRM/Toolboxes/introduction%20to%20iwrm/Tutorial_text.pdf
4. Pramod R. Bhave, 2011, Water Resources Systems, Narosa Publishers.
5. The 17 Goals, United Nations, https://sdgs.un.org/goals.

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO	PSO	PSO3
C01	3	2	2	3								2	2	2	1
C02	3	1	2	2								2	2	2	1
C03	3	2	1	2								2	2	2	1
CO4	3	2	1	2								2	2	2	2
CO5	3	2	2	2								2	2	2	1
Avg	3	1.8	1.6	2.2								2	2	2	1.2

21153OE74A ELECTRICAL, ELECTRONIC AND MAGNETIC MATERIALS **L T P C**
3 0 0 3

COURSE OBJECTIVES:

The main learning objective of this course is to prepare the students for:

- Understanding the importance of various materials used in electrical, electronics and
- magnetic applications
- Acquiring knowledge on the properties of electrical, electronics and magnetic materials.
- Gaining knowledge on the selection of suitable materials for the given application
- Knowing the fundamental concepts in Semiconducting materials
- Getting equipped with the materials used in optical and optoelectronic applications.

UNIT I DIELECTRIC MATERIALS 9

Dielectric as Electric Field Medium, leakage currents, dielectric loss, dielectric strength, breakdown voltage, breakdown in solid dielectrics, flashover, liquid dielectrics, electric conductivity in solid, liquid and gaseous dielectrics, Ferromagnetic materials, properties of ferromagnetic materials in static fields, spontaneous, polarization, curie point, anti-ferromagnetic materials, piezoelectric materials, pyroelectric materials.

UNIT II MAGNETIC MATERIALS 9

Classification of magnetic materials, spontaneous magnetization in ferromagnetic materials, magnetic Anisotropy, Magnetostriction, diamagnetism, magnetically soft and hard materials, special purpose materials, feebly magnetic materials, Ferrites, cast and cermet permanent magnets, ageing of magnets. Factors effecting permeability and Hysteresis

UNIT III SEMICONDUCTOR MATERIALS 9

Properties of semiconductors, Silicon wafers, integration techniques, Large and very large scale Integration techniques. Concept of superconductivity; theories and examples for high temperature superconductivity; discussion on specific superconducting materials; comments on fabrication and engineering applications.

UNIT IV MATERIALS FOR ELECTRICAL APPLICATIONS 9

Materials used for Resistors, rheostats, heaters, transmission line structures, stranded conductors, bimetals fuses, soft and hard solders, electric contact materials, electric carbon materials, thermocouple materials. Solid, Liquid and Gaseous insulating materials, Effect of moisture on insulation.

UNIT V OPTICAL AND OPTOELECTRONIC MATERIALS 9

Principles of photoconductivity - effect of impurities - principles of luminescence-laser principles - He-Ne, injection lasers, LED materials - binary, ternary photoelectronic materials - LCD materials - photo detectors - applications of optoelectronic materials - optical fibres and materials - electro optic modulators - Kerr effect - Pockels effect.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

After completion of this course, the students will be able to

- Understand various types of dielectric materials, their properties in various conditions.
- Evaluate magnetic materials and their behavior.
- Evaluate semiconductor materials and technologies.

Select suitable materials for electrical engineering applications.

- Identify right material for optical and optoelectronic applications

TEXT BOOKS:

1. Pradeep Fulay, “Electronic, Magnetic and Optical materials”, CRC Press, taylor and Francis, 2nd illustrated edition, 2017.
2. “R K Rajput”, “A course in Electrical Engineering Materials”, Laxmi Publications, 2009.

REFERENCE BOOKS:

1. T K Basak, “A course in Electrical Engineering Materials”, New Age Science Publications, 2009
2. TTTI Madras, “Electrical Engineering Materials”, McGraw Hill Education, 2004.
3. Adrianus J. Dekker, “Electrical Engineering Materials”, PHI Publication, 2006.
4. S. P. Seth, P. V. Gupta “A course in Electrical Engineering Materials”, Dhanpat Rai & amp; Sons, 2011.
5. C. Kittel, “Introduction to Solid State Physics”, 7th Edition, John Wiley & Sons,Singapore, (2006).

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO 2	PSO3
C01	3	2	2	3								2	2	2	1
C02	3	1	2	2								2	2	2	1
C03	3	2	1	2								2	2	2	1
CO4	3	2	1	2								2	2	2	2
CO5	3	2	2	2								2	2	2	1
Avg	3	1.8	1.6	2.2								2	2	2	1.2

21150OE74B GEOGRAPHICAL INFORMATION SYSTEM

	L	T	P	C
	3	0	0	3

OBJECTIVE:

To impart the knowledge on basic components, data preparation and implementation of Geographical Information System.

UNIT I FUNDAMENTALS OF GIS 9

Introduction to GIS - Basic spatial concepts - Coordinate Systems - GIS and Information Systems – Definitions – History of GIS - Components of a GIS – Hardware, Software, Data, People, Methods – Proprietary and open source Software - Types of data – Spatial, Attribute data- types of attributes – scales/ levels of measurements.

UNIT II SPATIAL DATA MODELS 9

Database Structures – Relational, Object Oriented – Entities – ER diagram - data models - conceptual, logical and physical models - spatial data models – Raster Data Structures – Raster Data Compression - Vector Data Structures - Raster vs Vector Models- TIN and GRID data models.

UNIT III DATA INPUT AND TOPOLOGY 9

Scanner - Raster Data Input – Raster Data File Formats – Georeferencing – Vector Data Input -Digitizer – Datum Projection and reprojection -Coordinate Transformation – Topology - Adjacency, connectivity and containment – Topological Consistency – Non topological file formats - Attribute Data linking – Linking External Databases – GPS Data Integration

UNIT IV DATA QUALITY AND STANDARDS 9

Data quality - Basic aspects - completeness, logical consistency, positional accuracy, temporal accuracy, thematic accuracy and lineage – Metadata – GIS Standards –Interoperability - OGC - Spatial Data Infrastructure

UNIT V DATA MANAGEMENT AND OUTPUT 9

Import/Export – Data Management functions- Raster to Vector and Vector to Raster Conversion - Data Output - Map Compilation – Chart/Graphs – Multimedia – Enterprise Vs. Desktop GIS- distributed GIS.

TOTAL:45 PERIODS

COURSE OUTCOMES:

On completion of the course, the student is expected to

CO1 Have basic idea about the fundamentals of GIS.
CO2 Understand the types of data models.
CO3 Get knowledge about data input and topology
CO4 Gain knowledge on data quality and standards
CO5 Understand data management functions and data output

TEXT BOOKS:

1. Kang - Tsung Chang, Introduction to Geographic Information Systems, McGraw Hill Publishing, 2nd Edition, 2011.
2. Ian Heywood, Sarah Cornelius, Steve Carver, Srinivasa Raju, “An Introduction Geographical Information Systems, Pearson Education, 2nd Edition,2007.

REFERENCE:

1. Lo. C. P., Albert K.W. Yeung, Concepts and Techniques of Geographic Information Systems, Prentice-Hall India Publishers, 2006.

CO – PO – PSO MAPPING: GEOGRAPHIC INFORMATION SYSTEM

PO	Graduate Attribute	Course Outcome					Average
		CO1	CO2	CO3	CO4	CO5	
PO1	Engineering Knowledge	3	3	3	3	3	3
PO2	Problem Analysis				3	3	3
PO3	Design/Development of Solutions			3	3	3	3
PO4	Conduct Investigations of Complex Pr			3	3	3	3
PO5	Modern Tool Usage		3		3	3	3
PO6	The Engineer and Society						
PO 7	Environment and Sustainability						
PO 8	Ethics						
PO 9	Individual and Team Work						
PO 10	Communication						
PO 11	Project Management and Finance						
PO 12	Life-long Learning						
PSO 1	Knowledge of Geoinformatics disciplin	3	3	3	3	3	3
PSO 2	Critical analysis of Geoinformatics Engineering problems and innovations	3	3	3	3	3	3
PSO 3	Conceptualization and evaluation of D solutions	3	3	3	3	3	3

21153OE74B **ENERGY TECHNOLOGY** **L T P C**
3 0 0 3

UNIT I INTRODUCTION 8

Units of energy, conversion factors, general classification of energy, world energy resources and energy consumption, Indian energy resources and energy consumption, energy crisis, energy alternatives, Renewable and non-renewable energy sources and their availability. Prospects of Renewable energy sources

UNIT II CONVENTIONAL ENERGY 8

Conventional energy resources, Thermal, hydel and nuclear reactors, thermal, hydel and nuclear power plants, efficiency, merits and demerits of the above power plants, combustion processes, fluidized bed combustion.

UNIT III NON-CONVENTIONAL ENERGY 10

Solar energy, solar thermal systems, flat plate collectors, focusing collectors, solar water heating, solar cooling, solar distillation, solar refrigeration, solar dryers, solar pond, solar thermal power generation, solar energy application in India, energy plantations. Wind energy, types of windmills, types of wind rotors, Darrieus rotor and Gravian rotor, wind electric power generation, wind power in India, economics of wind farm, ocean wave energy conversion, ocean thermal energy conversion, tidal energy conversion, geothermal energy.

UNIT IV BIOMASS ENERGY 10

Biomass energy resources, thermo-chemical and biochemical methods of biomass conversion, combustion, gasification, pyrolysis, biogas production, ethanol, fuel cells, alkaline fuel cell, phosphoric acid fuel cell, molten carbonate fuel cell, solid oxide fuel cell, solid polymer electrolyte fuel cell, magneto hydrodynamic power generation, energy storage routes like thermal energy storage, chemical, mechanical storage and electrical storage.

UNIT V ENERGY CONSERVATION 9

Energy conservation in chemical process plants, energy audit, energy saving in heat exchangers, distillation columns, dryers, ovens and furnaces and boilers, steam economy in chemical plants, energy conservation.

TOTAL: 45 PERIODS

OUTCOMES:

On completion of the course, the students will be able to

CO1: Students will be able to describe the fundamentals and main characteristics of renewable energy sources and their differences compared to fossil fuels.

CO2: Students will excel as professionals in the various fields of energy engineering

CO3: Compare different renewable energy technologies and choose the most appropriate based on local conditions.

CO4: Explain the technological basis for harnessing renewable energy sources.

CO5: Identify and critically evaluate current developments and emerging trends within the field of renewable energy technologies and to develop in-depth technical understanding of energy problems at an advanced level.

TEXT BOOKS

1. Rao, S. and Parulekar, B.B., Energy Technology, Khanna Publishers, 2005.
2. Rai, G.D., Non-conventional Energy Sources, Khanna Publishers, New Delhi, 1984.
3. Bansal, N.K., Kleeman, M. and Meliss, M., Renewable Energy Sources and Conversion Technology, Tata McGraw Hill, 1990.
4. Nagpal, G.R., Power Plant Engineering, Khanna Publishers, 2008.

REFERENCES

1. Nejat Vezirog, Alternate Energy Sources, IT, McGraw Hill, New York.
2. El. Wakil, Power Plant Technology, Tata McGraw Hill, New York, 2002.
3. Sukhatme. S.P., Solar Enery - Thermal Collection and Storage, Tata McGraw hill, New Delhi, 1981.

Course articulation matrix

Course Outcomes	Program Outcomes															
	Statements	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	Students will be able to describe the fundamentals and main characteristics of renewable energy sources and their differences compared to fossil fuels.	**2**	**3**	**2**	**3**	**3**	**-**	**-**	**-**	**1**	**1**	**-**	**3**	**1**	**1**	**3**
CO2	Students will excel as professionals in the various fields of energy engineering	**2**	**3**	**1**	**3**	**3**	**-**	**-**	**-**	**1**	**1**	**-**	**3**	**2**	**1**	**3**
CO3	Compare different renewable energy technologies and choose the most appropriate based on local conditions.	**2**	**2**	**2**	**3**	**3**	**1**	**1**	**-**	**1**	**1**	**-**	**3**	**2**	**1**	**3**
CO4	Explain the technological basis for harnessing renewable energy sources.	**2**	**2**	**1**	**3**	**3**	**1**	**1**	**1**	**1**	**-**	**1**	**3**	**1**	**1**	**3**
CO5	Identify and critically evaluate current developments and emerging trends within the field of renewable energy technologies and to develop in-depth technical understanding of energy problems at an advanced level	**2**	**2**	**1**	**3**	**3**	**1**	**1**	**1**	**1**	**-**	**1**	**3**	**2**	**1**	**3**
OVERALL CO		**2**	**2**	**1**	**3**	**3**	**2**	**2**	**1**	**1**	**1**	**1**	**3**	**2**	**1**	**3**

21154OE74A **INDUSTRIAL SAFETY** **L T P C**
3 0 0 3

OBJECTIVES:

- To educate about the health hazards and the safety measures to be followed in the industrial environment.
- Describe industrial legislations (Factories Acts, Workmen's Compensation and other laws) enacted for the protection of employees health at work settings
- Describe methods of prevention and control of Occupational Health diseases, accidents / emergencies and other hazards

UNIT I INTRODUCTION 9

Need for developing Environment, Health and Safety systems in work places - Accident Case Studies - Status and relationship of Acts - Regulations and Codes of Practice - Role of trade union safety representatives. International initiatives - Ergonomics and work place.

UNIT II OCCUPATIONAL HEALTH AND HYGIENE 9

Definition of the term occupational health and hygiene - Categories of health hazards - Exposure pathways and human responses to hazardous and toxic substances - Advantages and limitations of environmental monitoring and occupational exposure limits - Hierarchy of control measures for occupational health risks - Role of personal protective equipment and the selection criteria - Effects on humans - control methods and reduction strategies for noise, radiation and excessive stress.

UNIT III WORKPLACE SAFETY AND SAFETY SYSTEMS 9

Features of Satisfactory and Safe design of work premises – good housekeeping - lighting and colour, Ventilation and Heat Control – Electrical Safety – Fire Safety – Safe Systems of work for manual handling operations – Machine guarding – Working at different levels – Process and System Safety.

UNIT IV HAZARDS AND RISK MANAGEMENT 9

Safety appraisal - analysis and control techniques – plant safety inspection – Accident investigation - Analysis and Reporting - Hazard and Risk Management Techniques - major accident hazard control – Onsite and Offsite emergency Plans.

UNIT V ENVIRONMENTAL HEALTH AND SAFETY MANAGEMENT 9

Concept of Environmental Health and Safety Management – Elements of Environmental Health and Safety Management Policy and methods of its effective implementation and review – Elements of Management Principles – Education and Training – Employee Participation.

TOTAL: 45 PERIODS

OUTCOMES:

After completion of this course, the student is expected to be able to:

- Describe, with example, the common work-related diseases and accidents in occupational setting
- Name essential members of the Occupational Health team
- What roles can a community health practitioners play in an Occupational setting to ensure the protection, promotion and maintenance of the health of the employee

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO	PSO	PSO3
C01	3	2	2	3								2	2	2	1
C02	3	1	2	2								2	2	2	1
C03	3	2	1	2								2	2	2	1
CO4	3	2	1	2								2	2	2	2
CO5	3	2	2	2								2	2	2	1
Avg	3	1.8	1.6	2.2								2	2	2	1.2

21152OE74A **WEARABLE DEVICES** **L T P C**

3 0 0 3

OBJECTIVES:

The student should be made to:

- To know the hardware requirement of wearable systems
- To understand the communication and security aspects in the wearable devices
- To know the applications of wearable devices in the field of medicine

UNIT I INTRODUCTION TO WEARABLE SYSTEMS AND SENSORS 9

Wearable Systems- Introduction, Need for Wearable Systems, Drawbacks of Conventional Systems for Wearable Monitoring, Applications of Wearable Systems, Types of Wearable Systems, Components of wearable Systems. Sensors for wearable systems-Inertia movement sensors, Respiration activity sensor, Impedance plethysmography, Wearable ground reaction force sensor.

UNIT II SIGNAL PROCESSING AND ENERGY HARVESTING FOR WEARABLE DEVICES 9

Wearability issues -physical shape and placement of sensor, Technical challenges - sensor design, signal acquisition, sampling frequency for reduced energy consumption, Rejection of irrelevant information. Power Requirements- Solar cell, Vibration based, Thermal based, Human body as a heat source for power generation, Hybrid thermoelectric photovoltaic energy harvests, Thermopiles.

UNIT III WIRELESS HEALTH SYSTEMS 9

Need for wireless monitoring, Definition of Body area network, BAN and Healthcare, Technical Challenges- System security and reliability, BAN Architecture – Introduction, Wireless communication Techniques.

UNIT IV SMART TEXTILE 9

Introduction to smart textile- Passive smart textile, active smart textile. Fabrication Techniques- Conductive Fibres, Treated Conductive Fibres, Conductive Fabrics, Conductive Inks.Case study- smart fabric for monitoring biological parameters - ECG, respiration.

UNIT V APPLICATIONS OF WEARABLE SYSTEMS 9

Medical Diagnostics, Medical Monitoring-Patients with chronic disease, Hospital patients, Elderly patients, neural recording, Gait analysis, Sports Medicine.

OUTCOMES:

On successful completion of this course, the student will be able to

CO1: Describe the concepts of wearable system.

CO2: Explain the energy harvestings in wearable device.

CO3: Use the concepts of BAN in health care.

CO4: Illustrate the concept of smart textile

CO5: Compare the various wearable devices in healthcare system

TOTAL: 45 PERIODS

TEXT BOOKS

1. Annalisa Bonfiglo and Danilo De Rossi, Wearable Monitoring Systems, Springer, 2011

2. Zhang and Yuan-Ting, Wearable Medical Sensors and Systems,Springer, 2013
3. Edward Sazonov and Micheal R Neuman, Wearable Sensors: Fundamentals, Implementation and Applications, Elsevier, 2014
4. Mehmet R. Yuce and JamilY.Khan, Wireless Body Area Networks Technology, Implementation applications,Pan Stanford Publishing Pte.Ltd, Singapore, 2012

REFERENCES:

1. Sandeep K.S, Gupta, Tridib Mukherjee and Krishna Kumar Venkatasubramanian, Body Area Networks Safety, Security, and Sustainability, Cambridge University Press, 2013.
2. Guang-Zhong Yang, Body Sensor Networks, Springer, 2006.

CO's- PO's & PSO's MAPPING

CO's	PO's												PSO's		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	3	2	1	1	2			1					1		1
2	3	2	1	1	2			1					1		1
3	3	2	1	1	2			1					1		1
4	3	2	1	1	2			1					1		1
5	3	2	1	1	2			1					1		1
AVg.															

211520E74B **MEDICAL INFORMATICS** **L T P C**
3 0 0 3

PREAMBLE:

1. To study the applications of information technology in health care management.
2. This course provides knowledge on resources, devices, and methods required to optimize the acquisition, storage, retrieval, and use of information in health and biomedicine.

UNIT I INTRODUCTION TO MEDICAL INFORMATICS 9

Introduction - Structure of Medical Informatics -Internet and Medicine -Security issues, Computer based medical information retrieval, Hospital management and information system, Functional capabilities of a computerized HIS, Health Informatics – Medical Informatics, Bioinformatics

UNIT II COMPUTERS IN CLINICAL LABORATORY AND MEDICAL IMAGING 9

Automated clinical laboratories-Automated methods in hematology, cytology and histology, Intelligent Laboratory Information System - Computer assisted medical imaging- nuclear medicine, ultrasound imaging, computed X-ray tomography, Radiation therapy and planning, Nuclear Magnetic Resonance.

UNIT III COMPUTERISED PATIENT RECORD 9

Introduction - conventional patient record, Components and functionality of CPR, Development tools, Intranet, CPR in Radiology- Application server provider, Clinical information system, Computerized prescriptions for patients.

UNIT IV COMPUTER ASSISTED MEDICAL DECISION-MAKING 9

Neuro computers and Artificial Neural Networks application, Expert system-General model of CMD, Computer-assisted decision support system-production rule system cognitive model, semantic networks, decisions analysis inclinical medicine-computers in the care of critically ill patients, Computer aids for the handicapped.

UNIT V RECENT TRENDS IN MEDICAL INFORMATICS 9

Virtual reality applications in medicine, Virtual endoscopy, Computer assisted surgery, Surgical simulation, Telemedicine - Tele surgery, Computer assisted patient education and health- Medical education and healthcare information, computer assisted instruction in medicine.

TOTAL : 45 PERIODS

COURSE OUTCOMES:

Upon completion of the course, students will be able to:

1. Explain the structure and functional capabilities of Hospital Information System.
2. Describe the need of computers in medical imaging and automated clinical laboratory.
3. Articulate the functioning of information storage and retrieval in computerized patient record system.
4. Apply the suitable decision support system for automated clinical diagnosis.
5. Discuss the application of virtual reality and telehealth technology in medical industry.

TEXT BOOKS:

1. Mohan Bansal, “Medical informatics”, Tata McGraw Hill Publishing Ltd, 2003.
2. R.D.Lele, “Computers in medicine progress in medical informatics”, Tata Mcgraw Hill,2005

REFERENCES:

1. Kathryn J. Hannah, Marion J Ball, “Health Informatics”, 3rd Edition, Springer, 2006.

CO’s- PO’s & PSO’s MAPPING

CO’s	PO’s												PSO’s		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	3	2	1	1	2			1					1	1	1
2	3	2	1	1	2			1					1	1	1
3	3	2	1	1	2			1					1	1	1
4	3	2	1	1	2			1					1	1	1
5	3	2	1	1	2			1					1	1	1
AVg.															

21154OE74B ADDITIVE MANUFACTURING L T P C 2 0 2 3

COURSE OBJECTIVES:

 To introduce the development of Additive Manufacturing (AM), various business opportunities and applications

 To familiarize various software tools, processes and techniques to create physical objects that satisfy product development / prototyping requirements, using AM.

 To be acquainted with vat polymerization and direct energy deposition processes

 To be familiar with powder bed fusion and material extrusion processes.

 To gain knowledge on applications of binder jetting, material jetting and sheet lamination processes

UNIT I INTRODUCTION 6

Overview - Need - Development of Additive Manufacturing (AM) Technology: Rapid Prototyping- Rapid Tooling - Rapid Manufacturing - Additive Manufacturing. AM Process Chain- ASTM/ISO 52900 Classification - Benefits. Applications: Building Printing - Bio Printing - Food Printing- Electronics Printing. Business Opportunities and Future Directions – Case studies: Automobile, Aerospace, Healthcare.

UNIT II DESIGN FOR ADDITIVE MANUFACTURING (DfAM) 6

Concepts and Objectives - AM Unique Capabilities - Part Consolidation – Topology Optimization- Generative design - Lattice Structures - Multi-Material Parts and Graded Materials - Data Processing: CAD Model Preparation - AM File formats: STL-Problems with STL- AMF Design for Part Quality Improvement: Part Orientation - Support Structure - Slicing - Tool Path Generation – Design rules for Extrusion based AM.

UNIT III VAT POLYMERIZATION AND DIRECTED ENERGY DEPOSITION 6

Photo polymerization: Stereolithography Apparatus (SLA)- Materials -Process – top down and bottom up approach - Advantages - Limitations - Applications. Digital Light Processing (DLP) - Process - Advantages - Applications. Continuous Liquid Interface Production (CLIP)Technology.

Directed Energy Deposition: Laser Engineered Net Shaping (LENS)- Process - Material Delivery - Materials - Benefits -Applications.

UNIT IV POWDER BED FUSION AND MATERIAL EXTRUSION 6

Powder Bed Fusion: Selective Laser Sintering (SLS): Process - Powder Fusion Mechanism - Materials and Application. Selective Laser Melting (SLM), Electron Beam Melting (EBM): Materials - Process - Advantages and Applications.

Material Extrusion: Fused Deposition Modeling (FDM)- Process-Materials -Applications and Limitations.

UNIT V OTHER ADDITIVE MANUFACTURING PROCESSES 6

Binder Jetting: Three-Dimensional Printing - Materials - Process - Benefits- Limitations - Applications.

Material Jetting: Multijet Modeling- Materials - Process - Benefits - Applications.

Sheet Lamination: Laminated Object Manufacturing (LOM)- Basic Principle- Mechanism: Gluing or Adhesive Bonding - Thermal Bonding- Materials-Application and Limitation.

TOTAL 30 PERIODS

ADDITIVE MANUFACTURING LABORATORY

Experiments

1. Modelling and converting CAD models into STL file.
2. Manipulation and error fixing of STL file.
3. Design and fabrication of parts by varying part orientation and support structures.
4. Fabrication of parts with material extrusion AM process.
5. Fabrication of parts with vat polymerization AM process.
6. Design and fabrication of topology optimized parts.

TOTAL: 30 PERIODS

Equipment required - lab

1. Extrusion based AM machine
2. Resin based AM machine
3. Mechanical design software
4. Open-source AM software for STL editing, manipulation and slicing.

COURSE OUTCOMES:

At the end of this course students shall be able to:

CO1: Recognize the development of AM technology and how AM technology propagated into various businesses and developing opportunities.

CO2: Acquire knowledge on process of transforming a concept into the final product in AM technology.

CO3: Elaborate the vat polymerization and direct energy deposition processes and its applications.

CO4: Acquire knowledge on process and applications of powder bed fusion and material extrusion.

CO5: Evaluate the advantages, limitations, applications of binder jetting, material jetting and sheet lamination processes.

TEXT BOOKS:

1. Ian Gibson, David Rosen, Brent Stucker, Mahyar Khorasani "Additive manufacturing technologies". 3rd edition Springer Cham, Switzerland. (2021). ISBN: 978-3-030-56126-0
2. Andreas Gebhardt and Jan-Steffen Hötter "Additive Manufacturing: 3D Printing for Prototyping and Manufacturing", Hanser publications, United States, 2015, ISBN: 978-1-56990-582-1.

REFERENCES:

1. Andreas Gebhardt, "Understanding Additive Manufacturing: Rapid Prototyping, Rapid Manufacturing", Hanser Gardner Publication, Cincinnati., Ohio, 2011, ISBN :9783446425521.
2. Milan Brandt, "Laser Additive Manufacturing: Materials, Design, Technologies, and Applications", Woodhead Publishing., United Kingdom, 2016, ISBN: 9780081004333.
3. Amit Bandyopadhyay and Susmita Bose, "Additive Manufacturing", 1st Edition, CRC Press., United States, 2015, ISBN-13: 978-1482223590.
4. Kamrani A.K. and Nasr E.A., "Rapid Prototyping: Theory and practice", Springer., United States ,2006, ISBN: 978-1-4614-9842-1.
5. Liou, L.W. and Liou, F.W., "Rapid Prototyping and Engineering applications: A tool box for prototype development", CRC Press., United States, 2011, ISBN: 9780849334092.

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO	PSO	PSO3
C01	3	2	2	3								2	2	2	1
C02	3	1	2	2								2	2	2	1
C03	3	2	1	2								2	2	2	1
CO4	3	2	1	2								2	2	2	2
CO5	3	2	2	2								2	2	2	1
Avg	3	1.8	1.6	2.2								2	2	2	1.2

PONNAIYAH RAMAJAYAM INSTITUTE OF SCIENCE & TECHNOLOGY (PRIST)

Declared as DEEMED-TO-BE-UNIVERSITY
U/s 3 of UGC Act, 1956

DEPARTMENT OF ELECTRICAL & ELECTRONICS ENGINEERING

Mapping of Courses to Cross cutting Issues
B.Tech Electrical and electronics Engineering (R-2021)

Programme Name & Code	Course Code	Title of the Course	Cross cutting Issues							
			Gender Sensitization and Human Values	Professional Ethics and Human Values	Environment and Sustainability and Human Values	Human Values	Professional Ethics	Environment and Sustainability	Professional Ethics, Human Values and Environment and Sustainability	Gender Sensitization
B.Tech - 21UGEEEFT	21147IP	Induction Programme								
B.Tech - 21UGEEEFT	21147S11	Professional English – I					✓			
B.Tech - 21UGEEEFT	21148S12	Matrices and Calculus								
B.Tech - 21UGEEEFT	21149S13	Engineering Physics								
B.Tech - 21UGEEEFT	21149S14	Engineering Chemistry								
B.Tech - 21UGEEEFT	21150S15	Problem Solving and Python programming								
B.Tech - 21UGEEEFT	21147S21	Professional English – II					✓			
B.Tech - 21UGEEEFT	21148S22	Statistics and Numerical Methods								

B.Tech - 21UGEEEFT	21149S23C	Physics for Electrical Engineering								
B.Tech - 21UGEEEFT	21154S24	Engineering Graphics								
B.Tech - 21UGEEEFT	21154S25	Basic Civil and Mechanical Engineering								
B.Tech - 21UGEEEFT	21153S26B	Electric Circuit Analysis								
B.Tech - 21UGEEEFT	21148S31C	Probability and Complex Functions								
B.Tech - 21UGEEEFT	21153C32	Digital Logic Circuits								
B.Tech - 21UGEEEFT	21153C33	Electromagnetic Fields								
B.Tech - 21UGEEEFT	21153C34	Electrical Machines – I								
B.Tech - 21UGEEEFT	21153S35	Electron Devices and Circuits								
B.Tech - 21UGEEEFT	21153S36	C Programming and Data Structures								
B.Tech - 21UGEEEFT	21153C41	Electrical Machines – II								
B.Tech - 21UGEEEFT	21153C42	Transmission and Distribution								
B.Tech - 21UGEEEFT	21153C43	Measurements and Instrumentation								
B.Tech - 21UGEEEFT	21153C44	Linear Integrated Circuits								
B.Tech - 21UGEEEFT	21153C45	Microprocessors and Microcontrollers								
B.Tech - 21UGEEEFT	21149S46	Environmental Sciences and Sustainability						✓		
B.Tech - 21UGEEEFT	21153C51	Power System Analysis								
B.Tech - 21UGEEEFT	21153C52	Control Systems								
B.Tech - 21UGEEEFT	21153C53	Power Electronics								
B.Tech - 21UGEEEFT	21147MC51D	Disaster Management					✓			
B.Tech - 21UGEEEFT	21153E55A	Special Electrical Machunes								
B.Tech - 21UGEEEFT	21153E56B	Smart Grids								
B.Tech - 21UGEEEFT	21147MC61E	Safety in engineering industries								

B.Tech - 21UGEEEFT	**21153C62**	Power System Operation and Control								
B.Tech - 21UGEEEFT	**21153C63**	Protection and Switchgear								
B.Tech - 21UGEEEFT	**21150OE61A**	IoT Concepts and Applications								
B.Tech - 21UGEEEFT	**21153E64B**	Power Quality								
B.Tech - 21UGEEEFT	**21153E65A**	HVDC and FACTS								
B.Tech - 21UGEEEFT	**21153E66A**	Digital Signal Processing System								
B.Tech - 21UGEEEFT	**21147S71**	Human Values and Ethics				✓				
B.Tech - 21UGEEEFT	**21150OE74 B**	Data Science Fundamentals								
B.Tech - 21UGEEEFT	**21155OE74 A**	Geographical Information System								
B.Tech - 21UGEEEFT	**21153C77**	High Voltage Engineering								
B.Tech - 21UGEEEFT	**21153P81**	Project Work/ Internship								

1.3.1SUPPORTINGDOCUMENTS

Courses (offered in 2021-2022) which address the Gender Sensitization, Human Values, Professional Ethics, Environment and sustainability.

SCHOOL OF ENGINEERING AND TECHNOLOGY

DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

Gender Sensitization and Human Values	
Professional Ethics	
Human Values	
Environment and sustainability	
Professional Ethics & Human Values	

PROGRAMME EDUCATIONAL OBJECTIVES:

PEO1: To enable graduates to pursue research, or have a successful career in academia or industries associated with Electrical and Electronics Engineering, or asentrepreneurs.

PEO2: To provide students with strong foundational concepts and also advanced techniques and tools in order to enable them to build solutions or systems of varying complexity.

PEO3: To prepare students to critically analyze existing literature in an area of specialization andethically develop innovative and research oriented methodologies to solve the problem sidentified.

PROGRAMME OUTCOMES:

Engineering Graduates will be able to:

A. **Engineering knowledge**: Apply the knowledge of mathematics, science, engineeringfundamentals, and an engineering specialization to the solution of complex engineering problems.

B. **Problem analysis**: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics,natural sciences, and engineering sciences.

C. **Design/development of solutions**: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

D. **Conduct investigations of complex problems**:Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data,and synthesis of the information to provide valid conclusions.

E. **Modern tool usage**: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understandingof the limitations.

F. **The engineer and society**: Apply reasoning informed by the contextual knowledge toassess societal, health, safety, legal and cultural issues and the consequent responsibilities relevantto the professional engineering practice.

G. **Environment and sustainability**: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

H. **Ethics**: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

I. **Individual and team work**: Function effectively as an individual, and as a member orleaderin diverseteams,and in multi disciplinary settings.

J. **Communication**: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend andwrite effective reports and design documentation, make effective presentations, and giveandreceive clearinstructions.

K. **Project management and finance**: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multi disciplinary environments.

L. **Life-long learning**: Recognize the need for, and have the preparation and ability toengage in independent and life-long learning in the broadest context of technological change.

MAPPING OF PROGRAMME EDUCATIONAL OBJECTIVES WITH PROGRAMME OUTCOMES

PROGRAMME EDUCATIONAL OBJECTIVES	PROGRAMM OUTCOMES												
	A	B	C	D	E	F	G	H	I	J	K	L	M
1	3	3	2	3	2	1	1	2	1	1	3	1	3
2	3	3	3	3	3	1	1	1	1	1	1	2	2
3	3	3	3	3	3	2	2	3	1	2	2	2	2

1-Reasonable:2-Significant:3-Strong

1. PROGRAM SPECIFIC OUTCOMES(PSOs):

Oncompletion of Electrical and Electronics Engineering program,the student will have the Following Program Specific Outcomes.

1. **Foundation of Electrical Engineering:**Ability to understand the principles and working of electrical components,circuits,systems and control that are forming apart of power generation,transmission,distribution, utilization, conservation and energysaving.Students can assess the power management,auditing, crisis and energy saving aspects.

2. **Foundation of Mathematical Concepts**: Ability to apply mathematical methodologies to solve problems related with electrical engineering using appropriate engineering tools and algorithms.

3. **Computing and Research Ability:** Ability to use knowledge in various domains to identify research gaps and hence to provide solution which leads to new ideas and innovations.

COURSE STRUCTURE

B.TECH-EEE

R2021

SEMESTER I

S.No	Course Code	CourseTitle	L	T	P	C
1		InductionProgramme	-	-	-	0
2	**21147S11**	Professional English –I	3	0	0	3
3	**21148S12**	Matrices and Calculus	3	1	0	4
4	**21149S13**	Engineering Physics	3	0	0	3
5	**21149S14**	Engineering Chemistry	3	0	0	3
6	**21150S15**	Problem Solving and Python programming	3	0	0	3
7	**21150L16**	Problem Solving and Python Programming Laboratory	0	0	4	2
8	**21149L17**	Physics and Chemistry Laboratory	0	0	4	2
9	**21147L18**	**Communication Laboratory- I**	0	0	2	1
				TOTALCREDITS		**21**

SEMESTER–II

S.No	CourseCode	CourseName	L	T	P	C
1	**21147S21**	Professional English–II	2	0	0	2
2	**21148S22**	Statistics and Numerical Methods	3	1	0	4
3	**21149S23C**	Physics for Electrical Engineering	3	0	0	3
4	**21154S24**	Engineering Graphics	2	0	4	4
5	**21154S25**	Basic Civil and Mechanical Engineering	3	0	0	3
6	**21153S26B**	Electric Circuit Analysis	3	1	0	4
7	**21154L21**	Engineering Practices Laboratory	0	0	4	2
8	**21153L22B**	Electric Circuits Laboratory	0	0	4	2
9	**21147L23**	Communication Laboratory-II	0	0	4	2
				TOTALCREDITS		**26**

SEMESTER III

S.No	CourseCode	Course Name	L	T	P	C
1	**21148S31C**	Probability and Complex Functions	3	1	0	4
2	**21153C32**	Digital Logic Circuits	3	0	0	3
3	**21153C33**	Electromagnetic Fields	3	1	0	4
4	**21153C34**	Electrical Machines–I	3	0	0	3
5	**21153S35**	Electron Devices and Circuits	3	0	0	3
6	**21153S36**	C Programming and Data Structures	3	0	0	3
7	**21153L31**	Electronic Devices and Circuits Laboratory	0	0	4	2
8	**21153L32**	Electrical Machines Laboratory- I	0	0	4	2
9	**21153L33**	CProgramming and Data Structures Laboratory	0	0	4	2
10	**21153L34**	Professional Development	0	0	2	1
					TOTALCREDITS	**27**

SEMESTER IV

S.No	CourseCode	Course Name	L	T	P	C
1	**21153C41**	Electrical Machines– II	3	0	0	3
2	**21153C42**	Transmission and Distribution	3	0	0	3
3	**21153C43**	Measurements and Instrumentation	3	0	0	3
4	**21153C44**	Linear Integrated Circuits	3	0	0	3
5	**21153C45**	Microprocessors and Microcontrollers	3	0	0	3
6	**21149S46**	Environmental Sciences and Sustainability	2	0	0	2
7	**21153L47**	Electrical Machines Laboratory- II	0	0	4	2
8	**21153L48**	Linearand Digital Circuits Laboratory	0	0	4	2
9	**21153L49**	Microprocessors and Microcontrollers Laboratory	0	0	4	2
					TOTALCREDITS	**23**

SEMESTER-V

S.No	CourseCode	Course Name	L	T	P	C
1	**21153C51**	Power System Analysis	3	0	0	3
2	**21153C52**	Control Systems	3	0	0	3
3	**21153C53**	Power Electronics	3	0	0	3
4	**21153E54_**	Elective I	3	0	0	3
5	**21153E55_**	Elective II	2	0	2	3
6	**21153E56_**	ElectiveIII	2	0	2	3
7	**21147MC51_**	Mandatory Course I	3	0	0	0
8	**21153L57**	Control and Instrumentation Laboratory	0	0	4	2
9	**21153L58**	Power Electronics Laboratory	0	0	4	2
					TOTALCREDITS	**22**

SEMESTER– VI

S.No	CourseCode	Course Name	L	T	P	C
1	**21150OE61_**	OpenElectiveI	2	0	2	3
2	**21153C62**	Power System Operation and Control	3	0	0	3
3	**21153C63**	Protection and Switchgear	3	0	0	3
4	**21153E64_**	ElectiveIV	3	0	0	3
5	**21153E65_**	ElectiveV	2	0	2	3
6	**21153E66_**	ElectiveVI	2	0	2	3
7	**21147MC61_**	Mandatory Course II	3	0	0	0
8	**21153L67**	Power System Laboratory	0	0	4	2
					TOTALCREDITS	**20**

SEMESTER-VII

S.No	CourseCode	Course Name	L	T	P	C
1	21147S71	Human Values anEthics	2	0	0	2
2	211_ _OE72 _	OpenElectiveII	2	0	2	3
3	211_ _OE73 _	OpenElectiveIII	3	0	0	3
4	211_ _OE74_	OpenElectiveIV	3	0	0	3
5	21160E75_	Elective I	3	0	0	3
6	21153E76_	Elective II	2	0	2	3
7	21153C77	High Voltage Engineering	3	0	0	3
					TOTALCREDITS	**20**

SEMESTER–VIII

S.No	CourseCode	CourseName	L	T	P	C
1.	21153P81	ProjectWork/Internship	0	0	20	10
				TOTALCREDITS		**10**

LIST OF ELECTIVES

AUDIT COURSES I (VSEMESTER)

S.No	CourseCode	CourseName	L	T	P	C
1.	21147MC51A	Introduction to Women and Gender Studies	3	0	0	0
2.	21147MC51B	Elements of Literature	3	0	0	0
3.	21147MC51C	Film Appreciation	3	0	0	0
4.	21147MC51D	Disaster Management	3	0	0	0

AUDIT COURSES II (VI SEMESTER)

S.No	CourseCode	Course Name	L	T	P	C
1.	21147MC61A	Well Being withTraditional Practices(Yoga,Ayurvedaand Siddha)	3	3	0	0
2.	21147MC61B	History of Science and Technology in India	3	0	0	0
3.	21147MC61C	Political and Economic Thought for a Humane Society	3	0	0	0
4.	21147MC61D	State,Nation Building and Politics in India	3	0	0	0
5.	21147MC61E	Safety in Engineering Industries	3	0	0	0

ELECTIVE–I (VSEMESTER)

S.No	CourseCode	Course Name	L	T	P	C
1.	21153E54A	Utilization and Conservation of Electrical Energy	3	0	0	3
2.	21153E54B	Embedded System Design	3	0	0	3
3.	21153E54C	Electric Vehicle Architecture	3	0	0	3
4.	21153E54D	Energy Management and Auditing	3	0	0	3
5.	21153E54E	SMPS and UPS	3	0	0	3
6.	21153E54F	Smart System Automation	3	0	0	3

ELECTIVE–II(VSEMESTER)

S.No	CourseCode	Course Name	L	T	P	C
1.	21153E55A	Special Electrical Machines	3	0	0	3
2.	21153E55B	Process Modeling and Simulation	3	0	0	3
3.	21153E55C	Energy Storage Systems	3	0	0	3
4.	21153E55D	Testing of Electric Vehicles	3	0	0	3
5.	21153E55E	Non Linear Control	3	0	0	3

ELECTIVE–III(VSEMESTER)

S.No	CourseCode	CourseName	L	T	P	C
1	21153E56A	Embedded C -Programming	3	0	0	3
2	21153E56B	Smart Grids	3	0	0	3
3	21153E56C	Control of Power Electronics Circuits	3	0	0	3
4	21153E56D	VLSI Design	3	0	0	3
5	21153E56E	Intelligent control of Electric Vehicles	3	0	0	3
6	21153E56F	Adaptive Control	3	0	0	3
7	21153E56G	PLC Programming	3	0	0	3

ELECTIVE–IV(VISEMESTER)

S.No	CourseCode	CourseName	L	T	P	C
1	21153E64A	Power Systems Transients	3	0	0	3
2	21153E64B	Power Quality	3	0	0	3
3	21153E64C	Power Electronics for Renewable Energy Systems	3	0	0	3
4	21153E64D	Embedded System for Automotive Applications	3	0	0	3
5	21153E64E	Grid Integration of Electric Vehicles	3	0	0	3
6	21153E64F	Optimal Control	3	0	0	3

ELECTIVE– V(VISEMESTER)

S.No	CourseCode	Course Name	L	T	P	C
1	21153E65A	HVDC and FACTS	3	0	0	3
2	21153E65B	Electrical Drives	3	0	0	3
3	21153E65C	Embedded Control for ElectricalDrives	3	0	0	3
4	21153E65D	Design of Electric Vehicle Charging System	3	0	0	3
5	21153E65E	Model Based Control	3	0	0	3
6	21153E65F	Grid integrating Techniques and Challenges	3	0	0	3

ELECTIVE–VI(VI SEMESTER)

S.No	CourseCode	CourseName	L	T	P	C
1	21153E66A	Digital signal processing system	3	0	0	3
2	21153E66B	Under Ground Cable Engineering	3	0	0	3
3	21153E66C	Analysis of Electrical Machines	3	0	0	3
4	21153E66D	Design of Motor and Power Converters for ElectricVehicles	3	0	0	3
5	21153E66E	Hybrid EnergyTechnology	3	0	0	3
6	21153E66F	Computer Control of Processes	3	0	0	3

ELECTIVE–VII (VIISEMESTER)

S.No	CourseCode	CourseName	L	T	P	C
1.	21160S75A	Total quality management system	3	0	0	3
2.	21160S75B	Engineering Economics and Financial Accounting	3	0	0	3
3.	21160S75C	Human Resource Management	3	0	0	3
4.	21160S75D	Knowledge Management	3	0	0	3
5.	21160S75E	Industrial Management	3	0	0	3
6.	21160S75F	Principles of Management	3	0	0	3

ELECTIVE–VIII(VIISEMESTER)

S.No	CourseCode	Course Name	L	T	P	C
1	21153E76A	Substation Engineering and Substation and Substation Automation	3	0	0	3
2	21153E76B	Multilevel Power Converters	3	0	0	3
3	21153E76C	Embedded Processors	3	0	0	3
4	21153E76D	Electric Vehicle Design,MechanicsandControl	3	0	0	3
5	21153E76E	System Identification	3	0	0	3
6	21153E76F	Design and Modelling of Renewable Energy system	3	0	0	3

OPEN ELECTIVE I (VI SEM)

S.No	CourseCode	Course Name	L	T	P	C
1	21150OE61A	IoT Concepts and Applications	2	0	2	3
2	21150OE61B	Augmented and Virtual Reality	2	0	2	3

OPEN ELECTIVE II(VII SEM)

S.No	CourseCode	Course Name	L	T	P	C
1	21150OE74A	Artificial Intelligence and Machine Learning Fundamentals	2	0	2	3
2	21150OE74B	Data Science Fundamentals	2	0	2	3

OPEN ELECTIVE III (VIISEM)

S.No	CourseCode	CourseName	L	T	P	C
1	21147OE73A	English for Competitative Exam	3	0	0	3
2	21154OE73A	Industrial Management	3	0	0	3
3	21154OE73B	Introductionton on destructive testing	3	0	0	3
4	21155OE73A	Remote Sensing Concepts	3	0	0	3
5	21155OE73B	Drinking WaterSupply and Treatment	3	0	0	3
6	21152OE73A	NanoTechnology	3	0	0	3
7	21152OE73B	Signals and Systems	3	0	0	3

OPENELECTIVEIV(VIISEM)

S.No	CourseCode	CourseName	L	T	P	C
1	21154OE74A	Additive Manufacturing	3	0	0	3
2	21154OE74B	Industrial Safety	3	0	0	3
3	21155OE74A	Geographical Information System	3	0	0	3
4	21155OE74B	Basics of Integrated Water Resources Management	3	0	0	3
5	21152OE74A	Wearable devices	3	0	0	3
6	21152OE74B	Medical Informatics	3	0	0	3

CREDITS DISTRIBUTION

CGPA CREDITS

Semester	Core	Elective	Free Elective	Management Elective	RSD Course	Others	Total
I	21	-	-	-	-	-	21
II	26	-	-	-	-	-	26
III	27	-	-	-	-	-	27
IV	23	-	-	-	-	-	23
V	13	09	-	-	-	-	22
VI	08	09	03	-	-	-	20
VII	05	03	09	03	-	-	20
VIII	10	-	-	-	-	-	10
Over ALL Credits							**169**

NON CGPA CREDITS

Semester	Mandatory Course	Total
I	01	**01**
II	-	**-**
III	-	**-**
IV	-	**-**
V	01	**01**
VI	01	**01**
VII	-	**-**
VIII	-	**-**
Co Curricular Activities	In-plantTraining,IndustrialVisit ,Seminars &Conferences	**-**
TOTALNON-CGPA CREDITS		**03**

TOTAL CREDITS	
CGPA CREDITS	**169**
NON-CGPA CREDITS	**03**
TOTAL	**172**

SYLLABI

INDUCTION PROGRAMME

This is a mandatory 2 week programme to be conducted as soon as the students enter the institution.Normal classes start only after the induction program is over.

The induction programme has been introduced by AICTE with the following objective:

“Engineering colleges were established to train graduates well in the branch/department of admission,have a holistic outlook, and have a desire to work for national needs and beyond. The graduatingstudent must have knowledge and skills in the area of his/her study. However, he/she must also havebroad understanding of society and relationships. Character needs to be nurtured as an essentialquality by which he/she would understand and fulfill his/her responsibility as an engineer, a citizen anda human being.Besidestheabove,severalmeta-skillsand underlyingvaluesare needed.”

“One will have to work closely with the newly joined students in making them feel comfortable, allowthem to explore their academic interests and activities, reduce competition and make them work forexcellence,promotebondingwithinthem,build relationsbetween teachers and students, giveabroaderviewoflife,andbuildcharacter. “

Hence,thepurposeofthisprogrammeistomakethestudentsfeelcomfortableintheirnewenvironment, openthemup,setahealthy daily routine,createbondinginthe batchas well asbetween faculty and students, develop awareness, sensitivity and understanding of the self, peoplearoundthem,society atlarge,andnature.

The followingare the activities underthe induction programin whichthe studentwould befullyengaged throughouttheday fortheentiredurationoftheprogram.

(i) PhysicalActivity

Thiswouldinvolveadailyroutineofphysicalactivitywithgamesandsports,yoga,gardening,etc.

(ii) CreativeArts

Every studentwouldchooseoneskillrelated totheartswhethervisualartsorperformingarts.Examples are painting, sculpture, pottery, music, dance etc. The student would pursue it everyday forthe duration of the program. These would allow for creative expression. It would develop a sense ofaesthetics and alsoenhancecreativitywhichwould,hopefully,growintoengineeringdesignlater.

(iii) UniversalHumanValues

This is the anchoring activity of the Induction Programme. It gets the student to explore oneself andallows one to experience the joy oflearning, stand up to peer pressure, take decisions with courage,beaware ofrelationships withcolleagues and supportingstay in the hostel anddepartment,besensitive to others, etc. A module in Universal Human Values provides the base. Methodology ofteaching this content is extremely important. It must not be through do's and dont's, but get students toexplore and think by engaging them in a dialogue. It is best taught through group discussions and reallifeactivitiesratherthanlecturing.

Discussions wouldbe conducted insmallgroups ofabout20studentswith afaculty mentoreach.Itwouldbeeffectivethatthefacultymentorassignedisalsothefacultyadvisorforthestudent forthefulldurationoftheUG programme.

(iv) LiteraryActivity

Literary activity would encompass reading, writing and possibly, debating, enacting aplay etc.

(v) ProficiencyModules

Thiswouldaddresssomelacunasthatstudents mighthave,forexample,English,computerfamiliarityetc.

(vi) Lecturesby EminentPeople

Motivationallecturesbyeminentpeoplefromallwalksoflifeshouldbearrangedtogivethestudentsexposuretopeople whoaresocially activeorinpubliclife.

(vii) VisitstoLocal Area

Acoupleofvisitstothelandmarksofthecity,orahospitalororphanagecouldbeorganized.Thiswouldfamiliariz ethemwith theareaaswellasexposethemto theunderprivileged.

(viii) FamiliarizationtoDept./Branch&Innovations

They should be toldaboutwhat gettinginto a branch or department means whatrole it plays insociety,through itstechnology.They should also be shown the laboratories,workshops & otherfacilities.

(ix) DepartmentSpecificActivities

Aboutaweekcanbespentinintroducingactivities(games,quizzes,socialinteractions,smallexperiments,des ignthinkingetc.)thatarerelevanttotheparticularbranchofEngineering/Technology/Architecture that can serve as a motivation and kindle interest in buildingthings (become a maker) in that particular field. This can be conducted in the form of a workshop. Forexample, CSE and IT students may be introduced to activities that kindle computational thinking, andget them to build simple games. ECE students may be introduced to building simple circuits as anextension of their knowledge in Science, and so on. Students may be asked to build stuff using theirknowledgeofscience.

Induction Programme is totally an activity based programme and therefore there shall be notests/assessmentsduringthisprogramme.

References:

Guide toInductionprogram fromAICTE

21147S11 **PROFESSIONAL ENGLISH I** **LT P C**
3 00 3

COURSE OBJECTIVES :

- To improve the communicative competence of learners
- To learn to use basic grammatic structures in suitable contexts
- To acquire lexical competence and use them appropriately in a sentence and understand their meaning in a text
- To help learners use language effectively in professional contexts
- To develop learners' ability to read and write complex texts, summaries, articles, blogs, definitions, essays and user manuals.

UNIT I INTRODUCTION TO EFFECTIVE COMMUNICATION 1

What is effective communication? (Explain using activities) Why is communication critical for excellence during study, research and work? What are the seven C's of effective communication? What are key language skills? What is effective listening? What does it involve? What is effective speaking? What does it mean to be an excellent reader? What should you be able to do? What is effective writing? How does one develop language and communication skills? What does the course focus on? How are communication and language skills going to be enhanced during this course? What do you as a learner need to do to enhance your English language and communication skills to get the best out of this course?

INTRODUCTION TO FUNDAMENTALS OF COMMUNICATION 8

Reading - Reading brochures (technical context), telephone messages / social media messages relevant to technical contexts and emails. Writing - Writing emails / letters introducing oneself. Grammar - Present Tense (simple and progressive); Question types: Wh/ Yes or No/ and Tags. Vocabulary - Synonyms; One word substitution; Abbreviations & Acronyms (as used in technical contexts).

UNIT II NARRATION AND SUMMATION 9

Reading - Reading biographies, travelogues, newspaper reports, Excerpts from literature, and travel & technical blogs. Writing - Guided writing-- Paragraph writing Short Report on an event (field trip etc.) Grammar -Past tense (simple); Subject-Verb Agreement; and Prepositions. Vocabulary - Word forms (prefixes& suffixes); Synonyms and Antonyms. Phrasal verbs.

UNIT III DESCRIPTION OF A PROCESS / PRODUCT 9

Reading - Reading advertisements, gadget reviews; user manuals. Writing - Writing definitions; instructions; and Product /Process description. Grammar - Imperatives; Adjectives; Degrees of comparison; Present & Past Perfect Tenses. Vocabulary - Compound Nouns, Homonyms; and Homophones, discourse markers (connectives & sequence words).

UNIT IV CLASSIFICATION AND RECOMMENDATIONS 9

Reading - Newspaper articles; Journal reports -and Non Verbal Communcation (tables, pie charts etc,.). Writing - Note-making / Note-taking (*Study skills to be taught, not tested); Writing recommendations; Transferring information from non verbal (chart , graph etc, to verbal mode) Grammar - Articles; Pronouns - Possessive & Relative pronouns. Vocabulary - Collocations; Fixed / Semi fixed expressions.

UNIT V EXPRESSION **9**

Reading - Reading editorials; and Opinion Blogs; Writing - Essay Writing (Descriptive or narrative). Grammar - Future Tenses, Punctuation; Negation (Statements & Questions); and Simple, Compound & Complex Sentences. Vocabulary - Cause & Effect Expressions - Content vs Function words.

TOTAL : 45 PERIODS

LEARNING OUTCOMES :

At the end of the course, learners will be able

CO1: To use appropriate words in a professional context

CO2: To gain understanding of basic grammatic structures and use them in right context.

CO3: To read and infer the denotative and connotative meanings of technical texts

CO4: To write definitions, descriptions, narrations and essays on various topics

TEXT BOOKS :

1. English for Engineers & Technologists Orient Blackswan Private Ltd. Department of English, Anna University, (2020 edition)
2. English for Science & Technology Cambridge University Press, 2021.
   Authored by Dr. Veena Selvam, Dr. Sujatha Priyadarshini, Dr. Deepa Mary Francis, Dr. KN. Shoba, and Dr. Lourdes Joevani, Department of English, Anna University.

REFERENCE BOOKS:

1. Technical Communication - Principles And Practices By Meenakshi Raman & Sangeeta Sharma, Oxford Univ. Press, 2016, New Delhi.
2. A Course Book On Technical English By Lakshminarayanan, Scitech Publications (India) Pvt. Ltd.
3. English For Technical Communication (With CD) By Aysha Viswamohan, Mcgraw Hill Education, ISBN : 0070264244.
4. Effective Communication Skill, Kulbhusan Kumar, RS Salaria, Khanna Publishing House.
5. Learning to Communicate - Dr. V. Chellammal, Allied Publishing House, New Delhi,2003.

ASSESSMENT PATTERN

Two internal assessments and an end semester examination to test students' reading and writing skills along with their grammatical and lexical competence.

MAPPING OF COs WITH POs AND PSOs

COs	POs												PSOs		
	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	1	1	1	1	1	3	3	3	1	3	-	3	-	-	-
2	1	1	1	1	1	3	3	3	1	3	-	3	-	-	-
3	2	3	2	3	2	3	3	3	2	3	3	3	-	-	-
4	2	3	2	3	2	3	3	3	2	3	3	3	-	-	-
5	2	3	3	3	-	3	3	3	2	3	-	3	-	-	-
Avg.	1.6	2.2	1.8	2.2	1.5	3	3	3	1.6	3	3	3	-	-	-

21148S12 **MATRICES AND CALCULUS**

L	T	P	C
3	**1**	**0**	**4**

COURSE OBJECTIVES :

- To develop the use of matrix algebra techniques that is needed by engineers for practical applications.
- To familiarize the students with differential calculus.
- To familiarize the student with functions of several variables. This is needed in many branches of engineering.
- To make the students understand various techniques of integration.
- To acquaint the student with mathematical tools needed in evaluating multiple integrals and their applications.

UNIT I MATRICES 9 + 3

Eigenvalues and Eigenvectors of a real matrix – Characteristic equation – Properties of Eigenvalues and Eigenvectors – Cayley - Hamilton theorem – Diagonalization of matrices by orthogonal transformation - Reduction of a quadratic form to canonical form by orthogonal transformation – Nature of quadratic forms – Applications : Stretching of an elastic membrane.

UNIT II DIFFERENTIAL CALCULUS 9 + 3

Representation of functions - Limit of a function - Continuity - Derivatives - Differentiation rules (sum, product, quotient, chain rules) - Implicit differentiation - Logarithmic differentiation - Applications : Maxima and Minima of functions of one variable.

UNIT III FUNCTIONS OF SEVERAL VARIABLES 9 + 3

Partial differentiation – Homogeneous functions and Euler's theorem – Total derivative – Change of variables – Jacobians – Partial differentiation of implicit functions – Taylor's series for functions of two variables – Applications : Maxima and minima of functions of two variables and Lagrange's method of undetermined multipliers.

UNIT IV INTEGRAL CALCULUS 9 + 3

Definite and Indefinite integrals - Substitution rule - Techniques of Integration : Integration by parts, Trigonometric integrals, Trigonometric substitutions, Integration of rational functions by partial fraction, Integration of irrational functions - Improper integrals - Applications : Hydrostatic force and pressure, moments and centres of mass.

UNIT V MULTIPLE INTEGRALS 9 + 3

Double integrals – Change of order of integration – Double integrals in polar coordinates – Area enclosed by plane curves – Triple integrals – Volume of solids – Change of variables in double and triple integrals – App lications : Moments and centres of mass, moment of inertia.

TOTAL : 60 PERIODS

COURSE OUTCOMES:

At the end of the course the students will be able to

CO1: Use the matrix algebra methods for solving practical problems.

CO2: Apply differential calculus tools in solving various application problems.

CO3: Able to use differential calculus ideas on several variable functions.

CO4:Apply different methods of integration in solving practical problems.

CO5: Apply multiple integral ideas in solving areas, volumes and other practical problems.

TEXT BOOKS :

1. Kreyszig.E, "Advanced Engineering Mathematics", John Wiley and Sons, 10th Edition, New Delhi, 2016.
2. Grewal.B.S., “Higher Engineering Mathematics”, Khanna Publishers, New Delhi, 44th Edition , 2018.
3. James Stewart, " Calculus : Early Transcendentals ", Cengage Learning, 8th Edition, New Delhi, 2015. [For Units II & IV - Sections 1.1, 2.2, 2.3, 2.5, 2.7 (Tangents problems only), 2.8, 3.1 to 3.6, 3.11, 4.1, 4.3, 5.1 (Area problems only), 5.2, 5.3, 5.4 (excluding net change theorem), 5.5, 7.1 - 7.4 and 7.8].

REFERENCES :

1. Anton. H, Bivens. I and Davis. S, " Calculus ", Wiley, 10th Edition, 2016
2. Bali. N., Goyal. M. and Watkins. C., “ Advanced Engineering Mathematics ”, Firewall Media (An imprint of Lakshmi Publications Pvt., Ltd.,), New Delhi, 7th Edition, 2009.
3. Jain . R.K. and Iyengar. S.R.K., “ Advanced Engineering Mathematics ”, Narosa Publications, New Delhi, 5th Edition, 2016.
4. Narayanan. S. and Manicavachagom Pillai. T. K., “ Calculus " Volume I and II, S. Viswanathan Publishers Pvt. Ltd., Chennai, 2009.
5. Ramana. B.V., " Higher Engineering Mathematics ", McGraw Hill Education Pvt. Ltd,New Delhi, 2016.
6. Srimantha Pal and Bhunia. S.C, " Engineering Mathematics " Oxford University Press, 2015.
7. Thomas. G. B., Hass. J, and Weir. M.D, " Thomas Calculus ", 14th Edition, Pearson India, 2018.

MAPPING OF COs WITH POs AND PSOs

COs	POs												PSOs		
	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	3	1	1	0	0	0	0	2	0	2	3	-	-	-
2	3	3	1	1	0	0	0	0	2	0	2	3	-	-	-
3	3	3	1	1	0	0	0	0	2	0	2	3	-	-	-
4	3	3	1	1	0	0	0	0	2	0	2	3	-	-	-
5	3	3	1	1	0	0	0	0	2	0	2	3	-	-	-
Avg.	3	3	1	1	0	0	0	0	2	0	2	3	-	-	-

21149S13 **ENGINEERING PHYSICS** **LTPC**
3003

COURSE OBJECTIVES:

- To make the students effectively to achieve an understanding of mechanics.
- To enable the students to gain knowledge of electromagnetic waves and its applications.
- To introduce the basics of oscillations, optics and lasers.
- Equipping the students to be successfully understand the importance of quantum physics.
- To motivate the students towards the applications of quantum mechanics.

UNIT I MECHANICS 9

Multiparticle dynamics: Center of mass (CM) - CM of continuous bodies - motion of the CM - kinetic energy of system of particles. Rotation of rigid bodies: Rotational kinematics - rotational kinetic energy and moment of inertia - theorems of M .I -moment of inertia of continuous bodies - M.I of a diatomic molecule - torque - rotational dynamics of rigid bodies - conservation of angular momentum - rotational energy state of a rigid diatomic molecule - gyroscope - torsional pendulum - double pendulum - Introduction to nonlinear oscillations.

UNIT II ELECTROMAGNETIC WAVES 9

The Maxwell's equations - wave equation; Plane electromagnetic waves in vacuum, Conditions on the wave field - properties of electromagnetic waves: speed, amplitude, phase, orientation and waves in matter - polarization - Producing electromagnetic waves - Energy and momentum in EM waves: Intensity, waves from localized sources, momentum and radiation pressure - Cell-phone reception. Reflection and transmission of electromagnetic waves from a non-conducting medium-vacuum interface for normal incidence.

UNIT III OSCILLATIONS, OPTICS AND LASERS 9

Simple harmonic motion - resonance -analogy between electrical and mechanical oscillating systems - waves on a string - standing waves - traveling waves - Energy transfer of a wave - sound waves - Doppler effect. Reflection and refraction of light waves - total internal reflection - interference - Michelson interferometer -Theory of air wedge and experiment. Theory of laser - characteristics - Spontaneous and stimulated emission - Einstein's coefficients - population inversion - Nd-YAG laser, CO_2 laser, semiconductor laser -Basic applications of lasers in industry.

UNIT IV BASIC QUANTUM MECHANICS 9

Photons and light waves - Electrons and matter waves -Compton effect - The Schrodinger equation (Time dependent and time independent forms) - meaning of wave function - Normalization -Free particle - particle in a infinite potential well: 1D,2D and 3D Boxes- Normalization, probabilities and the correspondence principle.

UNIT V APPLIED QUANTUM MECHANICS 9

The harmonic oscillator(qualitative)- Barrier penetration and quantum tunneling(qualitative)- Tunneling microscope - Resonant diode - Finite potential wells (qualitative)- Bloch's theorem for particles in a periodic potential -Basics of Kronig-Penney model and origin of energy bands.

TOTAL : 45 PERIODS

COURSE OUTCOMES:

After completion of this course, the students should be able to

CO1: Understand the importance of mechanics.
CO2: Express their knowledge in electromagnetic waves.
CO3: Demonstrate a strong foundational knowledge in oscillations, optics and lasers.
CO4: Understand the importance of quantum physics.
CO5: Comprehend and apply quantum mechanical principles towards the formation of energy bands.

TEXT BOOKS:

1. D.Kleppner and R.Kolenkow. An Introduction to Mechanics. McGraw Hill Education (Indian Edition), 2017.
2. E.M.Purcell and D.J.Morin, Electricity and Magnetism, Cambridge Univ.Press, 2013.
3. Arthur Beiser, Shobhit Mahajan, S. Rai Choudhury, Concepts of Modern Physics, McGraw-Hill (Indian Edition), 2017.

REFERENCES:

1. R.Wolfson. Essential University Physics. Volume 1 & 2. Pearson Education (Indian Edition), 2009.
2. Paul A. Tipler, Physic – Volume 1 & 2, CBS, (Indian Edition), 2004.
3. K.Thyagarajan and A.Ghatak. Lasers: Fundamentals and Applications, Laxmi Publications, (Indian Edition), 2019.
4. D.Halliday, R.Resnick and J.Walker. Principles of Physics, Wiley (Indian Edition), 2015.
5. N.Garcia, A.Damask and S.Schwarz. Physics for Computer Science Students. Springer-Verlag, 2012.

MAPPING OF COs WITH POs AND PSOs

COs	Pos											PSOs		
	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	3	2	1	1	1	-	-	-	-	-	-	-	-	-
2	3	3	2	1	2	1	-	-	-	-	-	-	-	-	-
3	3	3	2	2	2	1	-	-	-	-	-	1	-	-	-
4	3	3	1	1	2	1	-	-	-	-	-	-	-	-	
5	3	3	1	1	2	1	-	-	-	-	-	-	-	-	-
Avg.	3	3	1.6	1.2	1.8	1	-	-	-	-	-	1	-	-	-

21149S14 **ENGINEERING CHEMISTRY** **LTPC**
3003

COURSE OBJECTIVES:

- To inculcate sound understanding of water quality parameters and water treatment techniques.
- To impart knowledge on the basic principles and preparatory methods of nanomaterials.
- To introduce the basic concepts and applications of phase rule and composites.
- To facilitate the understanding of different types of fuels, their preparation, properties and combustion characteristics.
- To familiarize the students with the operating principles, working processes and applications of energy conversion and storage devices.

UNIT I WATER AND ITS TREATMENT 9

Water: Sources and impurities, **Water quality parameters:** Definition and significance of-colour, odour, turbidity, pH, hardness, alkalinity, TDS, COD and BOD, flouride and arsenic. **Municipal water treatment:** primary treatment and disinfection (UV, Ozonation, break-point chlorination)**. Desalination of brackish water**: Reverse Osmosis. **Boiler troubles:** Scale and sludge, Boiler corrosion, Caustic embrittlement, Priming &foaming. **Treatment of boiler feed water**: Internal treatment (phosphate, colloidal, sodium aluminate and calgon conditioning) and External treatment – Ion exchange demineralisation and zeolite process.

UNIT II NANOCHEMISTRY 9

Basics: Distinction between molecules, nanomaterials and bulk materials; **Size-dependent properties** (optical, electrical, mechanical and magnetic); **Types of nanomaterials**: Definition, properties and uses of – nanoparticle, nanocluster, nanorod, nanowire and nanotube. **Preparation of nanomaterials:** sol-gel, solvothermal, laser ablation, chemical vapour deposition, electrochemical deposition and electro spinning. **Applications** of nanomaterials in medicine, agriculture, energy, electronics and catalysis.

UNIT III PHASE RULE AND COMPOSITES 9

Phase rule: Introduction, definition of terms with examples. One component system - water system; Reduced phase rule; Construction of a simple eutectic phase diagram - Thermal analysis; Two component system: lead-silver system - Pattinson process.

Composites: Introduction: Definition & Need for composites; **Constitution**: Matrix materials (Polymer matrix, metal matrix and ceramic matrix) and Reinforcement (fiber, particulates, flakes and whiskers). **Properties and applications of**: Metal matrix composites (MMC), Ceramic matrix composites and Polymer matrix composites. **Hybrid composites -** definition and examples.

UNIT IV FUELS AND COMBUSTION 9

Fuels: Introduction: Classification of fuels; **Coal and coke**: Analysis of coal (proximate and ultimate), Carbonization, Manufacture of metallurgical coke (Otto Hoffmann method). **Petroleum and Diesel:** Manufacture of synthetic petrol (Bergius process), Knocking - octane number, diesel oil - cetane number; **Power alcohol and biodiesel.**

Combustion of fuels: Introduction: Calorific value - higher and lower calorific values, Theoretical calculation of calorific value; **Ignition temperature**: spontaneous ignition temperature, Explosive range; **Flue gas analysis -** ORSAT Method. **CO_2 emission and carbon foot print.**

UNIT V ENERGY SOURCES AND STORAGE DEVICES 9

Stability of nucleus: mass defect (problems), binding energy; Nuclear energy: light water nuclear power plant, breeder reactor. **Solar energy conversion:** Principle, working and applications of solar cells**; Recent developments in solar cell materials. Wind energy; Geothermal energy;Batteries:** Types of batteries, Primary battery - dry cell, Secondary battery - lead acid battery and lithium-ion-battery; **Electric vehicles-working principles; Fuel cells:** H_2-O_2 fuel cell, microbial fuel cell; **Supercapacitors:** Storage principle, types and examples.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of the course, the students will be able:

CO1: To infer the quality of water from quality parameter data and propose suitable treatment methodologies to treat water.

CO2: To identify and apply basic concepts of nanoscience and nanotechnology in designing the synthesis of nanomaterials for engineering and technology applications.

CO3: To apply the knowledge of phase rule and composites for material selection requirements.

CO4: To recommend suitable fuels for engineering processes and applications.

CO5: To recognize different forms of energy resources and apply them for suitable applications in energy sectors.

TEXT BOOKS:

1. P. C. Jain and Monica Jain, "Engineering Chemistry", 17th Edition, DhanpatRai Publishing Company (P) Ltd, New Delhi, 2018.
2. Sivasankar B., "Engineering Chemistry", Tata McGraw-Hill Publishing Company Ltd, New Delhi, 2008.
3. S.S. Dara, "A text book of Engineering Chemistry", S. Chand Publishing, 12th Edition, 2018.

REFERENCES:

1. B. S. Murty, P. Shankar, Baldev Raj, B. B. Rath and James Murday, "Text book of nanoscience and nanotechnology", Universities Press-IIM Series in Metallurgy and Materials Science, 2018.
2. O.G. Palanna, "Engineering Chemistry" McGraw Hill Education (India) Private Limited, 2nd Edition, 2017.
3. Friedrich Emich, "Engineering Chemistry", Scientific International PVT, LTD, New Delhi, 2014.
4. ShikhaAgarwal, "Engineering Chemistry-Fundamentals and Applications", Cambridge University Press, Delhi, Second Edition, 2019.
5. O.V. Roussak and H.D. Gesser, Applied Chemistry-A Text Book for Engineers and Technologists, Springer Science Business Media, New York, 2nd Edition, 2013.

MAPPING OF COs WITH POs AND PSOs

COs	POs												PSOs		
	PO01	**PO02**	**PO03**	**PO04**	**PO05**	**PO06**	**PO07**	**PO08**	**PO09**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
1	3	2	2	1	-	1	1	-	-	-	-	1	-	-	-
2	2	-	-	1	-	2	2	-	-	-	-	-	-	-	-
3	3	1	-	-	-	-	-	-	-	-	-	-	-	-	-
4	3	1	1	-	-	1	2	-	-	-	-	-	-	-	-
5	3	1	2	1	-	2	2	-	-	-	-	2	-	-	-
Avg.	2.8	1.3	1.6	1	-	1.5	1.8	-	-	-	-	1.5	-	-	-

21150S15 PROBLEM SOLVING AND PYTHON PROGRAMMING LTP C
3 00 3

COURSE OBJECTIVES:

- To understand the basics of algorithmic problem solving.
- To learn to solve problems using Python conditionals and loops.
- To define Python functions and use function calls to solve problems.
- To use Python data structures - lists, tuples, dictionaries to represent complex data.
- To do input/output with files in Python.

UNIT I COMPUTATIONAL THINKING AND PROBLEM SOLVING 9

Fundamentals of Computing – Identification of Computational Problems -Algorithms, building blocks of algorithms (statements, state, control flow, functions), notation (pseudo code, flow chart, programming language), algorithmic problem solving, simple strategies for developing algorithms (iteration, recursion). Illustrative problems: find minimum in a list, insert a card in a list of sorted cards, guess an integer number in a range, Towers of Hanoi.

UNIT II DATA TYPES, EXPRESSIONS, STATEMENTS 9

Python interpreter and interactive mode,debugging; values and types: int, float, boolean, string, a nd list; variables, expressions, statements, tuple assignment, precedence of operators, comments; Illustrative programs: exchange the values of two variables, circulate the values of n variables, distance between two points.

UNIT III CONTROL FLOW, FUNCTIONS, STRINGS 9

Conditionals:Boolean values and operators, conditional (if), alternative (if-else),chained conditional (if-elif-else);Iteration: state, while, for, break, continue, pass; Fruitful functions: return values,parameters, local and global scope, function composition, recursion; Strings: string slices,immutability, string functions and methods, string module; Lists as arrays. Illustrative programs: square root, gcd, exponentiation, sum an array of numbers, linear search, binary search.

UNIT IV LISTS, TUPLES, DICTIONARIES 9

Lists: list operations, list slices, list methods, list loop, mutability, aliasing, cloning lists, list parameters; Tuples: tuple assignment, tuple as return value; Dictionaries: operations and methods; advanced list processing list comprehension; Illustrative programs: simple sorting, histogram, Students marks statement, Retail bill preparation.

UNIT V FILES, MODULES, PACKAGES 9

Files and exceptions: text files, reading and writing files, format operator; command line arguments, errors and exceptions, handling exceptions, modules, packages; Illustrative programs: word count, copy file, Voter’s age validation, Marks range validation (0-100).

TOTAL : 45 PERIODS

COURSE OUTCOMES:

Upon completion of the course, students will be able to

CO1: Develop algorithmic solutions to simple computational problems.
CO2: Develop and execute simple Python programs.
CO3: Write simple Python programs using conditionals and loops for solving problems.
CO4: Decompose a Python program into functions.
CO5: Represent compound data using Python lists, tuples, dictionaries etc.
CO6: Read and write data from/to files in Python programs.

TEXT BOOKS:

1. Allen B. Downey, “Think Python: How to Think like a Computer Scientist”, 2nd Edition, O’Reilly Publishers, 2016.
2. Karl Beecher, “Computational Thinking: A Beginner's Guide to Problem Solving and Programming”, 1st Edition, BCS Learning & Development Limited, 2017.

REFERENCES:

1. Paul Deitel and Harvey Deitel, “Python for Programmers”, Pearson Education, 1st Edition, 2021.
2. G Venkatesh and Madhavan Mukund, “Computational Thinking: A Primer for Programmers and Data Scientists”, 1st Edition, Notion Press, 2021.
3. John V Guttag, "Introduction to Computation and Programming Using Python: With Applications to Computational Modeling and Understanding Data”, Third Edition, MIT Press, 2021
4. Eric Matthes, “Python Crash Course, A Hands - on Project Based Introduction to Programming”, 2nd Edition, No Starch Press, 2019.
5. https://www.python.org/
6. Martin C. Brown, “Python: The Complete Reference”, 4th Edition, Mc-Graw Hill, 2018.

MAPPING OF COs WITH POs AND PSOs

COs	POs												PSOs		
	PO01	**PO02**	**PO03**	**PO04**	**PO05**	**PO06**	**PO07**	**PO08**	**PO09**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
1	3	3	3	3	2	-	-	-	-	-	2	2	3	3	-
2	3	3	3	3	2	-	-	-	-	-	2	2	3	-	-
3	3	3	3	3	2	-	-	-	-	-	2	-	3	-	-
4	2	2	-	2	2	-	-	-	-	-	1	-	3	-	-
5	1	2	-	-	1	-	-	-	-	-	1	-	2	-	-
6	2	2	-	-	2	-	-	-	-	-	1	-	2	-	-
Avg.	2	3	3	3	2	-	-	-	-	-	2	2	3	3	-

21150L16 PROBLEM SOLVING AND PYTHON PROGRAMMING LABORATORY **LTPC**
0042

COURSE OBJECTIVES:

- To understand the problem solving approaches.
- To learn the basic programming constructs in Python.
- To practice various computing strategies for Python-based solutions to real world problems.
- To use Python data structures - lists, tuples, dictionaries.
- To do input/output with files in Python.

EXPERIMENTS:

Note: The examples suggested in each experiment are only indicative. The lab instructor is expected to design other problems on similar lines. The Examination shall not be restricted to the sample experiments listed here.

1. Identification and solving of simple real life or scientific or technical problems, and developing flow charts for the same. (Electricity Billing, Retail shop billing, Sin series, weight of a motorbike, Weight of a steel bar, compute Electrical Current in Three Phase AC Circuit, etc.)
2. Python programming using simple statements and expressions (exchange the values of two variables, circulate the values of n variables, distance between two points).
3. Scientific problems using Conditionals and Iterative loops. (Number series, Number Patterns, pyramid pattern)
4. Implementing real-time/technical applications using Lists, Tuples. (Items present in a library/Components of a car/ Materials required for construction of a building –operations of list & tuples)
5. Implementing real-time/technical applications using Sets, Dictionaries. (Language, components of an automobile, Elements of a civil structure, etc.- operations of Sets & Dictionaries)
6. Implementing programs using Functions. (Factorial, largest number in a list, area of shape)
7. Implementing programs using Strings. (reverse, palindrome, character count, replacing characters)
8. Implementing programs using written modules and Python Standard Libraries (pandas, numpy. Matplotlib, scipy)
9. Implementing real-time/technical applications using File handling. (copy from one file to another, word count, longest word)
10. Implementing real-time/technical applications using Exception handling. (divide by zero error, voter's age validity, student mark range validation)
11. Exploring Pygame tool.
12. Developing a game activity using Pygame like bouncing ball, car race etc.

TOTAL: 60 PERIODS

COURSE OUTCOMES:

On completion of the course, students will be able to:

CO1: Develop algorithmic solutions to simple computational problems

CO2: Develop and execute simple Python programs.

CO3: Implement programs in Python using conditionals and loops for solving problems..

CO4: Deploy functions to decompose a Python program.

CO5: Process compound data using Python data structures.

CO6: Utilize Python packages in developing software applications.

TEXT BOOKS:

1. Allen B. Downey, "Think Python : How to Think like a Computer Scientist", 2nd Edition, O'Reilly Publishers, 2016.
2. Karl Beecher, "Computational Thinking: A Beginner's Guide to Problem Solving and Programming", 1st Edition, BCS Learning & Development Limited, 2017.

REFERENCES:

1. Paul Deitel and Harvey Deitel, "Python for Programmers", Pearson Education, 1st Edition, 2021.
2. G Venkatesh and Madhavan Mukund, "Computational Thinking: A Primer for Programmers and Data Scientists", 1st Edition, Notion Press, 2021.
3. John V Guttag, "Introduction to Computation and Programming Using Python: With Applications to Computational Modeling and Understanding Data'', Third Edition, MIT Press , 2021
4. Eric Matthes, "Python Crash Course, A Hands - on Project Based Introduction to Programming", 2nd Edition, No Starch Press, 2019.
5. https://www.python.org/
6. Martin C. Brown, "Python: The Complete Reference", 4th Edition, Mc-Graw Hill, 2018.

MAPPING OF COs WITH POs AND PSOs

COs	POs												PSOs		
	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	3	3	3	3	-	-	-	-	-	3	2	3	3	-
2	3	3	3	3	3	-	-	-	-	-	3	2	3	-	-
3	3	3	3	3	2	-	-	-	-	-	2	-	3	-	-
4	3	2	-	2	2	-	-	-	-	-	1	-	3	-	-
5	1	2	-	-	1	-	-	-	-	-	1	-	2	-	-
6	2	-	-	-	2	-	-	-	-	-	1	-	2	-	-
Avg.	2	3	3	3	2	-	-	-	-	-	2	2	3	3	-

21149L17 PHYSICS AND CHEMISTRY LABORATORY LTPC
0042

PHYSICS LABORATORY : (Any Seven Experiments)

COURSE OBJECTIVES:

- To learn the proper use of various kinds of physics laboratory equipment.
- To learn how data can be collected, presented and interpreted in a clear and concise manner.
- To learn problem solving skills related to physics principles and interpretation of experimental data.
- To determine error in experimental measurements and techniques used to minimize such error.
- To make the student as an active participant in each part of all lab exercises.

1. Torsional pendulum - Determination of rigidity modulus of wire and moment of inertia of regular and irregular objects.
2. Simple harmonic oscillations of cantilever.
3. Non-uniform bending - Determination of Young's modulus
4. Uniform bending – Determination of Young's modulus
5. Laser- Determination of the wave length of the laser using grating
6. Air wedge - Determination of thickness of a thin sheet/wire
7. a) Optical fibre -Determination of Numerical Aperture and acceptance angle
   b) Compact disc- Determination of width of the groove using laser.
8. Acoustic grating- Determination of velocity of ultrasonic waves in liquids.
9. Ultrasonic interferometer – determination of the velocity of sound and compressibility of liquids
10. Post office box -Determination of Band gap of a semiconductor.
11. Photoelectric effect
12. Michelson Interferometer.
13. Melde's string experiment
14. Experiment with lattice dynamics kit.

TOTAL: 30 PERIODS

COURSE OUTCOMES:

Upon completion of the course, the students should be able to

CO1: Understand the functioning of various physics laboratory equipment.

CO2: Use graphical models to analyze laboratory data.

CO3: Use mathematical models as a medium for quantitative reasoning and describing physical reality.

CO4: Access, process and analyze scientific information.

CO5: Solve problems individually and collaboratively.

MAPPING OF COs WITH POs AND PSOs

CO's	PO's												PSO's		
	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	2	3	1	1	-	-	-	-	-	-	-	-	-	-
2	3	3	2	1	1	-	-	-	-	-	-	-	-	-	-
3	3	2	3	1	1	-	-	-	-	-	-	-	-	-	-
4	3	3	2	1	1	-	-	-	-	-	-	-	-	-	-
5	3	2	3	1	1	-	-	-	-	-	-	-	-	-	-
Avg.	3	2.4	2.6	1	1	-	-	-	-	-	-	-	-	-	-

<u>CHEMISTRY LABORATORY: (Any seven experiments to be conducted)</u>

COURSE OBJECTIVES:

- To inculcate experimental skills to test basic understanding of water quality parameters, such as, acidity, alkalinity, hardness, DO, chloride and copper.
- To induce the students to familiarize with electroanalytical techniques such as, pH metry, potentiometry and conductometry in the determination of impurities in aqueous solutions.
- To demonstrate the analysis of metals and alloys.
- To demonstrate the synthesis of nanoparticles

1. Preparation of Na_2CO_3 as a primary standard and estimation of acidity of a water sample using the primary standard
2. Determination of types and amount of alkalinity in water sample.
   - Split the first experiment into two
3. Determination of total, temporary & permanent hardness of water by EDTA method.
4. Determination of DO content of water sample by Winkler's method.
5. Determination of chloride content of water sample by Argentometric method.
6. Estimation of copper content of the given solution by Iodometry.
7. Estimation of TDS of a water sample by gravimetry.
8. Determination of strength of given hydrochloric acid using pH meter.
9. Determination of strength of acids in a mixture of acids using conductivity meter.
10. Conductometric titration of barium chloride against sodium sulphate (precipitation titration)
11. Estimation of iron content of the given solution using potentiometer.
12. Estimation of sodium /potassium present in water using flame photometer.
13. Preparation of nanoparticles (TiO_2/ZnO/CuO) by Sol-Gel method.
14. Estimation of Nickel in steel
15. Proximate analysis of Coal

TOTAL : 30 PERIODS

COURSE OUTCOMES :

CO1: To analyse the quality of water samples with respect to their acidity, alkalinity, hardness and DO.
CO2: To determine the amount of metal ions through volumetric and spectroscopic techniques
CO3: To analyse and determine the composition of alloys.
CO4: To learn simple method of synthesis of nanoparticles
CO5: To quantitatively analyse the impurities in solution by electroanalytical techniques

TEXT BOOKS :

1. J. Mendham, R. C. Denney, J.D. Barnes, M. Thomas and B. Sivasankar, Vogel's Textbook of Quantitative Chemical Analysis (2009).

MAPPING OF COs WITH POs AND PSOs

COs	POs												PSOs		
	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	-	1	-	-	2	2	-	-	-	-	2	-	-	-
2	3	1	2	-	-	1	2	-	-	-	-	1	-	-	-
3	3	2	1	1	-	-	1	-	-	-	-	-	-	-	-
4	2	1	2	-	-	2	2	-	-	-	-	-	-	-	-
5	2	1	2	-	1	2	2	-	-	-	-	1	-	-	-
Avg.	2.6	1.3	1.6	1	1	1.4	1.8	-	-	-	-	1.3	-	-	-

SEMESTER II

21147S21 **PROFESSIONAL ENGLISH-II** **LTPC**

2002

COURSE OBJECTIVES:

- To engage learners in meaningful language activities to improve their reading and writing skills
- To learn various reading strategies and apply in comprehending documents in professional context.
- To help learners understand the purpose, audience, contexts of different types of writing
- To develop analytical thinking skills for problem solving in communicative contexts
- To demonstrate an understanding of job applications and interviews for internship and placements

UNIT I MAKING COMPARISONS 6

Reading - Reading advertisements, user manuals, brochures; Writing - Professional emails, Email etiquette - Compare and Contrast Essay; Grammar - Mixed Tenses, Prepositional phrases

UNIT II EXPRESSING CAUSAL RELATIONS IN SPEAKING AND WRITING 6

Reading - Reading longer technical texts- Cause and Effect Essays, and Letters / emails of complaint, Writing - Writing responses to complaints. Grammar - Active Passive Voice transformations, Infinitive and Gerunds

UNIT III PROBLEM SOLVING 6

Reading - Case Studies, excerpts from literary texts, news reports etc. Writing - Letter to the Editor, Checklists, Problem solution essay / Argumentative Essay. Grammar - Error correction; If conditional sentences

UNIT IV REPORTING OF EVENTS AND RESEARCH 6

Reading -Newspaper articles; Writing - Recommendations, Transcoding, Accident Report, Survey Report Grammar - Reported Speech, Modals Vocabulary - Conjunctions- use of prepositions

UNIT V THE ABILITY TO PUT IDEAS OR INFORMATION COGENTLY 6

Reading - Company profiles, Statement of Purpose, (SOP), an excerpt of interview with professionals; Writing - Job / Internship application - Cover letter & Resume; Grammar - Numerical adjectives, Relative Clauses.

TOTAL : 30 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able

CO1: To compare and contrast products and ideas in technical texts.

CO2: To identify and report cause and effects in events, industrial processes through technical texts

CO3:To analyse problems in order to arrive at feasible solutions and communicate them in the written format.

CO4: To present their ideas and opinions in a planned and logical manner

CO5:To draft effective resumes in the context of job search.

TEXT BOOKS :

1. English for Engineers & Technologists (2020 edition) Orient Blackswan Private Ltd. Department of English, Anna University.
2. English for Science & Technology Cambridge University Press 2021.

3. Authored by Dr. Veena Selvam, Dr. Sujatha Priyadarshini, Dr. Deepa Mary Francis, Dr. KN. Shoba, and Dr. Lourdes Joevani, Department of English, Anna University.

REFERENCE BOOKS:

1. Raman. Meenakshi, Sharma. Sangeeta (2019). Professional English. Oxford university press. New Delhi.
2. Improve Your Writing ed. V.N. Arora and Laxmi Chandra, Oxford Univ. Press, 2001, NewDelhi.
3. Learning to Communicate – Dr. V. Chellammal. Allied Publishers, New Delhi, 2003
4. Business Correspondence and Report Writing by Prof. R.C. Sharma & Krishna Mohan, Tata McGraw Hill & Co. Ltd., 2001, New Delhi.
5. Developing Communication Skills by Krishna Mohan, Meera Bannerji- Macmillan India Ltd. 1990, Delhi.

ASSESSMENT PATTERN

Two internal assessments and an end semester examination to test students' reading and writing skills along with their grammatical and lexical competence.

MAPPING OF COs WITH POs AND PSOs

COs	POs												PSOs		
	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	3	3	3	3	3	3	3	2	3	3	3	-	-	-
2	3	3	3	3	3	3	3	3	2	3	3	3	-	-	-
3	3	3	3	3	3	3	3	3	2	3	3	3	-	-	-
4	3	3	3	3	2	3	3	3	2	3	3	3	-	-	-
5	-	-	-	-	-	-	-	-	3	3	3	3	-	-	-
Avg.	3	3	3	3	2.75	3	3	3	2.2	3	3	3	-	-	-

21148S22 **STATISTICS AND NUMERICAL METHODS** **LTPC**
3104

COURSE OBJECTIVES:

- This course aims at providing the necessary basic concepts of a few statistical and numerical methods and give procedures for solving numerically different kinds of problems occurring in engineering and technology.
- To acquaint the knowledge of testing of hypothesis for small and large samples which plays an important role in real life problems.
- To introduce the basic concepts of solving algebraic and transcendental equations.
- To introduce the numerical techniques of interpolation in various intervals and numerical techniques of differentiation and integration which plays an important role in engineering and technology disciplines.
- To acquaint the knowledge of various techniques and methods of solving ordinary differential equations.

UNIT I TESTING OF HYPOTHESIS — 9 + 3

Sampling distributions - Tests for single mean, proportion and difference of means (Large and small samples) – Tests for single variance and equality of variances – Chi square test for goodness of fit – Independence of attributes.

UNIT II DESIGN OF EXPERIMENTS — 9 + 3

One way and two way classifications - Completely randomized design – Randomized block design – Latin square design - 2^2 factorial design.

UNIT III SOLUTION OF EQUATIONS AND EIGENVALUE PROBLEMS — 9 + 3

Solution of algebraic and transcendental equations - Fixed point iteration method – Newton Raphson method- Solution of linear system of equations - Gauss elimination method – Pivoting - Gauss Jordan method – Iterative methods of Gauss Jacobi and Gauss Seidel - Eigenvalues of a matrix by Power method and Jacobi's method for symmetric matrices.

UNIT IV INTERPOLATION, NUMERICAL DIFFERENTIATION AND NUMERICAL INTEGRATION — 9 +3

Lagrange's and Newton's divided difference interpolations – Newton's forward and backward difference interpolation – Approximation of derivates using interpolation polynomials – Numerical single and double integrations using Trapezoidal and Simpson's 1/3 rules.

UNIT V NUMERICAL SOLUTION OF ORDINARY DIFFERENTIAL EQUATIONS — 9 +3

Single step methods: Taylor's series method - Euler's method - Modified Euler's method - Fourth order Runge-Kutta method for solving first order differential equations - Multi step methods: Milne's and Adams - Bash forth predictor corrector methods for solving first order differential equations.

TOTAL: 60 PERIODS

COURSE OUTCOMES:

Upon successful completion of the course, students will be able to:

CO1: Apply the concept of testing of hypothesis for small and large samples in real life problems.

CO2: Apply the basic concepts of classifications of design of experiments in the field of agriculture.

CO3: Appreciate the numerical techniques of interpolation in various intervals and apply the numerical techniques of differentiation and integration for engineering problems.

CO4: Understand the knowledge of various techniques and methods for solving first and second order ordinary differential equations.

CO5: Solve the partial and ordinary differential equations with initial and boundary conditions by using certain techniques with engineering applications.

TEXT BOOKS:

1. Grewal, B.S., and Grewal, J.S., "Numerical Methods in Engineering and Science", Khanna Publishers, 10th Edition, New Delhi, 2015.
2. Johnson, R.A., Miller, I and Freund J., "Miller and Freund's Probability and Statistics for Engineers", Pearson Education, Asia, 8th Edition, 2015.

REFERENCES:

1. Burden, R.L and Faires, J.D, "Numerical Analysis", 9th Edition, Cengage Learning, 2016.
2. Devore. J.L., "Probability and Statistics for Engineering and the Sciences", Cengage Learning, New Delhi, 8th Edition, 2014.
3. Gerald. C.F. and Wheatley. P.O. "Applied Numerical Analysis" Pearson Education, Asia, New Delhi, 7th Edition, 2007.
4. Gupta S.C. and Kapoor V. K., " Fundamentals of Mathematical Statistics", Sultan Chand & Sons, New Delhi, 12th Edition, 2020.
5. Spiegel. M.R., Schiller. J. and Srinivasan. R.A., "Schaum's Outlines on Probability and Statistics ", Tata McGraw Hill Edition, 4th Edition, 2012.
6. Walpole. R.E., Myers. R.H., Myers. S.L. and Ye. K., "Probability and Statistics for Engineers and Scientists", 9th Edition, Pearson Education, Asia, 2010.

MAPPING OF COs WITH POs AND PSOs

COs	POs												PSOs		
	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	3	1	1	1	0	0	0	2	0	2	3	-	-	-
2	3	3	1	1	1	0	0	0	2	0	2	3	-	-	-
3	3	3	1	1	1	0	0	0	2	0	2	3	-	-	-
4	3	3	1	1	1	0	0	0	2	0	2	3	-	-	-
5	3	3	1	1	1	0	0	0	2	0	2	3	-	-	-
Avg.	3	3	1	1	1	0	0	0	2	0	2	3	-	-	-

21149S23C **PHYSICS FOR ELECTRICAL ENGINEERING**

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

- To make the students to understand the basics of dielectric materials and insulation.
- To understand the electrical properties of materials including free electron theory, applications of quantum mechanics and magnetic materials.
- To instil knowledge on physics of semiconductors, determination of charge carriers and device applications
- To establish a sound grasp of knowledge on different optical properties of materials, optical displays and applications
- To inculcate an idea of significance of nano structures, quantum confinement and ensuing nano device applications.

UNIT I DIELECTRIC MATERIALS AND INSULATION 9

Matter polarization and relative permittivity: definition - dipole moment and polarization vector P- polarization mechanisms: electronic, ionic, orientational, interfacial and total polarization - frequency dependence - local field and Causius-Mossetti equation - dielectric constant and dielectric loss - Gauss's law and boundary conditions - dielectric strength, introduction to insulation breakdown in gases, liquids and solids - capacitor materials - typical capacitor constructions - piezoelectricity, ferroelectricity and pyroelectricity – quartz oscillators and filters – piezo and pyroelectric crystals.

UNIT II ELECTRICAL AND MAGNETIC PROPERTIES OF MATERIALS 9

Classical free electron theory - Expression for electrical conductivity – Thermal conductivity, expression - Quantum free electron theory :Tunneling - degenerate states - Fermi- Dirac statistics - Density of energy states - Electron in periodic potential - Energy bands in solids - tight binding approximation - Electron effective mass - concept of hole. Magnetic materials: Dia, para and ferromagnetic effects - paramagnetism in the conduction electrons in metals - exchange interaction and ferromagnetism - quantum interference devices – GMR devices.

UNIT III SEMICONDUCTORS AND TRANSPORT PHYSICS 9

Intrinsic Semiconductors - Energy band diagram - direct and indirect band gap semiconductors - Carrier concentration in intrinsic semiconductors – extrinsic semiconductors - Carrier concentration in N-type & P-type semiconductors – Variation of carrier concentration with temperature - Carrier transport in Semiconductors: Drift, mobility and diffusion - Hall effect and devices - Ohmic contacts - Schottky diode.

UNIT IV OPTICAL PROPERTIES OF MATERIALS 9

Classification of optical materials - Optical processes in semiconductors: optical absorption and emission, charge injection and recombination, optical absorption, loss and gain. Optical processes in quantum wells - Optoelectronic devices: light detectors and solar cells - light emitting diode - laser diode - optical processes in organic semiconductor devices –excitonic state - Electro-optics and nonlinear optics: Modulators and switching devices – plasmonics.

UNIT V NANO DEVICES 9

Density of states for solids - Significance between Fermi energy and volume of the material - Quantum confinement - Quantum structures - Density of states for quantum wells, wires and dots - Band gap of nanomaterials –Tunneling - Single electron phenomena - Single electron Transistor. Conductivity of metallic nanowires – Ballistic transport – Quantum resistance and conductance –

Carbon nanotubes: Properties and applications - Spintronic devices and applications – Optics in quantum structures – quantum well laser.

TOTAL: 45 PERIODS

OUTCOMES:
At the end of the course, the students should be able to
CO1: know basics of dielectric materials and insulation.
CO2:gain knowledge on the electrical and magnetic properties of materials and their applications
CO3:understand clearly of semiconductor physics and functioning of semiconductor devices
CO4:understand the optical properties of materials and working principles of various optical devices
CO5:appreciate the importance of nanotechnology and nanodevices.

TEXT BOOKS:

1. S.O. Kasap. Principles of Electronic Materials and Devices, McGraw Hill Education (Indian Edition), 2020.
2. R.F.Pierret. Semiconductor Device Fundamentals. Pearson (Indian Edition), 2006.
3. G.W.Hanson. Fundamentals of Nanoelectronics. Pearson Education (Indian Edition), 2009.

REFERENCES:

1. Laszlo Solymar, Walsh, Donald, Syms and Richard R.A., Electrical Properties of Materials, Oxford Univ. Press (Indian Edition) 2015.
2. Jasprit Singh, Semiconductor Optoelectronics: Physics and Technology, McGraw-Hill Education (Indian Edition), 2019.
3. Charles Kittel, Introduction to Solid State Physics, Wiley India Edition, 2019.
4. Mark Fox, Optical Properties of Solids, Oxford Univ.Press, 2001.
5. Parag K. Lala, Quantum Computing: A Beginner's Introduction, McGraw-Hill Education (Indian Edition), 2020.

MAPPING OF COs WITH POs AND PSOs

COs	POs												PSOs		
	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	2	1	-	-	1	-	-	-	-	-	-	-	-	-
2	3	2	1	-	-	1	-	-	-	-	-	-	-	-	-
3	3	2	1	-	-	1	-	-	-	-	-	-	-	-	-
4	3	2	1	-	-	1	-	-	-	-	-	-	-	-	-
5	3	2	1	-	-	1	-	-	-	-	-	-	-	-	-
Avg.	3	2	1			1	-	-	-	-	-	-	-	-	-

21154S25 BASIC CIVIL AND MECHANICAL ENGINEERING LTPC
3003

COURSE OBJECTIVES:

- To provide the students an illustration of the significance of the Civil and Mechanical Engineering Profession in satisfying the societal needs.
- To help students acquire knowledge in the basics of surveying and the materials used for construction.
- To provide an insight to the essentials of components of a building and the infrastructure facilities.
- To explain the component of power plant units and detailed explanation to IC engines their working principles.
- To explain the Refrigeration & Air-conditioning system.

UNIT I PART A: OVERVIEW OF CIVIL ENGINEERING 5

Civil Engineering contributions to the welfare of Society - Specialized sub disciplines in Civil Engineering – Structural, Construction, Geotechnical, Environmental, Transportation and Water Resources Engineering – National building code – terminologists: Plinth area, Carpet area, Floor area, Buildup area, Floor space index - Types of buildings: Residential buildings, Industrial buildings.

UNIT I PART B: OVERVIEW OF MECHANICAL ENGINEERING 4

Overview of Mechanical Engineering - Mechanical Engineering Contributions to the welfare of Society –Specialized sub disciplines in Mechanical Engineering – Manufacturing, Automation, Automobile and Energy Engineering - Interdisciplinary concepts in Mechanical Engineering.

UNIT II SURVEYING AND CIVIL ENGINEERING MATERIALS 9

Surveying: Objects – Classification – Principles – Measurements of Distances and angles – Leveling – Determination of areas– Contours.

Civil Engineering Materials: Bricks – Stones – Sand – Cement – Concrete – Steel - Timber - Modern Materials, Thermal and Acoustic Insulating Materials, Decorative Panels, Water Proofing Materials. Modern uses of Gypsum, Pre-fabricated Building component (brief discussion only)

UNIT III BUILDING COMPONENTS AND INFRASTRUCTURE 9

Building plans – Setting out of a Building - Foundations: Types of foundations - Bearing capacity and settlement – Brick masonry – Stone Masonry – Beams – Columns – Lintels – Roofing – Flooring – Plastering.

Types of Bridges and Dams – Water Supply Network - Rain Water Harvesting – Solid Waste Management - Introduction to Highways and Railways - Introduction to Green Buildings.

UNIT IV INTERNAL COMBUSTION ENGINES AND POWER PLANTS 9

Classification of Power Plants- Working principle of steam, Gas, Diesel, Hydro -electric and Nuclear Power plants- Internal combustion engines as automobile power plant – Working principle of Petrol and Diesel Engines – Four stroke and two stroke cycles – Comparison of four stroke and two stroke engines. Working principle of Boilers-Turbines, Reciprocating Pumps (single acting and double acting) and Centrifugal Pumps, Concept of hybrid engines. Industrial safety practices and protective devices

UNIT V REFRIGERATION AND AIR CONDITIONING SYSTEM 9

Terminology of Refrigeration and Air Conditioning. Principle of vapour compression and absorption system–Layout of typical domestic refrigerator–Window and Split type room Air conditioner. Properties of air - water mixture, concepts of psychometric and its process.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

CO1: Understanding profession of Civil and Mechanical engineering.
CO2: Summarise the planning of building, infrastructure and working of Machineries.
CO3: Apply the knowledge gained in respective discipline
CO4: Illustrate the ideas of Civil and Mechanical Engineering applications.
CO5: Appraise the material, Structures, machines and energy.

TEXT BOOKS:

1. G Shanmugam, M S Palanichamy, Basic Civil and Mechanical Engineering, McGraw Hill Education; First edition, 2018

REFERENCES:

1. Palanikumar, K. Basic Mechanical Engineering, ARS Publications, 2018.
2. Ramamrutham S., "Basic Civil Engineering", Dhanpat Rai Publishing Co.(P) Ltd, 2013.
3. Seetharaman S., "Basic Civil Engineering", Anuradha Agencies, 2005.
4. Shantha Kumar SRJ., "Basic Mechanical Engineering", Hi-tech Publications, Mayiladuthurai, 2000.

MAPPING OF COs WITH POs AND PSOs

COs	POs												PSOs		
	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	2	-	-	1	-	-	1	2	1	2	-	1	-	-	-
2	2	-	-	-	-	-	1	2	1	2	-	2	-	-	-
3	2	-	-	-	-	-	1	2	2	2	-	2	-	-	-
4	2	-	-	-	-	-	1	2	1	2	-	2	-	-	-
5	2	-	-	-	-	-	1	2	1	2	-	2	-	-	-
Avg.	2	-	-	0.2	-	-	1	2	1.2	2	-	1.8	-	-	-

21154S24 **ENGINEERING GRAPHICS** **LTPC**

2044

COURSE OBJECTIVES:

The main learning objective of this course is to prepare the students for:

1. Drawing engineering curves.
2. Drawing freehand sketch of simple objects.
3. Drawing orthographic projection of solids and section of solids.
4. Drawing development of solids
5. Drawing isometric and perspective projections of simple solids.

CONCEPTS AND CONVENTIONS (Not for Examination)

Importance of graphics in engineering applications – Use of drafting instruments – BIS conventions and specifications – Size, layout and folding of drawing sheets – Lettering and dimensioning.

UNIT I PLANE CURVES 6+12

Basic Geometrical constructions, Curves used in engineering practices: Conics – Construction of ellipse, parabola and hyperbola by eccentricity method – Construction of cycloid – construction of involutes of square and circle – Drawing of tangents and normal to the above curves.

UNIT II PROJECTION OF POINTS, LINES AND PLANE SURFACE 6+12

Orthographic projection- principles-Principal planes-First angle projection-projection of points. Projection of straight lines (only First angle projections) inclined to both the principal planes - Determination of true lengths and true inclinations by rotating line method and traces. Projection of planes (polygonal and circular surfaces) inclined to both the principal planes by rotating object method.

UNIT III PROJECTION OF SOLIDS AND FREEHAND SKETCHING 6+12

Projection of simple solids like prisms, pyramids, cylinder, cone and truncated solids when the axis is inclined to one of the principal planes and parallel to the other by rotating object method. Visualization concepts and Free Hand sketching: Visualization principles –Representation of Three Dimensional objects – Layout of views- Freehand sketching of multiple views from pictorial views of objects.

Practicing three dimensional modeling of simple objects by CAD Software(Not for examination)

UNIT IV PROJECTION OF SECTIONED SOLIDS AND DEVELOPMENT OF SURFACES **6 +12**

Sectioning of above solids in simple vertical position when the cutting plane is inclined to the one of the principal planes and perpendicular to the other – obtaining true shape of section. Development of lateral surfaces of simple and sectioned solids – Prisms, pyramids cylinders and cones.

Practicing three dimensional modeling of simple objects by CAD Software(Not for examination)

UNIT V ISOMETRIC AND PERSPECTIVE PROJECTIONS 6+12

Principles of isometric projection – isometric scale –Isometric projections of simple solids and truncated solids - Prisms, pyramids, cylinders, cones- combination of two solid objects in simple vertical positions - Perspective projection of simple solids-Prisms, pyramids and cylinders by visual ray method.

Practicing three dimensional modeling of isometric projection of simple objects by CAD Software(Not for examination)

TOTAL: (L=30+P=60) 90 PERIODS

COURSE OUTCOMES:

On successful completion of this course, the student will be able to

CO1: Use BIS conventions and specifications for engineering drawing.

CO2: Construct the conic curves, involutes and cycloid.

CO3: Solve practical problems involving projection of lines.

CO4: Draw the orthographic, isometric and perspective projections of simple solids.

CO5: Draw the development of simple solids.

TEXT BOOK:

1. Bhatt N.D. and Panchal V.M., “Engineering Drawing”, Charotar Publishing House, 53^{rd} Edition, 2019.
2. Natrajan K.V., “A Text Book of Engineering Graphics”, Dhanalakshmi Publishers, Chennai, 2018.
3. Parthasarathy, N. S. and Vela Murali, “Engineering Drawing”, Oxford University Press, 2015

REFERENCES:

1. Basant Agarwal and Agarwal C.M., “Engineering Drawing”, McGraw Hill, 2^{nd} Edition, 2019.
2. Gopalakrishna K.R., “Engineering Drawing” (Vol. I&II combined), Subhas Publications, Bangalore, 27^{th} Edition,2017.
3. Luzzader, Warren.J. and Duff,John M., “Fundamentals of Engineering Drawing with an introduction to Interactive Computer Graphics for Design and Production, Eastern Economy Edition, Prentice Hall of India Pvt. Ltd, New Delhi, 2005.
4. Parthasarathy N. S. and Vela Murali, “Engineering Graphics”, Oxford University, Press, New Delhi, 2015.
5. Shah M.B., and Rana B.C., “Engineering Drawing”, Pearson Education India, 2^{nd} Edition, 2009.
6. Venugopal K. and Prabhu Raja V., “Engineering Graphics", New Age International (P) Limited, 2008.

Publication of Bureau of Indian Standards:

1. IS 10711 – 2001: Technical products Documentation – Size and lay out of drawing sheets.
2. IS 9609 (Parts 0 & 1) – 2001: Technical products Documentation – Lettering.
3. IS 10714 (Part 20) – 2001 & SP 46 – 2003: Lines for technical drawings.
4. IS 11669 – 1986 & SP 46 –2003: Dimensioning of Technical Drawings.
5. IS 15021 (Parts 1 to 4) – 2001: Technical drawings – Projection Methods.

Special points applicable to University Examinations on Engineering Graphics:

1. There will be five questions, each of either or type covering all units of the syllabus.
2. All questions will carry equal marks of 20 each making a total of 100.
3. The answer paper shall consist of drawing sheets of A3 size only. The students will be permitted to use appropriate scale to fit solution within A3 size.
4. The examination will be conducted in appropriate sessions on the same day

MAPPING OF COs WITH POs AND PSOs

COs	POs												PSOs		
	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	1	2	-	2	-	-	-	-	3	-	2	2	2	-
2	3	1	2	-	2	-	-	-	-	3	-	2	2	2	-
3	3	1	2	-	2	-	-	-	-	3	-	2	2	2	-
4	3	1	2	-	2	-	-	-	-	3	-	2	2	2	-
5	3	1	2	-	2	-	-	-	-	3	-	2	2	2	-
Avg.	3	1	2	-	2	-	-	-	-	3	-	2	2	2	-

21153S26B **ELECTRIC CIRCUIT ANALYSIS**

L	T	P	C
3	1	0	4

COURSE OBJECTIVES:

- To introduce electric circuits and its analysis
- To provide key concepts to analyze and understand electrical circuits
- To impart knowledge on solving circuit equations using network theorems
- To educate on obtaining the transient response of circuits.
- To introduce the phenomenon of resonance in coupled circuits.
- To introduce Phasor diagrams and analysis of single &three phase circuits

UNIT I BASIC CIRCUITS ANALYSIS 9+3

Fundamentals concepts of R, L and C elements-Energy Sources- Ohm's Law -Kirchhoff 's Laws - DC Circuits - Resistors in series and parallel circuits - A.C Circuits - Average and RMS Value - Complex Impedance - Phasor diagram - Real and Reactive Power, Power Factor, Energy -Mesh current and node voltage methods of analysis D.C and A.C Circuits.

UNIT II NETWORK REDUCTION AND THEOREMS FOR DC AND AC CIRCUITS 9+3

Network reduction: voltage and current division, source transformation - star delta conversion. Theorems - Superposition, Thevenin's and Norton's Theorem - Maximum power transfer theorem - Reciprocity Theorem - Millman's theorem- Tellegen's Theorem-Statement, application to DC and AC Circuits.

UNIT III TRANSIENT RESPONSE ANALYSIS 9+3

Introduction – Laplace transforms and inverse Laplace transforms- standard test signals -Transient response of RL, RC and RLC circuits using Laplace transform for Source free, Step input and Sinusoidal input.

UNIT IV RESONANCE AND COUPLED CIRCUITS 9+3

Series and parallel resonance –frequency response – Quality factor and Bandwidth - Self and mutual inductance – Coefficient of coupling – Dot rule-Analysis of coupled circuits– Single Tuned circuits.

UNIT V THREE PHASE CIRCUITS 9+3

Analysis of three phase 3-wire and 4-wire circuits with star and delta connected loads, balanced and unbalanced - phasor diagram of voltages and currents - power measurement in three phase circuits-Power Factor Calculations.

TOTAL: 60 PERIODS

COURSE OUTCOMES:

After completing this course, the students will be able to:

CO1: Explain circuit's behavior using circuit laws.

CO2: Apply mesh analysis/ nodal analysis / network theorems to determine behavior of the given DC and AC circuit

CO3: Compute the transient response of first order and second order systems to step and sinusoidal input

CO4: Compute power, line/ phase voltage and currents of the given three phase circuit

CO5: Explain the frequency response of series and parallel RLC circuits

CO6: Explain the behavior of magnetically coupled circuits.

TEXT BOOKS:

1. William H. HaytJr, Jack E. Kemmerly and Steven M. Durbin, "Engineering Circuits Analysis", McGraw Hill publishers, 9th edition, New Delhi, 2020.

2. Charles K. Alexander, Mathew N.O. Sadiku, “Fundamentals of Electric Circuits”, Second Edition, McGraw Hill, 2019.
3. Allan H. Robbins, Wilhelm C. Miller, “Circuit Analysis Theory and Practice”, Cengage Learning India, 2013.

REFERENCES

1. Chakrabarti A, “Circuits Theory (Analysis and synthesis), Dhanpat Rai& Sons, New Delhi, 2020.
2 Joseph A. Edminister, Mahmood Nahvi, “Electric circuits”, Schaum’s series, McGraw-Hill, First Edition, 2019.
4. M E Van Valkenburg, “Network Analysis”,Prentice-Hall of India Pvt Ltd, New Delhi, 2015.
5. Richard C. Dorf and James A. Svoboda, “Introduction to Electric Circuits”, 7th Edition, John Wiley Sons, Inc. 2018.
6. Sudhakar A and Shyam Mohan SP, “Circuits and Networks Analysis and Synthesis”, McGraHill, 2015.

MAPPING OF COs WITH POs AND PSOs

COs	POs												PSOs		
	PO1	PO2	PO3	PO4	PO5	P06	P07	PO8	PO9	PO10	PO11	PO12	PS01	PS02	PS03
CO1	3	3	3	2	2	-	2	1	-	-	-	3	3	3	3
CO2	3	3	3	3	2	-	2	1	-	-	-	3	3	3	3
CO3	3	3	3	3	2	-	2	1	-	-	-	3	3	3	3
CO4	3	3	3	3	2	-	2	1	-	-	-	3	3	3	3
CO5	3	3	3	3	2	-	2	1	-	-	-	3	3	3	3
CO6	3	3	3	3	2	-	2	1	-	-	-	3	3	3	3
Avg.	3	3	3	2.8	2	-	2	1	-	-	-	3	3	3	3

21154L71 ENGINEERING PRACTICES LABORATORY LTPC 0042

COURSE OBJECTIVES:

The main learning objective of this course is to provide hands on training to the students in:

1. Drawing pipe line plan; laying and connecting various pipe fittings used in common household plumbing work; Sawing; planing; making joints in wood materials used in common household wood work.
2. Wiring various electrical joints in common household electrical wire work.
3. Welding various joints in steel plates using arc welding work; Machining various simple processes like turning, drilling, tapping in parts; Assembling simple mechanical assembly of common household equipments; Making a tray out of metal sheet using sheet metal work.
4. Soldering and testing simple electronic circuits; Assembling and testing simple electronic components on PCB.

GROUP – A (CIVIL & ELECTRICAL)

PART I CIVIL ENGINEERING PRACTICES 15

PLUMBING WORK:

a) Connecting various basic pipe fittings like valves, taps, coupling, unions, reducers, elbows and other components which are commonly used in household.
b) Preparing plumbing line sketches.
c) Laying pipe connection to the suction side of a pump
d) Laying pipe connection to the delivery side of a pump.
e) Connecting pipes of different materials: Metal, plastic and flexible pipes used in household appliances.

WOOD WORK:

a) Sawing,
b) Planing and
c) Making joints like T-Joint, Mortise joint and Tenon joint and Dovetail joint.

Wood Work Study:

a) Studying joints in door panels and wooden furniture
b) Studying common industrial trusses using models.

PART II ELECTRICAL ENGINEERING PRACTICES 15

a) Introduction to switches, fuses, indicators and lamps Basic switch board wiring with lamp, fan and three pin socket
b) Staircase wiring
c) Fluorescent Lamp wiring with introduction to CFL and LED types.
d) Energy meter wiring and related calculations/ calibration
e) Study of Iron Box wiring and assembly
f) Study of Fan Regulator (Resistor type and Electronic type using Diac/Triac/quadrac)
g) Study of emergency lamp wiring/Water heater

GROUP – B (MECHANICAL AND ELECTRONICS)

PART III MECHANICAL ENGINEERING PRACTICES 15

WELDING WORK:

a) Welding of Butt Joints, Lap Joints, and Tee Joints using arc welding.
b) Practicing gas welding.

BASIC MACHINING WORK:

a) (simple)Turning.
b) (simple)Drilling.
c) (simple)Tapping.

ASSEMBLY WORK:

a) Assembling a centrifugal pump.
b) Assembling a household mixer.
c) Assembling an airconditioner.

SHEET METAL WORK:

a) Making of a square tray

FOUNDRY WORK:

a) Demonstrating basic foundry operations.

PART IV ELECTRONIC ENGINEERING PRACTICES 15

SOLDERING WORK:

a) Soldering simple electronic circuits and checking continuity.

ELECTRONIC ASSEMBLY AND TESTING WORK:

a) Assembling and testing electronic components on a small PCB.

ELECTRONIC EQUIPMENT STUDY:

a) Study an elements of smart phone.
b) Assembly and dismantle of LED TV.
c) Assembly and dismantle of computer/ laptop

TOTAL : 60 PERIODS

COURSE OUTCOMES:

Upon completion of this course, the students will be able to:

CO1: Draw pipe line plan; lay and connect various pipe fittings used in common household plumbing work; Saw; plan; make joints in wood materials used in common household wood work.

CO2: Wire various electrical joints in common household electrical wire work.

CO3: Weld various joints in steel plates using arc welding work; Machine various simple processes like turning, drilling, tapping in parts; Assemble simple mechanical assembly of common household equipments; Make a tray out of metal sheet using sheet metal work.

CO4: Solder and test simple electronic circuits; Assemble and test simple electronic components on PCB.

MAPPING OF COs WITH POs AND PSOs

COs	POs												PSOs		
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**P06**	**P07**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PS01**	**PS02**	**PS03**
1	3	2	-	-	1	1	1	-	-	-	-	2	2	1	1
2	3	2	-	-	1	1	1	-	-	-	-	2	2	1	1
3	3	2	-	-	1	1	1	-	-	-	-	2	2	1	1
Avg.	3	2	-	-	1	1	1	-	-	-	-	2	2	1	1

21147L23 COMMUNICATION LABORATORY LTPC

0042

COURSE OBJECTIVES

- To identify varied group discussion skills and apply them to take part in effective discussions in a professional context.
- To analyse concepts and problems and make effective presentations explaining them clearly and precisely.
- To be able to communicate effectively through formal and informal writing.
- To be able to use appropriate language structures to write emails, reports and essays
- To give instructions and recommendations that are clear and relevant to the context

UNIT I 12

Speaking-Role Play Exercises Based on Workplace Contexts, talking about competition-discussing progress toward goals-talking about experiences- talking about events in life- discussing past events- Writing: writing emails (formal & semi-formal).

UNIT II 12

Speaking: discussing news stories-talking about frequency-talking about travel problems- discussing travel procedures- talking about travel problems- making arrangements-describing arrangements- discussing plans and decisions- discussing purposes and reasons- understanding common technology terms-Writing: - writing different types of emails.

UNIT III 12

Speaking: discussing predictions-describing the climate-discussing forecasts and scenarios- talking about purchasing-discussing advantages and disadvantages- making comparisons- discussing likes and dislikes- discussing feelings about experiences-discussing imaginary scenarios Writing: short essays and reports-formal/semi-formal letters.

UNIT IV 12

Speaking: discussing the natural environment-describing systems-describing position and movement-explaining rules-(example- discussing rental arrangements)- understanding technical instructions- Writing: writing instructions-writing a short article.

UNIT V 12

Speaking: describing things relatively-describing clothing-discussing safety issues(making recommendations) talking about electrical devices-describing controlling actions- Writing: job application(Cover letter + Curriculum vitae)-writing recommendations.

TOTAL: 60 PERIODS

LEARNING OUTCOMES

At the end of the course, learners will be able

- Speak effectively in group discussions held in formal/semi formal contexts.
- Discuss, analyse and present concepts and problems from various perspectives to arrive at suitable solutions
- Write emails, letters and effective job applications.
- Write critical reports to convey data and information with clarity and precision
- Give appropriate instructions and recommendations for safe execution of tasks

MAPPING OF COs WITH POs AND PSOs

COs	POs											PSOs		
	PO1	PO2	PO3	PO4	PO5	P06	P07	PO8	PO9	PO10	PO11	PO12	PS01	PS02	PS03
1	2	3	3	3	1	3	3	3	3	3	3	3	-	-	-
2	2	3	3	3	1	3	3	3	3	3	3	3	-	-	-
3	2	2	3	3	1	3	3	3	3	3	3	3	-	-	-
4	3	3	3	3	3	3	3	3	3	3	3	3	-	-	-
5	3	3	3	3	3	3	3	3	3	3	3	3	-	-	-
Avg.	2.4	2.8	3	3	1.8	3	3	3	3	3	3	3	-	-	-

Assessment Pattern

- One online / app based assessment to test speaking and writing skills
- Proficiency certification is given on successful completion of speaking and writing.

21148S31C PROBABILITY AND COMPLEX FUNCTIONS LTPC
3104

COURSE OBJECTIVES:

- This course aims at providing the required skill to apply the statistical tools in engineering problems.
- To introduce the basic concepts of probability and random variables.
- To introduce the basic concepts of two dimensional random variables.
- To develop an understanding of the standard techniques of complex variable theory in particular analytic function and its mapping property.
- To familiarize the students with complex integration techniques and contour integration techniques which can be used in real integrals.
- To acquaint the students with Differential Equations which are significantly used in engineering problems.

UNIT I PROBABILITY AND RANDOM VARIABLES 9 + 3

Axioms of probability – Conditional probability – Baye's theorem - Discrete and continuous random variables – Moments – Moment generating functions – Binomial, Poisson, Geometric, Uniform, Exponential and Normal distributions – Functions of a random variable.

UNIT II TWO-DIMENSIONAL RANDOM VARIABLES 9 + 3

Joint distributions – Marginal and conditional distributions – Covariance – Correlation and linear regression – Transformation of random variables – Central limit theorem (for independent and identically distributed random variables).

UNIT III ANALYTIC FUNCTIONS 9 + 3

Analytic functions – Necessary and sufficient conditions for analyticity in Cartesian and polar coordinates - Properties – Harmonic conjugates – Construction of analytic function – Conformal Mapping – Mapping by functions $w=z+c$, cz, $1/z$,z^2 – Bi linear transformation

UNIT IV COMPLEX INTEGRATION 9 + 3

Line integral - Cauchy's integral theorem – Cauchy's integral formula – Taylor's and Laurent's series – Singularities – Residues – Residue theorem – Application of residue theorem for evaluation of real integrals – Applications of circular contour and semicircular contour (with poles NOT on real axis).

UNIT V ORDINARY DIFFERENTIAL EQUATIONS 9 + 3

Higher order linear differential equations with constant coefficients - Method of variation of parameters – Homogenous equation of Euler's and Legendre's type – System of simultaneous linear first order differential equations with constant coefficients - Method of undetermined coefficients.

TEXT BOOKS

1. Johnson. R.A., Miller. I and Freund. J., "Miller and Freund's Probability and Statistics for Engineers", Pearson Education, Asia, 9th Edition, 2016.
2. Milton. J. S. and Arnold. J.C., "Introduction to Probability and Statistics", Tata McGraw Hill, 4th Edition, 2007.
3. Grewal.B.S., "Higher Engineering Mathematics", Khanna Publishers, New Delhi, 44th Edition, 2018.

REFERENCES

1. Devore. J.L., "Probability and Statistics for Engineering and the Sciences", Cengage Learning, New Delhi, 8^{th} Edition, 2014.
2. Papoulis. A. and Unnikrishnapillai . S., "Probability, Random Variables and Stochastic Processes", McGraw Hill Education India, 4^{th} Edition, New Delhi, 2010.
3. Ross . S.M., "Introduction to Probability and Statistics for Engineers and Scientists", 5^{th}Edition, Elsevier, 2014.
4. Spiegel. M.R., Schiller. J. and Srinivasan . R.A., "Schaum's Outline of Theory and Problems of Probability and Statistics", Tata McGraw Hill Edition, 4^{th} Edition, 2012.
5. Walpole. R.E., Myers. R.H., Myers. S.L. and Ye. K., "Probability and Statistics for Engineers and Scientists", Pearson Education, Asia, 9^{th} Edition, 2010.
6. Kreyszig.E, "Advanced Engineering Mathematics", John Wiley and Sons, 10^{th} Edition, New Delhi, 2016.

MAPPING OF COs WITH POs AND PSOs

COs	POs												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	3	0	0	0	0	0	0	2	0	0	2	-	-	-
2	3	3	0	0	0	0	0	0	2	0	0	2	-	-	-
3	3	3	0	0	0	0	0	0	2	0	0	2	-	-	-
4	3	3	0	0	0	0	0	0	2	0	0	2	-	-	-
5	3	3	0	0	0	0	0	0	2	0	0	2	-	-	-
Avg.	3	3	0	0	0	0	0	0	2	0	0	2	-	-	-

21153C33 **ELECTROMAGNETIC FIELDS** **LTPC**
3104

COURSE OBJECTIVES:

- To introduce the basic mathematical concepts related to electromagnetic vector fields
- To impart knowledge on the concepts of
  - ✓ Electrostatic fields, electric potential, energy density and their applications.
  - ✓ Magneto static fields, magnetic flux density, vector potential and its applications.
  - ✓ Different methods of emf generation and Maxwell's equations
  - ✓ Electromagnetic waves and characterizing parameters

UNIT I ELECTROSTATICS – I 12

Sources and effects of electromagnetic fields – Coordinate Systems – Vector fields –Gradient, Divergence, Curl – theorems and applications - Coulomb's Law – Electric field intensity – Field due to discrete and continuous charges – Gauss's law and applications.

UNIT II ELECTROSTATICS – II 12

Electric potential – Electric field and equipotential plots, Uniform and Non-Uniform field, Utilization factor – Electric field in free space, conductors, dielectrics - Dielectric polarization –Dielectric strength - Electric field in multiple dielectrics – Boundary conditions, Poisson's and Laplace's equations, Capacitance, Energy density, Applications.

UNIT III MAGNETOSTATICS 12

Lorentz force, magnetic field intensity (H) – Biot-Savart's Law - Ampere's Circuit Law – H due to straight conductors, circular loop, infinite sheet of current, Magnetic flux density (B) – B in free space, conductor, magnetic materials – Magnetization, Magnetic field in multiple media –Boundary conditions, scalar and vector potential, Poisson's Equation, Magnetic force, Torque, Inductance, Energy density, Applications.

UNIT IV ELECTRODYNAMIC FIELDS 12

Magnetic Circuits - Faraday's law – Transformer and motional EMF – Displacement current -Maxwell's equations (differential and integral form) – Relation between field theory and circuit theory – Applications.

UNIT V ELECTROMAGNETIC WAVES 12

Electromagnetic wave generation and equations – Wave parameters; velocity, intrinsic impedance, propagation constant – Waves in free space, lossy and lossless dielectrics, conductors- skin depth - Poynting vector – Plane wave reflection and refraction.

TOTAL: 60 PERIODS

COURSE OUTCOMES:

Upon the successful completion of the course, students will be able to:

CO1: Visualize and explain Gradient, Divergence, and Curl operations on electromagnetic vector fieldsand identify the electromagnetic sources and their effects.

CO2: Compute and analyse electrostatic fields, electric potential, energy density along with their applications.

CO3: Compute and analyse magneto static fields, magnetic flux density, vector potential along with their applications.

CO4: Explain different methods of emf generation and Maxwell's equations

CO5: Explain the concept of electromagnetic waves and characterizing parameters

TEXT BOOKS:

1. Mathew N. O. Sadiku, S.V. Kulkarni 'Principles of Electromagnetics', 6th Edition, Oxford University Press Inc. Asian edition, 2015.
2. William H. Hayt and John A. Buck, 'Engineering Electromagnetics', McGraw Hill Special Indian edition, 2014.
3. Kraus and Fleish, 'Electromagnetics with Applications', McGraw Hill International Editions, Fifth Edition, 2010.

REFERENCES

1. V.V.Sarwate, 'Electromagnetic fields and waves', Second Edition, Newage Publishers, 2018.
2. J.P.Tewari, 'Engineering Electromagnetics - Theory, Problems and Applications', Second Edition, Khanna Publishers 2013.
3. Joseph. A.Edminister, 'Schaum's Outline of Electromagnetics, Fifth Edition (Schaum's Outline Series), McGraw Hill, 2018.
4. S.P.Ghosh, Lipika Datta, 'Electromagnetic Field Theory', First Edition, McGraw Hill Education(India) Private Limited, 2017.
5. K A Gangadhar, 'Electromagnetic Field Theory', Khanna Publishers; Sixteenth Edition Eighth Reprint :2015

MAPPING OF COs WITH POs AND PSOs

	POs												PSOs		
COs	PO1	PO2	PO3	PO4	PO5	P06	P07	PO8	PO9	PO10	PO11	PO12	PS01	PS02	PS03
CO1	3	2	-	-	-	-	3	1	-	-	-	1	3	2	1
CO2	3	2	1	2	-	-	1	1	-	-	-	1	3	2	1
CO3	3	2	1	2	-	-	1	1	-	-	-	1	3	2	1
CO4	3	2	1	2	-	-	1	1	-	-	-	1	3	2	1
CO5	3	2	1	2	-	-	1	1	-	-	-	1	3	2	1
Avg.	3	2	1	2	-	-	1.4	1	-	-	-	1	3	2	1

21153C32 **DIGITAL LOGIC CIRCUITS** **L T P C**

3 0 0 3

COURSE OBJECTIVES:

- To introduce the fundamentals of combinational and sequential digital circuits.
- To study various number systems and to simplify the mathematical expressions using Boolean functions word problems
- To study implementation of combinational circuits using Gates` and MSI Devices.
- To study the design of various synchronous and asynchronous circuits
- To introduce digital simulation techniques for development of application oriented logic circuit

UNIT I NUMBER SYSTEMS AND DIGITAL LOGIC FAMILIES 9

Number system, error detection, corrections & codes conversions, Boolean algebra: De-Morgan's theorem, switching functions and minimization using K-maps & Quine McCluskey method - Digital Logic Families -comparison of RTL, DTL, TTL, ECL and MOS families - operation, characteristics of digital logic family.

UNIT II COMBINATIONAL CIRCUITS 9

Combinational logic - representation of logic functions-SOP and POS forms, K-map representations - minimization using K maps - simplification and implementation of combinational logic – multiplexers and de multiplexers - code converters, adders, subtractors, Encoders and Decoders.

UNIT III SYNCHRONOUS SEQUENTIAL CIRCUITS 9

Sequential logic- SR, JK, D and T flip flops - level triggering and edge triggering - counters - asynchronous and synchronous type - Modulo counters - Shift registers - design of synchronous sequential circuits – Moore and Mealy models- Counters, state diagram; state reduction; state assignment.

UNIT IV ASYNCHRONOUS SEQUENTIAL CIRCUITS AND PROGRAMMABILITY9 LOGIC DEVICES

Asynchronous sequential logic Circuits-Transition stability, flow stability-race conditions, hazards &errors in digital circuits; analysis of asynchronous sequential logic circuits-introduction to Programmability Logic Devices: PROM – PLA –PAL, CPLD-FPGA.

UNIT V VHDL 9

RTL Design – combinational logic – Sequential circuit – Operators – Introduction to Packages – Subprograms – Test bench. (Simulation /Tutorial Examples: adders, counters, flip flops, Multiplexers & De multiplexers).

TOTAL : 45 PERIODS

COURSE OUTCOMES:

Upon the successful completion of the course, students will be able to:

CO1: Explain various number systems and characteristics of digital logic families

CO2: Apply K-maps and Quine McCluskey methods to simplify the given Boolean expressions

CO3: Explain the implementation of combinational circuit such as multiplexers and de multiplexers - code converters, adders, subtractors, Encoders and Decoders

CO4: Design various synchronous and asynchronous circuits using Flip Flops

CO5: Explain asynchronous sequential circuits and programmable logic devices

CO6: Use VHDL for simulating and testing RTL, combinatorial and sequential circuits

TEXTBOOKS:

1. Morris Mano.M, 'Digital Logic and Computer Design', Prentice Hall of India, 3rd Edition, 2005.
2. Donald D.Givone, 'Digital Principles and Design', Tata McGraw Hill, 1st Edition, 2003
3. Thomas L Floyd, 'Digital fundamentals', Pearson Education Limited, 11th Edition, 2018

REFERENCES:

1. Tocci R.J., Neal S. Widmer, 'Digital Systems: Principles and Applications', Pearson Education Asia, 12th Edition, 2017.
2. Donald P Leach, Albert Paul Malvino, Goutam Sha, 'Digital Principles and Applications', Tata McGraw Hill, 7th Edition, 2010.

MAPPING OF COs WITH POs AND PSOs

COs	POs												PSOs		
	PO1	PO2	PO3	PO4	PO5	P06	P07	PO8	PO9	PO10	PO11	PO12	PS01	PS02	PS03
CO1	3	3	3	1	3	-	-	1	-	-	-	1	3	-	1
CO2	3	3	3	1	3	-	-	1	-	-	-	1	3	-	1
CO3	3	3	3	1	3	-	-	1	-	-	-	1	3	-	1
CO4	3	3	3	1	3	-	-	1	-	-	-	1	3	-	1
CO5	3	3	3	1	3	-	-	1	-	-	-	1	3	-	1
Avg	3	3	3	1	3	-	-	1	-	-	-	1	3	-	1

21153S35 ELECTRON DEVICES AND CIRCUITS LTPC

3003

COURSE OBJECTIVES:

- To understand the structure of basic electronic devices.
- To be exposed to active and passive circuit elements.
- To familiarize the operation and applications of transistor like BJT and FET.
- To explore the characteristics of amplifier gain and frequency response.
- To learn the required functionality of positive and negative feedback systems.

UNIT I PN JUNCTION DEVICES 9

PN junction diode –structure, operation and V-I characteristics, diffusion and transition capacitance - Clipping & Clamping circuits - Rectifiers - Half Wave and Full Wave Rectifier- Display devices- LED, Laser diodes, Zener diode characteristics- Zener diode Reverse characteristics - Zener diode as regulator.

UNIT II TRANSISTORS AND THYRISTORS 9

BJT, JFET, MOSFET- structure, operation, characteristics and Biasing UJT, Thyristors and IGBT - Structure and characteristics.

UNIT III AMPLIFIERS 9

BJT small signal model - Analysis of CE, CB, CC amplifiers- Gain and frequency response -MOSFET small signal model- Analysis of CS and Source follower - Gain and frequency response- High frequency analysis.

UNIT IV MULTISTAGE AMPLIFIERS AND DIFFERENTIAL AMPLIFIER 9

BIMOS cascade amplifier, Differential amplifier – Common mode and Difference mode analysis - FET input stages - Single tuned amplifiers - Gain and frequency response - Neutralization methods, power amplifiers -Types (Qualitative analysis).

UNIT V FEEDBACK AMPLIFIERS AND OSCILLATORS 9

Advantages of negative feedback - voltage / current, series, Shunt feedback -positive feedback - Condition for oscillations, phase shift - Wien bridge, Hartley, Colpitts and Crystal oscillators.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

Upon successful completion of the course, the students will be able to:

CO1: Explain the structure and operation of PN junction devices (diode, Zener diode, LED and Laser diode)

CO2: Design clipper, clamper, half wave and full wave rectifier, regulator circuits using PN junction diodes

CO3: Analyze the structure and characteristics BJT, FET, MOSFET, UJT, Thyristor and IGBT

CO4: Analyze the performance of various configurations of BJT and MOSFET based amplifier

CO5: Explain the characteristics of MOS based cascade and differential amplifier

CO6: Explain the operation of various feedback amplifiers and oscillators

TEXT BOOKS:

1. David A. Bell , "Electronic devices and circuits", Oxford University higher education, 5th edition 2008.
2. Sedra and smith, "Microelectronic circuits",7th Edition., Oxford University Press, 2017

REFERENCES:

1. Balbir Kumar, Shail.B.Jain, "Electronic devices and circuits" PHI learning private limited, 2nd edition 2014.
2. Thomas L.Floyd, "Electronic devices" Conventional current version, Pearson prentice hall, 10th Edition, 2017.
3. Donald A Neamen, "Electronic Circuit Analysis and Design" Tata McGraw Hill, 3rd Edition, 2003.
4. Robert L.Boylestad, "Electronic devices and circuit theory", 11th edition, Pearson prentice Hall 2013.
5. Robert B. Northrop, "Analysis and Application of Analog Electronic Circuits to Biomedical Instrumentation", CRC Press, Second edition, 2012.

MAPPING OF COs WITH POs AND PSOs

COs	POs												PSOs		
	PO1	PO2	PO3	PO4	PO5	P06	P07	PO8	PO9	PO10	PO11	PO12	PS01	PS02	PS03
CO1	2	2	3	2	2	-	-	1	-	-	-	1	3	-	1
CO2	2	2	3	2	2	-	-	1	-	-	-	1	3	-	1
CO3	2	2	3	2	2	-	-	1	-	-	-	1	3	-	1
CO4	2	2	3	2	2	-	-	1	-	-	-	1	3	-	1
CO5	2	2	3	2	2	-	-	1	-	-	-	1	3	-	1
Avg.	2	2	3	2	2	-	-	1	-	-	-	1	3	-	1

21153C34	ELECTRICAL MACHINES - I	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To understand the concept of electromechanical energy conversion system.
- To identify the appropriate machine for a given application based on its characteristics.
- To identify the appropriate test to determine the performance parameters of a given machine.
- To familiarize with the procedure for parallel operation of generators and transformers.
- To deliberate the working of auto transformer and three phase transformers.

UNIT I ELECTROMECHANICAL ENERGY CONVERSION 9

Fundamentals of Magnetic circuits- Statically and dynamically induced EMF - Principle of electromechanical energy conversion forces and torque in magnetic field systems- energy balance in magnetic circuits- magnetic force- co-energy in singly excited and multi excited magnetic field system mmf of distributed windings - Winding Inductances-, magnetic fields in rotating machines- magnetic saturation and leakage fluxes. Introduction to Indian Standard Specifications (ISS) - Role and significance in testing.

UNIT II DC GENERATORS 9

Principle of operation, constructional details, armature windings and its types, EMF equation, wave shape of induced emf, armature reaction, demagnetizing and cross magnetizing Ampere turns, compensating winding, commutation, methods of improving commutation, interpoles, OCC and load characteristics of different types of DC Generators. Parallel operation of DC Generators, equalizing connections- applications of DC Generators.

UNIT III DC MOTORS 9

Principle of operation, significance of back emf, torque equations and power developed by armature, speed control of DC motors, starting methods of DC motors, load characteristics of DC motors, losses and efficiency in DC machine, condition for maximum efficiency. Testing of DC Machines: Brake test, Swinburne’s test, Hopkinson's test, Field test, Retardation test, Separation of core losses-applications of DC motors.

UNIT IV SINGLE PHASE TRANSFORMER 9

Construction and principle of operation, equivalent circuit, phasor diagrams, testing - polarity test, open circuit and short circuit tests, voltage regulation, losses and efficiency, all day efficiency, back-to-back test, separation of core losses, parallel operation of single-phase transformers, applications of single-phase transformer.

UNIT V AUTOTRANSFORMER AND THREE PHASE TRANSFORMER 9

Construction and working of auto transformer, comparison with two winding transformers, applications of autotransformer. Three Phase Transformer- Construction, types of connections and their comparative features, Scott connection, applications of Scott connection.

TOTAL : 45 PERIODS

TEXT BOOKS

1. I. J. Nagrath and D. P. Kothari, “Electric Machines”, McGraw Hill Education, 5th Edition, 2017.
2. P. S. Bimbhra, “Electric Machinery”, Khanna Publishers, 2nd Edition, 2021.

REFERENCES

1. A. E. Fitzgerald and C. Kingsley, "Electric Machinery”, New York, McGraw Hill Education, 6th Edition 2017.
2. A. E. Clayton and N. N. Hancock, “Performance and design of DC machines”, CBS Publishers, 2018.
3. M. G. Say, “Performance and design of AC machines”, CBS Publishers, First Edition 2008.
4. Sahdev S. K. “Electrical Machines”, Cambridge University Press, 2018.

COURSE OUTCOMES:

At the end of the course students will be able to:

CO1: Apply the laws governing the electromechanical energy conversion for singly and multiple excited systems.

CO2: Explain the construction and working principle of DC machines.

CO3: Interpret various characteristics of DC machines.

CO4: Compute various performance parameters of the machine, by conducting suitable tests.

CO5: Draw the equivalent circuit of transformer and predetermine the efficiency and regulation.

CO6: Describe the working principle of auto transformer, three phase transformer with different types of connections.

MAPPING OF COs WITH POs AND PSOs

COs	POs												PSOs		
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**P06**	**P07**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PS01**	**PS02**	**PS03**
CO1	3	3	1	1	1	-	-	1	-	-	-	1	3	2	2
CO2	3	3	1	1	1	-	-	1	-	-	-	1	3	1	1
CO3	3	3	1	1	1	-	-	1	-	-	-	1	3	1	1
CO4	3	3	1	1	1	-	-	1	-	-	-	1	3	3	2
CO5	3	3	1	1	1	-	-	1	-	-	-	1	3	3	2
CO6	3	3	1	1	1	-	-	1	-	-	-	1	3	3	2
Avg	3	3	1	1	1	-	-	1	-	-	-	1	3	3	3

21153S36 C PROGRAMMING AND DATA STRUCTURES

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

- To introduce the basics of C programming language.
- To learn the concepts of advanced features of C.
- To understand the concepts of ADTs and linear data structures.
- To know the concepts of non-linear data structure and hashing.
- To familiarize the concepts of sorting and searching techniques.

UNIT I C PROGRAMMING FUNDAMENTALS (8+1 SKILL) 9

Data Types - Variables - Operations - Expressions and Statements - Conditional Statements - Functions - Recursive Functions - Arrays - Single and Multi-Dimensional Arrays.

UNIT II C PROGRAMMING - ADVANCED FEATURES (8+1 SKILL) 9

Structures - Union - Enumerated Data Types - Pointers: Pointers to Variables, Arrays and Functions - File Handling - Preprocessor Directives.

UNIT III LINEAR DATA STRUCTURES (8+1 SKILL) 9

Abstract Data Types (ADTs) - List ADT - Array-Based Implementation - Linked List - Doubly- Linked Lists - Circular Linked List - Stack ADT - Implementation of Stack - Applications - Queue ADT - Priority Queues - Queue Implementation - Applications.

UNIT IV NON-LINEAR DATA STRUCTURES (8+1 SKILL) 9

Trees - Binary Trees - Tree Traversals - Expression Trees - Binary Search Tree - Hashing - Hash Functions - Separate Chaining - Open Addressing - Linear Probing- Quadratic Probing - Double Hashing - Rehashing.

UNIT V SORTING AND SEARCHING TECHNIQUES (8+1 SKILL) 9

Insertion Sort - Quick Sort - Heap Sort - Merge Sort -Linear Search - Binary Search.

TOTAL: 45 PERIODS

SKILL DEVELOPMENT ACTIVITIES (Group Seminar/Mini Project/Assignment/Content Preparation / Quiz/ Surprise Test / Solving GATE questions/ etc)

COURSE OUTCOMES:

CO1 Develop C programs for any real world/technical application.

CO2 Apply advanced features of C in solving problems.

CO3 Write functions to implement linear and non-linear data structure operations.

CO4 Suggest and use appropriate linear/non-linear data structure operations for solving a given problem.

CO5 Appropriately use sort and search algorithms for a given application.

CO6 Apply appropriate hash functions that result in a collision free scenario for data storage and retrieval.

TEXT BOOKS:

1. Mark Allen Weiss, “Data Structures and Algorithm Analysis in C”, Second Edition, Pearson Education, 1997.
2. ReemaThareja, “Programming in C”, Second Edition, Oxford University Press, 2016.

REFERENCES:

1. Brian W. Kernighan, Rob Pike, “The Practice of Programming”, Pearson Education, 1999.
2. Paul J. Deitel, Harvey Deitel, “C How to Program”, Seventh Edition, Pearson Education, 2013.
3. Alfred V. Aho, John E. Hopcroft, Jeffrey D. Ullman, “Data Structures and Algorithms”, Pearson Education,1983.
4. Ellis Horowitz, SartajSahni and Susan Anderson, “Fundamentals of Data Structures”, Galgotia, 2008.

List of Open Source Software/ Learning website:

https://www.coursera.org/specializations/data-structures-algorithms

https://nptel.ac.in/courses/112107243

https://nptel.ac.in/courses/112105598

MAPPING OF COs WITH POs AND PSOs

COs	POs												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	2	3	1	2	2	1	1	-	1	2	1	3	2	1	3
2	1	2	1	2	2	-	-	-	1	1	1	2	2	2	2
3	2	3	1	2	3	-	-	-	1	1	1	2	2	1	2
4	2	1	-	1	1	-	-	-	2	1	1	2	2	3	1
5	1	2	1	2	2	1	1	-	1	2	1	3	2	2	3
Avg.	2	2	1	2	2	1	1	-	1	1	1	2	2	2	2

21153L31 ELECTRONIC DEVICES AND CIRCUITS LABORATORY L TPC
0031.5

COURSE OBJECTIVES:

- To enable the students to understand the behavior of semiconductor device based on experimentation.
- Be exposed to active and passive circuit elements.
- Familiarize the operation and characteristics of transistor like BJT and FET.
- Explore the characteristics of amplifier gain and frequency response.
- Learn the required functionality of positive and negative feedback systems.

LIST OF EXPERIMENTS

1. Characteristics of Semiconductor diode, Zener diode , photo diode , and photo transistor,
2. Characteristics of NPN Transistor under common emitter , common collector and common base configurations
3. Characteristics of JFET and draw the equivalent circuit
4. Characteristics of UJT and generation of saw tooth waveforms
5. Design and frequency response characteristics of a Common Emitter amplifier
6. Characteristics of light activated relay circuit

7. Design and testing of RC phase shift and LC oscillators
8. Characteristics of Single Phase half-wave and full wave rectifiers with inductive and capacitive filters
9. Design of Differential amplifiers using FET
10. Measurement of frequency and phase angle using CRO
11. Realization of passive filters

TOTAL : 45 PERIODS

COURSE OUTCOMES:

Upon successful completion of the course, the students will be able to:

CO1: Analyze the characteristics of PN, Zener diode and BJT in CE,CC,CB configurations experimentally

CO2: Analyze the characteristics of JFET and UJT experimentally

CO3: Analyze frequency response characteristics of a Common Emitter amplifier experimentally

CO4: Analyze the characteristics of RC phase shift and LC oscillators experimentally

CO5: Analyze the characteristics of half-wave and full-wave rectifier with and without filters experimentally

CO6: Analyze the characteristics of FET based differential amplifier experimentally

CO7: Calculate the frequency and phase angle using CRO experimentally

CO8: Analyze the frequency response characteristics of passive filters experimentally

MAPPING OF COs WITH POs AND PSOs

COs	POs												PSOs		
	PO1	PO2	PO3	PO4	PO5	P06	P07	PO8	PO9	PO10	PO11	PO12	PS01	PS02	PS03
CO1	-	-	-	3	3	-	-	1.5	-	-	3	-	-	3	3
CO2	-	-	3	3	3	-	-	1.5	-	-	3	-	-	3	3
CO3	-	3	2	3	-	-	-	1.5	-	-	3	-	-	3	3
CO4	-	3	3	3	-	-	-	1.5	-	-	3	-	-	3	3
CO5	-	-	-	-	3	-	-	1.5	-	-	-	-	-	3	3
CO6	-	-	-	-	3	-	-	1.5	-	-	-	-	-	3	3
CO7	-	-	-	-	3	-	-	1.5	-	-	3	-	-	3	3
CO8	-	-	-	-	3	-	-	1.5	-	-	3	-	-	3	3
Avg	-	3	2.7	3	3	-	-	1.5	-	-	3	-	-	3	3

21153L32 ELECTRICAL MACHINES LABORATORY-I LTPC

0031.5

COURSE OBJECTIVES:

- To expose the students to determine the characteristics of DC machines and transformers by performing experiments on these machines.
- To provide hands on experience to evaluate the performance parameters of DC machines and transformer by conducting suitable tests.

LIST OF EXPERIMENTS:

1. Open circuit and load characteristics of DC shunt generator- calculation of critical resistance and critical speed.
2. Load characteristics of DC compound generator with differential and cumulative connections.
3. Load test on DC shunt motor.
4. Load test on DC compound motor.
5. Load test on DC series motor.
6. Swinburne's test and speed control of DC shunt motor.
7. Hopkinson's test on DC motor – generator set.
8. Load test on single-phase transformer and three phase transformers.
9. Open circuit and short circuit tests on single phase transformer.
10. Sumpner's test on single phase transformers.
11. Separation of no-load losses in single phase transformer.
12. Study of starters and 3-phase transformers connections.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of the course students will be able to:

CO1: Construct the circuit with appropriate connections for the given DC machine/transformer.

CO2: Experimentally determine the characteristics of different types of DC machines.

CO3: Demonstrate the speed control techniques for a DC motor for industrial applications.

CO4: Identify suitable methods for testing of transformer and DC machines.

CO5: Predetermine the performance parameters of transformers and DC motor.

CO6: Understand DC motor starters and 3-phase transformer connections.

MAPPING OF COs WITH POs AND PSOs

COs	POs												PSOs		
	PO1	PO2	PO3	PO4	PO5	P06	P07	PO8	PO9	PO10	PO11	PO12	PS01	PS02	PS03
CO1	3	3	1	1	-	-	-	-	1	-	-	-	3	1	1
CO2	3	3	1	1	-	-	-	-	1	-	-	-	3	3	2
CO3	3	3	1	1	-	-	-	-	1	-	-	-	3	3	2
CO4	3	3	1	1	-	-	-	-	1	-	-	-	2	3	2
CO5	3	3	1	1	-	-	-	-	1	-	-	-	2	3	2
CO6	3	3	1	1	-	-	-	-	1	-	-	-	2	3	1
Avg	3	3	1	1	-	-	-	-	1	-	-	-	2.5	2.6	1.6

21153L33 C PROGRAMMING AND DATA STRUCTURES LABORATORY LTPC

0 031.5

COURSE OBJECTIVES:

- To develop applications in C
- To implement linear and non-linear data structures
- To understand the different operations of search trees
- To get familiarized to sorting and searching algorithms

LIST OF EXPERIMENTS

1. Practice of C programming using statements, expressions, decision making and iterative statements
2. Practice of C programming using Functions and Arrays
3. Implement C programs using Pointers and Structures
4. Implement C programs using Files
5. Development of real time C applications
6. Array implementation of List ADT
7. Array implementation of Stack and Queue ADTs
8. Linked list implementation of List, Stack and Queue ADTs
9. Applications of List, Stack and Queue ADTs
10. Implementation of Binary Trees and operations of Binary Trees
11. Implementation of Binary Search Trees
12. Implementation of searching techniques
13. Implementation of Sorting algorithms : Insertion Sort, Quick Sort, Merge Sort
14. Implementation of Hashing – any two collision techniques

TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of the course, the students will be able to:

CO1 Use different constructs of C and develop applications

CO2 Write functions to implement linear and non-linear data structure operations

CO3 Suggest and use the appropriate linear / non-linear data structure operations for a given problem

CO4 Apply appropriate hash functions that result in a collision free scenario for data storage and Retrieval

CO5 Implement Sorting and searching algorithms for a given application

MAPPING OF COs WITH POs AND PSOs

COs	POs												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	2	3	1	2	2	1	1	-	1	2	1	3	2	1	3
2	1	2	1	2	2	-	-	-	1	1	1	2	2	2	2
3	2	3	1	2	3	-	-	-	1	1	1	2	2	1	2
4	2	1	-	1	1	-	-	-	2	1	1	2	2	3	1
5	1	2	1	2	2	1	1	-	1	2	1	3	2	2	3
Avg.	2	2	1	2	2	1	1	-	1	1	1	2	2	2	2

21153L34 PROFESSIONAL DEVELOPMENT L T P C
0 0 2 1

COURSE OBJECTIVES:

- To be proficient in important Microsoft Office tools: MS WORD, EXCEL, POWERPOINT.
- To be proficient in using MS WORD to create quality technical documents, by using standard templates, widely acceptable styles and formats, variety of features to enhance the presentability and overall utility value of content.
- To be proficient in using MS EXCEL for all data manipulation tasks including the common statistical, logical, mathematical etc., operations, conversion, analytics, search and explore, visualize, interlink, and utilizing many more critical features offered
- To be able to create and share quality presentations by using the features of MS PowerPoint, including: organization of content, presentability, aesthetics, using media elements and enhance the overall quality of presentations.

MS WORD: 10 Hours

Create and format a document
Working with tables
Working with Bullets and Lists
Working with styles, shapes, smart art, charts
Inserting objects, charts and importing objects from other office tools
Creating and Using document templates
Inserting equations, symbols and special characters
Working with Table of contents and References, citations
Insert and review comments
Create bookmarks, hyperlinks, endnotes footnote
Viewing document in different modes
Working with document protection and security
Inspect document for accessibility

MS EXCEL: 10 Hours

Create worksheets, insert and format data
Work with different types of data: text, currency, date, numeric etc.
Split, validate, consolidate, Convert data
Sort and filter data
Perform calculations and use functions: (Statistical, Logical, Mathematical, date, Time etc.,)
Work with Lookup and reference formulae
Create and Work with different types of charts
Use pivot tables to summarize and analyse data
Perform data analysis using own formulae and functions
Combine data from multiple worksheets using own formulae and built-in functions to generate results
Export data and sheets to other file formats
Working with macros
Protecting data and Securing the workbook

MS POWERPOINT: **10 Hours**

Select slide templates, layout and themes
Formatting slide content and using bullets and numbering
Insert and format images, smart art, tables, charts
Using Slide master, notes and handout master
Working with animation and transitions
Organize and Group slides
Import or create and use media objects: audio, video, animation
Perform slideshow recording and Record narration and create presentable videos

TOTAL: 30 PERIODS

COURSE OUTCOMES:

On successful completion the students will be able to

- Use MS Word to create quality documents, by structuring and organizing content for their day to day technical and academic requirements
- Use MS EXCEL to perform data operations and analytics, record, retrieve data as per requirements and visualize data for ease of understanding

Use MS PowerPoint to create high quality academic presentations by including common tables, charts, graphs, interlinking other elements, and using media objects

21149S46	ENVIRONMENTAL SCIENCES AND SUSTAINABILITY	L	T	P	C
		2	0	0	2

COURSE OBJECTIVES:

- To introduce the basic concepts of environment, ecosystems and biodiversity and emphasize on the biodiversity of India and its conservation.
- To impart knowledge on the causes, effects and control or prevention measures of environmental pollution and natural disasters.
- To facilitate the understanding of global and Indian scenario of renewable and nonrenewable resources, causes of their degradation and measures to preserve them.
- To familiarize the concept of sustainable development goals and appreciate the interdependence of economic and social aspects of sustainability, recognize and analyze climate changes, concept of carbon credit and the challenges of environmental management.
- To inculcate and embrace sustainability practices and develop a broader understanding on green materials, energy cycles and analyze the role of sustainable urbanization.

UNIT I ENVIRONMENT AND BIODIVERSITY 6

Definition, scope and importance of environment - need for public awareness. Eco-system and Energy flow- ecological succession. Types of biodiversity: genetic, species and ecosystem diversity- values of biodiversity, India as a mega-diversity nation - hot-spots of biodiversity - threats to biodiversity: habitat loss, poaching of wildlife, man-wildlife conflicts - endangered and endemic species of India - conservation of biodiversity: In-situ and ex-situ.

UNIT II ENVIRONMENTAL POLLUTION **6**

Causes, Effects and Preventive measures of Water, Soil, Air and Noise Pollutions.

Solid, Hazardous and E-Waste management. Case studies on Occupational Health and Safety Management system (OHASMS). Environmental protection, Environmental protection acts .

UNIT III RENEWABLE SOURCES OF ENERGY 6

Energy management and conservation, New Energy Sources: Need of new sources. Different types new energy sources. Applications of- Hydrogen energy, Ocean energy resources, Tidal energy conversion. Concept, origin and power plants of geothermal energy.

UNIT IV SUSTAINABILITY AND MANAGEMENT 6

Development, GDP, Sustainability- concept, needs and challenges-economic, social and aspects of sustainability-from unsustainability to sustainability-millennium development goals, and protocols -Sustainable Development Goals-targets, indicators and intervention areas Climate change- Global, Regional and local environmental issues and possible solutions-case studies. Concept of Carbon Credit, Carbon Footprint. Environmental management in industry-A case study.

UNIT V SUSTAINABILITY PRACTICES 6

Zero waste and R concept, Circular economy, ISO 14000 Series, Material Life cycle assessment, Environmental Impact Assessment. Sustainable habitat: Green buildings, Green materials, Energy efficiency, Sustainable transports. Sustainable energy: Non-conventional Sources, Energy Cycles-carbon cycle, emission and sequestration, Green Engineering: Sustainable urbanization- Socio-economical and technological change.

TOTAL: 30 PERIODS

COURSE OUTCOMES:

- To recognize and understand the functions of environment, ecosystems and biodiversity and their conservation.
- To identify the causes, effects of environmental pollution and natural disasters and contribute to the preventive measures in the society.
- To identify and apply the understanding of renewable and non-renewable resources and contribute to the sustainable measures to preserve them for future generations.
- To recognize the different goals of sustainable development and apply them for suitable technological advancement and societal development.
- To demonstrate the knowledge of sustainability practices and identify green materials, energy cycles and the role of sustainable urbanization.

TEXT BOOKS:

1. Anubha Kaushik and C. P. Kaushik’s “Perspectives in Environmental Studies”, 6th Edition, New Age International Publishers ,2018.
2. Benny Joseph, ‘Environmental Science and Engineering’, Tata McGraw-Hill, New Delhi, 2016.
3. Gilbert M.Masters, ‘Introduction to Environmental Engineering and Science’, 2nd edition, Pearson Education, 2004.
4. Allen, D. T. and Shonnard, D. R., Sustainability Engineering: Concepts, Design and Case Studies, Prentice Hall.
5. Bradley. A.S; Adebayo, A.O., Maria, P. Engineering applications in sustainable design and development, Cengage learning.
6. Environment Impact Assessment Guidelines, Notification of Government of India, 2006.
7. Mackenthun, K.M., Basic Concepts in Environmental Management, Lewis Publication, London, 1998.

REFERENCES

1. R.K. Trivedi, 'Handbook of Environmental Laws, Rules, Guidelines, Compliances and Standards', Vol. I and II, Enviro Media. 38.
2. Cunningham, W.P. Cooper, T.H. Gorhani, 'Environmental Encyclopedia', Jaico Publ., House, Mumbai, 2001.
3. Dharmendra S. Sengar, 'Environmental law', Prentice hall of India PVT. LTD, New Delhi, 2007.
4. Rajagopalan, R, 'Environmental Studies-From Crisis to Cure', Oxford University Press, 2005.
5. Erach Bharucha "Textbook of Environmental Studies for Undergraduate Courses" Orient Blackswan Pvt. Ltd. 2013.

MAPPING OF COs WITH POs AND PSOs

COs	POs												PSOs		
	PO1	PO2	PO3	PO4	PO5	P06	P07	PO8	PO9	PO10	PO11	PO12	PS01	PS02	PS03
1	2	1	-	-	-	2	3	-	-	-	-	2	-	-	-
2	3	2	-	-	-	3	3	-	-	-	-	2	-	-	-
3	3	-	1	-	-	2	2	-	-	-	-	2	-	-	-
4	3	2	1	1	-	2	2	-	-	-	-	2	-	-	-
5	3	2	1	-	-	2	2	-	-	-	-	1	-	-	-
Avg.	2.8	1.8	1	1	-	2.2	2.4	-	-	-	-	1.8	-	-	-

21153C42 TRANSMISSION AND DISTRIBUTION

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

- To impart knowledge about the configuration of the electrical power systems.
- To study the line parameters and interference with neighboring circuits.
- To understand the mechanical design and performance analysis of transmission lines.
- To learn about different insulators and underground cables.
- To understand and analyze the distribution system.

UNIT I TRANSMISSION LINE PARAMETERS 9

Structure of electric power system - Parameters of single and three phase transmission lines with single and double circuits -Resistance, inductance, and capacitance of solid, stranded, and bundled conductors - Typical configuration, conductor types - Symmetrical and unsymmetrical spacing and transposition - application of self and mutual GMD; skin and proximity effects - Effects of earth on the capacitance of the transmission line - interference with neighboring communication circuits.

UNIT II MODELLING AND PERFORMANCE OF TRANSMISSION LINES 9

Performance of Transmission lines - short line, medium line and long line - equivalent circuits, phasor diagram, attenuation constant, phase constant, surge impedance - transmission efficiency and voltage regulation, real and reactive power flow in lines - Power Circle diagrams - Ferranti effect - Formation of Corona - Critical Voltages - Effect on line Performance.

UNIT III SAG CALCULATION AND LINE SUPPORTS 9

Mechanical design of overhead lines - Line Supports -Types of towers - Tension and Sag Calculation for different weather conditions - Methods of grounding - Insulators: Types, voltage distribution in insulator string, improvement of string efficiency, testing of insulators.

UNIT IV UNDERGROUND CABLES 9

Underground cables - Types of cables - Construction of single-core and 3-core belted cables - Insulation Resistance - Potential Gradient - Capacitance of single-core and 3-core belted cables - Grading of cables - Power factor and heating of cables- DC cables.

UNIT V DISTRIBUTION SYSTEMS 9

Distribution Systems - General Aspects - Kelvin's Law - AC and DC distributions -Concentrated and Distributed loading- Techniques of Voltage Control and Power factor improvement - Distribution Loss - Types of Substations - Trends in Transmission and Distribution: EHVAC, HVDC and FACTS (Qualitative treatment only).

TOTAL: 45 PERIODS

TEXT BOOKS:

1. D.P.Kothari, I.J. Nagarath, 'Power System Engineering', Mc Graw-Hill Publishing Company limited, New Delhi, Third Edition, 2019.
2. C.L.Wadhwa, 'Electrical Power Systems', New Age International Ltd, seventh edition 2022.
3. S.N. Singh, 'Electric Power Generation, Transmission and Distribution', Prentice Hall of India Pvt. Ltd, New Delhi, Second Edition, 2008.

REFERENCE BOOKS:

1. B.R.Gupta, 'Power System Analysis and Design' S. Chand, New Delhi, Sixth Edition, 2011.
2. Luces M.Fualken berry, Walter Coffer, 'Electrical Power Distribution and Transmission', Pearson Education, 2007.
3. Arun Ingole, "Power transmission and distribution" Pearson Education, first edition, 2018
4. J.Brian Hardy and Colin R.Bayliss 'Transmission and Distribution in Electrical Engineering', Newnes; Fourth Edition, 2011.
5. G.Ramamurthy, "Handbook of Electrical power Distribution," Universities Press, 2013.
6. V.K.Mehta, Rohit Mehta, 'Principles of power system', S. Chand & Company Ltd, New Delhi, 2013
7. Hadi Saadat, 'Power System Analysis', McGraw Hill Education Pvt. Ltd., New Delhi, 3rd Edition, 23rd reprint, 2015.
8. R.K.Rajput, 'A Text Book of Power System Engineering' 2nd edition, Laxmi Publications (P) Ltd, New Delhi, 2016.

COURSE OUTCOMES

On the successful completion of the course, students will be able to:

CO1 : Understand the structure of power system, computation of transmission line parameters for different configurations.

CO2 : Model the transmission lines to determine the line performance and to understand the impact of Ferranti effect and corona on line performance.

CO3 : Do Mechanical design of transmission lines, grounding and to understand about the insulators in transmission system.

CO4 : Design the underground cables and understand the performance analysis of underground cable.

CO5 : Understand the modelling, performance analysis and modern trends in distribution system.

MAPPING OF COs WITH POs AND PSOs

COs	POs												PSOs		
	PO1	PO2	PO3	PO4	PO5	P06	P07	PO8	PO9	PO10	PO11	PO12	PS01	PS02	PS03
CO1	2	1	-	-	-	-	-	1	-	-	-	-	3	1	1
CO2	3	2	1	1	-	1	-	2	-	-	-	-	3	2	1
CO3	3	2	1	1	-	1	-	2	-	-	-	-	3	3	1
CO4	3	2	1	1	-	1	-	2	-	-	-	-	3	3	1
CO5	3	2	1	1	-	1	-	2	-	-	-	-	3	3	1
Avg	2.8	1.8	1	1		1	-	1.8					3	2.4	1

21153C44 **LNEAR INTEGRATED CIRCUITS**

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

To impart knowledge on the following topics

- Signal analysis using Op-amp based circuits.
- Applications of Op-amp.
- Functional blocks and the applications of special ICs like Timers, PLL circuits, regulator Circuits.
- IC fabrication procedure.

UNIT I IC FABRICATION 9

IC classification, fundamental of monolithic IC technology, epitaxial growth, masking and etching, diffusion of impurities. Realisation of monolithic ICs and packaging. Fabrication of diodes, capacitance, resistance, FETs and PV Cell.

UNIT II CHARACTERISTICS OF OPAMP 9

Ideal OP-AMP characteristics, DC characteristics, AC characteristics, differential amplifier; frequency response of OP-AMP; Voltage-shunt feedback and inverting amplifier - Voltage series feedback: and Non-Inverting Amplifier - Basic applications of op-amp -, summer, differentiator and Integrator-V/I & I/V converters.

UNIT III APPLICATIONS OF OPAMP 9

Instrumentation amplifier and its applications for transducer Bridge, Log and Antilog Amplifiers- Analog multiplier & Divider, first and second order active filters, comparators, multi vibrators, waveform generators, clippers, clampers, peak detector, S/H circuit, D/A converter (R- 2R ladder and weighted resistor types), A/D converters using OP-AMPs.

UNIT IV SPECIAL ICs 9

Functional block, characteristics of 555 Timer and its PWM application IC-566 voltage controlled oscillator IC; 565-phase locked loop IC, AD633 Analog multiplier ICs.

UNIT V APPLICATION ICs **9**

AD623 Instrumentation Amplifier and its application as load cell weight measurement-- IC voltage regulators -LM78XX, LM79XX; Fixed voltage regulators its application as Linear power supply -- LM317, 723 Variability voltage regulators, switching regulator- SMPS-- ICL 8038 function generator IC.

TOTAL :45 PERIODS

COURSE OUTCOMES:

Upon successful completion of the course, the students will be able to:

CO1 Explain monolithic IC fabrication process

CO2 Explain the fabrication of diodes, capacitance, resistance, FETs and PV Cell.

CO3 Analyze the characteristics and basic applications (inverting/non-inverting amplifier, summer, differentiator, integrator, V/I and I/V converter) of Op-Amp

CO4 Explain circuit and applications of op-amp based instrumentation amplifier, log/antilog amplifier, analog multiplier /divider, active filters, comparators, waveform generators, A/D and D/A converters

CO5 Explain Functional blocks, characteristics and applications of Timer, PLL, analog multiplier ICs.

CO6 Explain the applications of ICs in Instrumentation amplifier, fixed and variable voltage regulator, SMPS and function generator

TEXT BOOKS:

1. David A. Bell, 'Op-amp & Linear ICs', Oxford, Third Edition, 2011
2. D. Roy Choudhary, Sheil B. Jani, 'Linear Integrated Circuits', , New Age, Fourth Edition, 2018.
3. Ramakant A.Gayakward, 'Op-amps and Linear Integrated Circuits', IV edition, Pearson Education, PHI 2021.

REFERENCES

1. Fiore,"Opamps& Linear Integrated Circuits Concepts & applications", Cengage, 2010.
2. Floyd ,Buchla,"Fundamentals of Analog Circuits, Pearson, 2013.
3. Jacob Millman, Christos C.Halkias, 'Integrated Electronics - Analog and Digital circuits system', McGraw Hill, 2nd Edition, 2017.
4. Robert F.Coughlin, Fredrick F. Driscoll, 'Op-amp and Linear ICs', Pearson, 6th edition,2012.
5. Sergio Franco, 'Design with Operational Amplifiers and Analog Integrated Circuits', McGraw Hill, 2016 – Fourth Edition.
6. Muhammad H. Rashid,' Microelectronic Circuits Analysis and Design' Cengage Learning, 2nd Edition, 2012.

MAPPING OF COs WITH POs AND PSOs

COs	POs											PSOs		
	PO1	PO2	PO3	PO4	PO5	P06	P07	PO8	PO9	PO10	PO11	PO12	PS01	PS02	PS03
CO1	2	2	3	2	2	-	-	1	-	-	-	1	3	2	1
CO2	2	2	3	2	2	-	-	1	-	-	-	1	3	2	1
CO3	2	2	3	2	2	-	-	1	-	-	-	1	3	2	1
CO4	2	2	3	2	2	-	-	1	-	-	-	1	3	2	1
CO5	2	2	3	2	2	-	-	1	-	-	-	1	3	2	1
Avg	2	2	3	2	2	-	-	1	-	-	-	1	3	2	1

21153C43 **MEASUREMENTS AND INSTRUMENTATION** **LT P C3003**

COURSE OBJECTIVES

- To educate the fundamental concepts and characteristics of measurement and errors
- To impart the knowledge on the functional aspects of measuring instruments
- To infer the importance of various bridge circuits used with measuring instruments.
- To educate the fundamental working of sensors and transducers and their applications
- To summarize the overall measurement and instrumentation with the knowledge on digital instrumentation principles.

UNIT I CONCEPTS OF MEASUREMENTS 9

Instruments: classification, applications – Elements of a generalized measurement system - Static and dynamic characteristics - Errors in measurement -Statistical evaluation of measurement data.

UNIT II MEASUREMENT OF PARAMETERS IN ELECTRICAL SYSTEMS 9

Classification of instruments – moving coil and moving iron meters – Induction type, dynamometer type watt meters – Energy meter – Megger – Instrument transformers (CT & PT).

UNIT III AC/DC BRIDGES AND INSTRUMENTATION AMPLIFIERS 9

Wheatstone bridge, Kelvin double bridge - Maxwell, Hay, Wien and Schering bridges – Errors and compensation in A.C. bridges - Instrumentation Amplifiers.

UNIT IV TRANSDUCERS FOR MEASUREMENT OF NON- ELECTRICAL PARAMETERS 9

Classification of transducers – Measurement of pressure, temperature, displacement, flow, angular velocity – Digital transducers – Smart Sensors.

UNIT V DIGITAL INSTRUMENTATION 9

A/D converters: types and characteristics – Sampling, Errors- Measurement of voltage, Current, frequency and phase - D/A converters: types and characteristics- DSO- Data Loggers – Basics of PLC programming and Introduction to Virtual Instrumentation - Instrument standards.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

Upon successful completion of the course, the students should have the:
CO1: Ability to understand the fundamental art of measurement in engineering.
CO2: Ability to understand the structural elements of various instruments.
CO3: Ability to understand the importance of bridge circuits.
CO4: Ability to understand about various transducers and their characteristics by experiments.
CO5: Ability to understand the concept of digital instrumentation and virtual instrumentation by experiments.

TEXT BOOKS:

1. A.K. Sawhney, Puneet Sawhney 'A Course in Electrical & Electronic Measurements & Instrumentation', Dhanpat Rai and Co, New Delhi, Edition 2011.
2. H.S. Kalsi, 'Electronic Instrumentation', Tata McGraw-Hill, New Delhi, 2010

REFERENCES:

1. M.M.S. Anand, 'Electronics Instruments and Instrumentation Technology', Prentice Hall India, New Delhi, 2009
2. J.J. Carr, 'Elements of Electronic Instrumentation and Measurement', Pearson Education India, New Delhi, 2011

3. W.Bolton, Programmable Logic Controllers, 6th Edition, Elseiver, 2015.
4. R.B. Northrop, 'Introduction to Instrumentation and Measurements', Taylor & Francis, New Delhi, 3rd Edition 2014.
5. E. O. Doebelin and D. N. Manik, "Measurement Systems - Application and Design", Tata McGraw-Hill, New Delhi, 6th Edition 2017.
6. R. K. Rajput, "Electrical and Electronics Measurements and Instrumentation", Chand Pub, 2016

MAPPING OF COs WITH POs AND PSOs

COs	POs												PSOs		
	PO1	PO2	PO3	PO4	PO5	P06	P07	PO8	PO9	PO10	PO11	PO12	PS01	PS02	PS03
CO1	3	2	3	-	3	2	-	2	-	-	-	3	3	3	3
CO2	3	2	3	2	-	-	-		-	3	-	3	3	3	3
CO3	3	2	3	-	3	2	-		-	-	-	3	3	3	3
CO4	3	2	3	-	-	-	-	2	-	-	-	-	3	3	3
CO5	3	2	3	2	3	-	-		-	3	-	3	3	3	3
Avg	3	2	3	2	3	2	-	2	-	3	-	3	3	3	3

21153C45 MICROPROCESSOR AND MICROCONTROLLER LT P C
3 0 0 3

COURSE OBJECTIVES:

- To study the addressing modes & instruction set of 8085 &8051
- To develop skills in simple program writing in assembly languages
- To introduce commonly used peripheral/interfacing ICs.
- To study and understand typical applications of micro-processors.
- To study and understand the typical applications of micro-controllers

UNIT I INTRODUCTION TO 8085 ARCHITECTURE 9

Functional block diagram – Memory interfacing-I/O ports and data transfer concepts – Timing Diagram – Interrupt structure.

UNIT II 8085 INSTRUCTION SET AND PROGRAMMING 9

Instruction format and addressing modes – Assembly language format – Data transfer, data manipulation & control instructions – Programming: Loop structure with counting & Indexing - Look up table - Subroutine instructions, stack.

UNIT III INTERFACING BASICS AND ICS 9

Study of Architecture and programming of ICs: 8255 PPI, 8259PIC, 8251USART, 8279 Keyboard display controller and 8254 Timer/Counter – Interfacing with 8085 -A/D and D/A converter interfacing.
.

UNIT IV INTRODUCTION TO 8051 MICROCONTROLLER 9

Functional block diagram - Instruction format and addressing modes – Interrupt structure – Timer – I/O ports – Serial communication, Simple programming –keyboard and display interface – Temperature control system –stepper motor control - Usage of IDE for assembly language programming.

UNIT V INTRODUCTION TO RISC BASED ARCHITECTURE 9

PIC16 /18 architecture, Memory organization – Addressing modes – Instruction set - Programming techniques – Timers – I/O ports – Interrupt programming.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

Upon successful completion of the course, the students should have the:

CO1: Ability to write assembly language program for microprocessor and microcontroller

CO2: Ability to design and implement interfacing of peripheral with microprocessor and microcontroller

CO3: Ability to analyze, comprehend, design and simulate microprocessor based systems used for control and monitoring.

CO4: Ability to analyze, comprehend, design and simulate microcontroller based systems used for control and monitoring.

CO5: Ability to understand and appreciate advanced architecture evolving microprocessor field

TEXTBOOKS:

1. Ramesh S. Gaonkar, 'Microprocessor Architecture Programming and Application', Pen ram International (P)ltd., Mumbai, 6th Education, 2013.
2. Muhammad Ali Mazidi & Janice Gilli Mazidi, 'The 8051 Micro Controller and Embedded Systems', Pearson Education, Second Edition 2011.
3. Muhammad Ali Mazidi & Janice Gilli Mazidi, 'The PIC Micro Controller and Embedded Systems', 2010

REFERENCES:

1. Douglas V. Hall, "Micro-processors & Interfacing", Tata McGraw Hill 3rd Edition, 2017.
2. Krishna Kant, "Micro-processors & Micro-controllers", Prentice Hall of India, 2007.
3. Mike Predko, "8051 Micro-controllers", McGraw Hill, 2009
4. Kenneth Ayala, 'The 8051 Microcontroller', Thomson, 3rd Edition 2004.

MAPPING OF COs WITH POs AND PSOs

COs	POs												PSOs		
	PO1	PO2	PO3	PO4	PO5	P06	P07	PO8	PO9	PO10	PO11	PO12	PS01	PS02	PS03
CO1	2	1	2	3	-	-	-	1	-	-	-	3	3	1	3
CO2	2	1	2	3	-	-	-	1	-	-	-	3	3	1	3
CO3	2	1	2	3	-	-	-	1	-	-	-	3	3	1	3
CO4	2	1	2	3	-	-	-	1	-	-	-	3	3	1	3
CO5	2	1	2	3	-	-	-	1	-	-	-	3	3	1	3
Avg	2	1	2	3	-	-	-	1	-	-	-	3	3	1	3

21153C41 ELECTRICAL MACHINES - II **L T P C**

3 0 0 3

COURSE OBJECTIVES:

To impart knowledge on the following Topics

- Construction and performance of salient and non – salient type synchronous generators.
- Principle of operation and performance of synchronous motor.
- Construction, principle of operation and performance of induction machines.
- Starting and speed control of three-phase induction motors.
- Construction, principle of operation and performance of single phase induction motors and special machines.

UNIT I SYNCHRONOUS GENERATOR 9

Constructional details – Types of rotors –winding factors- EMF equation - Synchronous reactance – Armature reaction – Phasor diagrams of non-salient pole synchronous generator connected to infinite bus--Synchronizing and parallel operation – Synchronizing torque -Change of excitation and mechanical input- Voltage regulation – EMF, MMF, ZPF and A.S.A method – steady state power- angle characteristics– Two reaction theory –slip test -short circuit transients - Capability Curves.

UNIT II SYNCHRONOUS MOTOR 9

Principle of operation – Torque equation – Operation on infinite bus bars - V and Inverted V curves – Power input and power developed equations – Starting methods – Current loci for constant power input, constant excitation and constant power Developed-Hunting – natural frequency of oscillations – damper windings- synchronous condenser.

UNIT III THREE PHASE INDUCTION MOTOR 9

Constructional details – Types of rotors –– Principle of operation – Slip –cogging and crawling- Equivalent circuit – Torque-Slip characteristics - Condition for maximum torque – Losses and efficiency – Load test - No load and blocked rotor tests - Circle diagram - Separation of losses – Double cage induction motors –Induction generators – Synchronous induction motor.

UNIT IV STARTING AND SPEED CONTROL OF THREE PHASE INDUCTION MOTOR 9

Need for starting – Types of starters – DOL, Rotor resistance, Autotransformer and Star delta starters – Speed control – Voltage control, Frequency control and pole changing – Cascaded Connection-V/f control – Slip power recovery Scheme-Braking of three phase induction motor: Plugging, dynamic braking and regenerative braking.

UNIT V SINGLE PHASE INDUCTION MOTORS AND SPECIAL MACHINES 9

Constructional details of single phase induction motor – Double field revolving theory and operation – Equivalent circuit – No load and blocked rotor test – Performance analysis – Starting methods of single-phase induction motors - Capacitor-start capacitor run Induction motor- Shaded pole induction motor - Linear induction motor – Repulsion motor - Hysteresis motor - AC series motor- Servo motors- Stepper motors - introduction to magnetic levitation systems.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

Upon the successful completion of the course, students will have the:

CO1: Ability to understand the construction and working principle of Synchronous generator

CO2: Ability to understand the construction and working principle of Synchronous Motor

CO3: Ability to understand the construction and working principle of Three Phase Induction Motor

CO4: Acquire knowledge about the starting and speed control of induction motors.

CO5: To gain knowledge about the basic principles and working of Single phase induction motors and Special Electrical Machines

.

TEXT BOOKS:

1. A.E. Fitzgerald, Charles Kingsley, Stephen. D. Umans, 'Electric Machinery', Mc Graw Hill publishing Company Ltd, 6th Education 2017.
2. Stephen J. Chapman, 'Electric Machinery Fundamentals'4th edition, McGraw Hill Education Pvt. Ltd, 4th Edition 2017.
3. D.P. Kothari and I.J. Nagrath, 'Electric Machines', McGraw Hill Publishing Company Ltd, 5th Edition 2017
4. P.S. Bhimbhra, 'Electrical Machinery', Khanna Publishers, edition 2, 2021.

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1. Vincent Del Toro, 'Basic Electric Machines' Pearson India Education, 2016.
2. M.N. Bandyo padhyay, Electrical Machines Theory and Practice, PHI Learning PVT LTD., New Delhi, 2011.
3. B.R.Gupta, 'Fundamental of Electric Machines' New age International Publishers,3rd Edition, Reprint 2015.
4. Murugesh Kumar, 'Electric Machines', Vikas Publishing House Pvt. Ltd, First edition 2010.
5. Alexander S. Langsdorf, 'Theory of Alternating-Current Machinery', McGraw Hill Publications, 2001.

MAPPING OF COs WITH POs AND PSOs

COs	POs												PSOs		
	PO1	PO2	PO3	PO4	PO5	P06	P07	PO8	PO9	PO10	PO11	PO12	PS01	PS02	PS03
CO1	3	3	2	3	3	-	-	1	-	-	-	-	3	3	2
CO2	3	3	2	3	3	-	-	1	-	-	-	-	3	3	2
CO3	3	3	2	3	3	-	-	1	-	-	-	-	3	3	2
CO4	3	3	2	3	3	-	-	1	-	-	-	-	3	3	2
CO5	3	3	1	1	2	-	-	1	-	-	-	-	3	3	2
CO6	3	3	1	1	2	-	-	1	-	-	-	-	3	3	2
Avg	3	3	1.6	2.3	2.6	-	-	1	-	-	-	-	3	3	2

21153L47 ELECTRICAL MACHINES LABORATORY - II LT P C

0 0 3 1.5

COURSE OBJECTIVES:

- To expose the students to the operation of synchronous machines and induction motors and give them experimental skill.

LIST OF EXPERIMENTS

1. Regulation of three phase alternator by EMF and MMF methods.
2. Regulation of three phase alternator by ZPF and ASA methods.
3. Regulation of three phase salient pole alternator by slip test.
4. Measurements of negative sequence and zero sequence impedance of alternators.
5. V and Inverted V curves of Three Phase Synchronous Motor.
6. Load test on three-phase induction motor.
7. No load and blocked rotor tests on three-phase induction motor (Determination of equivalent circuit parameters).
8. Separation of No-load losses of three-phase induction motor.
9. Load test on single-phase induction motor.
10. No load and blocked rotor test on single-phase induction motor.
11. Study of Induction Motor Starters

TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of the course, the student should have the:

CO1: Ability to understand and analyze EMF and MMF methods

CO2: Ability to analyze the characteristics of V and Inverted V curves

CO3: Acquire hands on experience of conducting various tests on alternators and obtaining their performance indices using standard analytical as well as graphical methods. to understand the importance of Synchronous machines

CO4: Acquire hands on experience of conducting various tests on induction motors and obtaining their performance indices using standard analytical as well as graphical methods. to understand the importance of single and three phase Induction motors

CO5: Ability to acquire knowledge on separation of losses

MAPPING OF COs WITH POs AND PSOs

COs	POs												PSOs		
	PO1	PO2	PO3	PO4	PO5	P06	P07	PO8	PO9	PO10	PO11	PO12	PS01	PS02	PS03
CO1	3	3	1	1	-	-	-	1.5	1	-	-	3	3	3	2
CO2	3	3	1	1	-	-	-	1.5	1	-	-	3	3	3	2
CO3	3	3	1	1	-	-	-	1.5	1	-	-	3	3	3	1
CO4	3	3	1	1	-	-	-	1.5	1	-	-	3	3	3	1
CO5	3	3	1	1	-	-	-	1.5	1	-	-	2	3	3	2
Avg	3	3	1	1	-	-	-	1.5	1	-	-	2.8	3	3	1.6

21153L48 LINEAR AND DIGITAL CIRCUITS LABORATORY L T P C

0 0 3 1.5

COURSE OBJECTIVES:

- To learn design, testing and characterizing of circuit behavior with combinational logic gate ICs.
- To learn design, testing and characterizing of circuit behavior with register/ counter and sequential logic ICs.
- To learn design, testing and characterizing of circuit behavior with OPAMP ICs.
- To learn design, testing and characterizing of circuit behavior with analog Ics like 555 timer VCO and regulators.
- To learn design, testing and characterizing of circuit behavior with digital Ics like decoders, multiplexers.

LIST OF EXPERIMENTS

1. Implementation of Boolean Functions, Adder and Subtractor circuits.
2. Code converters: Excess-3 to BCD and Binary to Gray code converter and vice-versa.
3. Parity generator and parity checking.
4. Encoders and Decoders.
5. Counters: Design and implementation of 3-bit modulo counters as synchronous and Asynchronous types using FF IC's and specific counter IC.
6. Shift Registers: Design and implementation of 4-bit shift registers in SISO, SIPO, PISO, PIPO modes using suitability IC's.
7. Study of multiplexer and de multiplexer
8. Timer IC application: Study of NE/SE 555 timer in Astability, Monostability operation.
9. Application of Op-Amp: inverting and non-inverting amplifier, Adder, comparator, Integrator and Differentiator.
10. Voltage to frequency characteristics of NE/ SE 566 IC.
11. Variability Voltage Regulator using IC LM317.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of the course, the student should have the:

CO1: Ability to understand and implement Boolean Functions.

CO2: Ability to understand the importance of code conversion

CO3: Ability to Design and implement circuits with digital ICs like decoders, multiplexers, register.

CO4: Ability to acquire knowledge on Application of Op-Amp

CO5: Ability to Design and implement counters using analog ICs like timers, VCOs and digital ICs like Flip-flops and counters.

MAPPING OF COs WITH POs AND PSOs

COs	POs												PSOs		
	PO1	PO2	PO3	PO4	PO5	P06	P07	PO8	PO9	PO10	PO11	PO12	PS01	PS02	PS03
CO1	-	-	-	3	-	-	-	1.5	-	-	3	3	2	1	2
CO2	-	-	3	3	-	-	-	1.5	-	-	3	3	2	1	2
CO3	-	3	2	3	3	-	-	1.5	-	-	3	3	2	1	2
CO4	-	3	3	3	3	-	-	1.5	-	-	3	3	2	1	2
CO5	-	-	-	-	-	-	-	1.5	-	-	-	3	-	-	-
Avg	-	3	1.6	3	3	-	-	1.5	-	-	3	3	2	1	2

21153L48 MICROPROCESSOR AND MICROCONTROLLER LABORATORY L T P C
0 0 3 1.5

COURSE OBJECTIVES:

- To perform simple arithmetic operations using assembly language program and study the addressing modes & instruction set of 8085 & 8051
- To develop skills in simple program writing in assembly languages
- To write an assembly language program to convert Analog input to Digital output and Digital input to Analog output.
- To perform interfacing experiments with µP8085
- To perform interfacing experiments with µC8051.

PROGRAMMING EXERCISES / EXPERIMENTS WITH µP8085:

1. Simple arithmetic operations: Multi precision addition / subtraction /multiplication / division.
2. Programming with control instructions: Increment / Decrement, Ascending / Descending order, Maximum / Minimum of numbers, Rotate instructions, Hex / ASCII / BCD code conversions.
3. Interface Experiments: A/D Interfacing. D/A Interfacing. Traffic light controller
4. Stepper motor controller interface.
5. Displaying a moving/ rolling message in the student trainer kit's output device.

PROGRAMMING EXERCISES / EXPERIMENTS WITH µC8051:

6. Simple arithmetic operations with 8051: Multi precision addition / subtraction / multiplication/ division.
7. Programming with control instructions: Increment / Decrement, Ascending / Descending. order, Maximum / Minimum of numbers, Rotate instructions, Hex / ASCII / BCD code conversions.
8. Interface Experiments: A/D Interfacing. D/A Interfacing. Traffic light controller
9. Stepper motor controller interface.
10. Displaying a moving/ rolling message in the student trainer kit's output device.
11. Programming PIC architecture with software tools.

TOTAL :45 PERIODS

COURSE OUTCOMES:

After studying the above subject, students should have the:

CO1: Ability to write assembly language program for microprocessor.

CO2: Ability to write assembly language program for microcontroller

CO3: Ability to design and implement interfacing of peripheral with microprocessor and microcontroller

CO4: Ability to analyze, comprehend, design and simulate microprocessor based systems used for control and monitoring..

CO5: Ability to analyze, comprehend, design and simulate microcontroller based systems used for control and monitoring.

MAPPING OF COs WITH POs AND PSOs

COs	POs												PSOs		
	PO1	PO2	PO3	PO4	PO5	P06	P07	PO8	PO9	PO10	PO11	PO12	PS01	PS02	PS03
CO1	2	1	2	3	-	-	-	1.5	-	-	-	3	3	1	3
CO2	2	1	2	3	-	-	-	1.5	-	-	-	3	3	1	3
CO3	2	1	2	3	-	-	-	1.5	-	-	-	3	3	1	3
CO4	2	1	2	3	-	-	-	1.5	-	-	-	3	3	1	3
CO5	2	1	2	3	-	-	-	1.5	-	-	-	3	3	1	3
Avg	2	1	2	3	-	-	-	1.5	-	-	-	3	3	1	3

21153C51 POWER SYSTEM ANALYSIS L T P C

3 0 0 3

COURSE OBJECTIVES:

- Impact knowledge on need for operational studies, andTo model the power system under steady state operating condition.
- To understand and apply iterative techniques for power flow analysis.
- To model of carry out short circuit studies for power system during symmetrical fault.
- To model of carry out short circuit – studies during
- To study about the various methods for analyzing power system stability

UNIT I POWER SYSTEM 9

Need for system planning and operational studies - Power scenario in India - Power system components, Representation - Single line diagram - per unit quantities - p.u. impedance diagram - p.u. reactance diagram, Network graph Theory - Bus incidence matrices, Primitive parameters, Formation of bus admittance matrix – Direct inspection method – Singular Transformation method.

UNIT II POWER FLOW ANALYSIS 9

Bus classification - Formulation of Power Flow problem in polar coordinates - Power flow solution using Gauss Seidel method - Handling of Voltage controlled buses - Power Flow Solution by Newton Raphson method – Flow charts – Comparison of methods.

UNIT III SYMMETRICAL FAULT ANALYSIS 9

Assumptions in short circuit analysis - Symmetrical short circuit analysis using Thevenin's theorem - Bus Impedance matrix building algorithm (without mutual coupling) - Symmetrical fault analysis through bus impedance matrix - Post fault bus voltages - Fault level - Current limiting reactors.

UNIT IV UNSYMMETRICAL FAULT ANALYSIS 9

Symmetrical components - Sequence impedances - Sequence networks - Analysis of unsymmetrical faults at generator terminals: LG, LL and LLG - unsymmetrical fault occurring at any point in a power system.

UNIT V STABILITY ANALYSIS 9

Classification of power system stability - Rotor angle stability - Power-Angle equation - Steady state stability - Swing equation - Solution of swing equation by step by step method - Swing curve, Equal area criterion - Critical clearing angle and time, Multi-machine stability analysis - modified Euler method.

TOTAL : 45 PERIODS

COURSE OUTCOMES:

Upon the successful completion of the course, students should have the:

CO1: Ability to model the power system under steady state operating condition.
CO2: Ability to carry out power flow analysis using.
CO3: Ability to infer the significance of short circuit studies in designing circuit breakers.
CO4: Ability to analyze the state of the power system for various unsymmetrical faults.
CO5: Ability to analyze the stability of power system using different methods.

TEXT BOOKS:

1. John J. Grainger, William D. Stevenson, Jr, 'Power System Analysis', Mc Graw Hill Education (India) Private Limited, New Delhi, 2017.
2. Kothari D.P. and Nagrath I.J., 'Power System Engineering', Tata McGraw-Hill Education, 3rd edition 2019.
3. Hadi Saadat, 'Power System Analysis', Tata McGraw Hill Education Pvt. Ltd., New Delhi, 21st reprint, 2010.

REFERENCES

1. Pai M A, 'Computer Techniques in Power System Analysis', Tata Mc Graw-Hill Publishing Company Ltd., New Delhi, Second Edition, 2007.
2. J. Duncan Glover, Mulukutla S.Sarma, Thomas J. Overbye, 'Power System Analysis & Design', Cengage Learning, Fifth Edition, 2012.
3. P. Venkatesh, B. V. Manikandan, A. Srinivasan, S. Charles Raja, "Electrical Power Systems: Analysis, Security and Deregulation" Prentice Hall India (PHI), second edition - 2017
4. Gupta B.R., 'Power System - Analysis and Design', S. Chand Publishing, Reissue edition 2005.
5. Kundur P., 'Power System Stability and Control', Tata McGraw Hill Education Pvt. Ltd., New Delhi, 2013

MAPPING OF COs WITH POs AND PSOs

COs	POs												PSOs		
	PO1	PO2	PO3	PO4	PO5	P06	P07	PO8	PO9	PO10	PO11	PO12	PS01	PS02	PS03
CO1	3	2	2	1	1	-	-	-	1	-	-	-	1	-	2
CO2	3	3	3	2	1	-	-	-	1	-	-	-	1	1	1
CO3	3	3	3	2	1	-	-	-	1	-	-	1	1	1	1
CO4	3	2	2	2	2	-	-	-	1	-	-	1	1	1	2
CO5	3	3	2	2	2	-	-	-	1	-	-	1	1	1	1
Avg	3	2.6	2.4	1.8	1.4	-	-	-	1	-	-	1	1	1	1.4

21153C53 POWER ELECTRONICS L T P C

3 0 0 3

COURSE OBJECTIVES:

- To understand the various applications of power electronic devices for conversion, control and conditioning of the electrical power and to get an overview of different types of power semiconductor devices and their dynamic characteristics.
- To understand the operation, characteristics and performance parameters of controlled rectifiers
- To study the operation, switching techniques and basic topologies of DC-DC switching regulators.
- To learn the different modulation techniques of pulse width modulated inverters and to understand harmonic reduction methods.
- To study the operation of AC voltage controller and various configurations of AC voltage controller.

UNIT I SWITCHING POWER SUPPLIES 9

MOSFET dynamic behavior - driver and snubber circuits - low power high switching frequency switching Power supplies, buck, boost, buck-boost converters - Isolated topologies - resonant converters - switching loss calculations and thermal design.

UNIT II INVERTERS 9

IGBT: Static and dynamic behavior - single phase half bridge and full bridge inverters - VSI :(1phase and three phase inverters square wave operation) - Voltage control of inverters single, multi pulse, sinusoidal, space vector modulation techniques- various harmonic elimination techniques-CSI

UNIT III UNCONTROLLED RECTIFIERS 9

Power Diode - half wave rectifier - mid-point secondary transformer based full wave rectifier - bridge rectifier - voltage doubler circuit - distortion factor - capacitor filter for low power rectifiers - LC filters - Concern for power quality – three phase diode bridge.

UNIT IV CONTROLLED RECTIFIERS 9

SCR-Two transistor analogy based turn- ON - turn ON losses - thermal protection - controlled converters (1 pulse, 2 pulse, 3 pulse, 6 pulse) - displacement factor - ripple and harmonic factor - power factor mitigation, performance parameters – effect of source inductance - inverter angle limit.

UNIT V AC PHASE CONTROLLERS 9

TRIAC triggering concept with positive and negative gate pulse triggering, TRIAC based phase controllers - various configurations for SCR based single and three phase controllers.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

Upon the successful completion of the course, students will be able to:

CO1: Understand the operation of semiconductor devices and dynamic characteristics and to design &analyze the low power SMPS

CO2: Analyze the various uncontrolled rectifiers and design suitable filter circuits

CO3: Analyze the operation of the n-pulse converters and evaluate the performance parameters

CO4: Understand various PWM techniques and apply voltage control and harmonic elimination methods to inverter circuits.

CO5: Understand the operation of AC voltage controllers and its applications.

TEXT BOOKS:

1. Ned Mohan, T.M.Undeland, W.P.Robbins, "Power Electronics: Converters, applications and design", John Wiley and Sons, 3rd Edition (reprint), 2009
2. Rashid M.H., Power Electronics Circuits, Devices and Applications, Prentice Hall India, 3rd Edition, New Delhi, 2004.

REFERENCES:

1. Cyril. W.Lander, Power Electronics, McGraw Hill International, Third Edition, 1993.
2. P.S.Bimbhra, Power Electronics, Khanna Publishers, Third Edition 2003
3. Philip T.Krein, Elements of Power Electronics, Oxford University Press, 2013.
4. P.C.Sen, Power Electronics, Tata McGraw-Hill, 30^{th} reprint, 2008.

MAPPING OF COs WITH POs AND PSOs

COs	POs												PSOs		
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	3	3	3	3	-	-	2	1	-	-	3	3	3	3	3
CO2	3	3	3	3	-	-		1	-	-	-	-	3	3	3
CO3	3	3	3	3	-	-	2	1	-	-	2	-	3	3	3
CO4	3	3	3	3	-	-	1	1	-	-	2	3	3	3	3
CO5	3	3	3	3	-	-	1	1	-	-	2	3	3	3	3
Avg.	3	3	3	3	-	-	1.5	1	-	-	2.25	3	3	3	3

21153C52 CONTROL SYSTEMS LT P C

3 0 0 3

COURSE OBJECTIVES:

- To make the students to familiarize with various representations of systems.
- To make the students to analyze the stability of linear systems in the time domain and frequency domain.
- To make the students to analyze the stability of linear systems in the frequency domain.
- To make the students to design compensator based on the time and frequency domain specifications.
- To develop linear models: mainly state variable model and Transfer function model

UNIT I MODELING OF LINEAR TIME INVARIANT SYSTEM (LTIV) 9

Control system: Open loop and Closed loop - Feedback control system characteristics - First principle modeling: Mechanical, Electrical and Electromechanical systems - Transfer function representations: Block diagram and Signal flow graph.

UNIT II TIME DOMAIN ANALYSIS 9

Standard test inputs - Time response - Time domain specifications - Stability analysis: Concept of stability - Routh Hurwitz stability criterion - Root locus: Construction and Interpretation. Effect of adding poles and zeros

UNIT III FREQUENCY DOMAIN ANALYSIS 9

Bode plot, Polar plot and Nyquist plot: - Frequency domain specifications Introduction to closed loop Frequency Response. Effect of adding lag and lead compensators.

UNIT IV STATE VARIABLE ANALYSIS 9

State variable formulation - Non uniqueness of state space model - State transition matrix -Eigen values - Eigen vectors - Free and forced responses for Time Invariant and Time Varying Systems - Controllability - Observability

UNIT V DESIGN OF FEED BACK CONTROL SYSTEM 9

Design specifications - Lead, Lag and Lag-lead compensators using Root locus and Bode plot techniques -PID controller - Design using reaction curve and Ziegler-Nichols technique- PID control in State Feedback form.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

Upon the successful completion of the course, students will be able to:

CO1: Represent simple systems in transfer function and state variable forms.
CO2: Analyze simple systems in time domain.
CO3: Analyze simple systems in frequency domain.
CO4: Infer the stability of systems in time and frequency domain.
CO5: Interpret characteristics of the system and find out solution for simple control problems.

TEXT BOOKS:

1. Benjamin C. Kuo, “Automatic Control Systems”, 7th edition PHI Learning Private Ltd, 2010.
2. Nagarath, I.J. and Gopal, M., “Control Systems Engineering”, New Age International Publishers 2010.

REFERENCES:

1. Richard C.Dorf and Bishop, R.H., “Modern Control Systems”, Education Pearson, 3 Impression 2009.
2. John J.D., Azzo Constantine, H. and Houpis Sttuart, N Sheldon, “Linear Control System Analysis and Design with MATLAB”, CRC Taylor& Francis Reprint 2009.
3. Katsuhiko Ogata, “Modern Control Engineering”, PHI Learning Private Ltd, 5thEdition, 2010
4. NPTEL Video Lecture Notes on “Control Engineering” by Prof.S.D.Agashe, IIT Bombay.

MAPPING OF COs WITH POs AND PSOs

COs	POs												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	3	3	-	-	1	-	-	-	3	3	3	3
CO2	3	3	3	3	3	-	-	1	-	-	-	3	3	3	3
CO3	3	3	3	3	3	-	-	1	-	-	-	3	3	3	3
CO4	3	3	3	3	3	-	-	1	-	-	-	3	3	3	3
CO5	3	3	3	3	3	-	-	1	-	-	-	3	3	3	3
Avg.	3	3	3	3	3	-	-	1	-	-	-	3	3	3	3

21153L58 **POWER ELECTRONICS LABORATORY** **L T P C**
0 0 3 1.5

COURSE OBJECTIVES:

- To study the VI characteristics of SCR, TRIAC, MOSFET and IGBT.
- To analyze the performance of semi converter, full converter, step up, step down choppers by simulation and experimentation.
- To study the behavior of voltage waveforms of PWM inverter applying various modulation techniques.
- To design and analyze the performance of SMPS.
- To study the performance of AC voltage controller by simulation and Experimentation.

LIST OF EXPERIMENTS:

1. Characteristics of SCR and TRIAC.
2. Characteristics of MOSFET and IGBT.
3. AC to DC half controlled converter.
4. AC to DC fully controlled converter.
5. Step down and step up MOSFET based choppers.
6. IGBT based single phase PWM inverter.
7. IGBT based three phase PWM inverter.
8. AC Voltage controller.
9. Switched mode power converter.
10. Simulation of PE circuits (1Φ & 3Φ semi converter, 1Φ & 3Φ full converter, dc-dc converters, ac voltage controllers).

TOTAL :45 PERIODS

COURSE OUTCOMES:

Upon the successful completion of the course, students will be able to:

CO1: Determine the characteristics of SCR, IGBT, TRIAC, MOSFET and IGBT

CO2: Find the transfer characteristics of full converter, semi converter, step up and step down choppers by simulation experimentation.

CO3: Analyze the voltage waveforms for PWM inverter using various modulation techniques.

CO4: Design and experimentally verify the performance of basic DC/DC converter topologies used for SMPS.

CO5: Understand the performance of AC voltage controllers by simulation and experimentation

MAPPING OF COs WITH POs AND PSOs

COs	POs												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	3	3	-	-	1.5	-	-	-	3	3	3	3
CO2	3	3	3	3	3	-	-	1.5	-	-	-	3	3	3	3
CO3	3	3	3	3	3	-	-	1.5	-	-	-	3	3	3	3
CO4	3	3	3	3	3	-	-	1.5	-	-	-	3	3	3	3
CO5	3	3	3	3	3	-	-	1.5	-	-	-	3	3	3	3
Avg	3	3	3	3	3	-	-	1.5	-	-	-	3	3	3	3

21153L57 **CONTROL AND INSTRUMENTATION LABORATORY** **L T P C**
0 0 4 2

COURSE OBJECTIVES:

- To make the students familiarize with various representations of systems.
- To make the students analyze the stability of linear systems in the time domain and frequency domain.
- To make the students design compensator based on the time and frequency domain Specifications.
- To develop linear models mainly state variable model and transfer function model
- To make the students to design a complete closed loop control system for the physical systems.

LIST OF EXPERIMENTS:

1. Analog (op amp based) simulation of linear differential equations.
2. Numerical Simulation of given nonlinear differential equations.
3. Real time simulation of differential equations.
4. Mathematical modeling and simulation of physical systems in at least two fields.
   - Mechanical
   - Electrical
   - Chemical process
5. System Identification through process reaction curve.
6. Stability analysis using Pole zero maps and Routh Hurwitz Criterion in simulation platform.
7. Root Locus based analysis in simulation platform.
8. Determination of transfer function of a physical system using frequency response and Bode's asymptotes.
9. Design of Lag, lead compensators and evaluation of closed loop performance.
10. Design of PID controllers and evaluation of closed loop performance.
11. Discretization of continuous system and effect of sampling.
12. Test of controllability and observability in continuous and discrete domain in simulation platform.
13. State feedback and state observer design and evaluation of closed loop performance.
14. Mini Project 1: Simulation of complete closed loop control systems including sensor and actuator dynamics.
15. Mini Project 2: Demonstration of a closed loop system in hardware.

TOTAL :60 PERIODS

COURSE OUTCOMES:

At the end of this course, the students will demonstrate the ability

CO1: To model and analyze simple physical systems and simulate the performance in analog and digital platform.
CO2: To design and implement simple controllers in standard forms.
CO3: To design compensators based on time and frequency domain specifications.
CO4: To design a complete closed control loop and evaluate its performance for simple physical systems.
CO5: To analyze the stability of a physical system in both continuous and discrete domains.

MAPPING OF COs WITH POs AND PSOs

COs	POs												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	3	3	-	-	1.5	-	-	-	2	3	3	3
CO2	3	3	3	3	3	-	-	1.5	-	-	-	2	3	3	3
CO3	3	3	3	3	3	-	-	1.5	-	-	-	2	3	3	3
CO4	3	3	3	3	3	-	-	1.5	-	-	-	2	3	3	3
CO5	3	3	3	3	3	-	-	1.5	-	-	-	2	3	3	3
Avg	3	3	3	3	3	-	-	1.5	-	-	-	2	3	3	3

21153C63 PROTECTION AND SWITCHGEAR

	L	T	P	C
	3	0	0	3

COURSE OBJECTIVES:

- To understand the significance of protection, protection schemes and role of earthing.
- To study the characteristics, functions and application areas of various relays.
- To acquire practical knowledge about common faults in power system apparatus and applying suitable protective schemes.
- To understand the functioning of static relays and Numerical protection concepts.
- To understand the problems associated with circuit breaking and to discuss about various circuit breakers.

UNIT I PROTECTION SCHEMES 9

Significance and need for protective schemes - nature and causes of faults - types of faults Effects of faults - Zones of protection and essential qualities of protection – Types of Protection schemes - Power system Grounding and Methods of Grounding.

UNIT II BASICS OF RELAYS 9

Operating principles of relays -Universal torque equation - R-X diagram -Electromagnetic Relays – Over current, Directional and non-directional, Distance, Differential, Negative sequence and Under frequency relays.

UNIT III OVERVIEW OF EQUIPMENT PROTECTION 9

Current transformers and Potential transformers and their applications in protection schemes - Protection of transformer, generator, motor, bus bars and transmission line.

UNIT IV STATIC RELAYS AND NUMERICAL PROTECTION 9

Static relays - Phase, Amplitude Comparators - Synthesis of various relays using Static comparators – Block diagram of Numerical relays - Over current protection, transformer differential protection, and distantce protection of transmission lines.

UNIT V CIRCUIT BREAKERS 9

Physics of arcing phenomenon and arc interruption – DC and AC circuit breaking – re-striking voltage and recovery voltage - rate of rise of recovery voltage - current chopping - interruption of capacitive current - resistance switching - Types of circuit breakers – air blast, oil, SF6 and vacuum circuit breakers – comparison of different circuit breakers – HVDC Breaker.

TOTAL : 45 PERIODS

COURSE OUTCOMES:

Upon the successful completion of the course, students will have theability to:

CO1: Understand and select proper protective scheme and type of earthing.

CO2: Explain the operating principles of various relays.

CO3: Suggest suitable protective scheme for the protection of various power system apparatus.

CO4: Analyze the importance of static relays and numerical relays in power system protection.

CO5: Summarize the merits and demerits and application areas of various circuit breakers.

TEXT BOOKS:

1. Sunil S.Rao, 'Switchgear and Protection', Khanna Publishers, New Delhi, Four Edition, 2010.
2. Badri Ram ,B.H. Vishwakarma, 'Power System Protection and Switchgear', New Age International Pvt Ltd Publishers, Second Edition 2011.
3. B.Rabindranath and N.Chander, 'Power System Protection and Switchgear', New Age International (P) Ltd., Second Edition, 2018.
4. Arun Ingole, 'Switch Gear and Protection' Pearson Education, 2018.

REFERENCES

1. Y.G.Paithankar and S.R.Bhide, 'Fundamentals of power system protection', Second Edition,Prentice Hall of India Pvt. Ltd., New Delhi, 2013.
2. C.L.Wadhwa, 'Electrical Power Systems', 6th Edition, New Age International (P) Ltd., 2018
3. VK Metha," Principles of Power Systems", S. Chand, Reprint, 2013
4. Bhavesh Bhalja, R.P. Maheshwari, Nilesh G. Chotani,'Protection and Switchgear' Oxford University Press, 2nd Edition 2018.

MAPPING OF COs WITH POs AND PSOs

COs	POs												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	1	1	2	1	2	1	1	1	1	2	-	3	1	-
CO2	3	1	1	2	1	2	1	1	1	1	2	-	3	1	-
CO3	3	1	1	2	1	2	1	1	1	1	2	-	3	2	-
CO4	3	1	1	2	1	2	1	1	1	1	2	-	3	2	1
CO5	3	1	1	2	2	2	1	1	1	1	2	-	3	1	1
Avg.	3	1	1	2	1.2	2	1	1	1	1	2	-	3	1.4	1

21153C62 POWER SYSTEM OPERATION AND CONTROL L T P C
3 0 0 3

COURSE OBJECTIVES:

To impart knowledge on,

- The significance of power system operation and control.
- Real power- frequency interaction and design of power- frequency controller.
- Reactive power- voltage interaction and the compensators for maintaining the voltage profile.
- The generation scheduling and economic operation of power system.
- SCADA and its application for real time operation and control of power systems.

UNIT I INTRODUCTION 9

Power scenario in Indian grid - National and Regional load dispatching centres - Requirements of good power system - Necessity of voltage and frequency regulation - real power vs frequency and reactive power vs voltage control loops - System load variation, load curves - Load forecasting - Computational methods in load forecasting - Load shedding and Islanding - deregulation - Basics of electrical energy tariff.

UNIT II REAL POWER FREQUENCY CONTROL 9

Basics of speed governing mechanisms and modelling - Speed regulation of two generators in parallel Load Frequency Control (LFC) of single area system - Static and dynamic analysis - LFC of two area system -Tie line modelling - Block diagram representation of two area system - Static and dynamic analysis - Tie line with frequency bias control - State variable model - Integration of economic dispatch control with LFC.

UNIT III REACTIVE POWER – VOLTAGE CONTROL 9

Generation and absorption of reactive power - Basics of reactive power control - Automatic Voltage Regulator (AVR) - Brushless AC excitation system - Block diagram representation of AVR loop static and dynamic analysis - Stability compensation - Voltage drop in transmission line - Methods of reactive power injection - Tap changing transformer, SVC and STATCOM for voltage control.

UNIT IV ECONOMIC OPERATION OF POWER SYSTEM 9

Statement of economic dispatch problem - Input and output characteristics of thermal plant incremental cost curve - Optimal operation of thermal units without and with transmission losses (no derivation of transmission loss coefficients) - Lambda-iteration method - Base point and participation factors method. Statement of Unit Commitment (UC) problem - Constraints on UC problem - Solution of UC problem using priority list - Special aspects of short term and long-term hydrothermal scheduling problems.

UNIT V COMPUTER AIDED CONTROL OF POWER SYSTEM 9

Need of computer control of power system - Concept of energy control centers and functions - PMU system monitoring, Data acquisition and controls - System hardware configurations - SCADA and EMS functions - State estimation - Measurements and errors - Weighted least square estimation - Various operating states - State transition diagram.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

On the successful completion of the course, students will be able to:

CO1: Understand the day – to – day operation of power system.

CO2: Model and analyse the control actions that are implemented to meet the minute-to-minute variation of system real power demand.

CO3: Model and analyze the compensators for reactive power control and various devices used for voltage control.

CO4: Prepare day ahead and real time economic generation scheduling.

CO5: Understand the necessity of computer control of power systems.

TEXTBOOKS:

1. Olle. I. Elgerd, 'Electric Energy Systems theory – An introduction', McGraw Hill Education Pvt. Ltd., New Delhi, 2nd edition, 2017.
2. Allen. J. Wood and Bruce F. Wollen berg, 'Power Generation, Operation and Control', John Wiley & Sons, Inc., 3rd edition, 2013.
3. Abhijit Chakrabarti and Sunita Halder, 'Power System Analysis Operation and Control', PHI learning Pvt. Ltd., New Delhi, Fourth Edition, 2018.

REFERENCE BOOKS:

1. Kothari D.P. and Nagrath I.J., 'Power System Engineering', Tata McGraw- Hill Education, Second Edition, Reprint 2018.
2. Hadi Saadat, 'Power System Analysis', McGraw Hill Education Pvt. Ltd., New Delhi, 23rd reprint, 2015.
3. Kundur P., 'Power System Stability and Control, McGraw Hill Education Pvt. Ltd., New Delhi, 12th reprint, 2015.
4. B.M. Weedy, B.J. Cory et al, 'Electric Power systems', Wiley, Fifth Edition, 2012.

MAPPING OF COs WITH POs AND PSOs

COs	POs												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	1	-	-	-	-	-	1	-	-	-	2	3	3	3
CO2	3	2	1	1	-	1	-	2	-	2	-	2	3	3	3
CO3	3	2	1	1	-	1	-	2	-	2	-	2	3	3	3
CO4	3	2	1	1	-	1	-	2	-	2	-	2	3	1	2.33
CO5	2	1	-	-	-	-	-	1	-	2	-	2	3	3	3
Avg.	2	1.6	1	1	-	1	-	1.6	-	2	-	2	3	2.2	2.86

21153L67 **POWER SYSTEM LABORATORY**

L	T	P	C
0	0	3	1.5

COURSE OBJECTIVES:

1. To provide a better understanding of modelling of transmission lines in impedance and admittance forms.
2. To apply iterative techniques for power flow analysis and to carry out short circuit and stability studies on power system.
3. To analyze the load – frequency and voltage controls.
4. To analyze optimal dispatch of generators and perform state estimation.
5. To understand the operation of relays, characteristics, and applications.

LIST OF EXPERIMENTS:

1. Computation and modelling of transmission Lines.
2. Formation of Bus Admittance and Impedance Matrices.
3. Power Flow Analysis Using Gauss-Seidel Method.
4. Power Flow Analysis Using Newton Raphson Method.
5. Symmetric and Unsymmetrical Fault Analysis.
6. Transient Stability Analysis of SMIB System.
7. Load – Frequency Dynamics of Single- Area and Two-Area Power Systems.
8. Economic Dispatch in Power Systems.
9. State estimation: Weighted least square estimation.
10. Performance analysis of over current relay.
11. Performance analysis of impedance relay.
12. Testing of CT, PT, and Insulator string.
13. Relay Coordination in Radial Feeder Protection Scheme.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

On the successful completion of the laboratory, students will be able to:
CO1: Model and analyze the performance of the transmission lines.
CO2: Perform power flow, short circuit, and stability analysis for any power system network.
CO3: Understand, design, and analyze the load frequency control mechanism.
CO4: Perform optimal scheduling of generators and compute the state of the power system.
CO5: Understand, analyze, and apply the relays for power system protection.

MAPPING OF COs WITH POs AND PSOs

COs	POs												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	2	3	-	-	2	1	2	-	3	3	3	3
CO2	3	3	2	2	3	-	-	2	1	2	-	3	3	3	3
CO3	3	3	2	2	3	-	-	2	1	2	-	3	3	3	3
CO4	3	3	2	2	3	-	-	2	1	2	-	3	3	3	3
CO5	3	3	2	2	3	-	-	2	1	2	-	3	3	3	3
Avg	3	3	2	2	3	-	-	2	1	2	-	3	3	3	3

21153C77 **HIGH VOLTAGE ENGINEERING** **L T P C**

3 0 0 3

COURSE OBJECTIVES:

- Various types of over voltages in power system and protection methods.
- Generation of over voltages in laboratories.
- Measurement of over voltages.
- Nature of Breakdown mechanism in solid, liquid and gaseous dielectrics.
- Testing of power apparatus and insulation coordination.

UNIT I OVER VOLTAGES IN ELECTRICAL POWER SYSTEMS 9

Causes of over voltages and its effects on power system – Lightning, switching surges and temporary over voltages – Reflection and Refraction of Travelling waves- protection against over voltages_ Insulation Coordination.

UNIT II DIELECTRIC BREAKDOWN 9

Properties of Dielectric materials - Gaseous breakdown in uniform and non-uniform fields –Corona discharges – Vacuum breakdown – Conduction and breakdown in pure and commercial liquids, Maintenance of oil Quality – Breakdown mechanisms in solid and composite dielectrics- Applications of insulating materials in electrical equipment.

UNIT III GENERATION AND MEASUREMENTS OF HIGH VOLTAGES AND HIGH CURRENTS 9

Generation of High DC, AC, impulse voltages and currents - Analysis of DC/AC and Impulse generator circuits - Tripping and control of impulse generators**,** Measurement of High voltages and High currents - High Resistance with series ammeter - Dividers - Resistance, Capacitance and Mixed dividers - Peak Voltmeter, Generating Voltmeters, Electrostatic Voltmeters – Sphere Gaps, High current shunts- Digital techniques in high voltage measurement.

UNIT IV HIGH VOLTAGE TESTING & INSULATION COORDINATION 9

High voltage testing of electrical power apparatus- International and Indian standards – Power frequency, impulse voltage and DC testing of Insulators, circuit breakers, bushing, isolators and transformers - Insulation Coordination.

UNIT V APPLICATION IN INDUSTRY 9

Introduction – electrostatic applications- electrostatic precipitation, separation, painting / coating, spraying, imaging, printing, Transport of materials – manufacturing of sand paper – Smoke particle detector – Electrostatic spinning, pumping, propulsion – Ozone generation – Biomedical applications.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

Upon the successful completion of the course, students will be able to:

CO1: Explain various overvoltage's and its effects on power systems.

CO2: Understand the breakdown phenomena in different medium under uniform and non-uniform fields.
CO3: Explain the methodsof generating and measuring High DC, AC, Impulse voltage and currents.
CO4: Suggest and Conduct suitable HV testing of Electrical power apparatus as per Standards
CO5: Explain the Industrial Applications of Electrostatic Fields.

TEXT BOOKS

1. M.S.Naidu and V. Kamaraju, ‘High Voltage Engineering’, Tata McGraw Hill, Fifth Edition, 2013.
2. E. Kuffel and W.S. Zaengl, J.Kuffel, ‘High voltage Engineering fundamentals’, Newnes Second Edition, Elsevier , New Delhi, 2005.
3. C.L. Wadhwa, ‘High voltage Engineering’, New Age International Publishers, Fourth Edition, 2020.

REFERENCES

1. L.L.Alston, High Voltage Technology, Oxford University Press, First Indian Edition 2006.
2. C.L.Wadhwa, High voltage Engineering, New Age International Publishers, Fourth Edition, 2020
3. Mazen Abdel – Salam, Hussein Anis, Ahdab A-Morshedy, RoshdayRadwan, High Voltage Engineering – Theory &Practice,Second Edition, Taylor & Francis Gourp, 2019
4. Subir Ray.” An Introduction to High Voltage Engineering “PHI Learning Private Limited, New Delhi, Second Edition-2011

MAPPING OF COs WITH POs AND PSOs

COs	POs											PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2	-	-	-	-	-	-	-	-	-	-	3	2	-
CO2	3	2	-	1	-	-	-	-	-	-	-	-	3		-
CO3	2	2	3	1	-	-	-	-	-	-	2	3	3	2	-
CO4	1	2	3	1	-	-	-	1	1	-		3	3	2	-
CO5	2	2	1	-	-	2	-	-	-	-	2	-	3		2
Avg.	2	2	2.33	1	-	2	-	1	1	-	2	3	3	2	2

21153P81 **PROJECT WORK / INTERNSHIP**

L	T	P	C
0	0	20	10

COURSE OBJECTIVES:

The student should be made to learn methodology to select a good project and able to work in a team leading to development of hardware/software product.prepare a good technical report. Gain Motivation to present the ideas behind the project with clarity.

A Project topic must be selected either from research literature or the students themselves may propose suitable topics in consultation with their guides. The aim of the project work is to deepen Comprehension of principles by applying them to a new problem which may be the design /fabrication of any power component / circuit / sensor / Activator / Controller, a research investigation, a computer or management project or a design problem. The progress of the project is evaluated based on a minimum of two reviews. The review committee may be constituted by the Head of the Department. A project report is required at the end of the semester. The project work is evaluated jointly by external and internal examiners constituted by the Head of the Department based on oral presentation and the project report.

TOTAL : 300 PERIODS

COURSE OUTCOMES:

CO1 Ability to identify, formulate, design, interprete,analyze and provide solutions to complex engineering and societal issues by applying knowledge gained on basics of science and Enginnering.

CO2 Ability to choose, conduct and demonstrate a sound technical knowledge of their selected project topics in the field of power components, protection, highvoltage, electronics, process automation, power electronics and drives instrumentation and control by exploring suitable engineering and IT tools.

CO3 Ability to understand, formulate and propose new learning algorithms to solve engineering and societal problems of moderate complexity through multidisciplinary projectsunderstanding commitment towards sustainable development.

CO4 Ability to demonstrate, prepare reports, communicate and work in a team as a member/leader by adhering to ethical responsibilities.

CO5 Ability to acknowledge the value of continuing education for oneself and to stay up with technology advancements.

MAPPING OF COs WITH POs AND PSOs

COs	POs												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	3	-	-	-	-	-	-	-	-	3	3	3
CO2	-	-	-	-	3	3	-	-	-	-	-	-	3	-	-
CO3	-	-	-	-	-	-	3	-	3	-	-	-	-	-	3
CO4	-	-	-	-	-	-	-	3	3	3	3	-	-	-	3
CO5	-	-	-	-	-	-	-	-	-	-	-	3	3	3	3
Avg.	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3

1-low, 2-medium, 3-high, '-"- no correlation

MANDATORY COURSES I

21147MC51A INTRODUCTION TO WOMEN AND GENDER STUDIES **L T P C**
3 0 0 0

COURSE OUTLINE

UNIT I CONCEPTS
Sex vs. Gender, masculinity, femininity, socialization, patriarchy, public/ private, essentialism, binaryism, power, hegemony, hierarchy, stereotype, gender roles, gender relation, deconstruction, resistance, sexual division of labour.

UNIT II FEMINIST THEORY
Liberal, Marxist, Socialist, Radical, Psychoanalytic, postmodernist, ecofeminist.

UNIT III WOMEN'S MOVEMENTS: GLOBAL, NATIONAL AND LOCAL
Rise of Feminism in Europe and America.
Women's Movement in India.

UNIT IV GENDER AND LANGUAGE
Linguistic Forms and Gender.
Gender and narratives.

UNIT V GENDER AND REPRESENTATION
Advertising and popular visual media.

Gender and Representation in Alternative Media.
Gender and social media.

TOTAL : 45 PERIODS

21147MC51B ELEMENTS OF LITERATURE **L T P C**
3 0 0 0

OBJECTIVE:

- To make the students aware about the finer sensibilities of human existence through an art form. The students will learn to appreciate different forms of literature as suitable modes of expressing human experience.

1. COURSE CONTENTS
Introduction to Elements of Literature

1. **Relevance of literature**
   a) Enhances Reading, thinking, discussing and writing skills.
   b) Develops finer sensibility for better human relationship.
   c) Increases understanding of the problem of humanity without bias.
   d) Providing space to reconcile and get a cathartic effect.

2. **Elements of fiction**
   a) Fiction, fact and literary truth.

b) Fictional modes and patterns.
c) Plot character and perspective.

3. Elements of poetry

a) Emotions and imaginations.
b) Figurative language.
c) (Simile, metaphor, conceit, symbol, pun and irony).
d) Personification and animation.
e) Rhetoric and trend.

4. Elements of drama

a) Drama as representational art.
b) Content mode and elements.
c) Theatrical performance.
d) Drama as narration, mediation and persuasion.
e) Features of tragedy, comedy and satire.

3. READINGS:

1. An Introduction to the Study of English Literature, W.H. Hudson, Atlantic, 2007.
2. An Introduction to Literary Studies, Mario Klarer, Routledge, 2013.
3. The Experience of Poetry, Graham Mode, Open college of Arts with Open Unv Press, 1991.
4. The Elements of Fiction: A Survey, Ulf Wolf (ed), Wolfstuff, 2114.
5. The Elements of Drama, J.L.Styan, Literary Licensing, 2011.

Textbook:

*Reference Books:: To be decided by the teacher and student, on the basis of individual student so as to enable him or her to write the term paper.

4. OTHER SESSION:

4.1*Tutorials:
4.2*Laboratory:
4.3*Project: The students will write a term paper to show their understanding of a particular piece of literature

5.*ASSESSMENT:

5.1 HA:

Quizzes-HA:
Periodical Examination: one
Project/Lab: one (under the guidance of the teachers the students will take a volume of poetry, fiction or drama and write a term paper to show their understanding of it in a given context; sociological, psychological, historical, autobiographical etc.
Final Exam:

TOTAL : 45 PERIODS

OUTCOME OF THE COURSE:

- Students will be able to understand the relevance of literature in human life and appreciate its aspects in developing finer sensibilities.

21147MC51C **FILM APPRECIATION** **L T P C**
3 0 0 0

In this course on film appreciation, the students will be introduced broadly to the development of film as an art and entertainment form. It will also discuss the language of cinema as it evolved over a century. The students will be taught as to how to read a film and appreciate the various nuances of a film as a text. The students will be guided to study film joyfully.

Theme - A: The Component of FilmsA-
1: The material and equipment
A-2: The story, screenplay and script
A-3: The actors, crew members, and the director
A-4: The process of film making… structure of a film

Theme - B: Evolution of Film Language
B-1: Film language, form, movement etc.
B-2: Early cinema… **silent film** (Particularly French)
B-3: The emergence of feature films: **Birth of a Nation**B-
4: Talkies

Theme - C: Film Theories and Criticism/Appreciation C-
1: Realist theory; Auteurists
C-2: Psychoanalytic, Ideological, Feminists
C-3: How to read films?
C-4: Film Criticism / Appreciation

Theme – D: Development of Films D-
1: Representative Soviet films
D-2: Representative Japanese films
D-3: Representative Italian films
D-4: Representative Hollywood film and the studio system

Theme - E: Indian Films
E-1: The early era
E-2: The important films made by the directors
E-3: The regional films
E-4: The documentaries in India

READING:
A Reader containing important articles on films will be prepared and given to the students. The students must read them and present in the class and have discussion on these.

21147MC51D **DISASTER RISK REDUCTION AND MANAGEMENT** **L T P C**
3 0 0 0

COURSE OBJECTIVE

- To impart knowledge on concepts related to disaster, disaster risk reduction, disaster management
- To acquaint with the skills for planning and organizing disaster response

UNIT I HAZRADS, VULNERABILITY AND DISASTER RISKS 9

Definition: Disaster, Hazard, Vulnerability, Resilience, Risks – Types of Disasters: Natural, Human induced, Climate change induced –Earthquake, Landslide, Flood, Drought, Fire etc – Technological disasters- Structural collapse, Industrial accidents, oil spills Causes, Impacts including social, Economic, political, environmental, health, psychosocial, etc.- Disaster vulnerability profile of India and Tamil Nadu Global trends in disasters: urban disasters, pandemics, Complex emergencies, - -, Inter relations between Disasters and Sustainable development Goals.

UNIT II DISASTER RISK REDUCTION (DRR) 9

Sendai Framework for Disaster Risk Reduction**,** Disaster cycle Phases, Culture of safety, prevention, mitigation and preparedness community Based DRR, Structural - nonstructural measures, Roles and responsibilities of- community, Panchayati Raj Institutions / Urban Local Bodies (PRIs/ULBs), States, Centre, and other stakeholders - Early Warning System – Advisories from Appropriate Agencies.- Relevance of indigenous Knowledge, appropriate technology and Local resources.

UNIT III DISASTER MANAGEMENT 9

Components of Disaster Management – Preparedness of rescue and relief, mitigation, rehabilitation and reconstruction- Disaster Risk Management and post disaster management – Compensation and Insurance- Disaster Management Act (2005) and Policy Other related policies, plans, programmers and legislation Institutional Processes and Framework at State and Central Level- (NDMA -SDMA-DDMA-NRDF- Civic Volunteers)

UNIT IV TOOLS AND TECHNOLOGY FOR DISASTER MANAGEMENT 9

Early warning systems Components of Disaster Relief: Water, Food, Sanitation, Shelter, Health, Waste Management, Institutional arrangements (Mitigation, Response and Preparedness, – Role of GIS and Information Technology Components in Preparedness, Risk Assessment, Response and Recovery Phases of Disaster – Disaster Damage Assessment Elements of Climate Resilient Development –Standard operation Procedure for disaster response – Financial planning for disaster Management

UNIT V DISASTER MANAGEMENT: CASE STUDIES 9

Discussion on selected case studies to analyse the potential impacts and actions in the contest of disasters-Landslide Hazard Zonation: Earthquake Vulnerability Assessment of Buildings and Infrastructure: Case Studies, Drought Assessment: Case Studies, Coastal Flooding: Storm Surge Assessment, Floods: Fluvial and Pluvial Flooding: Case Studies; Forest Fire: Case Studies, Man Made disasters: Case Studies, Space Based Inputs for Disaster Mitigation and Management and field works related to disaster management.- Field work-Mock drill

TOTAL : 45 PERIODS

TEXT BOOKS:

1 Taimpo (2016), Disaster Management and Preparedness, CRC Publications

2 Singh R (2017), Disaster Management Guidelines for earthquakes, Landslides, Avalanches and tsunami, Horizon Press Publications

3 Singhal J.P. “Disaster Management”, Laxmi Publications, 2010. ISBN-10: 9380386427 ISBN-13: 978-9380386423

4 Tushar Bhattacharya, “Disaster Science and Management”, McGraw Hill India Education Pvt. Ltd., 2012. **ISBN-10:** 1259007367, **ISBN-13:** 978-1259007361]

REFERENCES

1. Govt. of India: Disaster Management Act, Government of India, New Delhi, 2005.
2. Government of India, National Disaster Management Policy, 2009.
3. Shaw R (2016), Community based Disaster risk reduction, Oxford University Press

COURSE OUTCOME:

CO1: To impart knowledge on the concepts of Disaster, Vulnerability and Disaster Risk reduction (DRR)

CO2: To enhance understanding on Hazards, Vulnerability and Disaster Risk Assessment prevention and risk reduction

CO3: To develop disaster response skills by adopting relevant tools and technology

CO4: Enhance awareness of institutional processes for Disaster response in the country and

CO5: Develop rudimentary ability to respond to their surroundings with potential Disaster response in areas where they live, with due sensitivity

COs – POs & PSOs MAPPING

COs	POs												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	3	3	2	3	-	-	2	2	-	-	2	-	2	-	1
2	3	3	3	3	-	-	2	1	-	-	2	-	2	-	1
3	3	3	3	3	-	-	2	2	-	-	-	-	2	-	1
4	3	3	2	3	-	-	2	1	-	-	2	-	2	-	1
5	3	3	2	3	-	-	2	2	-	-	2	-	3	-	1
AVG	3	3	3	3	-	-	2	2	-	-	2	-	2	-	1

MANDATORY COURSES II

21147MC61A **WELL-BEING WITH TRADITIONAL PRACTICES-YOGA, AYURVEDA AND SIDDHA** **L T P C**
3 0 0 0

COURSE OBJECTIVES:

- To enjoy life happily with fun filled new style activities that help to maintain health also
- To adapt a few lifestyle changes that will prevent many health disorders
- To be cool and handbill every emotion very smoothly in every walk of life
- To learn to eat cost effective but healthy foods that are rich in essential nutrients
- To develop immunity naturally that will improve resistance against many health disorders

UNIT I HEALTH AND ITS IMPORTANCE 2+4

Health: Definition - Importance of maintaining health - More importance on prevention than treatment

Ten types of health one has to maintain - Physical health - Mental health - Social health - Financial health - Emotional health - Spiritual health - Intellectual health - Relationship health - Environmental health - Occupational/Professional heath.

Present health status - The life expectancy-present status - mortality rate - dreadful diseases - Non-communicable diseases (NCDs) the leading cause of death - 60% - heart disease – cancer – diabetes - chronic pulmonary diseases - risk factors – tobacco – alcohol - unhealthy diet - lack of physical activities.

Types of diseases and disorders - Lifestyle disorders – Obesity – Diabetes - Cardiovascular diseases – Cancer – Strokes – COPD - Arthritis - Mental health issues.

Causes of the above diseases / disorders - Importance of prevention of illness - Takes care of health - Improves quality of life - Reduces absenteeism - Increase satisfaction - Saves time

Simple lifestyle modifications to maintain health - Healthy Eating habits (Balanced diet according to age) Physical Activities (Stretching exercise, aerobics, resisting exercise) - Maintaining BMI-Importance and actions to be taken

UNIT II DIET 4+6

Role of diet in maintaining health - energy one needs to keep active throughout the day - nutrients one needs for growth and repair - helps one to stay strong and healthy - helps to prevent diet-related illness, such as some cancers - keeps active and - helps one to maintain a healthy weight - helps to reduce risk of developing lifestyle disorders like diabetes – arthritis – hypertension – PCOD – infertility – ADHD – sleeplessness -helps to reduce the risk of heart diseases - keeps the teeth and bones strong.

Balanced Diet and its 7 Components - Carbohydrates – Proteins – Fats – Vitamins – Minerals - Fibre and Water.

Food additives and their merits & demerits - Effects of food additives - Types of food additives - Food additives and processed foods - Food additives and their reactions

Definition of BMI and maintaining it with diet
Importance - Consequences of not maintaining BMI - different steps to maintain optimal BM

Common cooking mistakes
Different cooking methods, merits and demerits of each method

UNIT III ROLE OF AYURVEDA & SIDDHA SYSTEMS IN MAINTAINING HEALTH 4+4

AYUSH systems and their role in maintaining health - preventive aspect of AYUSH - AYUSH as a soft therapy.
Secrets of traditional healthy living - Traditional Diet and Nutrition - Regimen of Personal and Social Hygiene - Daily routine (Dinacharya) - Seasonal regimens (Ritucharya) - basic sanitation and healthy living environment - Sadvritta (good conduct) - for conducive social life.
Principles of Siddha & Ayurveda systems - Macrocosm and Microcosm theory - Pancheekarana Theory / **(**Five Element Theory) 96 fundamental Principles - Uyir Thathukkal **(**Tri-Dosha Theory) - Udal Thathukkal
Prevention of illness with our traditional system of medicine
Primary Prevention - To decrease the number of new cases of a disorder or illness - Health promotion/education, and - Specific protective measures - Secondary Prevention - To lower the rate of established cases of a disorder or illness in the population (prevalence) - Tertiary Prevention - To decrease the amount of disability associated with an existing disorder.

UNIT IV MENTAL WELLNESS 3+4

Emotional health - Definition and types - Three key elements: the subjective experience - the physiological response - the behavioral response - Importance of maintaining emotional health - Role of emotions in daily life -Short term and long term effects of emotional disturbances - Leading a healthy life with emotions - Practices for emotional health - Recognize how thoughts influence emotions - Cultivate positive thoughts - Practice self-compassion - Expressing a full range of emotions.

Stress management - Stress definition - Stress in daily life - How stress affects one's life - Identifying the cause of stress - Symptoms of stress - Managing stress (habits, tools, training, professional help) - Complications of stress mismanagement.

Sleep - Sleep and its importance for mental wellness - Sleep and digestion.
Immunity - Types and importance - Ways to develop immunity

UNIT V YOGA 2+12

Definition and importance of yoga - Types of yoga - How to Choose the Right Kind for individuals according to their age - The Eight Limbs of Yoga - Simple yogasanas for cure and prevention of health disorders - What yoga can bring to our life.

TOTAL : 45 PERIODS

TEXT BOOKS:

1. Nutrition and Dietetics - Ashley Martin, Published by White Word Publications, New York, NY 10001, USA
2. Yoga for Beginners_ 35 Simple Yoga Poses to Calm Your Mind and Strengthen Your Body,
   by Cory Martin, Copyright © 2015 by Althea Press, Berkeley, California

REFERENCES:

1. WHAT WE KNOW ABOUT EMOTIONAL INTELLIGENCE How It Affects Learning, Work, Relationships, and Our Mental Health, by Moshe Zeidner, Gerald Matthews, and Richard D. Roberts
   A Bradford Book, The MIT Press, Cambridge, Massachusetts, London, England
2. The Mindful Self-Compassion Workbook, Kristin Neff, Ph.D Christopher Germer, Ph.D, Published by The Guilford Press A Division of Guilford Publications, Inc.370 Seventh Avenue, Suite 1200, New York, NY 10001

1. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4799645/
2. **Simple lifestyle modifications to maintain health**
   https://www.niddk.nih.gov/health-information/diet-nutrition/changing-habits-better-health#:~:text=Make%20your%20new%20healthy%20habit,t%20have%20time%20to%20cook.
3. **Read more**: https://www.legit.ng/1163909-classes-food-examples-functions.html
4. https://www.yaclass.in/p/science-state-board/class-9/nutrition-and-health-5926
5. **Benefits of healthy eating** https://www.cdc.gov/nutrition/resources-publications/benefits- of-healthy-eating.html
6. **Food additives** https://www.betterhealth.vic.gov.au/health/conditionsandtreatments/food-additives
7. **BMI** https://www.hsph.harvard.edu/nutritionsource/healthy-weight/
   https://www.who.int/europe/news-room/fact-sheets/item/a-healthy-lifestyle---who-recommendations
8. **Yoga** https://www.healthifyme.com/blog/types-of-yoga/
   https://yogamedicine.com/guide-types-yoga-styles/
   Ayurveda : https://vikaspedia.in/health/ayush/ayurveda-1/concept-of-healthy-living-in-ayurveda
9. **Siddha** : http://www.tkdl.res.in/tkdl/langdefault/Siddha/Sid_Siddha_Concepts.asp
10. **CAM :** https://www.hindawi.com/journals/ecam/2013/376327/
11. **Preventive** herbs : https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3847409/

COURSE OUTCOMES:

After completing the course, the students will be able to:

- Learn the importance of different components of health
- Gain confidence to lead a healthy life
- Learn new techniques to prevent lifestyle health disorders
- Understand the importance of diet and workouts in maintaining health

21147MC61B HISTORY OF SCIENCE AND TECHNOLOGY IN INDIA **L T P C**
3 0 0 0

UNIT I CONCEPTS AND PERSPECTIVES

Meaning of History
Objectivity, Determinism, Relativism, Causation, Generalization in History; Moral judgment in history
Extent of subjectivity, contrast with physical sciences, interpretation and speculation, causation verses evidence, concept of historical inevitability, Historical Positivism.
Science and Technology-Meaning, Scope and Importance, Interaction of science, technology & society, Sources of history on science and technology in India.

UNIT II HISTORIOGRAPHY OF SCIENCE AND TECHNOLOGY IN INDIA

Introduction to the works of D.D. Kosambi, Dharmpal, Debiprasad Chattopadhyay, Rehman, S. Irfan Habib, Deepak Kumar, Dhruv Raina, and others.

UNIT III SCIENCE AND TECHNOLOGY IN ANCIENT INDIA

Technology in pre-historic period
Beginning of agriculture and its impact on technology
Science and Technology during Vedic and Later Vedic times
Science and technology from 1st century AD to C-1200.

UNIT IV SCIENCE AND TECHNOLOGY IN MEDIEVAL INDIA

Legacy of technology in Medieval India, Interactions with Arabs
Development in medical knowledge, interaction between Unani and Ayurveda and alchemy
Astronomy and Mathematics: interaction with Arabic Sciences
Science and Technology on the eve of British conquest

UNIT V SCIENCE AND TECHNOLOGY IN COLONIAL INDIA

Science and the Empire
Indian response to Western Science
Growth of techno-scientific institutions

UNIT VI SCIENCE AND TECHNOLOGY IN A POST-INDEPENDENT INDIA

Science, Technology and Development discourse
Shaping of the Science and Technology Policy
Developments in the field of Science and Technology
Science and technology in globalizing India
Social implications of new technologies like the Information Technology and Biotechnology

TOTAL : 45 PERIODS

21147MC61C **POLITICAL AND ECONOMIC THOUGHT FOR A HUMANE SOCIETY** **L T P C**
3 0 0 0

Pre-Requisite**:** None. (Desirable: Universal Human Values 1, Universal Human Values 2)

OBJECTIVES:

- This course will begin with a short overview of human needs and desires and how different political-economic systems try to fullfill them. In the process, we will end with a critique of different systems and their implementations in the past, with possible future directions.

COURSE TOPICS:

Considerations for humane society, holistic thought, human being's desires, harmony in self, harmony in relationships, society, and nature, societal systems. **(9 lectures, 1 hour each)**

(Refs: A Nagaraj, M K Gandhi, JC Kumarappa)

Capitalism – Free markets, demand-supply, perfect competition, laissez-faire, monopolies, imperialism. Liberal democracy. **(5 lectures)**

(Refs: Adam smith, J S Mill)

Fascism and totalitarianism. World war I and II. Cold war. **(2 lectures)**

Communism – Mode of production, theory of labour, surplus value, class struggle, dialectical materialism, historical materialism, Russian and Chinese models.

(Refs: Marx, Lenin, Mao, M N Roy) **(5 lectures)**

Welfare state. Relation with human desires. Empowered human beings, satisfaction. **(3 lectures)**

Gandhian thought. Swaraj, Decentralized economy & polity, Community. Control over one's lives. Relationship with nature. **(6 lectures)**

(Refs: M K Gandhi, Schumacher, Kumarappa)

Essential elements of Indian civilization. **(3 lectures)**

(Refs: Pt Sundarlal, R C Mazumdar, Dharampal)

Technology as driver of society, Role of education in shaping of society. Future directions. **(4 lectures)** (Refs: Nandkishore Acharya, David Dixon, Levis Mumford)

Conclusion (2 lectures)

Total lectures: 39

Preferred Textbooks: See Reference Books

Reference Books: Authors mentioned along with topics above. Detailed reading list will be provided.

GRADING:

Mid sems	30
End sem	20
Home Assign	10
Term paper	40

TOTAL : 45 PERIODS

OUTCOME:

- The students will get an understanding of how societies are shaped by philosophy, political and economic system, how they relate to fulfilling human goals & desires with some case studies of how different attempts have been made in the past and how they have fared.

21147MC61D **STATE, NATION BUILDING AND POLITICS IN INDIA** **L T P C**
3 0 0 0

OBJECTIVE:

The objective of the course is to provide an understanding of the state, how it works through its main organs, primacy of politics and political process, the concept of sovereignty and its changing contours in a globalized world. In the light of this, an attempt will be made to acquaint the students with the main development and legacies of national movement and constitutional development in India, reasons for adopting a Parliamentary-federal system, the broad philosophy of the Constitution of India and the changing nature of Indian Political System. Challenges/ problems and issues concerning national integration and nation-building will also be discussed in the contemporary context with the aim of developing a future vision for a better India.

TOPICS:

Understanding the need and role of State and politics.

Development of Nation-State, sovereignty, sovereignty in a globalized world.

Organs of State – Executive, Legislature, Judiciary. Separation of powers, forms of government-unitary-federal, Presidential-Parliamentary,
The idea of India.

1857 and the national awakening.

1885 Indian National Congress and development of national movement – its legacies. Constitution making and the Constitution of India.
Goals, objective and philosophy.
Why a federal system?
National integration and nation-building.

Challenges of nation-building – State against democracy (Kothari)
New social movements.
The changing nature of Indian Political System, the future scenario.
What can we do?

TOTAL : 45 PERIODS

OUTCOME OF THE COURSE:

It is expected that this course will make students aware of the theoretical aspect of the state, its organs, its operationalization aspect, the background and philosophy behind the founding of the present political system, broad streams and challenges of national integration and nation-building in India. It will equip the students with the real understanding of our political system/ process in correct perspective and make them sit up and think for devising ways for better participation in the system with a view to making the governance and delivery system better for the common man who is often left unheard and unattended in our democratic setup besides generating a lot of dissatisfaction and difficulties for the system.

SUGGESTED READING:

i. Sunil Khilnani, The Idea of India. Penguin India Ltd., New Delhi.
ii. Madhav Khosla, The Indian Constitution, Oxford University Press. New Delhi, 2012.
iii. Brij Kishore Sharma, Introduction to the Indian Constitution, PHI, New Delhi, latest edition.
iv. Sumantra Bose, Transforming India: Challenges to the World's Largest Democracy, Picador India, 2013.
v. Atul Kohli, Democracy and Discontent: India's Growing Crisis of Governability, Cambridge University Press, Cambridge, U. K., 1991.
vi. M. P. Singh and Rekha Saxena, Indian Politics: Contemporary Issues and Concerns, PHI, New Delhi, 2008, latest edition.

vii. Rajni Kothari, Rethinking Democracy, Orient Longman, New Delhi, 2005.

21147MC61E **SafetyinEngineeringIndustries**

LTPC3
000

OBJECTIVES

- To Understand the Introduction and basic Terminologies safety.
- To enable the students to learn about the Important Statutory Regulations and standards.
- To enable students to Conduct and participate the various Safety activities in the Industry.
- To have knowledge about Workplace Exposures and Hazards.
- To assess the various Hazards and consequences through various Risk Assessment Techniques.

UNIT I SAFETY TERMINOLOGIES

Hazard-Types of Hazard- Risk-Hierarchy of Hazards Control Measures-Lead indicators- lag Indicators- Flammability- Toxicity Time-weighted Average (TWA) - Threshold LimitValue (TLV) - Short Term Exposure Limit (STEL)- Immediately dangerous to life or health (IDLH)- acute and chronic Effects- Routes of Chemical Entry-Personnel Protective Equipment- Health and Safety Policy-Material Safety Data Sheet MSDS

UNIT II STANDARDS AND REGULATIONS

Indian Factories Act-1948- Health- Safety- Hazardous materials and Welfare- ISO 45001:2018 occupational health and safety (OH&S) - Occupational Safety and Health Audit IS14489:1998- Hazard Identification and Risk Analysis- code of practice IS 15656:2006

UNIT III SAFETY ACTIVITIES

Toolbox Talk- Role of safety Committee- Responsibilities of Safety Officers and Safety Representatives- Safety Training and Safety Incentives- Mock Drills- On-site Emergency Action Plan- Off-site Emergency Action Plan- Safety poster and Display- Human Error Assessment

UNIT IV WORKPLACE HEALTH AND SAFETY

Noise hazard- Particulate matter- musculoskeletal disorder improper sitting poster and lifting Ergonomics RULE & REBA- Unsafe act & Unsafe Condition- Electrical Hazards- Crane Safety- Toxic gas Release

UNIT V HAZARD IDENTIFICATION TECHNIQUES

Job Safety Analysis-Preliminary Hazard Analysis-Failure mode and Effects Analysis- Hazard and Operability- Fault Tree Analysis- Event Tree Analysis Qualitative and Quantitative Risk Assessment- Checklist Analysis- Root cause analysis- What-If Analysis- and Hazard Identification and Risk Assessment

TOTAL : 45 PERIODS

Course outcomes

on completion of this course the student will be able:

- Understand the basic concept of safety.
- Obtain knowledge of Statutory Regulations and standards.
- Know about the safety Activities of the Working Place.
- Analyze on the impact of Occupational Exposures and their Remedies
- Obtain knowledge of Risk Assessment Techniques.

TEXTBOOKS

1. R.K. Jain and Prof. Sunil S. Rao Industrial Safety, Health and Environment Management Systems KHANNA PUBLISHER
2. L. M. Deshmukh Industrial Safety Management: Hazard Identification and Risk Control McGraw-Hill Education

REFERENCES

1. Frank Lees (2012) ‘Lees’ Loss Prevention in Process Industries.Butterworth-Heinemann publications, UK, 4th Edition.
2. John Ridley & John Channing (2008)Safety at Work: Routledge, 7th Edition.
3. Dan Petersen (2003) Techniques of Safety Management: A System Approach.
4. Alan Waring.(1996).Safety management system: Chapman &Hall,England
5. Society of Safety Engineers, USA

ONLINE RESOURCES

ISO 45001:2018 occupational health and safety (OH&S) International Organization for Standardization https://www.iso.org/standard/63787.html

Indian Standard code of practice on occupational safety and health audit https://law.resource.org/pub/in/bis/S02/is.14489.1998.pdf

Indian Standard code of practice on Hazard Identification and Risk Analysis IS 15656:2006 https://law.resource.org/pub/in/bis/S02/is.15656.2006.pdf

CO’s – PO’s & PSO’s MAPPING

Course Outcomes	Statement	Program Outcome														
		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
CO1	Understand the basic concept of safety.	3	3	3	1	1	3	2	2	3	3	1	3	3	3	3
CO2	Obtain knowledge of Statutory Regulations and standards.	2	3	2	2	1	3	2	3	3	2	1	3	3	3	3
CO3	Know about the safety Activities of the Working Place.	2	2	2	2	1	2	2	2	3	2	1	2	3	3	3
CO4	Analyze on the impact of Occupational Exposures and their Remedies	3	3	3	2	2	3	2	2	3	2	1	3	3	3	3
CO5	Obtain knowledge of Risk Assessment Techniques.	3	2	3	2	2	3	2	2	3	2	2	3	3	3	3
	Industrial safety	3	3	3	2	1	3	2	2	3	2	1	3	3	3	3

ELECTIVE 1 V SEM

21153E54A UTILIZATION AND CONSERVATION OF ELECTRICAL ENERGY **LTPC 3003**

COURSE OBJECTIVES:

- To know various electric drives and traction motors with applications
- To introduce the energy saving concept by different ways of illumination.
- To understand the different methods of electric heating and electric welding.
- To know the conversion of solar and wind energies into electrical energy for different applications.
- To study the domestic utilization of electrical energy.

UNIT I ELECTRIC DRIVES AND TRACTION (7+2 Skill) 9

Fundamentals of electric drive - choice of an electric motor - application of motors for particular services traction generator set, traction motors, power transformers - characteristic features of traction motor - systems of railway electrification - electric braking - train movement and energy consumption - traction motor control - track equipment and collection gear.

UNIT II ILLUMINATION (7+2 Skill) 9

Introduction - definition and meaning of terms used in illumination engineering - classification of light sources - incandescent lamps, sodium vapour lamps, mercury vapour lamps, fluorescent lamps – design of illumination systems - indoor lighting schemes - factory lighting halls - outdoor lighting schemes - flood lighting - street lighting - energy saving lamps, LED

UNIT III HEATING AND WELDING (7+2 Skill) 9

Introduction - advantages of electric heating - modes of heat transfer - methods of electric heating - resistance heating - arc furnaces - induction heating - dielectric heating - electric welding - types - resistance welding - arc welding - power supply for arc welding - radiation welding.

Unit IV ENERGY CONSERVATION AND ITS IMPORTANCE (7+2 Skill) 9

Energy conservation act 2001 and its Features-Review of Industrial Energy Conservation-Energy conservation in electrical Industries-Simulation study of energy conservation using power factor controller. (Three phase circuit simulation with and without capacitor)

UNIT V DOMESTIC UTILIZATION OF ELECTRICAL ENERGY (7+2 Skill) 9

House wiring - working principle of air conditioning system, Induction based appliances, Online an OFF line UPS, Batteries - Power quality aspects – nonlinear and domestic loads – Earthing syste for Domestic, Industrial and Substation.

TOTAL: 45 PERIODS

SKILL DEVELOPMENT ACTIVITIES (Group Seminar/Mini Project/Assignment/Conte Preparation/Quiz/Surprise Test/Solving Problems) 10

1. Choosing electrical motors for drives and traction applications.
2. A general design procedure for lighting schemes.
3. Design of heating element and study of welding methods.

4. Practical case studies of energy conservation.
5. Power requirement for different domestic appliances.

COURSE OUTCOMES:

At the end of the course, students should have the:

CO1 Ability to choose suitable electric drives for different applications
CO2 Ability to design the illumination systems for energy saving
CO3 Ability to demonstrate the utilization of electrical energy for heating and welding purposes
CO4 Ability to know the effective usage of solar and wind energies for electrical applications
CO5 Ability to do electric connection for any domestic appliance like refrigerator, batte charging circuit for a specific household application.
CO6 To illustrate the need for energy conservation and to simulate three phase pow control.

TEXT BOOKS:

1. N.V. Suryanarayana, "Utilisation of Electric Power", Wiley Eastern Limited, New Ag International Limited, 1994 & Second Edition 2017 Feb.
2. J.B.Gupta, "Utilisation Electric power and Electric Traction", S.K.Kataria and sons, 200 2012th Edition, 2013, January.
3. G.D.Rai,"Non-Conventional Energy sources",Khanna publications Ltd.,New Delhi 1998
4. D.P.Kothari, K.C.Singal, Rakesh Ranjan, "Renewable Energy Sources and Emergin Technologies", PHI Learing Private Limited, 3rd Edition 2022.
5. Industrial Energy Conservation, Volume I-II, S C Bhatia, Sarvesh Devraj, Energy conservation and Managment by Akshay A pujara1st edition, June 2018.

REFERENCES:

1. R.K.Rajput, Utilisation of Electric Power, Laxmi publications 2nd Edition 2016.
2. H.Partab, Art and Science of Utilisation of Electrical Energy", Edition, Dhanpat Rai and Co New Delhi-2004.
3. C.L.Wadhwa, "Generation, Distribution and Utilisation of Electrical Energy", New Ag international Pvt.Ltd., 3rd Edition, 2015 January.

MAPPING OF COs WITH POs AND PSOs

COs	POs												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PS01	PS02	PS03
CO1	3	3	2	1	-	1	-	1.5	-	-	-	-	3	-	-
CO2	2	1	3	-	-	-	-	1.5	-	-	-	-	3	-	-
CO3	3	2	2	-	-	1	-	1.5	-	-	-	-	3	-	-
CO4	1	2	3	-	-	-	-	1.5	-	-	-	-	3	-	-
CO5	1	1	3	-	-	1	-	1.5	-	-	-	-	3	3	2
CO6	3	3	3	-	-	-	-	1.5	-	-	-	-	3	3	3
Avg	2.2	2	2.6	1	-	1	-	1.5	-	-	-	-	3	3	2.5

21153E54B **EMBEDDED SYSTEM DESIGN** **LT P C**
2 0 2 3

COURSE OBJECTIVES:

- To introduce the Building Blocks of an embedded System and Software Tools
- To emphasize the role of Input/output interfacing with Bus Communication protocol.
- To illustrate the ISR and scheduling for the multitasking process.
- To explain the basics of a Real-time operating system
- To analyze the applications based on embedded design approaches

UNIT I INTRODUCTION TO EMBEDDED SYSTEMS 6

Introduction to Embedded Systems –Structural units in Embedded processor, selection of processor & memory devices- DMA – Memory management methods- Timer and Counting devices, Real Time Clock, In-circuit emulator, Target Hardware Debugging.

UNIT II EMBEDDED NETWORKING 6

Embedded Networking: Introduction, I/O Device Ports & Buses- Serial Bus communication protocols RS232 standard – RS485 – CAN Bus- Serial Peripheral Interface (SPI) – Inter-Integrated Circuits (I^2C).

UNIT III INTERRUPTS THE SERVICE MECHANISM AND DEVICE DRIVER 6

Programmed-I/O busy-wait approach without interrupt service mechanism-ISR concept-interrupt sources – multiple interrupts – context and periods for context switching, interrupt latency and deadline – Introduction to Device Drivers.

UNIT IV RTOS-BASED EMBEDDED SYSTEM DESIGN 6

Introduction to basic concepts of RTOS- Task, process & threads, interrupt routines in RTOS, Multiprocessing and Multitasking, Preemptive and non-preemptive scheduling, Task communication- shared memory, message passing- Interprocess Communication- Introduction to process synchronization using semaphores.

UNIT V EMBEDDED SYSTEM APPLICATION DEVELOPMENT 6

Embedded Product Development Life Cycle Case Study: Precision Agriculture- Autonomous car.

30 PERIODS

LAB COMPONENT: 30 PERIODS

1. Laboratory exercise: Use any Embedded processor/IDE/open source platform to give hands-on training on basic concepts of embedded system design:
   a) Introduction to IDE and Programming Environment.
   b) Configure timer block for signal generation (with given frequency).
   c) Interrupts programming example using GPIO.
   d) I^2C communication with peripherals
   e) Master-slave communication between processors using SPI.
   f) Networking of processor using Wi-Fi.
   g) Basic RTOS concept and programming

2. Assignment: Introduction to VxWorks, чC/OS-II, RT Linux
3. Embedded systems-based Mini project.

TOTAL: 30+30 = 60 PERIODS

COURSE OUTCOMES:

After completion of the above subject, students will be able to understand

CO1: The hardware functionals and software strategies required to develop various Embedded systems
CO2: The basic differences between various Bus communication standards
CO3: The incorporation of the interface as Interrupt services
CO4: The various scheduling algorithms through a Real-time operating system.
CO5: The various embedded concepts for developing automation applications.

TEXTBOOKS:

1. Rajkamal, 'Embedded system-Architecture, Programming, Design, McGraw-Hill Edu, 3rd edition 2017
2. Peckol, "Embedded system Design", John Wiley & Sons,2010.

REFERENCES:

1. Shibu. K.V, "Introduction to Embedded Systems", TataMcgraw Hill, 2nd edition 2017.
2. Lya B.Das," Embedded Systems" ,Pearson Education, 1st edition 2012.
3. Parag H.Dave,Himanshu B.Dave," Embedded Systems-Concepts ,Design and Programming, Pearson Education,2015, 1st edition.
4. Elicia White, "Making Embedded systems", O'Reilly Series ,SPD,2011, 1st edition.
5. Jonathan W. Valvano, 'Embedded Microcomputer Systems Real-time Interfacing', Cengage Learning , 3rd edition 2010.
6. Tammy Noergaard, "Embedded Systems Architecture", Newnes, 2nd edition, 2013.

List of Open Source Software/ Learning websites:

1. https://nptel.ac.in/courses/108102045
2. https://ece.uwaterloo.ca/~dwharder/icsrts/Lecture_materials/A_practical_introduction_to_real-time_systems_for_undergraduate_engineering.pdf
3. https://www.circuitbasics.com/basics-of-the-i2c-communication-protocol/
4. https://www.tutorialspoint.com/embedded_systems/es_interrupts.htm
5. https://www.theengineeringprojects.com/2016/11/examples-of-embedded-systems.html#:~:text=Embedded%20Product%3A%20Automatic%20Washing%20Machine,done%20by%20your%20machine%20itself.

MAPPING OF COs WITH POs AND PSOs

COs	POs												PSOs		
	PO1	PO2	PO3	PO4	PO5	P06	P07	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	2	2	1	-	-	-	-	-	-	-	2	2	3
CO2	3	2	3	2	1	-	-	-	-	-	-	-	2	1	3
CO3	3	3	2	3	1	-	-	-	-	-	-	-	2	1	2
CO4	3	2	2	2	1	-	-	-	-	-	-	-	1	2	3
CO5	3	2	1	2	1	-	-	-	1	-	-	-	3	1	2
Avg	3	2.2	2	2.2	1	-	-	-	1	-	-	-	2	1.4	2.6

21153E54C	ELECTRIC VEHICLE ARCHITECTURE	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To learn the structure of Electric Vehicle, Hybrid Electric Vehicle
- To study about the EV conversion components
- To know about the details and specifications for Electric Vehicles
- To understand the concepts of Plug-in Hybrid Electric Vehicle
- To model and simulate all types of DC motors

UNIT I VEHICLE ARCHITECTURE and SIZING (7+2 Skill) 9

Electric Vehicle History, and Evolution of Electric Vehicles. Series, Parallel and Series parallel Architecture, Micro and Mild architectures. Mountain Bike - Motorcycle- Electric Cars and Heavy Duty EVs. -Details and Specifications.

UNIT II VEHICLE MECHANICS (7+2 Skill) 9

Vehicle mechanics- Roadway fundamentals, Laws of motion, Vehicle Kinetics, Dynamics of vehicle motion, propulsion power, velocity and acceleration, Tire -Road mechanics, Propulsion System Design.

UNIT III POWER COMPONENTS AND BRAKES (7+2 Skill) 9

Power train Component sizing- Gears, Clutches, Differential, Transmission and Vehicle Brakes. EV power train sizing, HEV Powertrain sizing, Example.

UNIT IV HYBRID VEHICLE CONTROL STRATEGY (7+2 Skill) 9

Vehicle supervisory controll, Mode selection strategy, Modal Control strategies.

UNIT V PLUG-IN HYBRID ELECTRIC VEHICLE (7+2 Skill) 9

Introduction-History-Comparison with electrical and hybrid electrical vehicle-Construction and working of PHEV-Block diagram and components-Charging mechanisms-Advantages of PHEVs.

TOTAL : 45 PERIODS

SKILL DEVELOPMENT ACTIVITIES (Group Seminar/Mini Project/Assignment/Content Preparation / Quiz/ Surprise Test / etc) Basics of MATLAB simulation 10

1. Variables and Expressions Formats, Vectors and Matrices,
2. Arrays, Vectors,
3. Matrices, Built-in functions, Trigonometric functions,
4. Data types and Plotting.
5. Simulation of drive cycles.

COURSE OUTCOMES:

Upon completion of the course, students will be able to:

CO1: Summarize the History and Evolution of EVs, Hybrid and Plug-In Hybrid EVs

CO2: Describe the various EV components

CO3: Describe the concepts related in the Plug-In Hybrid Electric Vehicles

CO4: Analyse the details and Specifications for the various EVs developed.

CO5: Describe the hybrid vehicle control strategy.

REFERENCES:

1. Mehrdad Ehsani, YiminGao, Sebastian E. Gay, Ali Emadi, 'Modern Electric, Hybrid Electric and Fuel Cell Vehicles: Fundamentals, Theory and Design', CRC Press, 2004.
2. Build Your Own Electric Vehicle,Seth Leitman , Bob Brant, McGraw Hill, Third Edition 2013.
3. Advanced Electric Drive Vehicles, Ali Emadi, CRC Press, First edition 2017.
4. The Electric Vehicle Conversion Handbook: How to Convert Cars, Trucks, Motorcycles, and Bicycles -- Includes EV Components, Kits, and Project Vehicles Mark Warner, HP Books, 2011.
5. Heavy-duty Electric Vehicles from Concept to Reality, Shashank Arora, Alireza Tashakori Abkenar, Shantha Gamini Jayasinghe, Kari Tammi, Elsevier Science, 2021
6. Electric Vehicles Modern Technologies and Trends, Nil Patel, Akash Kumar Bhoi, Sanjeevikumar Padmanaban, Jens Bo Holm-Nielsen Springer, 2020
7. Hybrid Electric Vehicles: A Review of Existing Configurations and Thermodynamic Cycles, Rogelio León , Christian Montaleza , José Luis Maldonado , Marcos Tostado-Véliz and Francisco Jurado, Thermo, **2021**, 1, 134-150. https://doi.org/10.3390/thermo1020010.

MAPPING OF COs WITH POs AND PSOs

COs	POs												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	-	2	-	-	-	-	1	-	-	-	2	3	-	-
CO2	3	-	2	-	-	-	-	1	-	-	-	2	3	3	3
CO3	3	-	2	-	-	-	-	1	-	-	-	2	3	-	-
CO4	3	-	2	-	-	-	-	1	-	-	-	2	3	-	-
CO5	3	-	3	3	3	-	-	1	-	-	-	2	3	3	3
Avg	3	-	2.2	3	3	-	-	1	-	-	-	2	3	3	3

21153E54D **ENERGY MANAGEMENT AND AUDITING** **L T P C**
3 0 0 3

COURSE OBJECTIVES:

- To study the concepts behind economic analysis and Load management.
- To understand the basics of materials and energy balance.
- To analyze the energy efficiency in thermal utilities.
- To know the concept of compressed air system.
- To illustrate the concept of lighting systems and cogeneration.

UNIT I GENERAL ASPECTS OF ENERGY MANAGEMENT AND ENERGY AUDIT **(7+2 Skill) 9**

Commercial and Non-commercial energy - final energy consumption - energy needs of growing economy - energy pricing - energy conservation and its importance - Re-structuring of the energy supply sector - Energy Conservation Act 2001, Energy Conservation (Amendment) Act, 2010, and its features - electricity tariff - Thermal Basics - need and types of energy audit - Energy management/audit approach- understanding energy costs - maximizing system efficiencies - optimizing the input energy requirements - energy audit instruments - Case study.

UNIT II MATERIAL AND ENERGY BALANCE (7+2 Skill) 9

Methods for preparing process flow - material and energy balance diagrams - Energy policy purpose - location of energy management - roles and responsibilities of energy manager - employees training and planning- Financial Management: financial analysis techniques, simple payback period, return on investment, net present value, internal rate of return – Case Study.

UNIT III ENERGY EFFICIENCY IN THERMAL UTILITIES (7+2 Skill) 9

Introduction to fuels - properties of fuel oil, coal and gas - principles of combustion - combustion of oil, coal and gas - Boilers: Types, combustion in boilers, performances evaluation, analysis of losses - energy conservation opportunities - FBC boilers - Steam System: Properties of steam, assessment of steam distribution losses, steam leakages, steam trapping, condensate and flash steam recovery system, identifying opportunities for energy savings - Furnaces: Classification, general fuel economy measures in furnaces, excess air, heat distribution, temperature control, draft control, waste heat recovery – Refractory : types, selection and application of refractories, heat loss - Cogeneration: classification and saving potentials - Case Study.

UNIT IV ENERGY EFFICIENCY IN COMPRESSED AIR SYSTEM (7+2 Skill) 9

Compressed Air System: Types of air compressors - efficient compressor operation - Compressed air system components - leakage test - savings opportunities - Refrigeration System: Vapour compression refrigeration cycle - refrigerants - coefficient of performance - factors affecting Refrigeration and Air conditioning system - savings opportunities - Vapour absorption refrigeration system: working principle - types and comparison with vapour compression system - saving potential - Cooling Tower: Types and performance evaluation, efficient system operation - flow control strategies and energy saving - Diesel Generating system: Factors affecting selection - energy performance assessment of diesel conservation avenues - Case Study.

UNIT V ENERGY EFFICIENCY IN ELECTRICAL UTILITIES (7+2 Skill) 9

Electrical load management and maximum demand control - power factor improvement and its benefit - selection and location of capacitors - performance assessment of PF capacitors - automatic power factor controllers - transformer losses - Electric motors: Types - losses in induction motors - motor efficiency - factors affecting motor performance - rewinding and motor replacement issues - energy saving opportunities with energy efficient motors - soft starters with energy saver - variable speed drives – Fans and blowers: Types - efficient system operation - flow control strategies -Pumps and Pumping System: Types - system operation - flow control methods - Lighting System: Light source, choice of lighting, luminance requirements – ballast - occupancy sensors - energy efficient lighting controls - energy conservation avenues - Case Study.

TOTAL : 45 PERIODS

SKILL DEVELOPMENT ACTIVITIES (Group Seminar/Mini Project/Assignment/Content Preparation / Quiz/ Surprise Test / Solving GATE questions/ etc) 10

1. Study of energy conservation and audit
2. Performance study of Electric Motors.
3. Analysis on fan characteristic curves at different operating points
4. Case study of illumination system
5. Performance analysis of Compressors

COURSE OUTCOMES:

Upon completion of the course, students will be able to:

CO1 Students able to acquire knowledge in the field of energy management and auditing process.

CO2 Learned the about basic concepts of economic analysis and load management.

CO3 Able to design the effective thermal utility system.

CO4 Able to improve the efficiency in compressed air system.

CO5 Acquired the design concepts in the field of lighting systems, light sources and various forms of cogeneration.

TEXTBOOKS:

1. Mehmet Kanoglu, Yunus A Cengel, "Energy Efficiency and Management for Engineers", McGraw-Hill Education, First Edition, 2020.

REFERENCES:

1. Moncef Krati, ‘Energy Audit of Building Systems: An Engineering Approach’, Third Edition, CRC Press, Dec.2020.
2. Sonal Desai, ‘Handbook of Energy Audit’, McGraw Hill Education (India) Private Limited, 2015.
3. Michael P.Deru, Jim Kelsey, ‘Procedures for Commercial Building Energy Audits’, American Society of Heating, Refrigerating and Air conditioning Engineers, 2011.
4. Thomas D.Eastop, ‘Energy Efficiency: For Engineers and Technologists’, Longman Scientific & Technical, 1990, 1st Edition.
5. ‘Energy Managers and Energy Auditors Guide book’, Bureau of Energy Efficiency, 2006.
6. Larry C. Witte, Philip S.Schmidt, David R.Brown, ‘Industrial Energy Management and Utilization’, Springer Berlin Heidelberg, 1988.

List of Open Source Software/ Learning website:

1. http://lab.fs.uni-lj.si/kes/erasmus/Energy%20Management%20Handbook.pdf
2. https://www.sciencedirect.com/science/article/pii/S2212827114004491
3. https://mppolytechnic.ac.in/mp-staff/notes_upload_photo/CS595EnergyEfficiencyinElectricalUtilities-5391.pdf
4. http://knowledgeplatform.in/wp-content/uploads/2017/03/1.3-Energy-management-Audit.pdf

MAPPING OF COs WITH POs AND PSOs

COs	POs												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	-	2	-	-	-	1	-	-		2	3	2	3
CO2	3	-	-	-	-	-	2	1	3	-	1	2	3	2	3
CO3	3	-	1	2	3	-	-	1		-	-	2	3	2	3
CO4	3	3	-	-	-	-	-	1	3	-	-	2	3	2	3
CO5	3	-	1	2	-	-	-	1		-	2	2	3	2	3
Avg	3	2.5	1	2	3	-	2	1	3	-	1.5	2	3	2	3

21153E54E **SMPS AND UPS** **L T P C**

2 0 2 3

COURSE OBJECTIVES:

- To learn the working of isolated & non-isolated DC-DC converters
- To design isolated & non-isolated DC-DC converters.
- To drive the equations related with converter dynamics.
- To design and simulate P, PI & PID controller for buck, boost and buck-boost converters.
- To identify and study different configurations of the UPS.

UNIT I ANALYSIS OF NON-ISOLATED DC-DC CONVERTERS 6

Basic topologies: Buck, Boost and Buck-Boost Principles of operation – Continuous conduction mode– Concepts of volt-sec balance and charge balance – Analysis and design based on steady-state relationships – Introduction to discontinuous conduction mode.

UNIT II ANALYSIS OF ISOLATED DC-DC CONVERTERS 6

Introduction classification- forward- flyback- pushpull – half bridge – full bridge topologies- C'uk converter as cascade combination of boost followed by buck – isolated version of C'uk converter design of SMPS – Introduction to design of magnetic components for SMPS, using relevant software- Simulation of bidirectional DC DC converter (both non-isolated and isolated) considering EV as an example application.

UNIT III CONVERTER DYNAMICS 6

AC equivalent circuit analysis – State space averaging – Circuit averaging – Transfer function model for buck, boost and buck-boost converters – Simulation of basic topologies using state space model derived – Comparison with the circuit model based simulation already carried out.

UNIT IV CONTROLLER DESIGN 6

Review of P, PI, and PID control concepts – gain margin and phase margin – Bode plot based analysis – Design of controller for buck, boost and buck-boost converters.

UNIT V POWER CONDITIONERS AND UPS 6

Introduction – Power line disturbances – Power conditioners – UPS: Offline and On-line – Need for filters – Filter for PWM VSI – Front-end battery charger – boost charger.

30 PERIODS

LAB COMPONENT: 30 PERIODS

1. Simulation of Basic topologies.
2. Simulation of bidirectional DC DC converter (both non-isolated and isolated) considering
   EV as an example application.
3. Simulation of basic topologies using state space model derived – Comparison with the circuit model based simulation already carried out.
4. Simulation study of controller design for basic topologies.
5. Simulation of battery charger for EV applications.

TOTAL: 30+30 = 60 PERIODS

COURSE OUTCOMES:

At the end of the course, students should have the following capabilities:

CO1: Demonstrate the working of buck boost and buck- boost converters in continuous and discontinuous conduction mode.

CO2: Build buck/boost converters using suitable design method.

CO3: Analyze the behaviors of isolated DC-DC converters and to design SMPS for battery operated vehicle.

CO4: Compute state space averaged model and transfer function for buck, boost and buck-boost converters.

CO5: Demonstrate the P, PI and PID controller performance analytically and by simulation for buck boost and buck- boost converters.

CO6: Compare the different topologies of UPS and also simulate them.

TEXT BOOKS:

1. Robert W. Erickson & Dragon Maksimovic, " Fundamentals of Power Electronics", Third Edition, 2020
2. Ned Mohan," Power Electronics: A First Course", Johnwiley, 2013.
3. Marian K. Kazimierczuk and Agasthya Ayachit,"Laboratory Manual for Pulse-Width Modulated DC- DC Power Converters", Wiley 2016.
4. Power Electronics handbook, Industrial Electronics series, S.K.Varenina, CRC press, 2002.
5. Power Electronic Converters, Teuvo Suntio, Tuomas Messo, Joonas Puukko, First Edition 2017.

MAPPING OF COs WITH POs AND PSOs

COs	POs												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	3	-	-	3	3	-	2	-	3	3	3	3
CO2	3	3	3	3	-	-	3	3	-	2	-	3	3	3	3
CO3	3	3	3	3	-	-	3	-	-	3	-	3	3	3	3
CO4	3	3	3	3	-	-	-	-	-	2	-	3	3	3	3
CO5	3	3	3	3	-	-	3	3	-	3	-	3	3	3	3
CO6	3	3	3	3	-	-	3	3	-	3	-	3	3	3	3
Avg	3	3	3	3	-	-	3	3	-	2.5	-	3	3	3	3

21153E54F SMART SYSTEM AUTOMATION

L T P C
2 0 2 3

COURSE OBJECTIVES:

- To introduce the smart system technologies and its role in real time applications
- To teach the architecture and requirements of Home Automation.
- To provide an insight into smart appliances and energy management concepts.
- To familiarize the design and needs of smart wearable devices
- To teach the basics of robotics and its role for automation.

UNIT I INTRODUCTION 6

Overview of a smart system - Hardware and software selection ---Smart sensors and Actuators - Communication protocols used for smart systems.

UNIT II HOME AUTOMATION 6

Home Automation – System Architecture Essential Components- Design Considerations: Control Unit, Sensing Requirements, Communication, Data Security.

UNIT III SMART APPLIANCES AND ENERGY MANAGEMENT 6

Significance of smart appliances for energy management Smart Meters: Significance, Architecture & Energy Measurement Technique – Security Considerations.

UNIT IV SMART WEARABLE DEVICES 6

Body Area Networks Sensors- communication protocol for Wearable devices- Application of Smart Wearable in Healthcare & Activity Monitoring.

UNIT V EMBEDDED SYSTEMS AND ROBOTICS 6

Fundamental concepts in Robotics- Robots and Controllers components----Embedded processor based: pick and place robot- Mobile Robot Design- UAV.

30 PERIODS

LAB COMPONENTS: 30 PERIODS

1. Laboratory exercise: Use Arduino/ R pi/ any other Embedded processors to give hands on training to understand concepts related to smart automation.
   a) Hands on experiments based on Ubidots & Thing speak / Open-source Analytics Platform
   b) Design and implementation of a smart home system .
   c) Bluetooth Based Home Automation Project using Android Phone
   d) GSM Based Home Devices Control
   e) Pick and place robots using Arduino/ any suitable Embedded processor
2. Assignment: Revolution of Smart Automation system across the world and its current scope available in India
3. Mini project: Design of a Smart Automation system (for any application of students choice)

TOTAL: 30+30 = 60 PERIODS

COURSE OUTCOMES:

At the end of this course, the students will have the ability to

CO1: Understand the concepts of smart system design and its present developments.

CO2: Illustrate different embedded open-source and cost-effective techniques for developing solution for real time applications.

CO3: Acquire knowledge on different platforms and Infrastructure for Smart system design.

CO4: Infer about smart appliances and energy management concepts.

CO5: Improve Employability and entrepreneurship capacity due to knowledge upgradation on embedded system technologies.

TEXTBOOKS:

1. Grimm, Christoph, Neumann, Peter, Mahlknech and Stefan, Embedded Systems for Smart Appliances and Energy Management, Springer 2013, 1st Edition.
2. KazemSohraby, Daniel Minoli and TaiebZnati, Wireless Sensor Networks Technology, Protocols, and Applications, John Wiley & Sons, 2007, 1st Edition.
3. NilanjanDey, Amartya Mukherjee, Embedded Systems and Robotics with Open-Source Tools, CRC press, 2016, 1st Edition.

REFERENCES:

1. Thomas Bräunl, Embedded Robotics, Springer, 2003.
2. Raj Kamal, Embedded Systems - Architecture, Programming and Design, McGraw- Hill, 2008
3. Karim Yaghmour, Embedded Android, O'Reilly, 2013.
4. Steven Goodwin, Smart Home Automation with Linux and Raspberry Pi, Apress , 2013
5. C.K. Toh, AdHoc mobile wireless networks, Prentice Hall, Inc, 2002.
6. Anna Ha´c, Wireless Sensor Network Designs, John Wiley & Sons Ltd, 2003.
7. J. J. Craig, “Introduction to Robotics Mechanics and Control”, Pearson Education.
8. Y. Koren, “Robotics for Engineers”, McGraw-Hill.
9. Robert Faludi, Wireless Sensor Networks, O’Reilly, 2011.

List of Open Source Software/ Learning website:

1. https://microcontrollerslab.com/home-automation-projects-ideas/
2. https://www.learnrobotics.org/blog/simple-robot/
3. https://robolabor.ee/homelab/en/iot
4. https://electrovolt.ir/wp-content/uploads/2018/03/Exploring_Raspberry_Pi_Molloy_Derek_ElectroVolt.ir_.pdf
5. http://www.robot.bmstu.ru/files/books/(Ebook%20-%20English)%20Mcgraw-Hil,%20Pic%20Robotics%20--%20A%20Beginner'S%20Guide%20To%20Robotic.pdf

MAPPING OF COs WITH POs AND PSOs

COs	POs												PSOs		
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**P06**	**P07**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	2	1	3	1	3	-	-	-	-	-	-	-	1	2	2
CO2	3	1	2	2	3	-	-	-	-	-	-	-	1	1	3
CO3	2	2	3	2	3	-	-	-	-	-	-	-	2	2	2
CO4	2	2	2	1	3	-	-	-	-	-	-	-	1	2	2
CO5	3	2	2	2	3	-	-	-	1	-	-	-	2	2	3
Avg	2.4	1.6	2.4	1.6	3	-	-	-	1	-	-	-	1.4	1.8	2.4

ELECTIVE II (V SEMESTER)

21153E55A **SPECIAL ELECTRICAL MACHINES** **L T P C**
3 0 0 3

COURSE OBJECTIVES:

- To understand the working of special machines like stepper motor, switched reluctance motor, BLDC motor & PMSM
- To derive torque equation and study the characteristics of special machines
- To design the controller for special machines
- To study the working principle of synchronous reluctance motor
- To simulate closed loop operation of BLDC motor

UNIT I STEPPER MOTORS 6

Constructional features –Principle of operation –Types – Torque predictions – Linear and Non-linear analysis – Characteristics – Drive circuits – Closed loop control –Applications

UNIT II SWITCHED RELUCTANCE MOTORS 6

Constructional features –Principle of operation- Torque prediction–Characteristics-Power controllers – Control of SRM drive- Speed control-current control-design procedures- Sensor less operation of SRM – Current sensing-rotor position measurement and estimation methods- sensor less rotor position estimation-inductance based estimation –applications.

UNIT III PERMANENT MAGNET BRUSHLESS DC MOTORS 6

Fundamentals of Permanent Magnets- Types- Principle of operation- Magnetic circuit analysis EMF and Torque equations- Characteristics- Controller design-Transfer function –Machine, Load and Inverter-Current and Speed Controller.

UNIT IV PERMANENT MAGNET SYNCHROUNOUS MOTORS 6

Permanent Magnet ac Machines, Machine Configurations, PMSM Principle of operation – EMF and Torque equations - Phasor diagram - Torque speed characteristics –evaluation of control characteristics- design of current and speed controllers- Constructional features, operating principle and characteristics of synchronous reluctance motor.

UNIT V STUDY OF OTHER SPECIAL ELECTRICAL MACHINES 6

Principle of operation and characteristics of Hysteresis motor – AC series motors – Linear motor – Applications.

30 PERIODS

LAB COMPONENT: **30 PERIODS**

Using electromagnetic software

1) Simulation of BLDC motor
2) Simulation of SRM motor
3) Simulation of stepper motor
4) Simulation of PMSM motor
5) Simulation of any other special machines

TOTAL: 30+30 = 60 PERIODS

OURSE OUTCOMES:

CO1 Ability to model and analyze power electronic systems and equipment using computational software.

CO2 Ability to optimally design magnetics required in special machines based drive systems using FEM based software tools.
CO3 Ability to analyse the dynamic performance of special electrical machines
CO4 Ability to understand the operation and characteristics of other special electrical machines.
CO5 Ability to design and conduct experiments towards research.

REFERENCES:

1. Jacek F. Gieras, Dr. Rong-Jie Wang, Professor Maarten J. Kamper - Axial Flux Permanent Magnet Brushless Machines-Springer Netherlands 2008.
2. Bilgin, Berker Emadi, Ali Jiang, James Weisheng - Switched reluctance motor drives: fundamentals to applications-CRC 2019.
3. Ramu Krishnan - Permanent Magnet Synchronous and Brushless DC Motor Drives -CRC Press, Marcel Applications -CRC Press 2009

6.T.Kenjo, ' Stepping motors and their microprocessor controls', Oxford University press, New Delhi, 2000 Dekker 2009

4.T.J.E. Miller, 'Brushless magnet and Reluctance motor drives', Clarendon press, London, 1989

5.R. Krishnan - Switched Reluctance Motor Drives Modeling, Simulation, Analysis, Design, and Applications -CRC Press 2017.

MAPPING OF COs WITH POs AND PSOs

COs	POs												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	-	-	-	-	-	-	1	-	1	-	1	3	2	1
CO2	3	3	3	3	-	-	2	1	-	2	-	3	3	3	3
CO3	3	-	-	-	-	-	-	1	-	1	-	1	3	3	3
CO4	3	3	3	3	-	-	-	1	-	3	-	3	3	3	3
CO5	3	3	3	3	-	-	3	1	-	3	-	3	3	3	3
CO6	3	3	3	3	3	-	-	1	-	3	-	3	3	3	3
Avg	3	3	3	3	3	-	2.5	1	-	2.2	-	2.3	3	2.8	2.6

21153E55B **PROCESS MODELING AND SIMULATION**

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

- To understand the important of mathematical models for Industrial processes
- To acquaint students with different forms of mathematical models.
- To develop and simulate mathematical models for different Industrial processes.
- To apply Mathematical tools while developing mathematical models.
- To analyze the graphical response of developed mathematical models.

UNIT I GENERAL PRINCIPLES OF MODELLING (7+2 SKILL) 9

Introduction to mathematical modeling; Advantages and limitations of models and applications of process models of stand-alone unit operations and unit processes; Classification of models: Linear vs Nonlinear, Lumped parameter vs. Distributed parameter; Static vs. Dynamic, Continuous vs. Discrete; Numerical Methods: Iterative convergence methods, Numerical integration of ODE- IVP and ODEBVP

UNIT II MODELLING OF DISTRIBUTED PROCESSES (7+2 SKILL) 9

Steady state models giving rise to differential algebraic equation (DAE) systems; Rate basedApproaches for staged processes; Modeling of differential contactors – distributed parameter models of packed beds; Packed bed reactors; Modeling of reactive separation processes; Review of solution strategies for Differential Algebraic Equations (DAEs), Partial Differential Equations (PDEs), and available numerical software libraries.

UNIT III INTRODUCTION TO PROCESS MODELLING (7+2 SKILL) 9

Concept of degree of freedom analysis: System and its subsystem, System interaction, Degree of freedomin a system e.g. Heat exchanger, Equilibrium still, Reversal of information flow, Design variable selectionalgorithm, Information flow through subsystems, Structural effects of design variable selection, PersistentRecycle.

UNIT IV MODELLING OF INDUSTRIAL PROCESSES (7+2 SKILL) 9

Simple examples of process models; Models giving rise to nonlinear algebraic equation (NAE) systems, -steady state models of flash vessels, equilibrium staged processes distillation columns, absorbers,strippers, CSTR, heat exchangers, etc.; Review of solution procedures and available numerical softwarelibraries

UNIT V SIMULATION OF MATHEMATICAL MODELLING (7+2 SKILL) 9

Simulation and their approaches, Modular, Sequential, Simultaneous and Equation solving approach, Simulation softwares and their applications, Review of solution techniques and available numerical software libraries.- Case Studies.

TOTAL : 45 PERIODS

SKILL DEVELOPMENT ACTIVITIES (Group Seminar/Mini Project/Assignment/Content Preparation / Quiz/ Surprise Test / Solving GATE questions/ etc) 10

1. Developing steady state /Dynamic mathematical model of different unit processes (ODE or PDE)
2. Simulation of steady state/ dynamic models using appropriate software
3. Open loop study based on the developed mathematical model.
4. Development and simulation of unsteady state models for simple processes.

COURSE OUTCOMES:

CO1 Will be able to understand different methods of developing models for industrial processes.

CO2 Able to build mathematical models by applying relevant mathematics.

CO3 Able to implement mathematical models using relevant software.

CO4 Effectively perform analysis and subsequent conclusion for the developed mathematical models.

CO5 Able to interpret the results obtained from the mathematical model in terms of original real world problem

TEXT BOOKS:

1. Denn M. M.,"Process Modeling", Longman, 1986, 1st Edition.
2. Aris R.,"Mathematical Modeling,A Chemical Engineering Perspective (Process System Engineering)", Academic Press, 1999, Volume 1.

REFERENCES:

1 .Luyben W.L., “Process Modeling, Simulation, and Control for Chemical Engineering”, McGraw Hill, 2nd Edition, 1990.
2. D. F. Rudd and C. C. Watson, “ Strategy of Process Engineering”, Wiley international, 1st Edition, 1968.
3. M.M. Denn, “Process Modelling”, Wiley, New York, 1st Edition, 1986.
4. A. K. Jana, “Chemical Process Modelling and Computer Simulation”, PHI,1st Edition, 2011.
5. C.D. Holland, “Fundamentals of Modelling Separation Processes”, Prentice Hall, , 1st Edition, 1975.
6. HussainAsghar, “Chemical Process Simulation”, Wiley Eastern Ltd., New Delhi, , 1st Edition, 1986.

List of Open Source Software/ Learning website:

https://archive.nptel.ac.in/courses/103/107/103107096/

https://nptel.ac.in/courses/103101111

https://nptel.ac.in/courses/111107105

https://www.academia.edu/37228967/Process_Modeling_Simulation_and_Control_for_Chemical_Engineers

MAPPING OF COs WITH POs AND PSOs

COs	POs												PSOs		
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	3	1	-	-	2	1	-	1	1	1	1	1	1	2	2
CO2	3	1	2	-	-	1	-	1	1	1	1	1	1	2	2
CO3	1	-	2	3	-	1	-	1	1	1	1	1	1	2	2
CO4	1	-	3	-	-	1	2	1	1	1	1	1	1	2	2
CO5	1	2	-	3	-	1		1	1	1	1	1	1	2	2
Avg.	3	1	-	-	2	1	2	1	1	1	1	1	1	2	2

21153E55C **ENERGY STORAGE SYSTEMS** **LT P C**
3 0 0 3

COURSE OBJECTIVES:

Students will be able to:

- understand the various types of energy storage Technologies.
- analyze thermal storage system.
- analyze different battery storage technologies
- analyze the thermodynamics of Fuel Cell
- study the various applications of energy storage systems.

UNIT I INTRODUCTION (7+2 SKILL) 9

Necessity of energy storage – types of energy storage – comparison of energy storage technologies – Applications.

UNIT II THERMAL STORAGE SYSTEM (7+2 SKILL) 9

Thermal storage – Types – Modeling of thermal storage units – Simple water and rock bed storage system – pressurized water storage system – Modelling of phase change storage system – Simple units, packed bed storage units - Modelling using porous medium approach, Use of TRNSYS.

UNIT III ELECTRICAL ENERGY STORAGE (7+2 SKILL) 9

Fundamental concept of batteries – measuring of battery performance, charging and discharging, power density, energy density, and safety issues. Types of batteries – Lead Acid, Nickel – Cadmium, Zinc Manganese dioxide, Li-ion batteries - Mathematical Modelling for Lead Acid Batteries – Flow Batteries.

UNIT IV FUEL CELL (7+2 SKILL) 9

Fuel Cell – History of Fuel cell, Principles of Electrochemical storage – Types – Hydrogen oxygen cells, Hydrogen air cell, Hydrocarbon air cell, alkaline fuel cell, detailed analysis – advantages and disadvantages.

UNIT V ALTERNATE ENERGY STORAGE TECHNOLOGIES (7+2 SKILL) 9

Flywheel, Super capacitors, Principles & Methods – Applications, Compressed air Energy storage, Concept of Hybrid Storage – Applications, Pumped Hydro Storage – Applications.

TOTAL: 45 PERIODS

SKILL DEVELOPMENT ACTIVITIES (Group Seminar/Mini Project/Assignment/Content Preparation / Quiz/ Surprise Test / etc) 10

1. Model, simulate and analyze the performance characteristics of thermal storage systems
2. Develop a model for latent heat storage in phase changing materials.
3. Model, simulate and analyze the performance characteristics of Lead Acid Batteries
4. Model, simulate and analyze the performance characteristics of Fuel Cell
5. techno-economic analysis of different types of storage systems

COURSE OUTCOMES:

Upon the successful completion of the course, students will be able to:

CO1: Understand different types storage technologies

CO2: Design a thermal storage system
CO3: Model battery storage system
CO4: Analyze the thermodynamics of fuel cell
CO5: Analyze the appropriate storage technologies for different applications
CO6: explore the alternate energy storage technologies.

TEXT BOOKS:

1. Ibrahim Dincer and Mark A. Rosen, 'Thermal Energy Storage Systems and Applications', John Wiley & Sons, 3rd Edition, 2021.
2. Ru-shi Liu, Lei Zhang and Xueliang sun, 'Electrochemical technologies for energy storage and conversion', Wiley publications, 2nd Volume set, 2012.
3. James Larminie and Andrew Dicks, 'Fuel cell systems Explained', Wiley publications, 3rd Edition, 2018.

REFERENCES:

1. Lunardini.V.J, 'Heat Transfer in Cold Climates', John Wiley and Sons 1981, 1st Edition.
2. Schmidt.F.W. and Willmott.A.J., 'Thermal Energy Storage and Regeneration', Hemisphere Publishing Corporation, 1981, 1st Edition.

List of Open Source Software/ Learning website:

1. Prof. Subhasish Basu Majumder, "Electrochemical Energy Storage", NPTEL Course, https://nptel.ac.in/courses/113105102.
2. Prof. PK Das, "Energy conservation and waste heat recovery", NPTEL Course, https://nptel.ac.in/courses/112105221.

MAPPING OF COs WITH POs AND PSOs

COs	POs												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	1		-	-	-	-	-	-	-	-	-	2	-	3
CO2	3	-	2	-	-	-	-	-	-	-	-	-	2	-	3
CO3	3	-	2	-	-	-	-	-	-	-	-	-	2	-	3
CO4	3	-	2	-	-	-	-	-	-	-	-	-	2	-	3
CO5	3	-	2	-	-	-	-	-	-	-	-	-	2	-	3
CO6	-	3	-	-	-	2	-	1	-	-	-	-	2	-	3
Avg	3	2	2	-	-	2	-	1	-	-	-	-	2	-	3

21153E55D	**TESTING OF ELECTRIC VEHICLES**	**L**	**T**	**P**	**C**
		2	**0**	**2**	**3**

COURSE OBJECTIVES:

- To know various standardization procedures
- To learn the testing procedures for EV & HEV components
- To know the functional safety and EMC
- To realize the effect of EMC in EVs
- To study the effect of EMI in motor drives and in DC-DC converter system

UNIT I EV STANDARDIZATION 6

Introduction - Current status of standardization of electric vehicles, electric Vehicles and Standardization --Standardization Bodies Active in the Field – Standardization activities in countries like Japan. The International Electro Technical Commission Standardization of Vehicle Components.

UNIT II TESTING OF ELECTRIC MOTORS AND CONTROLLERS FOR ELECTRIC AND HYBRID ELECTRIC VEHICLES 6

Test Procedure Using M-G Set, electric motor, controller, application of Test Procedure, Analysis of Test Items for the Type Test - Motor Test and Controller Test (Controller Only) ----Test Procedure Using Eddy Current Type Engine Dynamometer, Test Strategy, Test Procedure, Discussion on Test Procedure. Test Procedure Using AC Dynamometer.

UNIT III FUNDAMENTALS OF FUNCTIONAL SAFETY AND EMC 6

Functional safety life cycle - Fault tree analysis-- Hazard and risk assessment – software development - Process models - Development assessments - Configuration management Reliability - Reliability block diagrams and redundancy - Functional safety and EMC---Functional safety and quality - Standards--Functional safety of autonomous vehicles.

UNIT IV EMC IN ELECTRIC VEHICLES 6

Introduction --EMC Problems of EVs, EMC Problems of Motor Drive, EMC Problems of DC-DC Converter System, EMC Problems of Wireless Charging System, EMC Problem of Vehicle Controller, EMC Problems of Battery Management System, Vehicle EMC Requirements-

UNIT V EMI IN MOTOR DRIVE AND DC-DC CONVERTER SYSTEM 6

Overview--EMI Mechanism of Motor Drive System, Conducted Emission Test of Motor Drive System, IGBT EMI Source, EMI Coupling Path, EMI Modelling of Motor Drive System. EMI in DC-DC Converter, EMI Source, The Conducted Emission High-Frequency, Equivalent Circuit of DC-DC Converter System, EMI Coupling Path

30 PERIODS

LAB COMPONENT: 30 PERIODS

1. Design and simulate motor controller for hybrid electric vehicle applications
2. Simulation of EMC analysis for Wireless power transfer EV charging.
3. Design and simulation of EMI filter

TOTAL: 30+30 = 60 PERIODS

COURSE OUTCOMES:

Upon completion of the course, students will be able to:
CO1: To describe the status and other details of standardization of EVs
CO2: To illustrate the testing protocols for EVs and HEV components
CO3: To analyze the safety cycle and need for functions safety for EVs
CO4: To analyze the problems related with EMC for EV components.
CO5: To evaluate the EMI in motor drive and DC-DC converter system.

REFERENCES:

1. Handbook of Automotive Power Electronics and Motor Drives, Ali Emadi, Taylor & Francis, 2005, 1st Edition.
2. Electromagnetic Compatibility of Electric Vehicle, Li Zhai, Springer 2021, 1st Edition.
3. EMC and Functional Safety of Automotive Electronics, Kai Borgeest, IET 2018, 1st Edition.
4. EMI/EMC Computational Modeling Handbook, Druce Archam beault, colin branch, Omar M.Ramachi ,Springer 2012, 2nd Edition.
5. Automotive EMC, Mark Steffika, Springer 2013, 1st Edition.
6. Electric Vehicle Systems Architecture and Standardization Needs, Reports of the PPP European Green Vehicles Initiative, Beate Müller, Gereon Meyer, Springer 2015, 1st Edition.

MAPPING OF COs WITH POs AND PSOs

COs	POs												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	1	1	-	-	-	2	-	-	-	-	-	3	-	2
CO2	3	1	1	-	-	-	1	-	-	-	-	-	3	-	2
CO3	3	1	1	-	-	-	2	-	-	-	-	-	3	-	2
CO4	3	1	1	-	-	-	1	-	-	-	-	-	3	-	2
CO5	3	1	1	-	-	-	2	-	-	-	-	-	3	-	3
Avg	3	1	1	-	-	-	1.8	2		3		2	3	3	2.3

21153E55E	NON LINEAR CONTROL	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To provide knowledge on design in state variable form
- To provide knowledge in phase plane analysis.
- To give basic knowledge in describing function analysis.
- To study the design of optimal controller.
- To study the design of optimal estimator including Kalman Filter

UNIT I STATE VARIABLE DESIGN (7+2 SKILL) 9

Introduction to state Model- effect of state Feedback- Necessary and Sufficient Condition for Arbitrary Pole-placement- pole placement Design- design of state Observers- separation principle- servo design: -State Feedback with integral control

UNIT II PHASE PLANE ANALYSIS (7+2 SKILL) 9

Features of linear and non-linear systems - Common physical non-linearities – Methods of linearization Concept of phase portraits – Singular points – Limit cycles – Construction of phaseportraits – Phase plane analysis of linear and non-linear systems – Isocline method.

UNIT III DESCRIBING FUNCTION ANALYSIS (7+2 SKILL) 9

Basic concepts, derivation of describing functions for common non-linearities – Describing function analysis of non-linear systems – limit cycles – Stability of oscillations.

UNIT IV OPTIMAL CONTROL (7+2 SKILL) 9

Introduction - Time varying optimal control – LQR steady state optimal control – Solution of Ricatti's equation – Application examples.

UNIT V OPTIMAL ESTIMATION (7+2 SKILL) 9

Optimal estimation – KalmanBucy Filter-Solution by duality principle-Discrete systems-Kalman Filter-Application examples.

TOTAL: 45 PERIODS

SKILL DEVELOPMENT ACTIVITIES (Group Seminar/Mini Project/Assignment/ Content Preparation / Quiz/ Surprise Test / Solving GATE questions/ etc) 10

1 Design of linear quadratic regulator (LQR) control system for any application of your own
2 Familiarization of Kalman filter in MATLAB
3 Seminar on pole placement design

COURSE OUTCOMES:

Students able to

CO1 Able to apply the knowledge gained on state feedback control and nonlinear control. (L3)
CO2 Ability to carryout analysis for common nonlinearities in a system. (L4)
CO3 Apply advanced control theory to practical engineering problems. (L3)
CO4 Design optimal controller. (L5)
CO5 Understand the basics and Importance of Kalman filter. (L2)

TEXT BOOKS:

1. G. J. Thaler, "Automatic Control Systems", Jaico Publishing House 1993.
2. M.Gopal, Modern Control System Theory, New Age International Publishers, 2002, 2nd Edition.
3. K. P. Mohandas, "Modern Control Engineering", Sanguine Technical Publishers, 2006, 1st Edition.

REFERENCES:

1. Ashish Tewari, 'Modern Control Design with Matlab and Simulink', John Wiley, New Delhi, 2002, 1st Edition.
2. K. Ogata, 'Modern Control Engineering', 5th Edition, PHI, New Delhi, 2009.
3. T. Glad and L. Ljung,, "Control Theory -Multivariable and Non-Linear Methods", Taylor & Francis, 2002, 1st Edition.
4. D.S.Naidu, "Optimal Control Systems" First Indian Reprint, CRC Press, 2009, 1st Edition.
5. William S Levine, "Control System Fundamentals," The Control Handbook, CRC Press, Tayler and Francies Group, 2011, 2nd Edition.

List of Open Source Software/ Learning website:

https://in.mathworks.com/discovery/kalman-filter.html
https://in.mathworks.com/help/control/getstart/design-an-lqr-servo-controller-insimulink.html
https://onlinecourses.nptel.ac.in/noc22_ee24/preview
http://www.nitttrc.edu.in/nptel/courses/video/101108047/lec22.pdf

MAPPING OF COs WITH POs AND PSOs

COs	POs												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	2	2	1	1	1	3	1	3	1	1	2	2	2
CO2	3	3	3	2	1	1	1	3	1	3	1	1	2	2	2
CO3	3	2	2	2	1	1	1	3	1	3	1	1	2	2	2
CO4	3	3	3	3	1	1	1	3	1	3	1	1	2	2	2
CO5	2	1	2	1	1	1	1	2	1	2	1	1	2	2	2
Avg.	2.8	2.2	2.4	2	1	1	1	2.8	1	2.8	1	1	2	2	2

ELECTIVE–III (VSEMESTER)

21153E56A **EMBEDDED C- PROGRAMMING** **LT P C**

3 0 0 3

COURSE OBJECTIVES:

- To expose the students to the fundamentals of embedded Programming
- To Introduce the GNU C Programming Tool Chain.
- To study the basic concepts of embedded C.
- To teach the basics of 8051 Programming
- To involve Discussions/ Practice/Exercise in revising & familiarizing the concepts acquired over the 5 Units of the subject for improved employability skills.

UNIT I BASIC C PROGRAMMING 6

Typical C Program Development Environment - Introduction to C Programming----Structured Program Development in C - Data Types and Operators - C Program Control - C Functions --- Introduction to Arrays.

UNIT II EMBEDDED C 6

Adding Structure to ‘C’ Code: Object-oriented programming with C, Header files for Project and Port, Examples. Meeting Real-time constraints: Creating hardware delays --- Need for timeout mechanism - Creating loop timeouts --Creating hardware timeouts.

UNIT III 8051 Programming in C 6

Data types and time delay in 8051, I/O programming in 8051, Logic operations in 8051, Data conversion program in 8051 Accessing code ROM space in 8051, Data serialization using 8051

UNIT IV 8051 SERIAL PORT AND INTERRUPT PROGRAMMING IN C 6

Basics of serial communication, 8051 interface to RS232- serial port programming in 8051. 8051 interrupts and programming, Programming for timer configuration.

UNIT V 8051 INTERFACING 6

8051: ADC interfacing , DAC interfacing, Sensor interfacing, LCD interfacing, Stepper motor interfacing.

30 PERIODS

LAB COMPONENT: **30 PERIODS**

1. Laboratory exercise: Use 8051 microcontroller/Embedded processor/IDE/open source platform to give hands-on training on Embedded C- programming.

   a. Introduction to IDE (like code blocks, vscode ,etc)and Programming Environment (like Keililu vision, Proteus)
   b. Configuring an I/O port using bitwise programming.
   c. Configuring timer for generating hardware delay.
   d. Flashing an LED using an interrupt
   e. Serial communication using UART port of 8051
   f. Interfacing an ADC with 8051

g. Interfacing an analog sensor with 8051
h. Interfacing 16x2 LCD with 8051
i. configuring timer for generating PWM signal
j. Interfacing a stepper motor with 8051

2. Assignment: Introduction to Arduino IDE, Raspberry Pi
3. Embedded C-Programming -based Mini project.

TOTAL: 30+30 = 60 PERIODS

COURSE OUTCOMES:

At the end of this course, the students will have the ability to

CO1: Deliver insight into embedded C programming and its salient features for embedded systems.

CO2:Illustrate the software and hardware architecture for distributed computing in embedded systems

CO3: Develop a solution for problems by using the conceptlearnednt in programming using the embedded controllers

CO4: Develop simple applications with 8051 by using its various features and interfacing with various external hardware.

CO5: Improved Employability and entrepreneurship capacity due to knowledge upgradation on recent trends in embedded programming skills.

TEXTBOOKS:

1. Paul Deitel and Harvey Deitel, "C How to Program", 9th Edition, Pearson Education Limited, 2022, 1st edition.
2. Michael J Pont, "Embedded C", Addison-Wesley, An imprint of Pearson Education, 2002.
3. William von Hagen, "The Definitive Guide to GCC", 2nd Edition, Apress Inc., 2006.
4. Gowrishankar S and Veena A, "Introduction to Python Programming", CRC Press, Taylor & Francis Group, 2019.

REFERENCES:

1. Noel Kalicharan, "Learn to Program with C", Apress Inc., 2015, 1st edition.
2. Steve Oualline, "Practical C programming", O'Reilly Media, 1997, 3rd edition.
3. Muhammad Ali Mazidi, Janice G. Mazidi and Rolin D. McKinlay, 'The 8051 Microcontroller and Embedded Systems' Prentice Hall, 2nd Edition 2007.
4. Myke Predko, "Programming and customizing the 8051 microcontrollers",McGraww Hill 2000, 1st edition.

List of Open Source Software/ Learning websites:

- https://www.hackerrank.com/
- https://www.cprogramming.com/
- https://www.allaboutcircuits.com/technical-articles/introduction-to-the-c-programming-language-for-embedded-applications/
- https://onlinecourses.nptel.ac.in/noc19_cs42/preview
- https://microcontrollerslab.com/8051-microcontroller-tutorials-c/
- https://www.circuitstoday.com/getting-started-with-keil-uvision

MAPPING OF COs WITH POs AND PSOs

COs	POs												PSOs		
	PO1	PO2	PO3	PO4	PO5	P06	P07	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1	1	2	3	1	-	-	-	-	-	-	-	1	2	2
CO2	1	1	2	2	1	-	-	-	-	-	-	-	1	3	2
CO3	2	2	3	2	3	-	-	-	-	-	-	-	2	3	3
CO4	3	2	3	2	3	-	-	-	-	-	-	-	1	1	1

CO5	3	2	1	2	1	-	-	-	1	-	-	-	2	3	2
Avg	2	1.6	2.2	2.2	1.8	-	-	-	1	-	-	-	1.4	2.4	2

21153E56B **SMART GRID** **LT P C3003**

COURSE OBJECTIVES:

- To understand the evolution of Smart and Interconnected energysystems.
- To understand the various challenges and benefits of smart grid and the national and international initiatives taken
- To understand the concepts related with transmission and distribution in smart grid technologies.
- To get an insight of the various smart measurementtechnologies.
- To understand the various computing technologies for Smart Operation of the Grid.

UNIT I INTRODUCTION (7+2 SKILL) 9

Evolution of Energy Systems, Concept, Definitions and Need, Difference between Conventional & Smart Grid, Drivers, structures, functions, opportunities, challenges and benefits of Smart Grid, Basics of Micro grid, National and International Initiatives in Smart Grid.

UNIT II SMART METERING (7+2 SKILL) 9

Introduction to Advanced Metering infrastructure (AMI) - drivers and benefits, AMI protocols, standards and initiatives, AMI needs in the smart grid, Real time management and control, Phasor Measurement Unit (PMU).

UNIT III SMART GRID TECHNOLOGIES (Transmission) (7+2 SKILL) 9

Technology Drivers, Smart energy resources, Smart substations, Substation Automation, Feeder Automation, Transmission systems: EMS, Wide area Monitoring, Protection and control.

UNIT IV SMART GRID TECHNOLOGIES (Distribution) (7+2 SKILL) 9

DMS, Volt/VAr control, Fault Detection, Isolation and service restoration, Outage management, High-Efficiency Distribution Transformers, Phase Shifting Transformers, Electric Vehicles.

UNIT V HIGH PERFORMANCE COMPUTING FOR SMART GRID APPLICATIONS (7+2 SKILL) 9

Local Area Network (LAN), House Area Network (HAN), Wide Area Network (WAN), Broadband over Power line (BPL), IP based Protocols, Computing technologies for Smart Grid applications (Web Service to CLOUD Computing), Role of big data and IoT, Cyber Security for Smart Grid.

TOTAL: 45 PERIODS

SKILL DEVELOPMENT ACTIVITIES (Group Seminar/Mini Project/Assignment/Content Preparation / Quiz/ Surprise Test / Solving GATE questions/ etc) 10

1. Assignment-Familiarization of National and International Initiatives in Smart Grid
2. Simulation of smart meter using (MATLAB/ ETAP/SCILAB/ LABVIEW/ Proteus/Equivalent open source software).
3. Visit to a substation for analysing the Automation Technologies like Monitoring, Protection and control.
4. Awareness about High- Efficiency Distribution Transformers, Phase Shifting Transformers in a substation.
5. Introduction to recent technologies in electric vehicles and understanding the operation of EV,HEV and PHEV.
6. Simulation of IoT based digital communication system for smart grid applications.

COURSE OUTCOMES:

After completion the above subject, students will be able to understand

CO1: To be able to understand the importance and objectives of Power System Grid.
CO2: To be able to know and understand the concept of a smart grid;
CO3: To identify and discuss smart metering devices and associated technologies.
CO4: To be able to get an overview of Microgrid and Electric Vehicle Technology.
CO5:To be able to have an up to date knowledge on the various computing technologies; to understand the role of Big Data and IoT for effective and efficient operation of Smart Grid.

TEXT BOOKS:

1. Smart Grids Advanced Technologies and Solutions, Second Edition, Edited by Stuart Borlase,CRC, 2018.
2. Janaka Ekanayake, Nick Jenkins, KithsiriLiyanage, Jianzhong Wu, Akihiko Yokoyama, “Smart Grid: Technology and Applications”, John Wiley,2012
3. James Momoh ,Smart Grid Fundamentals of Design and Analysis, IEEE press 2012.

REFERENCES:

1. Ahmed F. Zobaa, Trevor J. Bihl, Big data analytics in future power systems, 1st Edition, CRC press 2018.
2. C. Gungor et al., "Smart Grid Technologies: Communication Technologies and Standards," in IEEE Transactions on Industrial Informatics, vol. 7, no. 4, pp. 529-539, Nov. 2011.doi: 10.1109/TII.2011.2166794.
3. X. Fang, S. Misra, G. Xue and D. Yang, "Smart Grid – The New and Improved Power Grid: A Survey," in IEEE Communications Surveys & Tutorials, vol. 14, no. 4, pp. 944-980, Fourth Quarter 2012. doi: 10.1109/SURV.2011.101911.00087.
4. Stuart Borlase “Smart Grid : Infrastructure, Technology and Solutions”, CRC Press 2012.

MAPPING OF COs WITH POs AND PSOs

COs	POs												PSOs		
	PO1	PO2	PO3	PO4	PO5	P06	P07	PO8	PO9	PO10	PO11	PO12	PS01	PS02	PS03
CO1	3	3	2	3	3	-	-	1	-	-	-	2	3	3	-
CO2	3	3	2	3	3	-	-	1	-	-	-	2	3	3	-
CO3	3	3	2	3	3	-	-	1	-	-	-	2	3	3	-
CO4	3	3	2	3	3	-	-	1	-	-	-	2	3	3	-
CO5	3	3	2	3	3	-	-	1	-	-	-	2	3	3	-
Avg	3	3	2	3	3	-	-	1	-	-	-	2	3	3	-

21153E56C	**CONTROL OF POWER ELECTRONICS CIRCUITS**	**L**	**T**	**P**	**C**
		2	**0**	**2**	**3**

COURSE OBJECTIVES:

- To learn the basics of control system simulation.
- To do symbolic calculation.
- To study the principles of sliding mode control and the way of apply smc for buck converter.
- To learn the concept of power factor correction.
- To design simulate smc for buck converter and power factor correction circuit with controller.

UNIT I SIMULATION BASICS IN CONTROL SYSTEMS 6

Transfer Function-How to build transfer function, identify Poles, zeros, draw time response plots, bode plot (Bode Plots for Multiplication Factors, Constant, Single and Double Integration Functions, Single and Double Differentiation Functions, Single Pole and Single Zero Functions, RHP Pole and RHP Zero Functions), state space modelling-transfer function from state space Model.

UNIT II SYMBOLIC CALCULATIONS 6

Symbolic Variables Symbolic Vector Variables, Commands for Handling Polynomial Expressions - Extracting Parts of a Polynomial ....Factorization and Roots of Polynomials, Symbolic Matrix Algebra - Operations with Symbolic Matrices --Other Symbolic Matrix Operations.

UNIT III SLIDING MODE CONTROL BASICS 6

Introduction- Introduction to Sliding-Mode Control- Basics of Sliding-Mode Theory- Application of Sliding-Mode Control to DC-DC Converters–Principle-Sliding mode control of buck converter.

UNIT IV POWER FACTOR CORRECTION CIRCUITS 6

Introduction, Operating Principle of Single-Phase PFCs, Control of boost converter based PFCs, Designing the Inner Average-Current-Control Loop, Designing the Outer Voltage-Control Loop, Example of Single-Phase PFC Systems.

UNIT V CONTROLLER DESIGN FOR PFC CIRCUITS 6

Power factor correction circuit using other SMPS topologies: C'uk and SEPIC converter---PFC circuits employing bridgeless topologies.

30 PERIODS

LAB COMPONENT: 30 PERIODS

1. Simulation exercises on zero, first and second order basic blocks.
2. Simulation exercises based on symbolic calculations.
3. Simulation of Sliding mode control based buck converter.
4. Simulation of Single-Phase PFC circuit employing boost converter.
5. Simulation of Single-Phase PFC circuit employing C'uk converters.

TOTAL: 30+30 = 60 PERIODS

COURSE OUTCOMES:

At the end of the course, students should have the:

CO1: To calculate transfer function for constant, differential, integral, First order and Second order factors.

CO2: To illustrate the effect of poles and zero's in the 's' plane.

CO3: To select Symbolic equations for solving problems related with Matrices, Polynomial and vectors.

CO4: To compute the control expression for DC – DC buck converter using sliding mode control theory.

CO5: To determine the controller expression for power factor correction circuits.

CO6: To simulate sliding mode control of buck converter and power factor correction circuit.

TEXT BOOKS:

1. Feedback Control problems using MATLAB and the Control system tool box By Dean Frederick and Joe Chow, 2000, 1st Edition, Cengage Learning.
2. Ned Mohan,"Power Electronics: A First Course", Johnwiley, 2013, 1st Edition.
3. Marian K. Kazimierczuk and AgasthyaAyachit,"Laboratory Manual for Pulse-Width Modulated DC-DC Power Converters", Wiley 2016, 1st Edition.
4. Power Electronics handbook, Industrial Electronics series, S.K.Varenina, CRC press, 2002, 1st Edition.

REFERENCES:

2. Sliding mode control for Switching Power Converters:, Techniques and Implementation,Slew-Chong Tan, Yuk Ming Lai Chi-Kong Tse, 1st Edition, CRC Press.

3. Andre Kislovski, “Dynamic Analysis of Switching-Mode DC/DC Converters”, Springer 1991.
4. MATLAB Symbolic Algebra and Calculus Tools, Lopez Cesar, Apress, 2014.

MAPPING OF COs WITH POs AND PSOs

COs	POs												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	3	3	-	-	1	-	2	-	3	3	3	3
CO2	3	3	3	3	3	-	-	1	-	2	-	3	3	3	3
CO3	3	3	3	3	3	-	-	1	-	2	-	3	3	3	3
CO4	3	3	3	3	3	-	-	1	-	2	-	3	3	3	3
CO5	3	3	3	3	3	-	-	1	-	2	-	3	3	3	3
CO6	3	3	3	3	3	-	-	1	-	2	-	3	3	3	3
Avg	3	3	3	3	3	-	-	1	-	2	-	3	3	3	3

21153E56D VLSI DESIGN L T P C

2 0 2 3

COURSE OBJECTIVES

- To explain the basic concepts of CMOS and
- To introduce the IC fabrication methods
- To introduce the Reconfigurable Processor technologies
- To introduce the basics of analog VLSI design and its importance.
- To learn about the programming of Programmable device using Hardware description Language.

UNIT I CMOS BASICS 6

MOSFET Scaling CMOS logic design- Dynamic CMOS -Transmission Gates- BiCMOS

UNIT II IC FABRICATION 6

CMOS IC Fabrications: n well, p well, twin tub, SoI Design Rules and Layout.

UNIT III PROGRAMABLE LOGIC DEVICES 6

PAL, PLA, CPLD architecture and application.

UNIT IV RECONFIGURABLE PROCESSOR 6

FPGA- Architecture, FPGA based application development- Introduction to FPAA.

UNIT V HDL PROGRAMMING 6

Verilog HDL- Overview structural and behavioural modeling concepts-Design examples- Carry Look ahead adders, ALU, Shift Registers.

30 PERIODS

LAB COMPONENTS: 30 PERIODS

1. Laboratory exercise : Use any FPGA Board /IDE/open source package/ platform to give hands on training on CMOS design/ reconfigurable processor based applications.

   a) CMOS logic circuit simulation using any open source software package
   b) Experiments : structural and behavioural modeling based Verilog HDL programs
   c) Experiment: Combinational and sequential Digital logic implementation with

FPGA.

d) Implementation of carry look ahead adder with FPGA

e) Implementation of ALU with FPGA

2. Assignment : Low Power VLSI.
3. FPGA based Mini project .

TOTAL: 30+30 = 60 PERIODS

COURSE OUTCOMES:

At the end of this course, the students will have the ability to

CO1: Develop CMOS design techniques

CO2: Learn and build IC fabrication

CO3: Explain the need of reconfigurable computing with PLDs.

CO4: Design and development of reprogrammable FPGA.

CO5: Illustrate and develop HDL computational processes with improved design strategies.

TEXTBOOKS:

1. M.J.S Smith, "Application Specific integrated circuits",Addition Wesley Longman Inc. 1st Edition 2010.
2. Kamran Eshraghian,Douglas A.pucknell and Sholeh Eshraghian,"Essentials of VLSI circuits and system", Prentice Hall India,2005, 1st Edition.

REFERENCES:

1. Donald G. Givone, "Digital principles and Design", Tata McGraw Hill 2002, 1st Edition.
2. Charles H. Roth Jr., "Fundamentals of Logic design", Thomson Learning, 7th Edition 2013.
3. Nurmi, Jari (Ed.) "Processor Design System-On-Chip Computing for ASICs and FPGAs" Springer, 2007, 1st Edition.
4. Joao Cardoso, Michael Hübner, "Reconfigurable Computing: From FPGAs to Hardware/Software Codesign" Springer, 2011, 1st Edition.
5. Pierre-Emmanuel Gaillardon, Reconfigurable Logic: Architecture, Tools, and Applications, 1st Edition, CRC Press , 2018.

List of Open Source Software/ Learning website:

1) https://archive.nptel.ac.in/courses/108/107/108107129/
2) http://gn.dronacharya.info/ECEDept/Downloads/QuestionPapers/7th_Sem/VLSI-DESIGN/UNIT-1/Lecture-3.pdf
3) https://web.itu.edu.tr/~ateserd/vlsi2/2007/FPGAs&CPLD.pdf
4) https://kanchiuniv.ac.in/coursematerials/GSK_Notes_on_PLD_in_VLSI_design.pdf
5) https://www.xilinx.com/products/silicon-devices/resources/programming-an-fpga-an-introduction-to-how-it-works.html
6) https://www.allaboutcircuits.com/technical-articles/what-is-an-fpga-introduction-to-programmable-logic-fpga-vs-microcontroller/
7) https://www.tutorialspoint.com/vlsi_design/vlsi_design_vhdl_introduction.htm#:~:text=VHDL%20stands%20for%20very%20high,DoD)%20under%20the%20VHSIC%20program.

MAPPING OF COs WITH POs AND PSOs

COs	POs												PSOs		
	PO1	PO2	PO3	PO4	PO5	P06	P07	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	1	1	2	1	-	-	-	-	-	-	-	2	2	3
CO2	3	1	2	3	1	-	-	-	-	-	-	-	1	1	3
CO3	3	2	2	2	3	-	-	-	-	-	-	-	2	1	3
CO4	3	2	2	2	3	-	-	-	-	-	-	-	2	2	3
CO5	3	2	1	3	3	-	-	-	1	-	-	-	2	2	3
Avg	3	1.6	1.6	2.4	2.2	-	-	-	1	-	-	-	1.8	1.6	3

21153E56E	INTELLIGENT CONTROL OF ELECTRIC VEHICLES	L	T	P	C
		2	0	2	3

COURSE OBJECTIVES:

- To design and drive the mathematical model of a BLDC motor and its characteristics
- To learn the different control schemes for BLDC motor
- To study the basics of fuzzy logic
- To study the FPGA & VHDL basics
- To implement fuzzy logic control of BLDC motor in real time

UNIT I MATHEMATICAL MODEL AND CHARACTERISTICS ANALYSIS OF THE BLDC MOTOR 6

Structure and Drive Modes - Basic Structure, General Design Method, Drive Modes. Mathematical Model, Differential Equations, Transfer Functions, State-Space Equations. Characteristics Analysis, Starting Characteristics, Steady-State Operation, Dynamic Characteristics, Load Matching Commutation Transients

UNIT II SPEED CONTROL FOR ELECTRIC DRIVES 6

Introduction PID Control Principle, Anti windup Controller, Intelligent Controller. Vector Control. Control applied to BLDC motor-.

UNIT III FUZZY LOGIC 6

Membership functions: features, fuzzification, methods of membership value assignments Defuzzification: lambda cuts - methods fuzzy arithmetic and fuzzy measures: fuzzy arithmetic extension principle - fuzzy measures - measures of fuzziness fuzzy integrals fuzzy rule base and approximate reasoning : truth values and tables, fuzzy propositions, formation of rules decomposition of rules, aggregation of fuzzy rules, fuzzy reasoning-fuzzy inference systems, overview of fuzzy expert system-fuzzy decision making..

UNIT IV FPGA AND VHDL BASICS 6

Introduction – FPGA Architecture-Advantages-Review of FPGA family processors- Spartan 3, Spartan 6 and Spartan 7. VHDL Basics- Fundamentals-Instruction set-data type-conditional statements- programs like arithmetic, sorting, PWM generation, Speed detection.

UNIT V REAL TIME IMPLEMENTATION 6

Inverter design, identifying rotor position via hall effect sensors, open loop and fuzzy logic control of 48 V BLDC motor using FPGA ..

30 PERIODS

LAB COMPONENT: 30 PERIODS

1. Design and simulate speed controller for induction motors in EV for both dynamic and steady state performance
2. Simulate a fuzzy logic controller based energy storage system for EV.
3. Fuzzy logic control of BLDC motor using FPGA in real time

TOTAL: 30+30 = 60 PERIODS

COURSE OUTCOMES:

Upon the successful completion of the course, students will be able to:

CO1: To design the mathematical model of a BLDC motor and to discuss about its characteristics

CO2: To demonstrate the PID control, ant windup controller, Intelligent Controller and Vector Control. Control applied to BLDC motor.

CO3: To illustrate the basics of fuzzy logic system

CO4: To describe the basics of VHDL & FPGA applied to control of EVs.
CO5: To design and implement of fuzzy logic control scheme for BLDC motor using FPGA in real time.

REFERENCES:

2. Electric Powertrain Energy Systems, Power Electronics and Drives for Hybrid, Electric and Fuel Cell Vehicles, John G. Hayes, G. Abas Goodarzi, Wiley 1st Edition 2018.
3. VHDL Primer, A (3rd Edition), Jayaram Bhasker, Prentice Hall, 1st Edition 2015.
4. Iqbal Hussain, “Electric and Hybrid Vehicles: Design Fundamentals, Third Edition” CRC Press, Taylor & Francis Group, 2021, 1st Edition.
5. Chang-liang, Permanent Magnet Brushless DC Motor Drives and Controls, Xia Wiley 2012, 1st Edition.
6. M.N. Cirstea, A. Dinu, J.G. Khor,M. McCormick, Neural and Fuzzy Logic Control of Drives and Power Systems, Newnes publications, 1st Edition, 2002.
7. Wei Liu, Hybrid Electric Vehicle System Modeling and Control, Wiley 2017, 2nd Edition
8. Electric and Plug-in Hybrid Vehicle Networks Optimization and Control, Emanuele Crisostomi • Robert Shorten, Sonja Stüdli • Fabian Wirth, CRC Press, 1st Edition. 2018.

MAPPING OF COs WITH POs AND PSOs

COs	POs												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	2	-	-	-	3	-	2	-	3	3	3	-
CO2	3	3	2	2	-	-	-	3	-	2	-	3	3	3	3
CO3	3	3	3	3	-	-	-	-	-	2	-	3	3	2	3
CO4	3	3	3	3	-	-	-		-	2	-	3	3	3	3
CO5	3	3	3	3	3	-	-	3	-	2	-	3	3	3	3
Avg	3	3	2.6	2.6	3	-	-	3	-	2	-	3	3	2.8	2.4

21153E56F	ADAPTIVE CONTROL	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To impart knowledge on how to recursively estimate the parameters of discrete input – output models using recursive parameter estimation methods
- To make the student understand the principles of STR, MRAC and Gain scheduling.
- To make the student design simple adaptive controllers for linear systems using STR, MRAC and Gain scheduling

UNIT I INTRODUCTION (7+2 SKILL) 9

Introduction - Adaptive Schemes - The adaptive Control Problem – Applications-Parameter estimation:-LS, RLS: and ERLS

UNIT II GAIN SCHEDULING (7+2 SKILL) 9

Introduction- The principle - Design of gain scheduling controllers- Nonlinear transformations - application of gain scheduling - Auto-tuning techniques: Methods based on Relay feedback.

UNIT III DETERMINISTIC SELF-TUNING REGULATORS (7+2 SKILL) 9

Introduction- Pole Placement design - Indirect Self-tuning regulators - direct self-tuning regulators – Disturbances with known characteristics

UNIT IV STOCHASTIC AND PREDICTIVE SELF-TUNING REGULATORS (7+2 SKILL)9

Introduction – Design of minimum variance controller - Design of moving average controller -

stochastic self-tuning regulators

UNIT V MODEL – REFERENCE ADAPTIVE SYSTEM (7+2 SKILL) 9

Introduction- MIT rule - Determination of adaptation gain - Lyapunov theory -Design of MRAS using Lyapunov theory - Relations between MRAS and STR.

TOTAL:45 PERIODS

SKILL DEVELOPMENT ACTIVITIES (Group Seminar/Mini Project/Assignment/Content Preparation / Quiz/ Surprise Test / Solving GATE questions/ etc) 10

1 Learn any one relevant software tool (MATLAB/ SCILAB/ LABVIEW/ Equivalent open source software)
2 Design of gain scheduling adaptive control using any one software tool
3 Analysis/Problem Solving Ability to identify and define problems and solutions
4 Design and verification of MRAC by simulation.

COURSE OUTCOMES:

Students able to

CO1 Ability to apply the estimation algorithm to estimate the parameters of the process.(L3)
CO2 Ability to apply the adaptive control concepts to control a process. (L3)
CO3 Use appropriate software tools for design of adaptive controllers and analysis of the process. (L5)
CO4 Identify, formulate, carry out research by designing suitable adaptive schemes for complex instrumentation problem. (L5)
CO5 Apply the concepts to design adaptive control for multidisciplinary problem(L3)
CO6 Choose the techniques for self and lifelong learning to keep in pace with the new technology(L3)

TEXT BOOKS:

1. K.J. Astrom and B. J. Wittenmark, “Adaptive Control”, Second Edition, Pearson Education Inc., second Edition 2013.

REFERENCE BOOKS

1. T. Soderstorm and Petre Stoica, “System Identification”, Prentice Hall International(UK) Ltd., 1989, 1st Edition.
2. Lennart Ljung, “System Identification: Theory for the User”, Second Edition, Prentice Hall, 1999.

List of Open Source Software/ Learning website:

1 https://archive.nptel.ac.in/courses/108/102/108102113/
2 https://in.mathworks.com/help/slcontrol/adaptive-control-design.html
3 https://in.mathworks.com/videos/nonlinear-model-based-adaptive-robust-controller-in-an-oil-and-gas-wireline-operation-1637577967956.html
4 https://www.dynalog-us.com/adaptive-robot-control.htm
5 https://www.vlab.co.in/

MAPPING OF COs WITH POs AND PSOs

COs	POs												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	2	2	1	1	1	3	1	1	1	1	2	2	2
CO2	3	2	2	2	1	1	1	3	1	1	1	1	2	2	2
CO3	3	3	3	3	1	1	1	3	1	3	1	1	2	2	2
CO4	3	3	3	3	1	1	1	3	1	3	1	1	2	2	2
CO5	3	2	2	2	1	1	1	3	1	1	1	1	2	2	2
CO6	3	2	2	2	1	1	1	3	1	1	1	1	2	2	2
Avg.	3	2.3	2.3	2.3	1	1	1	3	1	1.6	1	1	2	2	2

21153E56G **PLC PROGRAMMING**

	L	T	P	C
	3	0	0	3

COURSE OBJECTIVES:

To know about the basics of PLC and Automation
To understand the importance of Automation
To explore various types and manufactures of PLCs.
To introduce types of programming languages of PLC and some exercise few programs.

UNIT I INTRODUCTION (7+2 SKILL) 9
Programmable Logic Controller (PLC)- Block diagram of PLC- Programming languages of PLC- Basic instruction sets- Design of alarm and interlocks- Networking of PLC- Overview of safety of PLC with case studies- Process Safety Automation: Levels of process safety through use of PLCs- IEC 61131-3 Standard - Application of international standards in process safety control.

UNIT II IEC 61131-3 (7+2 SKILL) 9
Rails- Rungs- Relay Logic- Latch switch- Timers- Counters- Boolean logics- Math Instructions- Data manipulation Instructions- Requirement of communication networks for PLC, PLC to PC Communication to computer- FBD equivalent to LL- FBD Programming- IL- SFC-ST.

UNIT III SCADA (7+2 SKILL) 9
Elements of SCADA system- History of SCADA, Remote Terminal Unit- Discrete control- Analog control, Master Terminal Unit- Operator interface.

UNIT IV HART and Field Bus (7+2 SKILL) 9
Introduction- Evolution of signal standards- HART communication protocol- communication modes- HART networks- HART commands- HART and OSI model- Field bus- Architecture- Basic requirements of field Busstandard- Field bus Topology- Interoperability- Interchangeability.

UNIT V PLC PROGRAMMING (7+2 SKILL) 9
Exercise in Programming Languages from IEC 61131-3: Traffic Light Control- Two way- Four way – Water Level Control- Automatic Material Sorting System- Automatic Bottle Filling System, Code Converters- DC motor Control- Alarm Circuit.

TOTAL : 45 PERIODS

SKILL DEVELOPMENT ACTIVITIES (Group Seminar/Mini Project/Assignment/Content Preparation / Quiz/ Surprise Test / Solving GATE questions/ etc) 10

1 Taking Local area to implement simple closed loop system for any system using PLC.
2 Making a complete automated control loop with Supervisory and HMI system.
3 Implementing an Alarm based control scheme and run in a simulated environment.
4 Designing an entire PLC logic for filling and draining water tank automatically.

COURSE OUTCOMES:

CO1 Understand the basics and need for Automation in industries
CO2 Explain the logic and flow of any particular programming written for a process
CO3 Apply the knowledge to design or improve an existing program to increase productivity of any process
CO4 Breakdown SCADA architecture and communication protocols.
CO5 Build and logic in any of the programming languages from IEC- 61131- 3 standard

TEXT BOOKS:

1. Frank D. Petruzella, “Programmable Logic Controllers”, 5th Edition, McGraw- Hill, New York, 2019.
2. Stuart Boyer A, “SCADA: Supervisory control and data Acquisition”, Fourth Edition, ISA- The Instrumentation, Systems, and Automation Society,2010

REFERENCES

1. Bolton. W, “Programmble Logic Controllers”, Elsevier Newnes, 6th Edition 2015.

List of Open-Source Software/ Learning website:

1. https://nptel.ac.in/courses/108105062
2. https://nptel.ac.in/courses/108105088
3. http://www.nitttrc.edu.in/nptel/courses/video/105105201/lec56.pdf
4. https://nptel.ac.in/courses/108106022
5. https://new.siemens.com/global/en/products/automation/systems/industrial/plc/logo/logo-software.html
6. https://componentsearchengine.com/library/proteus?gclid=CjwKCAjw_ISWBhBkEiwAdqxb9okU2ZZHcQoa9fSRK2Uq41Rq0GZxdGUP6_6GlBv77p4JqGt_iDAljhoCksEQAvD_BwE

MAPPING OF COs WITH POs AND PSOs

COs	POs												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	2	2	2	2	-	-	-	1	-	1	-	-	-	-	-
CO2	2	2	2	2	-	-	-	1	-	1	-	-	-	-	-
CO3	3	2	2	2	-	-	-	1	-	1	-	-	-	-	-
CO4	3	3	3	2	-	-	-	1	-	1	-	-	-	-	-
CO5	3	2	2	2	-	-	-	1	-	1	-	-	-	-	-
AVg.	2.6	2.2	2.2	2	-	-	-	1	-	1	-	-	-	-	-

ELECTIVE–IV(VISEMESTER)

21153E64A **POWER SYSTEM TRANSIENTS** **LT P C 3 0 0 3**

OBJECTIVES:

- To study the generation of switching transients and their control using circuit – theoretical concept.
- To study the mechanism of lighting strokes and the production of lighting surges.
- To study the propagation, reflection and refraction of travelling waves.
- To study the impact of voltage transients caused by faults, circuit breaker action, load rejection on integrated power system.

UNIT I INTRODUCTION AND SURVEY (7+2 Skill) 9

Sources of different types of transients - RL circuit transient with sine wave excitation - double frequency transients - basic transforms of the RLC circuit transients - study of transients in system planning - Importance of grounding.

UNIT II SWITCHING TRANSIENTS (7+2 Skill) 9

Basic concept of switching transients - resistance switching and equivalent circuit for interrupting the resistor current - load switching and equivalent circuit - waveforms for transient voltage across the load and the switch - normal and abnormal switching transients. Current suppression - current chopping - effective equivalent circuit - capacitance switching with a restrike, with multiple restrikes - ferro resonance.

UNIT III LIGHTNING TRANSIENTS (7+2 Skill) 9

Theories of cloud formation - mechanism of lightning discharges and characteristics of lightning strokes – model for lightning stroke - factors contributing to good line design - protection using ground wires - tower footing resistance - Interaction between lightning and power system.

UNIT IV TRAVELING WAVES ON TRANSMISSION LINE COMPUTATION OF TRANSIENTS (7+2 Skill) 9

Computation of transients - transient response of systems with series and shunt lumped parameters and distributed lines. Traveling wave concept - step response - Bewely's lattice diagram - standing waves and natural frequencies - reflection and refraction of travelling waves. Computation of overvoltages using EMTP.

UNIT V TRANSIENTS IN INTEGRATED POWER SYSTEM 9

The short line and kilometric fault- distribution of voltages in a power system Line dropping and load rejection - voltage transients on closing and reclosing lines--overvoltage induced by faults switching surges on integrated system Qualitative application of EMTP for transient computation.

TOTAL : 45 PERIODS

SKILL DEVELOPMENT ACTIVITIES (Group Seminar/Mini Project/Assignment/Content Preparation / Quiz/ Surprise Test / Solving GATE questions/ etc) 8

1. Simulation of circuit transients
2. Computation of over voltages for switching surges
3. Computation of over voltages for lightning surges
4. Computation of transients

COURSE OUTCOMES:

After completing the course, the students will be above to

CO1 : Explain the principles of transients and its concepts

CO2 : Know the different types of switching transients and the way to draw the necessary equivalent circuit.

CO3: Explain the concepts behind lighting and the way to protect the same.

CO4: Compute the transient behavior in transmission line

CO5: Explain the behavior of the Circuit during switching and to learn the simulation tool.

TEXT BOOKS:

1. Allan Greenwood, 'Electrical Transients in Power Systems', Wiley Inter Science, New York, 2nd Edition, 1991.
2. Pritindra Chowdhari, "Electromagnetic transients in Power System", John Wiley and Sons Inc., Second Edition, 2009.
3. C.S. Indulkar, D.P.Kothari, K. Ramalingam, 'Power System Transients – A statistical approach', PHI Learning Private Limited, Second Edition, 2010.

REFERENCES:

1. M.S.Naidu and V.Kamaraju, 'High Voltage Engineering', Tata McGraw Hill, Fifth Edition, 2013.
2. R.D. Begamudre, 'Extra High Voltage AC Transmission Engineering', Wiley Eastern Limited, 1986.
3. Y.Hase, Handbook of Power System Engineering," Wiley India, 2012.
4. J.L.Kirtley, "Electric Power Principles, Sources, Conversion, Distribution and use," Wiley, 2012.

MAPPING OF COs WITH POs AND PSOs

COs	POs												PSOs		
	PO1	PO2	PO3	PO4	PO5	P06	P07	PO8	PO9	PO10	PO11	PO12	PS01	PS02	PS03
CO1	3	3	3	3	2	-	2	-	-	-	-	3	3	3	3
CO2	3	3	3	3	2	-	2	-	-	-	-	3	3	3	3
CO3	3	3	3	3	2	-	2	-	-	-	-	3	3	3	3
CO4	3	3	3	3	2	-	2	-	-	-	-	3	3	3	3
CO5	3	3	3	3	2	-	2	-	-	-	-	3	3	3	3
Avg	3	3	3	3	2	-	2	-	-	-	-	3	3	3	3

21153E64B **POWER QUALITY** **L T P C**
3003

COURSE OBJECTIVES:

- To learn the basic definitions in Power Quality.
- To study the power quality issues in Single Phase and Three Phase Systems.
- To understand the principles of Power System Harmonics.
- To know the way to use DSTATCOM for Harmonic Mitigation.
- To learn the concepts related with Series Compensation.

UNIT I INTRODUCTION (7+2 Skill) 9

Introduction - Characterization of Electric Power Quality: Transients, short duration and long duration voltage variations, Voltage imbalance, waveform distortion, Voltage fluctuations, Power frequency variation, Power acceptability curves – power quality problems: poor load power factor, Non-linear and unbalanced loads, DC offset in loads, Notching in load voltage, Disturbance in supply voltage – Power quality standards.

UNIT II ANALYSIS OF SINGLE PHASE AND THREE PHASE SYSTEM (7+2 Skill) 9

Single phase linear and non-linear loads - single phase sinusoidal, non-sinusoidal source - supplying linear and nonlinear loads – three phase balanced system – three phase unbalanced system - three phase unbalanced and distorted source supplying non-linear loads - concept of power factor - three phase- three wire – three phase - four wire system.

UNIT III MITIGATION OF POWER SYSTEM HARMONICS (7+2 Skill) 9

Introduction - Principle of Harmonic Filters - Series-Tuned Filters - Double Band-Pass Filters - damped Filters - Detuned Filters - Active Filters - Power Converters - Harmonic Filter Design - Tuned Filter – Second-Order Damped Filter – Impedance Plots for Filter Banks – Impedance Plots for a Three-Branch 33 kV Filter.

UNIT IV LOAD COMPENSATION USING DSTATCOM (7+2 Skill) 9

Compensating single - phase loads - Ideal three phase shunt compensator structure - generating reference currents using instantaneous PQ theory - Instantaneous symmetrical components theory - Generating reference currents when the source is unbalanced -Realization and control of DSTATCOM – DSTATCOM in Voltage control mode.

UNIT V SERIES COMPENSATION OF POWER DISTRIBUTION SYSTEM (7+2 Skill) 9

Rectifier supported DVR - DC Capacitor supported DVR - DVR Structure - Voltage Restoration - Series Active Filter – Unified Power Quality Conditioner.

TOTAL : 45 PERIODS

SKILL DEVELOPMENT ACTIVITIES (Group Seminar/Mini Project/Assignment/Content Preparation / Quiz/ Surprise Test / Solving GATE questions/ etc) 10

1. Harmonic analysis of single phase power converters (Semi converters and Full Converters) with R and RL load via simulation
2. Harmonic analysis of three phase power converters (Semi converters and Full Converters) with R and RL load via simulation
3. Harmonic analysis of single phase inverters with R and RL load via simulation
4. Harmonic analysis of three phase inverters with R and RL load via simulation
5. Mitigation of Harmonics using Tuned Filter

List of Open Source Software/ Learning website:

1. http://nptel.iitm.ac.in/courses.php
2. https://old.amu.ac.in/emp/studym/2442.pdf
3. https://electricalacademia.com/electric-power
4. https://www.intechopen.com/books/6214
5. https://www.cde.com/resources/technical-papers/Mitigation-of-Harmonics.pdf
6. https://www.academia.edu/43237017/Use_Series_Compensation_in_Distribution_Networks_33_KV

COURSE OUTCOMES:

Upon completion of the course, students will be able to:

CO1 Use various definitions of power quality for power quality issues

CO2 Describe the concepts related with single phase / three phase, linear / nonlinear loads and single phase / three phase sinusoidal, non-sinusoidal source

CO3 Solve problems related with mitigation of Power System Harmonics

CO4 Use DSTATCOM for load compensation

CO5 Demonstrate the role of DVR, SAFs UPQC in power distribution systems

TEXTBOOKS:

1. Arindam Ghosh and Gerad Ledwich “Power Quality Enhancement Using Custom Power Devices”, Kluwer Academic Publishers, First Edition,2002
2. G.T.Heydt, “Electric Power Quality”, Stars in a Circle Publications, Second Edition, 2011.
3. George J. Wakileh, “Power System Harmonics – Fundamentals, Analysis and Filter Design”, Springer – Verlag Berlin Heidelberg, New York, 2019.

REFERENCES:

2. R.C.Duggan “Electric Power Systems Quality”, Tata MC Graw Hill Publishers, Third Edition, 2012.
3. Arrillga “Power System Harmonics”, John Wiely and Sons, 2003 2nd Edition.
4. Derek A.Paice “Power Electronic Converter Harmonics” IEEE Press, 1995, Wiley – IEE Press

1999, 18th Edition.

MAPPING OF COs WITH POs AND PSOs

COs	POs												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	3	-	-	3	3	-	3	-	3	3	3	3
CO2	3	3	3	3	-	-	3	3	-	3	-	3	3	3	3
CO3	3	3	3	3	-	-	3	3	-	3	-	3	3	3	3
CO4	3	3	3	3	-	-	3	3	-	3	-	3	3	3	3
CO5	3	3	3	3	-	-	3	3	-	3	-	3	3	3	3
Avg	3	3	3	3	-	-	3	3	-	3	-	3	3	3	3

21153E64C **POWER ELECTRONICS FOR RENEWABLE ENERGY SYSTEMS** **LTPC 3003**

COURSE OBJECTIVES:

- To learn the various types of renewable sources of energy.
- To understand the electrical machines to be used for wind energy conversion systems.
- To learn the principles of power converters used in solar PV system.
- To study the principle of power converters used in Wind system.
- To simulate the AC-DC, AC-AC Converters, Matrix Converters and PWM Inverters.

UNIT I INTRODUCTION TO RENEWABLE ENERGY SYSTEMS 6

Classification of Energy Sources – Importance of Non-conventional energy sources – Advantages and disadvantages of conventional energy sources--Environmental aspects of energy Impacts of renewable energy generation on the environment --- Qualitative study of renewable energy resources: Ocean energy, Biomass energy, Hydrogen energy, Solar Photovoltaic (PV), Fuel cells: Operating principles and characteristics, Wind Energy: Nature of wind, Types, control strategy, operating area.

UNIT II ELECTRICAL MACHINES FOR WIND ENERGY CONVERSION SYSTEMS (WECS) 6

Construction, Principle of operation and analysis: Squirrel Cage Induction Generator (SCIG), Doubly Fed Induction Generator (DFIG)---Permanent Magnet Synchronous Generator (PMSG).

UNIT III POWER CONVERTERS AND ANALYSIS OF SOLAR PV SYSTEMS 6

Power Converters: Line commutated converters (inversion-mode) - Boost and buck-boost converters- selection of inverter, battery sizing, array sizing. Simulation of line commutated converters, buck/boost converters. Analysis: Block diagram of the solar PV systems Types of Solar PV systems: Stand-alone PV systems, Grid integrated solar PV Systems Grid Connection Issues.

UNIT IV POWER CONVERTERS FOR WIND SYSTEMS 6

Power Converters: Three-phase AC voltage controllers- AC-DC-AC converters: uncontrolled rectifiers, PWM Inverters, Grid-Interactive Inverters Matrix converter.

UNIT V HYBRID RENEWABLE ENERGY SYSTEMS 9

Need for Hybrid Systems- Range and type of Hybrid systems- Case studies of Diesel-PV, Wind-PV, Micro hydel-PV, Biomass-Diesel systems Maximum Power Point Tracking (MPPT).

30 PERIODS

LAB COMPONENT: 30 PERIODS

1. Simulation on modelling of Solar PV System- V I Characteristics
2. Simulation on Modelling of fuel cell- V I Characteristics
3. Simulation of self- excited Induction Generator.
4. Simulation of DFIG/ PMSG based Wind turbine.
5. Simulation on Grid integration of RES.

TOTAL: 30+30 = 60 PERIODS

COURSE OUTCOMES:

At the end of the course, students should be able to:

CO1: Examine the available renewable energy sources.
CO2: Demonstrate the working principles of electrical machines and power converters used for wind energy conversion system
CO3: Demonstrate the principles of power converters used for solar PV systems
CO4: Examine the available hybrid renewable energy systems.
CO5: Simulate AC-DC converters, buck/boost converters, AC-AC converters and PWM inverters.

REFERENCES:

2. S.N.Bhadra, D. Kastha, & S. Banerjee "Wind Electrical Systems", Oxford University Press, 2009, 7th impression.
3. Rashid .M. H "Power electronics Hand book", Academic press,2nd Edition, 2006 4th Edition, 2017
4. Rai. G.D, "Non-conventional energy sources", Khanna publishers, 6th Edition, 2017.
5. Rai. G.D," Solar energy utilization", Khanna publishers, 5th Edition, 2008.
6. Gray, L. Johnson, "Wind energy system", prentice hall of india, 2nd Edition, 2006.
7. H.Khan "Non-conventional Energy sources ",Tata McGraw-hill Publishing Company, New Delhi, 2017, 3rd Edition.

MAPPING OF COs WITH POs AND PSOs

COs	POs												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	-	2	-	-	-	-	-	-	2	-	2	3	3	3
CO2	3	-	2	-	-	-	-	-	-	2	-	2	3	3	3
CO3	3	-	2	-	-	-	-	-	-	2	-	2	3	3	3
CO4	3	-	3	-	-	-	-	-	-	2	-	2	3	3	3
CO5	3	3	2.25	3	3	-	-	3	-	2	-	3	3	3	3
Avg	3	3	2	3	3	-	-	3	-	2	-	2.2	3	3	3

21153E64D EMBEDDED SYSTEM FOR AUTOMOTIVE APPLICATIONS LT P C 3003

COURSE OBJECTIVES:

- To expose the students to the fundamentals and building of Electronic Engine Control systems**.**
- To teach on sensor functional components for vehicles.
- To discuss on programmable controllers for vehicles management systems.
- To teach logics of automation & communication techniques for vehicle communication.
- To introduce the infotainment system development.

UNIT I INTRODUCTION TO AUTOMOTIVE SYSTEMS 6

Overview of Automotive systems, fuel economy, air-fuel ratio, emission limits and vehicle performance; Electronic control Unit- open-source ECU.

UNIT II SENSORS AND ACTUATORS FOR AUTOMOTIVES 6

Review of automotive sensors- sensors interface to the ECU, Smart sensor and actuators for automotive applications.

UNIT III VEHICLE MANAGEMENT SYSTEMS 6

Energy Management system -Adaptive cruise control - anti-locking braking system - Safety and Collision Avoidance.

UNIT IV ONBOARD DIAGONSTICS AND COMMUNICATION 6

OBD , Vehicle communication protocols- Bluetooth, CAN, LIN, FLEXRAY and MOST.

UNIT V RECENT TRENDS 6

Navigation- Autonomous car- Role of IoT in Automotive systems.

30 PERIODS

LAB COMPONENTS: 30 PERIODS

. 1. Laboratory exercise: Use MATLAB SIMULINK /equivalent simulation /open source tools
   a) Simulation study of automotive sensors and actuators components
   b) Adaptive cruise control, Anti-Lock Braking System
   c) CAN Connectivity in an Automotive Application using vehicle network toolbox
   d) Interfacing a sensor used in car with microcontroller.
   e) Establishing connection between Bluetooth module and microcontroller.
2. Assignment: AUTOSAR
3. Mini project : Battery Management system for EV batteries.

TOTAL: 30+30 = 60 PERIODS

COURSE OUTCOMES:

At the end of this course, the students will have the ability in

CO1: Insight into the significance of the role of embedded system for automotive applications.

CO2: Illustrate the need, selection of sensors and actuators and interfacing with ECU

CO3: Develop the Embedded concepts for vehicle management and control systems.

CO4: Demonstrate the need of Electrical vehicle and able to apply the embedded system technology for various aspects of EVs

CO5: Improved Employability and entrepreneurship capacity due to knowledge up gradation on recent trends in embedded systems design and its application in automotive systems.

TEXTBOOKS:

1. William B. Ribbens ,"Understanding Automotive Electronics", Elseiver,8th Edition, 2017.
2. Jurgen, R., Automotive Electronics Hand Book, McGraw Hill, 2nd Edition, 1999.
3. L.Vlacic,M.Parent,F.Harahima,"Intelligent Vehicle Technologies",SAE International, 2001, 1st Edition, 2017.

REFERENCES:

2. Ali Emedi, Mehrdedehsani, John M Miller , "Vehicular Electric power system- land, Sea, Air and Space Vehicles" Marcel Decker, 2004, 1st Edition.
3. Jack Erjavec,JeffArias,"Alternate Fuel Technology-Electric ,Hybrid& Fuel Cell Vehicles",Cengage ,2012, 2nd Edition.
4. Electronic Engine Control technology – Ronald K Jurgen Chilton's guide to Fuel Injection – Ford 2nd Edition, 2004.
5. Automotive Electricals / Electronics System and Components, Tom Denton, 5th Edition, 2017.
6. Uwe Kiencke, Lars Nielsen, "Automotive Control Systems: For Engine, Driveline, and Vehicle", Springer; 1st Edition, 2005.

7. Automotive Electricals Electronics System and Components, Robert Bosch Gmbh, 5 2014.
8. Automotive Hand Book, Robert Bosch, Bently Publishers, 10th Edition, 2018.

List of Open Source Software/ Learning website:

1) https://www.autosar.org/fileadmin/ABOUT/AUTOSAR_EXP_Introduction.pdf
2) https://microcontrollerslab.com/can-communication-protocol/
3) https://ackodrive.com/car-guide/different-types-of-car-sensors/
4) https://www.tomtom.com/blog/automated-driving/what-is-adaptive-cruise-control/
5) https://prodigytechno.com/difference-between-lin-can-and-flexray-protocols

MAPPING OF COs WITH POs AND PSOs

COs	POs												PSOs		
	PO1	PO2	PO3	PO4	PO5	P06	P07	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1	3	2	2	1	-	-	-	-	-	-	-	2	1	3
CO2	2	3	3	2	2	-	-	-	-	-	-	-	2	2	2
CO3	3	3	3	3	3	-	-	-	-	-	-	-	2	1	3
CO4	3	3	3	3	3	-	-	-	-	-	-	-	1	3	2
CO5	3	3	1	2	1	-	-	-	1	-	-	-	2	2	3
Avg	2.4	3	2.4	2.4	2	-	-	-	1	-	-	-	1.8	1.8	2.6

21153E64E	GRID INTEGRATION OF ELECTRIC VEHICLES	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To know the basic details of V2G
- To study the benefits & challenges of V2G
- To learn EV & V2G on the smart grids renewable energy systems
- To know the grid integration

UNIT I DEFINITION, And STATUS Of V2G (7+2 Skill) 9

Defining Vehicle to Grid (V2G) - History and Development of V2G. Incorporating V2G to the EV, Auditing and Metering, V2G in Practice , V2G - Power Markets and Applications . Electricity Markets and V2G Suitability , Long-Term Storage, Renewable Energy, and Other Grid Applications , Beyond the Grid: Other Concepts Related to V2G.

UNIT II BENEFITS AND CHALLENGES OF V2G (7+2 Skill) 9

Benefits of V2G, Technical Benefits: Storage Superiority and Grid Efficiency, Economic Benefits: EV Owners and Societal Savings, Environment and Health Benefits: Sustainability in Electricity and Transport, Other Benefits.

UNIT III CHALLENGES TO V2G (7+2 Skill) 9

Technical Challenges-Battery Degradation, Charger Efficiency, Aggregation and Communication, V2G in a Digital Society. The Economic and Business Challenges to V2G - Evaluating V2G Costs and Revenues , EV Costs and Benefits , Adding V2G Costs and Benefits , Additional V2G Costs , The Evolving Nature of V2G Costs and Benefits. Regulatory and Political Challenges to V2G , V2G and Regulatory Frameworks , Market Design Challenges. Other V2G Regulatory and Legal Challenges.

UNIT IV IMPACT OF EV AND V2G ON THE SMART GRID AND RENEWABLE ENERGY SYSTEMS (7+2 Skill) 9

Introduction - Types of Electric Vehicles - Motor Vehicle Ownership and EV Migration - Impact of Estimated EVs on Electrical Network - Impact on Drivers and the Smart Grid - Standardization and Plug-and-Play - IEC 61850 Communication Standard and IEC 61850-7-420 Extension.

UNIT V GRID INTEGRATION AND MANAGEMENT OF EVS (7+2 Skill) 9

Introduction - Machine to Machine (M2M) in distributed energy management systems - M2M communication for EVs - M2M communication architecture (3GPP) - Electric vehicle data logging - Scalability of electric vehicles -M2M communication with scheduling.

TOTAL : 45 PERIODS

SKILL DEVELOPMENT ACTIVITIES (Group Seminar/Mini Project/Assignment/Content Preparation / Quiz/ Surprise Test / etc) 10

1. Simulation of connecting three phase inverter to the grid.
2. Simulate and analyse the power quality issues of V2G systems
3. Design and simulate battery management system for smart grid with distributed generation.

COURSE OUTCOMES:

Upon completion of the course, students will be able to:

CO1 : Explain the concepts related with V2G

CO2 : Study the grid connection of 3 phase Q inverter

CO3 : Explain the technical, economics. business, regulatory & political challenges related with V2G

CO4 : Demonstrate the impact of EV and V2G on smart grid and renewable energy system

CO5 : Explain the concept of grid integration and management of EVs.

REFERENCES:

1. Advanced Electric Drive Vehicles, Ali Emadi, CRC Press 2017, 1st Edition.
2. Plug In Electric Vehicles in Smart Grids, Charging Strategies, Sumedha Rajakaruna , Farhad Shahnia and Arindam Ghosh,Springer,2015, 1st Edition.
3. ICT for Electric Vehicle Integration with the Smart Grid, Nand Kishor [1;] Jesus Fraile-Ardanuy, IET 2020, 1st Edition.
4. Vehicle-to-Grid: Linking Electric Vehicles to the Smart Grid, Junwei Lu and Jahangir Hossain, IET 2015, 1st Edition.
5. Lance Noel Gerardo Zarazua de Rubens Johannes Kester Benjamin K. Sovacool, Vehicle-to-Grid A Sociotechnical Transition Beyond Electric Mobility, 2019, 1st Edition.

MAPPING OF COs WITH POs AND PSOs

COs	POs												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	-	-	-	-	-	2	1	-	2	-	-	3	3	1
CO2	3	3	-	-	3	-	2	1	-	2	-	-	3	-	-
CO3	3	-	-	-	-	-	2	1	-	2	-	-	3	-	-
CO4	3	-	-	-	-	-	2	1	-	2	-	-	3	-	2
CO5	3	-	-	-	-	-	2	1	-	2	-	-	3	-	3
Avg	3	3	-	-	3	-	2	1	-	2	-	-	3	3	1.2

21153E64F **OPTIMAL CONTROL** **L T P C 3 0 0 3**

COURSE OBJECTIVES:

- To provide an exposure to different type of optimal control problems such as time- optimal, fuel optimal, energy optimal control problems.
- To impart knowledge and skills needed to design Linear Quadratic Regulator for Time-invariant and Time-varying Linear system (Continuous time and Discrete-time systems).
- To introduce concepts needed to design optimal controller using Dynamic Programming Approach and H-J-B equation.
- To provide an exposure to various types of fault tolerant control schemes such as Passive and active approaches.
- To introduce concepts needed to design optimal controller in the presence of state constraints and time optimal controller.

UNIT I CALCULUS OF VARIATIONS AND OPTIMAL CONTROL (7+2 SKILL) 9

Introduction – Performance Index- Constraints – Formal statement of optimal control system – Calculus of variations – Function, Functional, Increment, Differential and variation and optimum of function and functional – The basic variation problem Extrema of functions and functional with conditions – variational approach to optimal control system

UNIT II LINEAR QUADRATIC OPTIMAL CONTROL SYSTEM (7+2 SKILL) 9

Problem formulation – Finite time Linear Quadratic regulator – Infinite time LQR system: Time Varying case- Time-invariant case – Stability issues of Time-invariant regulator – Linear Quadratic Tracking system: Fine time case and Infinite time case

UNIT III DISCRETE TIME OPTIMAL CONTROL SYSTEMS (7+2 SKILL) 9

Variational calculus for Discrete time systems – Discrete time optimal control systems:- Fixedfinal state and open-loop optimal control and Free-final state and open-loop optimal control - Discrete time linear state regulator system – Steady state regulator system

UNIT IV PONTRYAGIN MINIMUM PRINCIPLE (7+2 SKILL) 9

Pontryagin Minimum Principle – Dynamic Programming:- Principle of optimality, optimal control using Dynamic Programming – Optimal Control of Continuous time and Discrete-time systems – Hamilton-Jacobi-Bellman Equation – LQR system using H-J-B equation

UNIT V CONSTRAINED OPTIMAL CONTROL SYSTEMS (7+2 SKILL) 9

Time optimal control systems – Fuel Optimal Control Systems- Energy Optimal Control Systems – Optimal Control Systems with State Constraints

TOTAL:45 PERIODS

SKILL DEVELOPMENT ACTIVITIES (Group Seminar/Mini Project/Assignment/Content Preparation / Quiz/ Surprise Test / Solving GATE questions/ etc) **10**

1. Interactive MATLAB based project learning in an optimal control system.
2. Familiarize yourself with optimal control software tool boxes.
3. Arrange a group brainstorming process to generate new ideas and possible solutions to an optimal control problem in any field.
4. Analyse the difference between optimal control systems with other types of control system.
5. Homework assignment on optimal control.

COURSE OUTCOMES:

Students able to

CO1 Explain different type of optimal control problems such as time-optimal, fuel optimal, energy optimal control problems.

CO2 Design Linear Quadratic Regulator for Time-invariant and Time-varying Linear system (Continuous time and Discrete-time systems)

CO3 Design optimal controller using Dynamic Programming Approach and H-J-B equation.

CO4 Explain the Pontryagin Minimum Principle.

CO5 Design optimal controller in the presence of state constraints and time optimal controller.

CO6 Understand the concepts of dynamic programming

TEXT BOOKS:

1. Donald E. Kirk, Optimal Control Theory – An Introduction, Dover Publications, Inc. Mineola, New York, 2012, 10th Edition.

REFERENCE BOOKS

1. D. Subbaram Naidu, Optimal Control Systems, CRC Press, New York, 2003, 1st Edition.
2. Frank L. Lewis, Draguna Vrabie, Vassilis L. Syrmos, Optimal Control, 3rd Edition, Wiley Publication, 2012, 3rd Edition.
3. Yan Wang, Cheng-Lin Liu, Zhi-Cheng Ji, Quantitative Analysis and Optimal Control of Energy Efficiency in Discrete Manufacturing System, Springer, 2020, 1st Edition.

List of Open Source Software/ Learning website:

1. https://in.mathworks.com/discovery/optimal-control.html#lqrlqg
2. https://www.codeproject.com/Articles/863257/Simple-Software-for-Optimal-Control
3. https://joss.theoj.org/papers/10.21105/joss.02809
4. https://www.ieee-ras.org/model-based-optimization-for-robotics/resources/optimization-tools
5. https://www.vlab.co.in/
6. https://ocw.mit.edu/courses/16-323-principles-of-optimal-control-spring-2008/

MAPPING OF COs WITH POs AND PSOs

COs	POs												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	-	1		1	-	1	1	1	1	1	1	2	2	2
CO2	-	2	2	2	1	2	1	1	1	1	1	1	2	2	2
CO3	2	2	2	-	1	1	1	1	1	1	1	1	2	2	2
CO4	2	2	2	-	1	1	1	1	1	1	1	1	2	2	2
CO5	-	1	2	1	1	1	1	1	1	1	1	1	2	2	2
CO6	1	1	1	1	1	-	1	1	1	1	1	1	**2**	**2**	**2**
Avg.	2	2	1.75	2	**1**	1.3	**1**	**1**	**1**	**1**	**1**	**1**	2	2	2

ELECTIVE– V(VISEMESTER)

21153E65A **HVDC AND FACTS** **L T P C3003**

COURSE OBJECTIVES:

To understand:

- The problems in AC transmission systems and DC transmission systems
- The operation and control of SVC and TCSC
- The concepts of IGBT based FACTS controllers
- The basic operation Line Commutated Converter(LCC) based HVDC links
- The features of voltage source converter based HVDC link..

UNIT I INTRODUCTION (7+2 Skill) 9

Reactive power control in electrical power transmission lines-load & system compensation, Uncompensated transmission line-shunt and series compensation. Need for HVDC Transmission, Comparison between AC & DC Transmission, , Types of HVDC transmission System.

UNIT II STATIC VAR COMPENSATOR (SVC) AND THYRISTOR **CONTROLLED SERIES COMPENSATOR (TCSC) (7+2 Skill) 9**

VI characteristics of FC+TSR, TSC+TSR, Voltage control by SVC-Advantages of slope in dynamic characteristics-Influence of SVC on system voltage-Design of SVC voltage regulator, Thyristor Controlled Series Compensator (TCSC), Concept of TCSC, Operation of the TCSC- Different modes of operation, Applications:

UNIT III VOLTAGE SOURCE CONVERTER BASED FACTS CONTROLLERS (7+2 Skill) 9

Static Synchronous Compensator (STATCOM)-Principle of operation-V-I Characteristics. Applications: Steady state power transfer-enhancement of transient stability-prevention of voltage instability. SSSC-operation of SSSC VI characteristics, Enhancement in Power transfer capability -, UPSC – Operation Principle Applications.

UNIT IV LINE COMMUTATED HVDC TRASMISSION (7+2 Skill) 9

Operation of Gratz bridge - Effect of delay in Firing Angle - Effect of commutation overlap - Equivalent circuit,. Basic concept of HVDC transmission. Model of operations and control of power flow CC and CIA mode of operation

UNIT V VSC BASED HVDC TRANSMISSION (7+2 Skill) 9

Basic 2 level IGBT inverter operation- 4 Quadrant operation- phase angle control- dq control- Control of power flow in VSC based HVDC Transmission, Topologies of MTDC system.

TOTAL: 45 PERIODS

SKILL DEVELOPMENT ACTIVITIES (Group Seminar/Mini Project/Assignment/Content Preparation / Quiz/ Surprise Test / Solving GATE questions/ etc) 10

1. Simulation of FC+TSR connected to IEEE 5 bus system
2. Realization of reactive power, support by SVC in open loop and closed loop control in simulation.
3. Regulation of line flows employing TCSC and TSSC in closed loop control in simulation
4. Simulation of two terminal HVDC Link, closed loop control in CC and CIA mode in simulation
5. Realization of four quadrant operation of VSC in open loop mode in simulation

COURSE OUTCOMES:

After completion the above subject, students will be able to understand

CO1: To Identify and understand the problems in AC transmission systems and understand the need for Flexible AC transmission systems and HVDC Transmission
CO2: To understand the operation and control of SVC and TCSC and its applications to enhance the stability and damping.
CO3: To Analyze basic operation and control of voltage source converter based FACTS controllers
CO4: To demonstrate basic operation and control of Line Commutated HVDC Transmission
CO5: To explain the d-q control based operation of VSC based HVDC Transmission

TEXT BOOKS:

1. R.Mohan Mathur, Rajiv K.Varma ,"Thyristor-Based Facts Controllers for Electrical Transmission Systems", IEEE press andJohnWiley&Sons,Inc,2002.
2. Narain G.Hingorani, "Understanding FACTS-Concepts and Technology of Flexible AC Transmission Systems", Standard Publishers Distributors,Delhi-110006,2011.

REFERENCES:

1. K.R.Padiyar,"FACTS Controllersin Power Transmission and Distribution", New Age International (P) Limited, Publishers, New Delhi, 2008
2. A.T.John,"FlexibleA.C.TransmissionSystems",InstitutionofElectricalandElectronic Engineers(IEEE), 1999.
3. V.K.Sood, HVDC and FACTS controllers-Applications of Static Converters in Power System, APRIL2004,KluwerAcademic Publishers,2004.

MAPPING OF COs WITH POs AND PSOs

COs	POs											PSOs		
	PO1	PO2	PO3	PO4	PO5	P06	P07	PO8	PO9	PO10	PO11	PO12	PS01	PS02	PS03
CO1	3	3	1	3	1	-	-	-	-	-	-	-	2	3	3
CO2	2	3	1	2	3	-	-	-	-	-	-	-	2	3	3
CO3	2	3	1	3	1	-	-	-	-	-	-	-	2	3	3
CO4	3	3	1	2	3	-	-	-	-	-	-	-	2	3	3
CO5	3	3	1	3	1	-	-	-	-	-	-	-	2	3	3
Avg	2.6	3	1	2.6	1.8	-	-	-	-	-	-	-	2	3	3

21153E65B **ELECTRICAL DRIVES** **L T P C 2 0 2 3**

COURSE OBJECTIVES:

At the end of the course, students should have the:

- To understand steady state operation and transient dynamics of a motor load system.
- To study and analyze the operation of the converter / chopper fed dc drive, both qualitatively and quantitatively.
- To study and understand the operation and performance of AC Induction motor drives.
- To study and understand the operation and performance of AC Synchronous motor drives.
- To analyze and design the current and speed controllers for a closed loop solid state DC motor drives.

UNIT I DRIVE CHARACTERISTICS 6

Electric drive – Equations governing motor load dynamics – steady state stability – multi quadrant Dynamics: acceleration, deceleration, starting & stopping – typical load torque characteristics – Selection of motor.

UNIT II CONVERTER / CHOPPER FED DC MOTOR DRIVE 6

Steady state analysis of the single and three phase converter fed separately excited DC motor drive – continuous and discontinuous conduction – Time ratio and current limit control – 4 quadrant operation of converter / chopper fed drive.

UNIT III INDUCTION MOTOR DRIVES 6

Stator voltage control – energy efficient drive – v/f control – constant air gap flux – field weakening mode – voltage / current fed inverter – closed loop control,

UNIT IV SYNCHRONOUS MOTOR DRIVES 6

V/f control and self-control of synchronous motor: Margin angle control and power factor control – permanent magnet synchronous motor.

UNIT V DESIGN OF CONTROLLERS FOR DRIVES 6

Transfer function for DC motor / load and converter – closed loop control with current and speed feedback – armature voltage control and field weakening mode – design of controllers; current controller and speed controller-converter selection and characteristics.

30 PERIODS

LAB COMPONENT: 30 PERIODS

1. Simulation of converter and chopper fed DC drive
2. Simulation of closed loop operation of stator voltage control of induction motor drive
3. Simulation of closed loop operation of v/f control of induction motor drive
4. Simulation of synchronous motor drive

TOTAL: 30+30 = 60 PERIODS

COURSE OUTCOMES:

After completion the above subject, students will be able to
CO1: Understand the basic requirements of motor selection for different load profiles.
CO2: Analyse the steady state behavior and stability aspects of drive systems.
CO3: Analyse the dynamic performance of the DC drive using converter and chopper control.
CO4: Simulate the AC drive.
CO5: Design the controller for electrical drives.

TEXTBOOKS:

1. Gopal K.Dubey, Fundamentals of Electrical Drives, Narosa Publishing House, 2nd Edition January 2010.
2. Bimal K.Bose. Modern Power Electronics and AC Drives, Pearson Education, 2002 1st Edition.

REFERENCES:

2. S.K.Pillai, A First course on Electrical Drives, Wiley Eastern Limited, 3rd Edition 2012.
3. Murphy J.M.D and Turnbull, Thyristor Control of AC Motor, Pergamon Press, Oxford 1988, 1st Edition.
4. Gopal K.Dubey, Power semiconductor controlled Drives, Prentice Hall Inc., New Jersey,1989, 1st Edition.
5. R.Krishnan, Electric Motor & Drives: Modeling, Analysis and Control, Prentice hall of India, 2001, 1st Edition.

MAPPING OF COs WITH POs AND PSOs

COs	POs												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	2	3	3	-	-	1	-	-	-	2	3	3	2
CO2	3	2	2	3	3	-	-	1	-	-	-	2	3	3	2
CO3	3	2	2	3	3	-	-	1	-	-	-	2	3	3	3
CO4	3	2	2	3	3	-	-	1	-	-	-	2	3	3	3
CO5	3	2	2	3	3	-	-	1	-	-	-	2	3	3	3
CO6	3	2	2	3	3	-	-	1	-	-	-	2	3	3	3
Avg	3	2	2	3	3	-	-	1	-	-	-	2	3	3	2

21153E65C **EMBEDDED CONTROL FOR ELECTRIC DRIVES** **LTPC**
2 02 3

COURSE OBJECTIVES:

- To provide the control concept for electrical drives
- To emphasize the need of embedded systems for controlling the electrical drives
- To provide knowledge about various embedded system-based control strategies for electrical drives
- To Impart the knowledge of optimization and machine learning techniques used for electrical drives
- To familiarize the high-performance computing for electrical drives.

UNIT I INTRODUCTION TO ELECTRIC DRIVES 6

Electric drives and its classification-Four-quadrant drive-Solid State Controlled Drives-Machine learning and optimization techniques for electrical drives.

UNIT II EMBEDDED SYSTEM FOR MOTOR CONTROL 6

Embedded Processors choice for motor control- Sensors and interface modules for Electric drives-IoT for Electrical drives applications

UNIT III INDUCTION MOTOR CONTROL 6

Speed control methods-PWM techniques- VSI fed three-phase induction motor- Fuzzy logic Based speed control for three-phase induction motor- Embedded processor based three phase induction motor speed control.

UNIT IV BLDC MOTOR CONTROL 6

Overview of BLDC Motor -Speed control methods --PWM techniques- Embedded processor based BDLC motor speed control.

UNIT V SRM MOTOR CONTROL 6

Overview of SRM Motor - Speed control methods PWM techniques- Embedded processor based SRM motor speed control.

30 PERIODS

LAB COMPONENTS: 30 PERIODS

1. Laboratory exercise: Use any System level simulator/MATLAB/open source platform to give hands-on training on simulation study on Electric drives and control.
   a. Simulation of four quadrant operation and speed control of DC motor
   b. Simulation of 3-phase inverter.
   c. Simulation of Speed control of Induction motor using any suitable software package.
   d. Simulation of Speed control of BLDC motor using any suitable software package.
   e. Simulation of Speed control of SRM using any suitable software package
2. Seminar: IoT-based Control and Monitoring for DC Motor/ any Electric drives.
3. Mini project.: Any Suitable Embedded processor-based speed control of Motors (DC/IM/BLDC/PMSM/SRM)

TOTAL: 30+30 = 60 PERIODS

COURSE OUTCOMES:

At the end of this course, the students will have the ability to

CO1: Interpret the significance of embedded control of electrical drives

CO2: Deliver insight into various control strategies for electrical drives.

CO3: Developing knowledge of Machine learning and optimization techniques for motor control.

CO4: Develop embedded system solutions for real-time application such as Electric vehicles and UAVs.

CO5: Improved Employability and entrepreneurship capacity due to knowledge up gradation on recent trends in embedded system skills required for motor control strategy.

TEXT BOOKS:

1. R.Krishnan, "Electric Motor Drives – Modeling, Analysis and Control",Prentice-Hall of India Pvt. Ltd., New Delhi,2010, 1st Edition.
2. Steve Kilts, "Advanced FPGA Design: Architecture, Implementation, and Optimization" Willey, 2007, 1st Edition.

REFERENCES:

1. VedamSubramanyam, "Electric Drives – Concepts and Applications", Tata McGraw- Hill publishing company Ltd., New Delhi, 2002, 2nd Edition.
2. K. Venkataratnam ,Special Electrical Machines, Universities Press, 2014, 1st Edition.
3. Steve Furber, 'ARM system on chip architecture', Addision Wesley, 2nd Edition 2015.
4. Ron Sass and AnderewG.Schmidt, " Embedded System design with platform FPGAs: Principles and Practices", Elsevier, 2010, 1st Edition.
5. Tim Wescott , Applied Control Theory for Embedded Systems **,** Elsevier, 2006, 1st Edition.

List of Open Source Software/ Learning website:

1) https://archive.nptel.ac.in/courses/108/104/108104140/
2) https://www.embedded.com/mcus-or-dsps-which-is-in-motor-control/
3) https://www.e3s-conferences.org/articles/e3sconf/pdf/2019/13/e3sconf_SeFet2019_01004.pdf
4) https://www.electronics-tutorials.ws/blog/pulse-width-modulation.html
5) http://kaliasgoldmedal.yolasite.com/resources/SEM/SRM.pdf

MAPPING OF COs WITH POs AND PSOs

COs	POs												PSOs		
	PO1	PO2	PO3	PO4	PO5	P06	P07	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1	1	2	2	1	-	-	-	-	-	-	-	2	1	2
CO2	2	1	3	2	1	-	-	-	-	-	-	-	2	1	2
CO3	3	2	3	3	3	-	-	-	-	-	-	-	1	3	3
CO4	3	2	3	3	3	-	-	-	-	-	-	-	3	3	3
CO5	3	2	1	2	1	-	-	-	1	-	-	-	2	2	3
Avg	2.4	1.6	2.4	2.4	1.8	-	-	-	1	-	-	-	2	2	2.6

21153E65D	DESIGN OF ELECTRIC VEHICLE CHARGING SYSTEM	L	T	P	C
		2	0	2	3

COURSE OBJECTIVES:

- To know the charging station and standards

- To learn the concepts of power converters in charging
- To find the charging scheme in renewable based EV charging
- To demonstrate the wireless power transfer technique
- To design & simulate power factor correction circuits

UNIT I CHARGING STATIONS AND STANDARDS 6

Introduction-Charging technologies- Conductive charging, EV charging infrastructure, International standards and regulations -- Inductive charging, need for inductive charging of EV, Modes and operating principle, Static and dynamic charging, Bidirectional power flow, International standards and regulations

UNIT II POWER ELECTRONICS FOR EV CHARGING 6

Layouts of EV Battery Charging Systems-AC charging-DC charging systems- Power Electronic Converters for EV Battery Charging- AC-DC converter with boost PFC circuit, with bridge and without bridge circuit - Bidirectional DC-DC Converters- Non-isolated DC-DC bidirectional converter topologies- Half-bridge bidirectional converter.

UNIT III EV CHARGING USING RENEWABLE AND STORAGE SYSTEMS 6

Introduction- - EV charger topologies , EV charging/discharging strategies --- Integration of EV charging-home solar PV system , Operation modes of EVC-HSP system , Control strategy of EVC- HSP system fast-charging infrastructure with solar PV and energy storage.

UNIT IV WIRELESS POWER TRANSFER 6

Introduction -- Inductive, Magnetic Resonance, Capacitive types. Wireless Chargers for Electric Vehicles - Types of Electric Vehicles - Battery Technology in EVs --Charging Modes in EVs Benefits of WPT. - WPT Operation Modes - Standards for EV Wireless Chargers, SAE J2954, IEC 61980. ISO 19363

UNIT V POWER FACTOR CORRECTION IN CHARGING SYSTEM 6

Need for power factor correction- Boost Converter for Power Factor Correction, Sizing the Boost Inductor, Average Currents in the Rectifier and calculation of power losses-

30 PERIODS

LAB COMPONENT: 30 PERIODS

2. Simulation and analysis for bi-directional charging V2G and G2V.
3. Design and demonstrate solar PV based EV charging station.
4. Simulate and infer wireless power charging station for EV charging.
5. Simulation of boost converter based power factor correction.

TOTAL: 30+30 = 60 PERIODS

COURSE OUTCOMES:

CO1: To illustrate various charging techniques and to know charging standards and regulations.
CO2: To demonstrate the working o DC-DC converters used for charging systems and principles
CO3: To illustrate the advantages of renewable system based charging systems
CO4: To demonstrate the principles of wireless power transfer.
CO5: To analyze the standards for wireless charging
CO6: To design and simulate boost converter based power factor correction.

REFERENCES:

1. Mobile Electric Vehicles Online Charging and Discharging, Miao Wang Ran Zhang Xuemin (Sherman) Shen, Springer 2016, 1st Edition.
2. Alicia Triviño-Cabrera, José M. González-González, José A. Aguado, Wireless Power

Transferor Electric Vehicles: Foundations and Design Approach, Springer Publisher 1st Edition. 2020.
3. Nil Patel, Akash Kumar Bhoi, Sanjeevikumar Padmanaban, Jens Bo Holm-Nielsen, Electric Vehicles Modern Technologies and Trends. Springer Publisher 1st Edition, 2021.
4. Cable Based and Wireless Charging Systems for Electric Vehicles, Technology and control, management and grid integration, Rajiv Singh, Sanjeevikumar Padmanaban, Sanjeet Dwivedi, Marta Molinas and Frede Blaabjerg, IET 2021, 1st Edition.
5. Electric and Hybrid Electric Vehicles, James D Halderman, Pearson, 2022, 1st Edition.
6. Handbook of Automotive Power Electronics and Motor Drives, Ali Emadi, Taylor & Francis, 2005.

MAPPING OF COs WITH POs AND PSOs

COs	POs												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	3	-	-	2	2	-	3	-	3	3	--	-
CO2	3	3	3	3	-	-	2	2	-	3	-	3	3	3	3
CO3	3				-	-			-		-		3	3	3
CO4	3	3	3	3	-	-	2	2	-	2	-	1	3	3	3
CO5	3	-	-	-	-	-	-	-	-	-	-	-	3	3	3
CO6	3	3	3	3	3	-	2	2	-	3	-	2	3	3	3
Avg	3	3	3	3	3	-	2	2	-	2.75	-	2.25	3	3	3

21153E65E MODEL BASED CONTROL

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

- To introduce the Knowledge about Multivariable and Multiloop systems.
- To understand the Model predictive control schemes and its elements.
- Get exposed to state space MPC along with case studies.
- To acquire knowledge on various constrained MPC.
- To make the student understand the principles of STR, MRAC and Gain scheduling.
- To make the student design simple adaptive controllers for linear systems

UNIT I INTRODUCTION TO MIMO CONTROL (7+2 SKILL) 9

Introduction to MIMO Systems-Multivariable control-Multiloop Control-Multivariable IMC-IMCPID-Case studies

UNIT II MODEL PREDICTIVE CONTROL SCHEMES (7+2 SKILL) 9

Introduction to Model Predictive Control - Model Predictive Control Elements - Generalized Predictive Control Scheme – Multivariable Generalized Predictive Control Scheme – Multiple Model based Model Predictive Control Scheme Case Studies

UNIT III STATE SPACE BASED MODEL PREDICTIVE CONTROL SCHEME (7+2 SKILL) 9

State Space Model Based Predictive Control Scheme - Review of Kalman Update based filters – State Observer Based Model Predictive Control Schemes – Case Studies

UNIT IV CONSTRAINED MODEL PREDICTIVE CONTROL SCHEME (7+2 SKILL) 9

Constraints Handling: Amplitude Constraints and Rate Constraints -Constraints and Optimization - Constrained Model Predictive Control Scheme - Case Studies.

UNIT V ADAPTIVE CONTROL SCHEME (7+2 SKILL) 9

Introduction to Adaptive Control-Gain Scheduling-Self tuning regulators-MARS-Adaptive Model Predictive Control Scheme -Case Studie

TOTAL:45 PERIODS

SKILL DEVELOPMENT ACTIVITIES (Group Seminar/Mini Project/Assignment/Content Preparation / Quiz/ Surprise Test / Solving GATE questions/ etc) 10

1 Explore various MIMO controllers presently used in industries.
2 Develop MPC, Adaptive and MIMO controllers for industrial processes.
3 Implement the controllers for MIMO systems.
4 Using software tools for practical exposures to the controllers used in industries by undergoing training.
5 Realisation of various optimization techniques for economical operation of process.

COURSE OUTCOMES:

Students able to

CO1 Ability to apply engineering knowledge to understand the control schemes on MIMO systems L3.
CO2 Ability to design controller for MIMO systemL5.
CO3 Ability to analyze the control schemes available in industries L4.
CO4 Ability to design MPC, Adaptive controllers for practical engineering problems L5.
CO5 Ability to choose suitable controllers for the given problems L5.

TEXT BOOKS:

1. Coleman Brosilow, Babu Joseph, "Techniques of Model-Based Control", Prentice Hall PTR Pub 2002, 1st Edition.
2. E. F. Camacho, C. Bordons ,"Model Predictive Control",Springer-Verlag London Limited 2007, 2nd Edition.
3. K.J. Astrom and B. J. Wittenmark, "Adaptive Control", Second Edition, Pearson Education Inc., second Edition 2013.

REFERENCES:

1. Paul Serban Agachi, Zoltan K. Nagy, Mircea Vasile Cristea, and Arpad Imre-Lucaci Model Based Control Case Studies in Process Engineering,WILEY-VCH Verlag GmbH & Co. KGaA, Weinheim 2007.1st Edition.
2. Ridong Zhang, Anke Xue Furong Gao,"Model Predictive Control Approaches Based on the Extended State Space Model and Extended Non-minimal State Space Model",Springer Nature Singapore Pte Ltd. 2019, 1st Edition.
3. J.A. ROSSITER "Model-Based Predictive Control A Practical Approach"Taylor & Francis e-Library, 2005, 1st edition.

List of Open Source Software/ Learning website:

2 https://nptel.ac.in/courses/103103037
3 https://nptel.ac.in/courses/108103007
4 https://onlinecourses.nptel.ac.in/noc21_ge01/preview
5 https://nptel.ac.in/courses/127106225

MAPPING OF COs WITH POs AND PSOs

COs	POs												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	2	2	1	1	1	1	1	1	1	1	2	2	2
CO2	3	3	3	3	1	1	1	1	1	1	1	1	2	2	2
CO3	3	3	3	2	1	1	1	1	1	1	1	1	2	2	2
CO4	3	3	3	3	1	1	1	1	1	1	1	1	2	2	2
CO5	3	3	3	3	1	1	1	1	1	1	1	1	2	2	2
Avg.	3	2.8	2.8	2.6	1	1	1	1	1	1	1	1	2	2	2

21153E65F **GRID INTEGRATING TECHNIQUES AND CHALLENGES** **LTPC**

2023

COURSE OBJECTIVES:

- To study about the present power Scenario
- To model a micro grid system
- To model power converter for grid interconnection
- To integrate wind energy conversion system with grid
- To simulate power converters like three phase inverters and DC-DC converters

UNIT I PRESENT POWER SCENARIO IN INDIA 6

Introduction --Thermal Power Plant , Components of Thermal Power Plant , Major Thermal Power Plants in India- Gas-Based Power Generation - Nuclear Power Plants -Hydropower Generation ---- Pumped Storage Plants - Solar Power---Wind Energy – Power plants India

UNIT II POWER GRIDS 6

Introduction -Electric Power ,Background , The Construction of a Power Grid System , Basic Concepts of Power Grids -Load Models--Transformers in Electric Power Grids Modelling a Microgrid System

UNIT III MODELING OF CONVERTERS IN POWER GRID DISTRIBUTED GENERATION SYSTEMS 6

Introduction Single-Phase DC/AC Inverters with Two Switches, Three-Phase DC/AC Inverters, Pulse Width Modulation Methods, The Triangular, The Identity Method, Analysis of DC/AC Three-Phase Inverters. Micro grid of Renewable Energy Systems- DC/DC Converters in Green Energy Pulse Width Modulation Sizing of an Inverter for Microgrid Operation, Sizing of a Rectifier for Microgrid Operation, The Sizing of DC/DC Converters for Micro grid

UNIT IV WIND ENERGY SYSTEM GRID INTEGRATION **6**

Introduction- Significance of Electrical Power Quality in Wind Power System--Integration Issues in Grid-Connected Wind Energy- Effect of Power Quality Issues, Importance of Custom Power Devices-Power Quality Point of View.

UNIT V GRID INTER CONNECTION **6**

Grid Code requirements-Grid integration of WECS-Grid Integration of PV systems

30 PERIODS

LAB COMPONENT **30 PERIODS**

1. Develop a model for the control of DC micro grid for non linear loads
2. Simulation study of three phase inverters with fixed and sine PWM techniques, Simulation and Design of buck/boost converters.
3. Simulate a Grid Connected Wind Energy System with STATCOM and investigate the improvement in power quality.

TOTAL: 30+30 = 60 PERIODS

COURSE OUTCOMES:

Upon completion of the course, Students able to

CO1 Review the power sector scenario in India.

CO2 Model a microgrid system

CO3 Model a converter for power grid distributed system.

CO4 Integrate wind energy system.

CO5 Simulate three phase inverter with fixed and sine PWM.

TEXT BOOKS:

1. Brian D'Andrade "The Power Grid", Academic Press, 1st Edition, 2017.
2. Yang Han, "Modeling and Control of Power Electronic Converters for Microgrid Applications", Springer, 1st Edition 2022.
3. Siegfried Heier, "Grid Integration of Wind Energy: Onshore and Offshore Conversion Systems", John Wiley & Sons, Ltd, 2014, 3rd Edition.

REFERENCES:

1. Integration of Renewable Energy Sources with Smart Grid, M. Kathiresh, A. Mahaboob Subahani, and G.R. Kanaga chidambaresan, Scrivener & Wiley, 2021, 1st Edition.
2. Control and Operation of Grid-Connected Wind Energy Systems, Ali M. Eltamaly, Almoataz Y. Abdelaziz, Ahmed G. Abo-Khalil, Springer 2021, 1st Edition.
3. Design of smart power grid renewable energy systems, Third Edition, Ali Keyhani, Wiley 2019.
4. Power Electronic Converters, Teuvo Suntio, Tuomas Messo, Joonas Puukko, Wiley 2017, 1st Edition.
5. Fundamentals of Power Electronics with MATLAB, Randall Shaffer, Laxmi publications, 2013, 2nd Edition.
6. Power Conversion and Control of Wind Energy Systems, Bin Wu, 2011, Wiley-IEEE, 1st Edition.
7. Wind Power Integration - Connection and System Operational Aspects, Brendan Fox, 2014, IET, 2nd Edition.
8. Renewable Energy Devices and Systems with Simulations in MATLAB and ANSYS, Frede Blaabjerg, Dan M. Ionel, CRC press, 2017, 1st Edition.

List of Open Source Software/ Learning website:

1. https://www.academia.edu/14628492/Current_Power_Scenario_In_India
2. https://energyeducation.ca/encyclopedia/Electrical_grid
3. https://www.academia.edu/32120081/Power_Converters_Modeling_in_Matlab_Simulink_for_Micr
4. ogrid_Simulations_Power_Converters_Modeling_in_Matlab_Simulink_for_Microgrid_Simulations
5. https://dnv.com/services/wind-farm-control-and-grid-integration
6. https://www.wind-energy-the-facts.org/images/chapter2.pdf

MAPPING OF COs WITH POs AND PSOs

COs	POs												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	-	-	-	-	-	-	-	-	3	-	3	3	3	3
CO2	3	-	2	-	3	-	-	-	-	3	-	3	3	3	3
CO3	3	3	3	2	3	-	-	-	-	3	-	3	3	3	3
CO4	3	3	1	3	3	-	-	-	-	3	-	3	3	3	3
CO5	3	3	2	3		-	-	-	-	3	-	3	3	3	3
Avg	3	3	2	2	3	-	-	-	-	3	-	3	3	3	3

ELECTIVE–VI(VI SEMESTER)

21153E66A **DIGITAL SIGNAL PROCESSING SYSTEM DESIGN** **LTPC**
2023

COURSE OBJECTIVES:

- To introduce the concept of analyzing discrete time signals & systems in the time and frequency domain through mathematical representation.
- To study the various time to frequency domain transformation techniques.
- To Understand the computation algorithmic steps for Fourier Transform.
- To study about filters and their design for digital implementation.
- To introduce the programmable digital signal processor & its application.

UNIT I INTRODUCTION 6

Classification of systems: Continuous, discrete, linear, causal, stable, dynamic, recursive, time variance; classification of signals: continuous and discrete, energy and power; mathematical representation of signals; spectral density; sampling techniques, quantization, quantization error, Nyquist rate, aliasing effect. Digital signal representation.

UNIT II DISCRETE TIME SYSTEM ANALYSIS 6

Z-transform and its properties, inverse z-transforms; difference equation – Solution by z-transform, application to discrete systems - Stability analysis, frequency response – Convolution – Introduction to Fourier Transform- Discrete time Fourier transform.

UNIT III DISCRETE FOURIER TRANSFORM & COMPUTATION 6

DFT properties, magnitude and phase representation - Computation of DFT using FFT algorithm – DIT & DIF - FFT using radix 2 – Butterfly structure.

UNIT IV DESIGN OF DIGITAL FILTERS 6

FIR & IIR filter realization – Parallel & cascade forms. FIR design: Windowing Techniques – Need and choice of windows – Linear phase characteristics. IIR design: Analog filter design Butterworth and Chebyshev approximations; digital design using impulse invariant and bilinear transformation --- Warping, prewarping Frequency transformation.

UNIT V DIGITAL SIGNAL PROCESSORS 6

Introduction – Architecture of one DSP processor for motor control – Features – Addressing Formats– Functional modes --Introduction to Commercial Processors

30 PERIODS

LAB COMPONENTS: 30 PERIODS

1. Laboratory exercise : Use any DSP processor/MATLAB/open source platform to give hands on training on basic concepts of Digital Signal Processing
    a) To determine impulse and step response of two vectors
    b) To perform convolution between two vectors .
    c) To compute DFT and IDFT of a given sequence.
    d) To perform linear convolution of two sequence using DFT
    e) Design and Implementation of FIR Filter
    f) Design and Implementation of IIR Filter
    g) To determine z-transform from the given transfer function and its ROC
2. Assignment : Implementation of FIR/IIR filter with FPGA.
3. DSP processors based Mini project.

TOTAL: 30+30 = 60 PERIODS

COURSE OUTCOMES:

At the end of this course, the students will have the ability to

CO1: Explain the concepts of digital signal processing

CO2: Illustrate the system representation using transforms

CO3: Learn the transformation techniques for time to frequency conversion

CO4: Design suitable digital FIR, IIR algorithm for the given specification

CO5: Use digital signal processor for application development

TEXTBOOKS:

1. J.G. Proakis and D.G. Manolakis, 'Digital Signal Processing Principles, Algorithms and Applications', Pearson Education, New Delhi, 4th Edition 2007.
2. Robert J.Schilling & Sandra L.Harris ,' Introduction to Digital Signal Processing using MATLAB', Cengage Learning, 2nd Edition 2013.

REFERENCES:

1. Emmanuel C Ifeachor and Barrie W Jervis ,"Digital Signal Processing – A Practical approach" Pearson Education, Second edition, 2002.
2. Alan V. Oppenheim, Ronald W. Schafer and John R. Buck, 'Discrete – Time Signal Processing', Pearson Education, New Delhi, 2nd Edition 2012.
3. SenM.kuo, Woonseng…s.gan, "Digital Signal Processors, Architecture, Implementations & Applications, Pearson, 1st Edition 2004.
4. S.K. Mitra, 'Digital Signal Processing – A Computer Based Approach', Tata McGraw Hill, New Delhi, 4th Edition 2013.
5. B. Venkataramani, M. Bhaskar, 'Digital Signal Processors, Architecture, Programming and Applications', Tata McGraw Hill, New Delhi, 2003, 1st Edition.

List of Open Source Software/ Learning website:

1. https://nptel.ac.in/courses/117102060
2. https://www.tutorialspoint.com/digital_signal_processing/index.htm
3. https://www.elprocus.com/digital-signal-processor/
4. https://www.sciencedirect.com/topics/computer-science/digital-signal-processing-algorithm#:~:text=Digital%20signal%20processing%20algorithms%20are,known%20as%20operations%20or%20ops.
5. https://www.electronicshub.org/introduction-to-fpga/

MAPPING OF COs WITH POs AND PSOs

COs	POs												PSOs		
	PO1	PO2	PO3	PO4	PO5	P06	P07	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1	3	2	2	1	-	-	-	-	-	-	-	1	2	1
CO2	2	3	3	2	2	-	-	-	-	-	-	-	2	3	1
CO3	3	3	3	3	3	-	-	-	-	-	-	-	2	2	2
CO4	3	3	3	3	3	-	-	-	-	-	-	-	2	2	3
CO5	3	3	3	2	1	-	-	-	1	-	-	-	2	2	3
Avg	2.4	3	2.8	2.4	2	-	-	-	1	-	-	-	1.8	2.2	2

21153E66B	UNDER GROUND CABLE ENGINEERING	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

To impart knowledge on the following topics

- Understanding Power Cable Characteristics and Applications.
- Cable Manufacturing.
- Installation of underground power cables
- Underground cable System Fault Locating.
- Testing and maintenance of Underground cable system.
- Cable Performance and Field Assessment of Power Cables

UNIT I INTRODUCTION TO ELECTRICAL POWER CABLES (7+2 SKILL) 9

Development of Underground Cables - Electric Lighting- Distribution of Energy for Lighting- - Paper Insulated Cables - Underground Residential Distribution Systems- Underground Residential Distribution Systems- Medium Voltage Cable Development.

UNIT II CABLE ARCHITECHTURE, DIELECTRIC THEORY AND CABLE9 CHARACTERISTICS (7+2 SKILL)

Architecture of Underground Cabling System - Basic Dielectric Theory of Cable - Conductors -Armour and Protective Finishes - Cable Characteristics: Electrical- Fundamentals of Electrical Insulation Materials - Electrical Properties of Cable Insulating Materials - Cable Standards and Quality Assurance - Cable design parameters- Current Carrying Capacity - Short-circuit Ratings.

UNIT III SUPPLY DISTRIBUTION SYSTEMS AND CABLES(7+2 SKILL) 9

Supply Distribution Systems - Distribution Cable Types, Design and Applications - Paper Insulated Distribution Cables - PVC Insulated Cables - Polymeric Insulated Distribution Cables for 6-30 kV - Manufacture of Distribution Cables - Joints and Terminations for Distribution Cables - Testing of Distribution Cables.

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UNIT IV TRANSMISSION SYSTEMS AND CABLES(7+2 SKILL) 9

Basic Cable Types for A.C. Transmission - Self-contained Fluid-filled Cables - Gas Pressure Cables - High Pressure Fluid-filled Pipe Cables - Polymeric Insulated Cables for Transmission Voltages - Techniques for Increasing Current Carrying Capacity - Transmission Cable Accessories and Jointing for Pressure-assisted and Polymeric Cables.

UNIT V CABLE INSTALLATION, TESTING, MAINTENANCE(7+2 SKILL) 9

Installation of Transmission Cables -Splicing, Terminating, and Accessories - Sheath Bonding and Grounding-Testing of Transmission Cable Systems - Underground System Fault Locating - Field Assessment of Power Cable Systems- Condition monitoring tests - PD measurements.

TOTAL : 45 PERIODS

SKILL DEVELOPMENT ACTIVITIES (GROUP SEMINAR/ MINI PROJECT/ ASSIGNMENT/ CONTENT PREPARATION/ QUIZ/ SURPRISE TEST /SOLVING GATE QUESTIONS /ETC. 1

1. Demonstration of cable architecture with cable samples of all types.
2. Understanding the cable manufacturing process through factory visit.
3. Familiarization of the cable laying procedure through field visits.
4. Familiarization of cable jointing / end termination techniques.
5. Understanding and familiarization of cable fault locating techniques through field visit to local distribution company or inhouse laboratory.
6. Understanding testing procedures and condition monitoring tests.

COURSE OUTCOMES:

CO1 Ability to understand the fundamental of underground cable system.

CO2 Ability to gain knowledge on the architecture of UG cable and physical and electrical characteristics of the UG cable.

CO3 Ability to understand different types of cable used in distribution system.

CO4 Ability to acquire knowledge on Underground cables used in transmission system

CO5 Ability to understand the cable installations procedures and practices.

CO6 Ability to understand the theory / methodology of cable fault detection and rectification, testing and maintenance.

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TEXT BOOKS:

1. William Thue, 'Electrical Power Cable Engineering', CRC Press Taylor & Francis Group., 6000 Broken Sound Parkway NW, Suite 300Boca Raton, FL 33487-2742, 3rd Edition 2017.
2. G. F. Moore, 'Electric Cables Handbook' -Third edition, Blackwell Science Ltd, 9600 Garsington Road, Oxford OX4 2DQ, UK., January 2017.

REFERENCES:

1. Leonard L. Grigsby, 'Electrical Power Cable Engineering' - CRC Press, Marcel Dekker, 3rd Edition 2012.
2. Christian Flytkjaer Jensen, Online Location of Faults on AC Cables in Underground Transmission Systems (Springer Theses), 2014, March.
3. https://kafactor.com/content/technical-resources/kerite-underground-cable-engineering-handbook.pdf
4. Handbook on Cable Fault Localization (April 2020) https://rdso.indianrailways.gov.in/works/uploads/File/Handbook%20on%20Cable%20Fault%20Localization(2).pdf
5. K. H. Ali et al.: Industry Practice Guide for Underground Cable Fault-Finding in the LVDN: https://ieeexplore.ieee.org/stamp/stamp.jsp?arnumber=9807279, June 2022.
6. R. W. Deltenre, J. J. Schwarz, and H. J. Wagnon, "Underground cable fault location: A handbook to TD-153," BDM Corp., Albuquerque, NM, USA, Final Rep. EPRI EL-363, 1977. [Online]. Available: https://www.osti.gov/servlets/purl/7233049, doi: 10.2172/7233049, January 1997.

MAPPING OF COs WITH POs AND PSOs

COs	POs												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	-	-	-	-	2	1	-	3	2	-	3	-	3
CO2	3	2	-	-	-	-	2	1	-	3	2	-	3	-	3
CO3	3	2	-	-	-	-	2	1	-	3	2	-	3	-	3
CO4	3	2	-	-	-	-	2	1	-	3	2	-	3	-	3
CO5	3	2	3	-	-	-	2	1	-	3	2	-	3	3	3
CO6	3	3	-	3	-	-	2	1	-	3	2	-	3	3	3
Avg	3	2.1	3	3	-	-	2	1	-	3	2	-	3	3	3

21153E66C **ANALYSIS OF ELECTRICAL MACHINES** **LT P C**
2 0 2 3

COURSE OBJECTIVES:

- To model & simulate all types of DC machines
- To develop reference frame equations for various elements like R, L and C
- To model an induction (three phase and 'n' phase) and synchronous machine
- To drive reference frame equations for induction and synchronous machine
- To study the need and working of multiphase induction and synchronous machine

UNIT I MODELING OF BRUSHED-DC ELECTRIC MACHINERY 6

Fundamentals of Operation – Introduction – Governing equations and modeling of Brushed DC-Motor – Shunt, Series and Compound – State model derivation – Construction of Model of a DC Machine using state equations- Shunt, Series and Compound..

UNIT II REFERENCE FRAME THEORY 6

Historical background – phase transformation and commutator transformation – transformation of variables from stationary to arbitrary reference frame .

UNIT III INDUCTION MACHINES 6

Three phase induction machine -- equivalent circuit- free acceleration characteristics – voltage and torque equations in machine variables and arbitrary reference frame variables – Simulation under no-load and load conditions- Machine variable form, arbitrary reference variable form.

UNIT IV SYNCHRONOUS MACHINES 6

Three phase synchronous machine --voltage and torque equations in machine variables and rotor reference frame variables (Park's equations).

UNIT V MULTIPHASE (MORE THAN THREE-PHASE) MACHINES CONCEPTS 6

Preliminary Remarks - Necessity of Multiphase Machines----Evolution of Multiphase Machines- Advantages of Multiphase Machines - Working Principle --Multiphase Induction Machine, Multiphase Synchronous Machine --Modeling of 'n' phase machine. Applications of Multiphase Machines

30 PERIODS

LAB COMPONENT: 30 PERIODS

1. Modeling of DC machines.
2. Simulation under no-load and loaded conditions for a PMDC motor
3. Simulation of smooth starting for DC motor.
4. Simulation under no-load and load conditions of a three phase induction machine in machine variable form and arbitrary reference variable form.
5. Simulation under no-load and load conditions of a three phase synchronous machine in machine variable form and arbitrary reference variable form.

TOTAL: 30+30 = 60 PERIODS

COURSE OUTCOMES:

At the end of the course, students should be able to:

CO1: Find the modeling for a brushed DC-Motor (Shunt, Series, Compound and separately excised motor) and to simulate DC motors using state models

CO2: Apply reference frame theory for, resistive and reactive elements (three phase)

CO3: Compute the equivalent circuit and torque of three phase induction motor and synchronous motor in machine variable arbitrary reference frame variable

CO4: Find the need and advantages of multiphase machines

CO5: Demonstrate the working of multiphase induction and synchronous machine.

CO6: Compute the model of three phase and multiphase induction and synchronous machine.

REFERENCES:

1. Stephen D. Umans, "Fitzgerald & Kingsley's Electric Machinery", Tata McGraw Hill, 7th Edition, 2020.
2. Bogdan M. Wilamowski, J. David Irwin, The Industrial Electronics Handbook, Second Edition, Power Electronics and Motor Drives, CRC Press, 2011, 1st Edition.
3. Paul C. Krause, Oleg Wasynczuk, Scott D. Sudhoff, Steven D. Pekarek, "Analysis of Electric Machinery and Drive Systems", 3rd Edition, Wiley-IEEE Press, 2013.
4. R. Krishnan, Electric Motor & Drives: Modeling, Analysis and Control, Pearson Education, 1st Imprint, 2015, 1st Edition.
5. R.Ramanujam, Modeling and Analysis of Electrical Machines, I.k.International Publishing House Pvt.Ltd,2018.
6. Chee Mun Ong, Dynamic Simulation of Electric Machinery using MATLAB, Prentice Hall, 1997,

1st Edition.

7. Atif Iqbal,Shaikh Moinoddin, Bhimireddy Prathap Reddy, Electrical Machine Fundamentals with Numerical Simulation using MATLAB/SIMULINK, Wiley,2021,1st Edition

MAPPING OF COs WITH POs AND PSOs

COs	POs												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	3	3	-	2	1	-	3	-	2	3	3	3
CO2	3	3	3	3	3	-	2	1	-	3	-	2	3	3	3
CO3	3	3	3	3	3	-	2	1	-	3	-	2	3	3	3
CO4	3	-	-	-	3	-	2	1	-	3	-	2	3	3	3
CO5	3	-	-	-	3	-	2	1	-	3	-	2	3	3	3
CO6	3	3	3	3	3	-	2	1	-	3	-	2	3	3	3
Avg	3	3	3	3	3	-	2	1	-	3	-	2	3	3	3

21153E66D **DESIGN OF MOTOR AND POWER CONVERTERS FOR ELECTRIC VEHICLES**

L T P C
2 0 2 3

COURSE OBJECTIVES:

- To review the drive cycles and requirements of EVs
- To know the working of motors used in Electric Vehicle
- To analyze and model the buck/boost converter operation and to design the same
- To learn the simulation basics of control systems
- To derive transfer functions for DC-DC converters

UNIT I ELECTRIC VEHICLE DYNAMICS 6

Standard drive cycles-Dynamics of Electric Vehicles-Tractive force-Maximum speed, torque, power, energy requirements of EVs.

UNIT II MOTORS FOR ELECTRIC VEHICLES 6

Introduction – Speed And Torque control of above and below rated speed-Speed control of EV in the constant power region of electric motors. DC Motors, Induction Motor, Permanent Magnet Synchronous Motors (PMSM), Brushless DC Motors, Switched Reluctance Motors (SRMs). Synchronous Reluctance Machines-Choice of electric machines for EVs.

UNIT III BASICS OF SIMULATION IN CONTROL SYSTEMS 6

Transfer Function-How to build transfer function, identify Poles, zeros, draw time response plots, bode plot (Bode Plots for Multiplication Factors, Constant, Single and Double Integration Functions, Single and Double Differentiation Functions, Single Pole and Single Zero Functions, RHP Pole and RHP Zero Functions), state space modelling-transfer function from state space Model.

UNIT IV MODELING OF DC-DC CONVERTERS 6

Overview of PWM Converter Modelling -Power Stage Modelling - PWM Block Modelling----Voltage Feedback Circuit and Small-Signal Model of PWM Converter - Averaging Power Stage Dynamics --- Average Models for buck/boost Converter - Small-Signal Model of Converter Power Stage --- Frequency Response of Converter

UNIT V POWER STAGE TRANSFER FUNCTIONS OF DC – DC CONVERTERS 6

Power Stage Transfer Functions of buck-boost Converter in CCM Operation, Input-to-Output Transfer Function, Duty Ratio-to-Output Transfer Function, Load Current-to-Output Transfer Function.

30 PERIODS

LAB COMPONENT: **30 PERIODS**

1. Simple simulation exercises of basic control systems
2. Bode plots and calculation of Gain margin and Phase margin for power stage transfer function via simulation.
3. Design of buck converter
4. Design of boost converter
5. Simulation of buck, boost and buck boost converter-open loop (With power circuit and Transfer function).

TOTAL: 30+30 = 60 PERIODS

COURSE OUTCOMES:

Upon completion of the course, students will be able to:

CO1: To use appropriate electric machine for electric vehicle application

CO2: To compute transfer function with factors such as constant, integral, differential, first order factor and second order factor (both numerators & denominators)

CO3: To compute transfer function from state models

CO4: To design buck, boost and buck-boost converter.

CO5: To compute a power stage transfer functions for DC-DC converters

CO6: To simulate DC-DC converters and to obtain gain margin and phase margin.

REFERENCES:

1. Power Electronic Converters, Teuvo Suntio, Tuomas Messo, Joonas Puukko, First Edition 2017.
2. Fundamentals of Power Electronics with MATLAB, Randall Shaffer, 2nd Edition, 2013, Lakshmi publications
3. Feedback Control problems using MATLAB and the Control system tool box, Dean Frederick and Joe Cho, 2000, 1st Edition, Cengage learning.
4. Handbook of Automotive Power Electronics and Motor Drives, Ali Emadi, Taylor & Francis, 2005,1st Edition.
5. Electrical Machine Fundamentals with Numerical Simulation using MATLAB/SIMULINK, Atif Iqbal, Shaikh Moinoddin, Bhimireddy Prathap Reddy, Wiley,2021, 1st Edition.
6. Emerging Power Converters for Renewable Energy and Electric Vehicles Modeling, Design, and Control, Md. Rabiul Islam,Md. Rakibuzzaman Shah, Mohd. Hasan Ali, CRC Press,2021, 1st Edition.
7. Iqbal Hussain, "Electric and Hybrid Vehicles: Design Fundamentals, Second Edition" CRC Press, Taylor & Francis Group, Third Edition 2021.

MAPPING OF COs WITH POs AND PSOs

COs	POs												COs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3		3	-	-	-	-	1	-	3	-	3	3	-	1
CO2	3	3	3	3	3	-	-	1	-	3	-	3	3	3	3
CO3	3	3	3	3	3	-	-	1	-	3	-	3	3	3	3
CO4	3	3	3	3	3	-	-	1	-	3	-	3	3	3	3
CO5	3	3	3	3	3	-	-	1	-	3	-	3	3	3	3
CO6	3	3	3	3	3	-	-	1	-	3	-	3	3	3	3
Avg	3	3	3	3	3	-	-	1	-	3	-	3	3	3	2.6

21153E66E **HYBRID ENERGY TECHNOLOGY** **LT P C**

3 0 0 3

COURSE OBJECTIVES:

- To provide knowledge about different types of hybrid energy systems.
- To analyze the various electrical Generators used for the Wind Energy Conversion Systems.
- To design the power converters used in SPV Systems.
- To analyze the various power converters used in hybrid energy systems and to understand the importance of standalone and grid-connected operation in Hybrid renewable energy systems.
- To analyze the performance of the various hybrid energy systems

UNIT I INTRODUCTION TO HYBRID ENERGY SYSTEMS (7+2 Skill) 9

Hybrid Energy Systems – Need for Hybrid Energy Systems – Solar-Wind-Fuel Cell-Diesel, Wind- Biomass-Diesel, Micro-Hydel-PV, Ocean and geyser energy - Classification of Hybrid Energy systems – Importance of Hybrid Energy systems – Advantages and Disadvantages - Environmental aspects of renewable energy - Impacts of renewable energy generation on the environment - Present Indian and international energy scenario of conventional and RE sources - Ocean energy, Hydel Energy - Wind Energy, Biomass energy, Hydrogen energy - Solar Photovoltaic (PV) and Fuel cells: Operating principles and characteristics.

UNIT II ELECTRICAL MACHINES FOR WIND ENERGY CONVERSION SYSTEMS (WECS) (7+2 Skill) 9

Review of reference theory fundamentals –Construction, Principle of operation and analysis: Squirrel Cage Induction Generator (SCIG), Doubly Fed Induction Generator (DFIG) - Permanent Magnet Synchronous Generator (PMSG).

UNIT III POWER CONVERTERS AND ANALYSIS OF SOLAR PV SYSTEMS (7+2 Skill) 9

Power Converters for SPV Systems - Line commutated converters (inversion-mode) - Boost and buck-boost converters- selection of inverter, battery sizing, array sizing - Analysis of SPV Systems - Block diagram of the solar PV systems - Types of Solar PV systems: Stand-alone PV systems,

UNIT IV ANALYSIS OF POWER CONVERTERS FOR HYBRID ENERGY SYSTEMS (7+2 Skill) 9

Introduction to Power Converters – Stand-alone Converters -AC-DC-AC converters: uncontrolled rectifiers, PWM Inverters - Bi-Directional Converters - Grid-Interactive Inverters - Matrix converter – Merits and Limitations.

UNIT V CASE STUDIES FOR HYBRID RENEWABLE ENERGY SYSTEMS (7+2 Skill) 9

Hybrid Systems- Range and type of Hybrid systems – Performance Analysis – Cost Analysis - Case studies of Diesel-PV, Wind-PV-Fuel-cell, Micro-hydel-PV, Biomass-Diesel-Fuel-cell systems.

TOTAL : 45 PERIODS

SKILL DEVELOPMENT ACTIVITIES (Group Seminar/Mini Project/Assignment/Content Preparation / Quiz/ Surprise Test / Solving GATE questions/ etc) 10

1. Simulation of Wind energy conversion system
2. Simulation of power converters
3. Simulations of AC-DC-AC converters, PWM inverters and Matrix Converters with Resistive and dynamic loads

COURSE OUTCOMES:

Upon completion of the course, students will be able to:

CO1: Analyze the impacts of hybrid energy technologies on the environment and demonstrate them to harness electrical power.

CO2: Select a suitable Electrical machine for Wind Energy Conversion Systems and simulate wind energy conversion system

CO3: Design the power converters such as AC-DC, DC-DC, and AC-AC converters for SPV systems.

CO4: Analyze the power converters such as AC-DC, DC-DC, and AC-AC converters for Hybrid energy systems.

CO5: Interpret the hybrid renewable energy systems.

TEXTBOOKS:

1. Bahman Zohuri, "Hybrid Energy Systems", Springer, First Edition, 2018.
2. S.M. Muyeen, "Wind Energy Conversion Systems", Springer First Edition, 2012
3. Md. Rabiul Islam, Md. Rakibuzzaman Shah, Mohd Hasan Ali, "Emerging Power Converters for Renewable Energy and Electric Vehicles", CRC Press, First Edison, 2021

REFERENCES:

1. Ernst Joshua, Wind Energy Technology, PHI, India, 2018, 3rd Edition.
2. S.N.Bhadra, D. Kastha, & S. Banerjee "Wind Electrical Systems", Oxford University Press, 7th Impression, 2005.
3. Rashid.M. H "Power electronics Hand book", Academic press,4th Edition, 2018.
4. Rai. G.D, "Non-conventional energy sources", Khanna publishers, 6th Edition, 2017.
5. Rai. G.D, "Solar energy utilization", Khanna publishers, 3rd Edition, 1987.
6. Gray, L. Johnson, "Wind energy system", Prentice Hall of India, 2nd Edition, 2006.
7. B.H.Khan "Non-conventional Energy sources", Tata McGraw hill Publishing Company, New Delhi, 2017, 3rd Edition.

List of Open Source Software/ Learning website:

1. https://www.sciencedirect.com/topics/engineering/hybrid-energy-system
2. https://www.sciencedirect.com/topics/engineering/wind-energy-conversion-system
3. https://www.academia.edu/35619294/Modeling_and_Performance_Analysis_of_Solar_PV_S
4. System_and_DC_DC_Converters
5. https://www.mdpi.com/journal/energies/special_issues/Power_Converter_Electric_Machines
6. _Renewable_Energy_Systems_Transportation
7. https://www.intechopen.com/chapters/64317

MAPPING OF COs WITH POs AND PSOs

COs	POs												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	2	-	-	-	-	-	3	-	3	3	3	3
CO2	3	3	3	2	3	-	-	-	-	3	-	3	3	3	3
CO3	3	3	3	2	3	-	-	-	-	3	-	3	3	3	3
CO4	3	3	3	2	3	-	-	-	-	3	-	3	3	3	3
CO5	3	3	3	2		-	-	-	-	3	-	3	3	3	3
Avg	3	3	3	2	3	-	-	-	-	3	-	3	3	3	3

21153E66F **COMPUTER CONTROL OF PROCESSES**

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

- To represent the linear time invariant System in discrete State Space form
- To analyze the controllability, observability and stability of a Discrete time System.
- To estimate model parameters from input/output measurements
- To Design Digital Controllers
- To Design Multi-loop and Multivariable Controllers for multivariable system

UNIT I DISCRETE STATE-VARIABLE TECHNIQUE (7+2 SKILL) 9

State equation of discrete data system with sample and hold – State transition equation – Methods of computing the state transition matrix – Decomposition of discrete data transfer functions – State diagrams of discrete data systems – System with zero-order hold – Controllability and observability of linear time invariant discrete data system –Stability tests of discrete-data system.

UNIT II SYSTEM IDENTIFICATION (7+2 SKILL) 9

Identification of Non-Parametric Input-Output Models: -Transient analysis-Frequency analysis-Correlation analysis- Spectral analysis – Identification of Parametric Input-Output Models: - Least Squares Method – Recursive Least Square Method.

UNIT III DIGITAL CONTROLLER DESIGN (7+2 SKILL) 9

Review of z-transform – Modified of z-transform – Pulse transfer function – Digital PID controller – Dead-beat controller and Dahlin's controller – Kalman's algorithm, Pole Placement Controller

UNIT IV MULTI-LOOP REGULATORY CONTROL (7+2 SKILL) 9

Multi-loop Control - Introduction – Process Interaction – Pairing of Inputs and Outputs -The Relative Gain Array (RGA) – Properties and Application of RGA - Multi-loop PID Controller – Biggest Log Modulus Tuning Method – De-coupler.

UNIT V MULTIVARIABLE REGULATORY CONTROL (7+2 SKILL) 9

Introduction to Multivariable control –Multivariable PID Controller – Multivariable Dynamic Matrix Controller – Case Studies: - Distillation Column, CSTR and Four-tank system.

TOTAL : 45 PERIODS

SKILL DEVELOPMENT ACTIVITIES (Group Seminar/Mini Project/ Assignment/ Content 10 Preparation / Quiz/ Surprise Test / Solving GATE questions/ etc)

1. Calculate the RGA to determine the recommended pairing between controlled and manipulated variables for any system.
2. Seminar on LS, RLS methods.
3. Design of DMC for distillation Column, CSTR and Four-tank systemin MATLAB.
4. Design a Multi-loop & Multivariable controller for MIMO system.
5. Design a model for any industrial process using parametric & non-parametric system.

COURSE OUTCOMES:

CO1 Develop mathematical models for discrete time systems using state variable techniques and analyze the stability of the systems. L4

CO2 Construct models from input-output data by least square and recursive least square method. L5

CO3 Ability to design different digital controllers to satisfy the required criterion. L5

CO4 Design a multi-loop controller and multivariable controller for multi-variable systems. L5
CO5 Ability to design multivariable dynamic matrix controller for industrial processes. L5

TEXT BOOKS:

1. Stephanopoulos, G., "Chemical Process Control -An Introduction to Theory and Practice", Prentice Hall of India, 1st Edition, 2015.
2. Sigurd Skogestad, Ian Postlethwaite, "Multivariable Feedback Control: Analysis and Design", John Wiley and Sons, 2005, 2nd Edition.

REFERENCE

1. Thomas E. Marlin, Process Control – Designing Processes and Control systems for Dynamic Performance, Mc-Graw-Hill,2000, 2nd Edition.
2. Gopal, M., "Digital Control and State Variable Methods", Tata Mc Graw Hill, 4th Edition, 2017.
3. P. Albertos and A. Sala, "Multivariable Control Systems An Engineering Approach", Springer Verlag, 1st Edition, 2004
4. Bequette, B.W., "Process Control Modeling, Design and Simulation", Prentice Hall of India, 1st Edition, 2003.
5. Dale E. Seborg, Duncan A. Mellichamp, Thomas F. Edgar, "Process Dynamics and Control", Wiley John and Sons, 4th Edition, 2016.

List of Open Source Software/ Learning website:

https://nptel.ac.in/courses/103104050

https://www.mathworks.com/matlabcentral/mlc-downloads/downloads/submissions/10816/versions/1/previews/Mimotools/rga.m/index.html
https://in.mathworks.com/help/ident/

https://ctms.engin.umich.edu/CTMS/index.php?example=Introduction&section=ControlDigital

MAPPING OF COs WITH POs AND PSOs

COs	POs												PSOs		
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	3	3	3	2	1	1	1	1	1	1	1	1	2	2	2
CO2	3	3	3	3	1	1	1	1	1	1	1	1	2	2	2
CO3	3	3	3	3	1	1	1	1	1	1	1	1	2	2	2
CO4	3	3	3	3	1	1	1	1	1	1	1	1	2	2	2
CO5	3	3	3	3	1	1	1	1	1	1	1	1	2	2	2
Avg.	3	3	3	2.8	1	1	1	1	1	1	1	1	2	2	2

ELECTIVE–VII (VIISEMESTER)

21160S75A **TOTAL QUALITY MANAGEMENT** **LTPC**
3003

COURSE OBJECTIVES:

- Teach the need for quality, its evolution, basic concepts, contribution of quality gurus, TQMframework, Barriers and Benefits of TQM.
- Explain the TQM Principles for application.
- Define the basics of Six Sigma and apply Traditional tools, New tools, Benchmarking andFMEA.
- Describe Taguchi's Quality Loss Function, Performance Measures and apply Techniqueslike QFD, TPM, COQ and BPR.
- Illustrate and apply QMS and EMS in any organization.

UNIT I INTRODUCTION 9

Introduction - Need for quality - Evolution of quality - Definition of quality Dimensions of product and service quality -Definition of TQM-- Basic concepts of TQM Gurus of TQM (Brief introduction)---TQM Framework- Barriers to TQM -Benefits of TQM.

UNIT II TQM PRINCIPLES 9

Leadership Deming Philosophy, Quality Council, Quality statements and Strategic planning- Customer Satisfaction -Customer Perception of Quality, Feedback, Customer complaints, Service Quality, Kano Model and Customer retention - Employee involvement – Motivation, Empowerment, Team and Teamwork, Recognition & Reward and Performance Appraisal-- Continuous process improvement -Juran Trilogy, PDSA cycle, 5S and Kaizen Supplier partnership – Partnering, Supplier selection, Supplier Rating and Relationship development.

UNIT III TQM TOOLS & TECHNIQUES I 9

The seven traditional tools of quality - New management tools -- Six-sigma Process Capability- Bench marking - Reasons to benchmark, Benchmarking process, What to Bench Mark, Understanding Current Performance, Planning, Studying Others, Learning from the data, Using the findings, Pitfalls and Criticisms of Benchmarking - FMEA Intent , Documentation, Stages: Design FMEA and Process FMEA.

UNIT IV TQM TOOLS & TECHNIQUES II 9

Quality circles - Quality Function Deployment (QFD) Taguchi quality loss function - TPM - Concepts, improvement needs - Performance measures- Cost of Quality BPR.

UNIT V QUALITY MANAGEMENT SYSTEM 9

Introduction-Benefits of ISO Registration-ISO 9000 Series of Standards-Sector-Specific Standards - AS 9100, TS16949 and TL 9000-- ISO 9001 Requirements-Implementation-Documentation- Internal Audits-Registration-ENVIRONMENTAL MANAGEMENT SYSTEM: Introduction–ISO 14000 Series Standards–Concepts of ISO 14001–Requirements of ISO 14001-Benefits of EMS.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

CO1: Ability to apply TQM concepts in a selected enterprise.
CO2: Ability to apply TQM principles in a selected enterprise.
CO3: Ability to understand Six Sigma and apply Traditional tools, New tools, Benchmarking andFMEA.
CO4: Ability to understand Taguchi's Quality Loss Function, Performance Measures and applyQFD, TPM, COQ and BPR.
CO5: Ability to apply QMS and EMS in any organization.

COs- POs & PSOs MAPPING

COs	POs												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1		3										3	2		3
2						3						3		2	
3					3				3					2	3
4		2			3	2	3	2				3	3	2	
5			3			3	3	2							
AVg.		2.5	3		3	2.6	3	2	3			3	2.5	2	3

TEXT BOOK:

1. Dale H.Besterfiled, Carol B.Michna,Glen H. Bester field,MaryB.Sacre, HemantUrdhwareshe and RashmiUrdhwareshe, "Total Quality Management", Pearson Education Asia, RevisedThird Edition, Indian Reprint, Sixth Impression,2013.

REFERENCES:

1 Joel.E. Ross, "Total Quality Management – Text and Cases",Routledge.,2017.

2. Kiran.D.R, "Total Quality Management: Key concepts and case studies, Butterworth -Heinemann Ltd, 2016.
3. Oakland, J.S. "TQM – Text with Cases", Butterworth – Heinemann Ltd., Oxford, Third Edition,2003.
4. Suganthi,L and Anand Samuel, "Total Quality Management", Prentice Hall (India) Pvt. Ltd.,2006 .

21160S75B ENGINEERING ECONOMICS AND FINANCIAL ACCOUNTING LTPC 3003

COURSE OBJECTIVES:

- Understanding the concept of Engineering Economics.
- Implement various micro economics concept in real life.
- Gaining knowledge in the field of macro economics to enable the students to have better
- understanding of various components of macro economics.
- Understanding the different procedures of pricing.
- Learn the various cost related concepts in micro economics.

UNIT I DEMAND & SUPPLY ANALYSIS 9

Managerial Economics - Relationship with other disciplines----Firms: Types, objectives and goals - Managerial decisions - Decision analysis.Demand - Types of demand---Determinants of demand - Demand function - Demand elasticity - Demand forecasting - Supply---Determinants of supply - Supply function Supply elasticity.

UNIT II PRODUCTION AND COST ANALYSIS 9

Production function - Returns to scale - Production optimization --- Least cost input Isoquants - Managerial uses of production function. Cost Concepts - Cost function - Determinants of cost --- Short run and Long run cost curves Cost Output Decision Estimation of Cost.

UNIT III PRICING 9

Determinants of Price - Pricing under different objectives and different market structures - Price discrimination Pricing methods in practice.

UNIT IV FINANCIAL ACCOUNTING (ELEMENTARY TREATMENT) 9

Balance sheet and related concepts - Profit & Loss Statement and related concepts ------ Financial Ratio Analysis - Cash flow analysis - Funds flow analysis --- Comparative financial statements -------Analysis & Interpretation of financial statements.

UNIT V CAPITAL BUDGETING (ELEMENTARY TREATMENT) 9

Investments - Risks and return evaluation of investment decision --- Average rate of return - Payback Period Net Present Value Internal rate of return.

TOTAL: 45 PERIODS

COURSE OUTCOMES: Students able to

CO1: Upon successful completion of this course, students will acquire the skills to apply the basics of economics and cost analysis to engineering and take economically sound decisions

CO2: Evaluate the economic theories, cost concepts and pricing policies

CO3: Understand the market structures and integration concepts

CO4: Understand the measures of national income, the functions of banks and concepts of globalization

CO5: Apply the concepts of financial management for project appraisal

TEXT BOOKS:

1. Panneer Selvam, R, “Engineering Economics”, Prentice Hall of India Ltd, New Delhi,2001.
2. Managerial Economics: Analysis, Problems and Cases - P. L. Mehta, Edition, 13. Publisher, Sultan Chand, 2007.

REFERENCES:

1. Chan S.Park, “Contemporary Engineering Economics”, Prentice Hall of India, 2011.
2. Donald.G. Newman, Jerome.P.Lavelle, “Engineering Economics and analysis” Engg. Press, Texas, 2010.
3. Degarmo, E.P., Sullivan, W.G and Canada, J.R, “Engineering Economy”, Macmillan, New York, 2011.
4. Zahid A khan: Engineering Economy, "Engineering Economy", Dorling Kindersley, 2012
5. Dr. S. N. Maheswari and Dr. S.K. Maheshwari: Financial Accounting, Vikas, 2009

MAPPING OF COS AND POS:

COs	POs												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1		3								2			1	3	
2		3												2	2
3		2													
4	2	3	3		2								2	3	
5	3	3	3		2								2		2
AVg.	2.5	2.4	3		2					2			1.8	2.6	2

21160S75C **HUMAN RESOURCE MANAGEMENT** **LTPC**

3003

OBJECTIVE:

- To provide knowledge about management issues related to staffing,
- To provide knowledge about management issues related to training,
- To provide knowledge about management issues related to performance
- To provide knowledge about management issues related to compensation
- To provide knowledge about management issues related to human factors consideration and compliance with human resource requirements.

UNIT I INTRODUCTION TO HUMAN RESOURCE MANAGEMENT 9

The importance of human resources – Objective of Human Resource Management---Human resource policies Role of human resource manager.

UNIT II HUMAN RESOURCE PLANNING 9

Importance of Human Resource Planning – Internal and External sources of Human Resources -- Recruitment--Selection – Socialization.

UNIT III TRAINING AND EXECUTIVE DEVELOPMENT 9

Types of training and Executive development methods – purpose – benefits.

UNIT IV EMPLOYEE COMPENSATION 9

Compensation plan – Reward – Motivation – Career Development -- Mentor – Protege relationships.

UNIT V PERFORMANCE EVALUATION AND CONTROL 9

Performance evaluation – Feedback The control process – Importance – Methods – grievances – Causes – Redressal methods.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

CO1: Students would have gained knowledge on the various aspects of HRM
CO2: Students will gain knowledge needed for success as a human resources professional.
CO3: Students will develop the skills needed for a successful HR manager.
CO4: Students would be prepared to implement the concepts learned in the workplace.

CO5: Students would be aware of the emerging concepts in the field of HRM

TEXT BOOKS:

1. Decenzo and Robbins, "Human Resource Management", 8th Edition, Wiley, 2007.
2. John Bernardin. H., "Human Resource Management – An Experimental Approach", 5th Edition, Tata McGraw Hill, 2013, New Delhi.

REFERENCES:

1. Luis R,. Gomez-Mejia, DavidB. Balkin and Robert L. Cardy, "Managing Human Resources", 7th Edition, PHI, 2012.
2. Dessler, "Human Resource Management", Pearson Education Limited, 2007.

COs- POs & PSOs MAPPING

COs	POs												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	2	2	1	2	2	2	1	1	2	1	1	1	1	1	1
2	3	3	2	3	2	2	2	2	3	1	2	1	1	2	1
3	3	3	3	3	3	3	2	2	3	1	2	1	1	2	1
4	3	3	2	3	3	2	2	2	2	1	1	1	1	1	1
5	3	3	1	2	2	2	2	2	2	1	1	1	1	1	1
AVg.	2.8	2.8	1.8	2.6	2.6	2.2	1.8	1.8	2.4	1	1.4	1	1	1.4	1

21160S75D KNOWLEDGE MANAGEMENT L T P C 3 0 0 3

COURSE OBJECTIVES:

The student should be made to:

- Learn the Evolution of Knowledge management.
- Be familiar with tools.
- Be exposed to Applications.
- Be familiar with some case studies.

UNIT I INTRODUCTION 9

Introduction: An Introduction to Knowledge Management - The foundations of knowledge management- including cultural issues- technology applications organizational concepts and processes- management aspects- and decision support systems. The Evolution of Knowledge management: From Information Management to Knowledge Management - Key Challenges Facing the Evolution of Knowledge Management - Ethics for Knowledge Management.

UNIT II CREATING THE CULTURE OF LEARNING AND KNOWLEDGE SHARING 9

Organization and Knowledge Management---Building the Learning Organization. Knowledge Markets: Cooperation among Distributed Technical Specialists – Tacit Knowledge and Quality Assurance.

UNIT III KNOWLEDGE MANAGEMENT-THE TOOLS 9

Telecommunications and Networks in Knowledge Management -- Internet Search Engines and Knowledge Management - Information Technology in Support of Knowledge Management ---- Knowledge Management and Vocabulary Control - Information Mapping in Information Retrieval --- Information Coding in the Internet Environment -------Repackaging Information.

UNIT IV KNOWLEDGE MANAGEMENT APPLICATION 9

Components of a Knowledge Strategy --Case Studies (From Library to Knowledge Center, Knowledge

Management in the Health Sciences, Knowledge Management in Developing Countries).

UNIT V FUTURE TRENDS AND CASE STUDIES 9

Advanced topics and case studies in knowledge management -- Development of a knowledge management map/plan that is integrated with an organization's strategic and business plan ----A case study on Corporate Memories for supporting various aspects in the process life -- cycles of an organization.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

Upon completion of the course, the student should be able to:

CO1: Understand the process of acquiry knowledge from experts
CO2: Understand the learning organization.
CO3: Use the knowledge management tools.
CO4: Develop knowledge management Applications.
CO5: Design and develop enterprise applications.

COs- POs & PSOs MAPPING

COs	POs												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1					1										
2					2								1		
3					2									2	
4				1	1				1					1	
5				1	1				1					1	
AVg.				1	1.4				1				1	1.33	

TEXT BOOK:

1. Srikantaiah, T.K., Koenig, M., “Knowledge Management for the Information Professional” Information Today, Inc., 2000.

REFERENCE:

1. Nonaka, I., Takeuchi, H., “The Knowledge-Creating Company: How Japanese Companies Create the Dynamics of Innovation”, Oxford University Press, 1995.

21160S75E	INDUSTRIAL MANAGEMENT	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

1. To study the basic concepts of management; approaches to management; contributors to management studies; various forms of business organization and trade unions function in professional organizations.
2. To study the planning; organizing and staffing functions of management in professional organization.
3. To study the leading; controlling and decision making functions of management in professional organization.
4. To learn the organizational theory in professional organization.
5. To learn the principles of productivity and modern concepts in management in professional organization.

UNIT I INTRODUCTION TO MANAGEMENT 9

Management: Introduction; Definition and Functions – Approaches to the study of Management – Mintzberg's Ten Managerial Roles – Principles of Taylor; Fayol; Weber; Parker – Forms of Organization: Sole Proprietorship; Partnership; Company (Private and Public); Cooperative – Public Sector Vs Private Sector Organization – Business Environment: Economic; Social; Political; Legal – Trade Union: Definition; Functions; Merits & Demerits.

UNIT II FUNCTIONS OF MANAGEMENT - I 9

Planning: Characteristics; Nature; Importance; Steps; Limitation; Planning Premises; Strategic Planning; Vision & Mission statement in Planning– Organizing: Organizing Theory; Principles; Types; Departmentalization; Centralization and Decentralization; Authority & Responsibility – Staffing: Systems Approach; Recruiting and Selection Process; Human Resource Development (HRD) Concept and Design.

UNIT III FUNCTIONS OF MANAGEMENT - II 9

Directing (Leading): Leadership Traits; Style; Morale; Managerial Grids (Blake-Mounton, Reddin) – Communication: Purpose; Model; Barriers – Controlling: Process; Types; Levels; Guidelines; Audit (External, Internal, Merits); Preventive Control – Decision Making: Elements; Characteristics; Nature; Process; Classifications.

UNIT IV ORGANIZATION THEORY 9

Organizational Conflict: Positive Aspects; Individual; Role; Interpersonal; Intra Group; Inter Group; Conflict Management – Maslow's hierarchy of needs theory; Herzberg's motivation-hygiene theory; McClelland's three needs motivation theory; Vroom's valence-expectancy theory – Change Management: Concept of Change; Lewin's Process of Change Model; Sources of Resistance; Overcoming Resistance; Guidelines to managing Conflict.

UNIT V PRODUCTIVITY AND MODERN TOPICS 9

Productivity: Concept; Measurements; Affecting Factors; Methods to Improve – Modern Topics (concept, feature/characteristics, procedure, merits and demerits): Business Process Reengineering (BPR); Benchmarking; SWOT/SWOC Analysis; Total Productive Maintenance; Enterprise Resource Planning (ERP); Management of Information Systems (MIS).

TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of the course the students would be able to

CO1 Explain basic concepts of management; approaches to management; contributors to management studies; various forms of business organization and trade unions function in professional organizations.

CO2 Discuss the planning; organizing and staffing functions of management in professional organization.

CO3 Apply the leading; controlling and decision making functions of management in professional organization.

CO4 Discuss the organizational theory in professional organization.

CO5 Apply principles of productivity and modern concepts in management in professional organization.

TEXTBOOKS:

1. M. Govindarajan and S. Natarajan, "Principles of Management", Prentice Hall of India, New Delhi, 2009.
2. Koontz. H. and Weihrich. H., "Essentials of Management: An International Perspective", 8th Edition, Tata McGrawhill, New Delhi, 2010.

REFERENCES:

1. Joseph J, Massie, "Essentials of Management", 4th Edition, Pearson Education, 1987.
2. Saxena, P. K., "Principles of Management: A Modern Approach", Global India Publications, 2009.
3. S.Chandran, "Organizational Behaviours", Vikas Publishing House Pvt. Ltd., 1994.
4. Richard L. Daft, "Organization Theory and Design", South Western College Publishing, 11th Edition, 2012.
5. S. TrevisCerto, "Modern Management Concepts and Skills", Pearson Education, 2018.

MAPPING OF COS AND POS:

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	1	1	1	1	1	3	2	3	2	3	1	3	1	1	1
2	1	1	1	1	1	3	2	3	2	3	1	3	1	1	1
3	1	1	1	1	1	3	2	3	2	3	1	3	1	1	1
4	1	1	1	1	1	3	2	3	2	3	1	3	1	1	1
5	1	1	1	1	1	3	2	3	2	3	1	3	1	1	1

21160S75F PRINCIPLES OF MANAGEMENT LT P C
3 0 0 3

COURSE OBJECTIVES:

- Sketch the Evolution of Management.
- Extract the functions and principles of management.
- Learn the application of the principles in an organization.
- Study the various HR related activities.
- Analyze the position of self and company goals towards business.

UNIT I INTRODUCTION TO MANAGEMENT AND ORGANIZATIONS 9

Definition of Management – Science or Art – Manager Vs Entrepreneur- types of managers-managerial roles and skills – Evolution of Management –Scientific, human relations, system and contingency approaches– Types of Business organization- Sole proprietorship, partnership, company-public and private sector enterprises- Organization culture and Environment – Current trends and issues in Management.

UNIT II PLANNING 9

Nature and purpose of planning – Planning process – Types of planning – Objectives – Setting objectives – Policies – Planning premises – Strategic Management – Planning Tools and Techniques – Decision making steps and process.

UNIT III ORGANISING 9

Nature and purpose – Formal and informal organization – Organization chart – Organization structure – Types – Line and staff authority – Departmentalization – delegation of authority – Centralization and decentralization – Job Design - Human Resource Management – HR Planning, Recruitment, selection, Training and Development, Performance Management, Career planning and management.

UNIT IV DIRECTING 9

Foundations of individual and group behaviour– Motivation – Motivation theories – Motivational techniques – Job satisfaction – Job enrichment – Leadership – types and theories of leadership – Communication – Process of communication – Barrier in communication – Effective communication – Communication and IT.

UNIT V CONTROLLING 9

System and process of controlling – Budgetary and non Budgetary control techniques – Use of computers and IT in Management control – Productivity problems and management – Control and performance – Direct and preventive control – Reporting.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

CO1: Upon completion of the course, students will be able to have clear understanding of managerial functions like planning, organizing, staffing, leading & controlling.
CO2: Have same basic knowledge on international aspect of management.
CO3: Ability to understand management concept of organizing.
CO4: Ability to understand management concept of directing.
CO5: Ability to understand management concept of controlling.

TEXT BOOKS:

1. Harold Koontz and Heinz Weihrich "Essentials of management" Tata McGraw Hill,1998.
2. Stephen P. Robbins and Mary Coulter, " Management", Prentice Hall (India)Pvt. Ltd., 10th Edition, 2009.

REFERENCES:

2. Robert Kreitner and MamataMohapatra, " Management", Biztantra, 2008.
3. Stephen A. Robbins and David A. Decenzo and Mary Coulter, "Fundamentals of

Management” Pearson Education, 7th Edition, 2011.
4. Tripathy PC and Reddy PN, “Principles of Management”, Tata Mcgraw Hill, 1999.

COs	POs												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	3		-	-	-	1	-	-	-	-	-	-	2	1	1
2	-	1	1	-	-	-	-	-	-	-	-	-	2	1	-
3	1		-	2	-	-	1	-	2	-	1	1	-	-	2
4	-	1	1	1	2	-	-	1	2	-	-	-	1	1	1
5	1		-	-	1	1	-	-	-	3	-	1	1	-	1
AVg.	1.66	1	1	1.5	1.5	1	1	1	2	3	1	1	1.5	1	1.25

ELECTIVE–VIII(VIISEMESTER)

21153E76A	SUBSTATION ENGINEERING AND AUTOMATION	L T P C 3 0 0 3

COURSE OBJECTIVES:

- To help engineering students to have a holistic understanding of the concepts behind substation engineering and design.
- The course aims to give an exposure to the students to the requirements of practical aspects including an overview of civil and mechanical aspects.
- Course aims to enhance the knowledge, and give the practical guidelines for site selection,construction, protection along with maintenance, safety in a substation.
- It also aims at providing knowledge about state-of-the-art technology in substation automation system

UNIT I SUBSTATION DESIGN DEVELOPMENT (7+2 SKILL) 9

Substation Introduction and Classifications, Different bus bar switching schemes for Substation. Standards and Practices, Factors Influencing Substation Design Altitude, Ambient Temperature, Earthquake and seismic zones, pollution and corrosion etc., Testing of Electrical Equipment, Concept and development of Single Line Diagram. Requirement of substation calculation.

UNIT II SUBSTATION EQUIPMENT (7+2 SKILL) 9

Selection and sizing of main substation equipment: Transformer, Isolator, Circuit Breaker, surge arrestor, Instrument transformers, classification of equipment with a practical overview, and the performance parameters. Classifications of MV Switchgear and Key Design Parameters, MV/LV Switchgear construction and design of control scheme. Station Auxiliary equipment: Diesel Generator System, Basics of AC/DC Auxiliary Power System & Sizing of Aux. Transformer, DC System Components, Battery Sizing & charger Sizing, DG Set Classification, and sizing. Introduction to gas insulated substation: Operating principle of GIS, Advantage over AIS, construction of GIS.

UNIT III PROTECTION AND SUBSTATION AUTOMATION (7+2 SKILL) 9

Power System protection, Overcurrent and Earth Fault protection and coordination. Distribution Feeder Protection, Transformer - Unit/Main Protection, Familiarization of NUMERICAL Relays, distance/differential protection for transmission line. Substation Automation: Evolution of Substation Automation, Communication System Fundamentals-Protocol fundamental and choosing the right protocol. Substation integration and automation functional architecture, Substation signal list DI, DO, AI, AO- Bay Control Unit (BCU), Remote Terminal Unit RTU.

UNIT IV SUBSTATION DESIGN & LAYOUT ENGINEERING (7+2 SKILL) 9

Layout aspects of Outdoor Air Insulated Substation and GIS: Statutory Clearances, Equipment Layout engineering aspects for Outdoor Substation/GIS and related calculations, and guide lines, Cable routing layout, Erection Key Diagram (EKD), switchyard earthing design as per IEEE80, Importance and Types of Earthing, Earthing Design, Types of Earthing Material, Direct stroke Lightning Protection for switchyard with IS/ IEC 62305. LV Cables Power & Control, MV Cables, Methods for Cable Installation, Practical aspects of Cable Sizing, Cable accessories, Illumination System Design.

UNIT V INTERFACE ENGINEERING (7+2 SKILL) 9

Civil & Structural Engineering - Familiarization of site development plan, equipment supports structures, foundation for equipment, familiarization of control building and substation building, infrastructure development, Mechanical System- Fire Detection, Alarm System and Fire Suppression System for transformer, Heating, Ventilation and Air-conditioning (HVAC) for Substation.

TOTAL : 45 PERIODS

SKILL DEVELOPMENT ACTIVITIES (GROUP SEMINAR/ MINI PROJECT/ ASSIGNMENT/ CONTENT PREPARATION/ QUIZ/ SURPRISE TEST /SOLVING GATE QUESTIONS /ETC.

1

0

1. Battery sizing for a substation with a load cycle based on IEEE 1115 Ni-cd - A case study
   OR
2. DG and auxiliary transformer sizing for a substation auxiliary power supply- A case study
3. Overcurrent Relay coordination in a substation- A case study
4. Earthmat sizing calculation for an outdoor substation based on IEEE80- A case study
   OR
5. Direct stroke lightning protection calculation for outdoor switchyard based on IEC 62305- A case study

COURSE OUTCOMES:

On successful completion of the course student will be able to:

CO 1: Understand the key deciding factors involved in substation design and operation

CO 2: Know about the sizing and selection of equipment which forms part of substation

CO 3: Know about composite layout design aspects of the substation with different services and the challenges including statutory clearances.

CO 4: Understand about Interdisciplinary aspects involved in substation design

CO 5: Understand different protection and control scheme involved in substation design

CO 6: Know about substation automation system and different communication protocol involved for efficient operation of a substation

REFERENCES:

2. McDonald John D, “Electric Power Substations Engineering”, CRC Press, 3rd Edition, 2012
3. Partap Singh Satnam, P.V. Gupta, “Sub-station Design and Equipment”, Dhanpat Rai Publications, 1st Edition, 2013
4. Sunil S. Rao, “Switchgear Protection and Power Systems (Theory, Practice & Solved Problems)”, Khanna Publications, 14th Edition, 2019 .
5. Electrical substation and engineering & practice by S.Rao, 3rd Edition, Khanna Publishers 2015
7. Manual on Substation by Central Board of irrigation and Power (CBIP) Publication No 342., 2006.
8. Substation automation system Design and implementation by Evelio Padilla by Wiley Publications, 1st Edition, 2015 November.

MAPPING OF COs WITH POs AND PSOs

COs	POs											PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1	3	2	-	2	1	3	2	-	-	-	3	3	-	1
CO2	3	3	3	3	2	3	-	1	2	-	-	2	3	-	1
CO3	3	2	3	3	1	3	-	2	2	-	-	3	3	-	1
CO4	3	1	2	-	-	3	2	1	2	-	-	2	3	-	1

CO5	3	3	3	3	-	3	2	1	1	-	-	3	3	-	1
CO6	-	2	3	3	-	3	-	1	-	-	-	3	3	-	1
Avg	2.6	2.3	2.6	3	1.6	2.6	2.3	1.3	1.75	-	-	2.6	3	-	1

21153E76B MULTILEVEL POWER CONVERTERS

L	T	P	C
2	0	2	3

COURSE OBJECTIVES:

- To learn multilevel topology (Symmetry & Asymmetry) with common DC bus link.
- To study the working of cascaded H Bridge, Diode Clamped and Flying Capacitor MLI.
- To study the working of MLI with reduced switch count.
- To simulate three level diode clamped MLI and three level flying capacitor based MLI with resistive and reactive load
- To simulate the MLI with reduced switch count.

UNIT I MULTILEVEL TOPOLOGIES 6

Introduction – Generalized Topology with a Common DC bus – Converters derived from the generalized topology – symmetric topology without a common DC link – Asymmetric topology.

UNIT II CASCADED H-BRIDGE MULTILEVEL INVERTERS 6

Introduction H-Bridge Inverter, Bipolar Pulse Width Modulation, Unipolar Pulse Width Modulation. Multilevel Inverter Topologies, CHB Inverter with Equal DC Voltage, H-Bridges with Unequal DC Voltages – PWM, Carrier-Based PWM Schemes, Phase-Shifted Multicarrier Modulation, Level-Shifted Multicarrier Modulation, Comparison Between Phase- and Level-Shifted PWM Schemes-Staircase Modulation

UNIT III DIODE CLAMPED MULTILEVEL CONVERTER 6

Introduction – Converter structure and Functional Description – Modulation of Multilevel converters – Voltage balance Control – Effectiveness Boundary of voltage balancing in DCMC converters – Performance results.

UNIT IV FLYING CAPACITOR MULTILEVEL CONVERTER 6

Introduction – Flying Capacitor topology – Modulation scheme for the FCMC – Dynamic voltage balance of FCMC.

UNIT V MULTILEVEL CONVERTER WITH REDUCED SWITCH COUNT 6

Multilevel inverter with reduced switch count-structures, working principles and pulse generation methods.

30 PERIODS

LAB COMPONENT: 30 PERIODS

1. Simulation of Fixed PWM, Sinusoidal PWM for an inverter,
2. Simulation of H bridge inverter with R load .
3. Simulation of three level diode clamped MLI with R load.

4. Simulation of three level capacitor clamped MLI with R load
5. Simulation of MLI with reduced switch configuration.

TOTAL: 30+30 = 60 PERIODS

COURSE OUTCOMES:

At the end of the course, students should be able to:

CO1: Examine the different topologies of multilevel inverters (MLIs) with and without DC link capacitor.

CO2: Examine the performance of MLIs with Bipolar Pulse Width Modulation (PWM) Unipolar PWM Carrier-Based PWM Schemes Phase Level Shifted Multicarrier Modulation

CO3: Demonstrate the working principles of Cascaded H-Bridge MLI, diode clamped MLI, flying capacitor MLI and MLI with reduced switch count

CO4: Analyze the voltage balancing performance in Diode clamped MLI.

CO5: Simulate three level, capacitor clamed and diode clamped MLI with R and RL load.

CO6: Simulate MLI with reduced switch configuration using fundamental switching scheme

TEXT BOOKS:

1. Rashid M.H,"Power Electronics Circuits, Devices and Applications", Prentice Hall India, Third Edition, New Delhi, 2014 Pearson 4th edition.
2. Sergio Alberto Gonzalez, Santiago Andres Verne, Maria Ines Valla,"Multilevel Converters for Industrial Applications", CRC Press, 22-Jul-2013, 20171st Edition.
3. BinWu, Mehdi Narimani,High Power Converters and AC drives by IEEE press 2017, 2nd Edition.

REFERENCEBOOKS:

1. Thomas A. Lipo, Pulse Width Modulation for Power Converters: Principles and Practice, D.Grahame Holmes, John Wiley & Sons, Oct-2003, 1st Edition.
2. Fang Lin Luo, Hong Ye,Advanced DC/AC Inverters: Applications in Renewable Energy, CRC Press, 22-Jan-2013, 2017, 1st Edition.
3. Hani Vahedi, Mohamed Trabelsi, Single-DC-Source Multilevel Inverters, Springer, 2019, 1st Edition.
4. Ersan Kabalcı, Multilevel Inverters Introduction and Emergent Topologies, Academic Press Inc,2021, 1st Edition.
5. Iftekhar Maswood, Dehghani Tafti,Advanced Multilevel Converters and Applications in Grid Integration, Wiley, 2018, 1st Edition.

MAPPING OF COs WITH POs AND PSOs

COs	POs												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	2	3	-	-	2	1	-	3	-	3	3	3	3
CO2	3	2	2	3	-	-	2	1	-	3	-	3	3	3	3
CO3	3	2	2	3	-	-	2	1	-	3	-	3	3	3	3
CO4	3	3	3	3	-	-	2	1	-	3	-	3	3	3	3
CO5	3	3	3	3	3	-	2	1	-	3	-	3	3	3	3
CO6	3	3	3	3	3	-	2	1	-	3	-	3	3	3	3
Avg	3	2.5	2.5	3	3	-	2	1	-	3	-	3	3	3	3

21153E76C **EMBEDDED PROCESSOR** **LT P C**

2 0 2 3

COURSE OBJECTIVES:

- To introduce the architecture of the ARM processor.
- To train students in ARM programming.
- To discuss memory management, append location development with an ARM processor.
- To involve Discussions/ Practice/Exercise in revising & familiarizing the concepts
- To impart the knowledge on single board embedded processors.

UNIT I ARM ARCHITECTURE 6

Architecture – Memory Organization – addressing modes -Registers – Pipeline----Interrupts – Coprocessors – Interrupt Structure

UNIT II ARM MICROCONTROLLER PROGRAMMING 6

ARM general Instruction set – Thumb instruction set –Introduction to DSP on ARM- basic programming.

UNIT III PERIPHERALS OF ARM 6

ARM: I/O Memory – EEPROM – I/O Ports – SRAM –Timer –UART Serial Communication with PC – ADC/DAC Interfacing-stepper motor interfacing

UNIT IV ARM COMMUNICATION 6

ARM With CAN, I^2C, and SPI protocols

UNIT V INTRODUCTION TO SINGLE BOARD EMBEDDED PROCESSOR 6

Raspberry Pi Architecture - Booting Up RPi- Operating System and Linux Commands---Working with RPi using Python and Sensing Data using Python-programming --- GPIO and interfacing peripherals With Raspberry Pi

30 PERIODS

LAB COMPONENTS: **30 PERIODS**

1. Laboratory exercise:
   a) Programming with IDE - ARM microcontroller
   b) Advanced Timer Features, PWM Generator.
   c) RTC interfacing with ARM using Serial communication programming, Stepper motor control.
   d) ARM-Based Wireless Environmental Parameter Monitoring System displayed through Mobile device.
2. Seminar:
   a) ARM and GSM/GPS interfacing
   b) Introduction to ARM Cortex Processor
3. Raspberry Pi based Mini project.

TOTAL: 30+30 = 60 PERIODS

COURSE OUTCOMES:

At the end of this course, the students will have the ability to

CO1: Interpret the basics and functionality of processor functional blocks.

CO2: Observe the specialty of RISC processor Architecture.

CO3: Incorporate the I/O hardware interface of processor with peripherals.

CO4: Emphasis the communication features of the processor.

CO5: Improved Employability and entrepreneurship capacity due to knowledge up gradation on recent trends in commercial embedded processors.

TEXTBOOKS:

1. Steve Furber, 'ARM system on chip architecture',Addisonn Wesley,2nd Edition,2015.
2. Andrew N. Sloss, Dominic Symes, Chris Wright, John Rayfield's ARM System Developer's Guide Designing and Optimizing System Software', Elsevier 2004, 1st Edition.

REFERENCES:

2. William Hohl, ' ARMAssebly Language' Fundamentals and Techniques, CRC Press, 2nd Edition 2014.
3. Rajkamal," Microcontrollers Architecture, Programming, Interfacing, & System Design, Pearson,2012, 2nd Edition.
4. ARM Architecture Reference Manual, LPC214x User Manual www.Nuvoton .com/websites on Advanced ARM Cortex Processors
5. ARM System Developer's Guide: Designing and Optimizing System Software 1st Edition (Designing and Optimizing System Software) Publisher: Morgan Kaufmann Publishers, 2011.

List of Open Source Software/ Learning websites:

1. https://nptel.ac.in/courses/117106111
2. https://onlinecourses.nptel.ac.in/noc20_cs15/preview
3. https://www.csie.ntu.edu.tw/~cyy/courses/assembly/12fall/lectures/handouts/lec08_ARMarch.pdf
4. https://maxembedded.com/2013/07/introduction-to-single-board-computing/
5. https://www.youtube.com/watch?v=J4fhE4Pp55E&list=PLGs0VKk2DiYypuwUUM2wxzcI9BJHK4Bfh

MAPPING OF COs WITH POs AND PSOs

COs	POs												PSOs		
	PO1	PO2	PO3	PO4	PO5	P06	P07	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1	1	2	2	1	-	-	-	-	-	-	-	2	1	2
CO2	1	1	2	2	1	-	-	-	-	-	-	-	1	2	2
CO3	3	2	3	2	3	-	-	-	-	-	-	-	3	3	3
CO4	3	2	3	2	3	-	-	-	-	-	-	-	2	3	3
CO5	3	2	1	2	1	-	-	-	1	-	-	-	1	2	2
Avg	2.2	1.6	2.2	2	1.8	-	-	-	1	-	-	-	1.8	2.2	2.4

21153E76D	ELECTRIC VEHICLE DESIGN, MECHANICS AND CONTROL	L	T	P	C
		2	0	2	3

COURSE OBJECTIVES:

- To learn the basics of EV and vehicle mechanics
- To know the EV architecture
- To study the energy storage system concepts
- To derive model for batteries and to know the different types of batteries and its charging methods
- To learn the control preliminaries for DC-DC converters.

UNIT I INTERNAL COMBUSTION ENGINES 6

IC Engines, BMEP and BSFC, Vehicle Fuel Economy, Emission Control Systems, Treatment of Diesel Exhaust Emissions.

UNIT II ELECTRIC VEHICLES AND VEHICLE MECHANICS 6

Electric Vehicles (EV), Hybrid Electric Vehicles (HEV), Engine ratings- Comparisons of EV with internal combustion Engine vehicles- Fundamentals of vehicle mechanics.

UNIT III BATTERY MODELING, TYPES AND CHARGING 6

Batteries in Electric and Hybrid Vehicles - Battery Basics Battery Parameters. Types- Lead Acid Battery - Nickel-Cadmium Battery - Nickel-Metal-Hydride (NiMH) Battery - Li-Ion Battery Li-Polymer Battery, Zinc-Air Battery, Sodium-Sulphur Battery, Sodium-Metal-Chloride, Research and Development for Advanced Batteries. Battery Modelling, Electric Circuit Models. Battery Pack Management, Battery Charging.

UNIT IV CONTROL PRELIMINARIES 6

Control Design Preliminaries - Introduction --Transfer Functions – Bode plot analysis for First order and second order systems - Stability---Transient Performance- Power transfer function for boost converter Gain margin and Phase margin study-open loop mode.

UNIT V CONTROL OF AC MACHINES 6

Introduction- Reference frame theory, basics-modeling of induction and synchronous machine in various frames-Vector control- Direct torque control.

30 PERIODS

LAB COMPONENT: 30 PERIODS

1. Develop a model that could estimate Soc and SoH of Li-Ion Battery.
2. Modelling and thermal analysis of Li-Ion Battery.
3. Simulation of boost converter and calculating gain and phase margin from the transfer function.
4. Simulation of vector control of induction motor

TOTAL: 30+30 = 60 PERIODS

COURSE OUTCOMES:

Upon completion of the course, students will be able to:

CO1: To describe the concepts related with EV, HEV and to compare the same with internal combustion engine vehicles

CO2: To find gain margin & phase margin for various types of transfer functions of boost converter

CO3: To demonstrate the Control of A C Machines

CO4: To explain the concepts related with batteries and parameters of battery

CO5: To module the battery and to study the research and development for batteries

REFERENCES:

2. Electric and Hybrid Vehicles, Design Fundamentals, Third Edition, Iqbal Husain, CRC Press, 2021.
3. Power Electronic Converters,: Dynamics and Control in Conventional and Renewable Energy Applications, Teuvo Suntio, Tuomas Messo, Joonas Puukko, 1st Edition, Wiley - VCH.
4. Ali Emadi, Mehrdad Ehsani, John M.Miller, “Vehicular Electric Power Systems”, Special Indian Edition, Marcel dekker, Inc 2003, 1st Edition.
5. C.C. Chan and K.T. Chau, 'Modern Electric Vehicle Technology', OXFORD University Press, 2001, 1st Edition.
6. Wie Liu, “Hybrid Electric Vehicle System Modeling and Control”, Second Edition, John Wiley & Sons, 2017, 2nd Edition.
7. Dynamic Simulation of Electric Machinery using MATLAB, Chee Mun Ong, Prentice Hall,1997, 1st Edition.
8. Electrical Machine Fundamentals with Numerical Simulation using MATLAB/ SIMULINK, Atif Iqbal, Shaikh Moinoddin, Bhimireddy Prathap Reddy, Wiley, 2021, 1st Edition.

MAPPING OF COs WITH POs AND PSOs

COs	POs												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	-	-	-	-	-	-	-	1	2	-	2	3	-	3
CO2	3	-	-	-	-	-	-	-	1	3	-	2	3	-	3
CO3	3	-	-	-	-	-	3	-	1	2	-	2	3	-	3
CO4	3	-	-	-	-	-	3	-	1	2	-	2	3	-	3
CO5	3	-	-	-	-	-	3	-	1	2	-	2	3	2	3
Avg	3	3	3	3	3	-	3	-	1	2.3	-	2	3	2.5	3

21153E76E SYSTEM IDENTIFICATION

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

- To elaborate the concept of estimating the state variables of a system using state estimation algorithms.
- To elaborate the concept of estimating the parameters of the Input-output models using parameter estimation algorithms.
- To make the student understand the various closed loop system identification techniques.
- To make the student understand the various closed loop system identification techniques.
- To provide the background on the practical aspects of conducting experiments for real time system identification.

UNIT I NON PARAMETRIC METHODS (7+2 SKILL) 9

Nonparametric methods: Transient analysis - frequency analysis - Correlation analysis - Spectral analysis.

UNIT II PARAMETRIC METHODS (7+2 SKILL) 9

Parametric model structures: ARX, ARMAX, OE, BJ models - The Least square estimate - Best linear unbiased estimation under linear constraints - Updating the Parameter estimates for linear regression models - Prediction error methods: Description of Prediction error methods - Optimal Prediction – Relationships between prediction error methods and other identification methods - theoretical analysis. Instrumental variable methods: Description of Instrumental variable methods - Theoretical analysis - covariance matrix of IV estimates - Comparison of optimal IV and prediction error methods.

UNIT III RECURSIVE IDENTIFICATION METHODS (7+2 SKILL) 9

The recursive least squares method - Recursive Instrumental variable method-the recursive prediction error method-model validation and model structure determination. Identification of systems operating in closed loop: Identifiability considerations - Direct identification - Indirect identification - Joint input – Output identification.

UNIT IV CLOSED- LOOP IDENTIFICATION (7+2 SKILL) 9

Identification of systems operating in closed loop: direct identification and indirect identification – Subspace Identification methods: classical and innovation forms – Relay feedback identification of stable processes.

UNIT V NONLINEAR SYSTEM IDENTIFICATION (7+2 SKILL) 9

Modeling of nonlinear systems using ANN- NARX & NARMAX - Training Feed-forward and Recurrent Neural Networks – TSK model – Adaptive Neuro-Fuzzy Inference System (ANFIS) - Introduction to Support Vector Regression.

TOTAL : 45 PERIODS

SKILL DEVELOPMENT ACTIVITIES (Group Seminar/Mini Project/Assignment/Content 10 Preparation /

Quiz/ Surprise Test / Solving GATE questions/ etc)

1. Familiarization of various system identification methods in MATLAB.
2. Seminar on ANFIS
3. Exploration of other advanced system identification methods.

COURSE OUTCOMES:

CO1 Ability to design and implement state estimation schemes. L5

CO2 Ability to develop various models (Linear & Nonlinear) from the experimental data. L5

CO3 Be able to choose a suitable model and parameter estimation algorithm for the identification of systems. L3

CO4 Be able to illustrate verification and validation of identified model. L3

CO5 Ability to develop the model for prediction and simulation purposes using suitable control schemes. L5

TEXT BOOKS:

1. Lennart Ljung, “System Identification: Theory for the user”, 2nd Edition, Prentice Hall, 1999.
2. Dan Simon, “Optimal State Estimation Kalman, H-infinity and Non-linear Approaches”, John Wiley and Sons, 2006,
3. Tangirala, A.K., “Principles of System Identification: Theory and Practice”, CRC Press, 2014, 1st Edition.

REFERENCE

2. Cortes, C., and Vapnik, V., “Support-Vector Networks, Machine Learning”, 1995, 1st Edition.
3. Miller, W.T., Sutton, R.S., and Webrose, P.J., “Neural Networks for Control”, MIT Press, 1996, 1st Edition.
4. Van der Heijden, F., Duin, R.P.W., De Ridder, D., and Tax, D.M.J., “Classification, Parameter Estimation and State Estimation”, An Engineering Approach Using MATLAB, John Wiley & Sons Ltd., 2017, 2nd Edition.
5. Karel J. Keesman, “System Identification an Introduction”, Springer, 2011, 1st Edition.
6. Tao Liu and Furong Gao, “Industrial Process Identification and control design, Step-test and relay-experiment-based methods”, Springer- Verlag London Ltd., 2012, 1st Edition.

List of Open Source Software/ Learning website:

https://in.mathworks.com/help/ident/

https://nptel.ac.in/courses/103106149

https://in.mathworks.com/help/curvefit/nonparametric-fitting.html

https://nptel.ac.in/courses/111102143

MAPPING OF COs WITH POs AND PSOs

COs	POs												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	3	1	1	1	1	1	1	1	1	2	2	2
CO2	3	3	3	3	1	1	1	1	1	1	1	1	2	2	2
CO3	3	2	2	2	1	1	1	1	1	1	1	1	2	2	2
CO4	3	2	2	2	1	1	1	1	1	1	1	1	2	2	2
CO5	3	3	3	3	1	1	1	1	1	1	1	1	2	2	2
Avg.	3	2.6	2.6	2.6	1	1	1	1	1	1	1	1	2	2	2

21153E76F DESIGN AND MODELLING OF RENEWABLE ENERGY SYSTEMS **LTPC**

3003

COURSE OBJECTIVES:

- To review the renewable energy systems and technology
- To learn the Single phase grid-connected photovoltaic systems and three phase photovoltaic systems
- To illustrate the small wind energy systems
- To simulate the Doubly-fed induction generator based WECS

UNIT I RENEWABLE ENERGY SYSTEMS: TECHNOLOGY OVERVIEW AND PERSPECTIVES **(7+2 Skill) 9**

Introduction-State of the Art- Examples of Recent Research and Development Challenges and Future Trends

UNIT II SINGLE-PHASE GRID-CONNECTED PHOTOVOLTAIC SYSTEMS **(7+2 Skill) 9**

Introduction- Demands for Grid-Connected PV Systems-Power Converter Technology for Single-Phase PV Systems, Transformer less AC-Module Inverters (Module-Integrated PV Converters, Transformer less Single-Stage String Inverters, DC-Module Converters in Transformer less Double-Stage PV Systems

UNIT III THREE-PHASE PHOTOVOLTAIC SYSTEMS: STRUCTURES, TOPOLOGIES **(7+2 Skill) 9**

Introduction-PV Inverter Structures, Three-Phase PV Inverter Topologies- -Control Building Blocks for PV Inverters, Modulation Strategies for Three-Phase PV Inverters, Implementation of the Modulation Strategies., Grid Synchronization, Implementation of the PLLs for Grid Synchronization, Current Control, Implementation of the Current Controllers, Maximum Power Point Tracking.

UNIT IV SMALL WIND ENERGY SYSTEMS **(7+2 Skill) 9**

Introduction-Generator Selection for Small-Scale Wind Energy Systems- Turbine Selection for Wind Energy- Self-Excited Induction Generators for Small Wind Energy Applications- Permanent Magnet Synchronous Generators for Small Wind Power Applications- Grid-Tied Small Wind Turbine Systems-Magnus Turbine-Based Wind Energy System

UNIT V DOUBLY-FED INDUCTION GENERATOR-BASED WECS **(7+2 Skill) 9**

Introduction – modelling of induction machine in machine variable form and arbitrary reference frame, modelling of Doubly-fed Induction Generator.

TOTAL : 45 PERIODS

SKILL DEVELOPMENT ACTIVITIES (Group Seminar/Mini Project/Assignment/Content Preparation / Quiz/ Surprise Test / Solving GATE questions/ etc) **10**

1. Simulation of inverter for PV systems
2. Simulation of WECS with DFIG

List of Open Source Software/ Learning website:

1. https://www.mdpi.com/journal/applsci/topical_collections/Susta_Energy
2. https://www.mathworks.com/help/sps/ug/single-phase-grid-connected-in-pv-system.html
3. https://www.sciencedirect.com/topics/engineering/three-phase-inverter
4. academia.edu/32704493/Wind_Power_Lecture_Notes
5. https://www.syscop.de/files/2018ss/WES/handouts/script.pdf
6. https://www.sciencedirect.com/topics/engineering/wound-rotor-induction-generator

COURSE OUTCOMES:

Upon completion of the course, students will be able to:

CO1: Review the perspectives of renewable energy systems

CO2: Integrate photovoltaic systems with grid
CO3: Study inverter for PV systems
CO4: Elaborate the working of small wind power systems
CO5: Study the features of induction machine and doubly fed induction machine

TEXT BOOKS:

1. Ahmad Azar, Nashwa Kamal, "Design, Analysis and Applications of Renewable Energy Systems", Academic Press, First Edition, 2021
2. Ahmad Azar, Nashwa Kamal, "Renewable Energy Systems", Academic Press, First Edition, 2021
3. Nabil Derbel, Quanmin ZhuModeling, "Identification and Control Methods in Renewable Energy Systems" , Springer, First Edition, 2019

REFERENCES:

2. Power Conversion and Control of Wind Energy Systems, Bin Wu, 2011, Wiley-IEEE, 1st Edition.
3. Wind Electrical Systems, S.N. Bhadra, 2005, Oxford, 7th Impression.
4. Wind Power Integration - Connection and System Operational Aspects, Brendan Fox, 2014, IET, 2nd Edition.
5. Renewable Energy Devices and Systems with Simulations in MATLAB and ANSYS, Frede Blaabjerg, Dan M. Ionel, CRC press, 2017, 1st Edition.

MAPPING OF COs WITH POs AND PSOs

COs	POs												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	-	3	2	-	-	-	-	-	-	-	-	3	-	2
CO2	3	2	3	3	-	-	-	-	-	-	-	-	3	3	3
CO3	3	2	3	3	2	-	-	-	-	-	-	-	3	3	3
CO4	3	2	3	3	-	-	-	-	-	-	-	-	3	3	3
CO5	3	2	3	3	2	-	-	-	-	-	-	-	3	3	3
Avg	3	2	3	2.8	2	-	-	-	-	-	-	-	3	3	2.8

OPEN ELECTIVE I (VI SEM)

21150OE61A **IOT CONCEPTS AND APPLICATIONS** **L T P C**
2 0 2 3

OBJECTIVES:

- To apprise students with basic knowledge of IoT that paves a platform to understand physical and logical design of IOT
- To teach a student how to analyse requirements of various communication models and protocols for cost-effective design of IoT applications on different IoT platforms.
- To introduce the technologies behind Internet of Things(IoT).
- To explain the students how to code for an IoT application using Arduino/Raspberry Pi open platform.
- To apply the concept of Internet of Things in real world scenario.

UNIT I INTRODUCTION TO INTERNET OF THINGS 5

Evolution of Internet of Things – Enabling Technologies – IoT Architectures: oneM2M, IoT World Forum (IoTWF) and Alternative IoT Models – Simplified IoT Architecture and Core IoT Functional Stack – Fog, Edge and Cloud in IoT

UNIT II COMPONENTS IN INTERNET OF THINGS 5

Functional Blocks of an IoT Ecosystem – Sensors, Actuators, and Smart Objects – Control Units Communication modules (Bluetooth, Zigbee,Wifi, GPS, GSM Modules)

UNIT III PROTOCOLS AND TECHNOLOGIES BEHIND IOT 6

IOT Protocols - IPv6, 6LoWPAN, MQTT, CoAP - RFID, Wireless Sensor Networks, BigData Analytics, Cloud Computing, Embedded Systems.

UNIT IV OPEN PLATFORMS AND PROGRAMMING 7

IOT deployment for Raspberry Pi /Arduino platform-Architecture -Programming – Interfacing – Accessing GPIO Pins – Sending and Receiving Signals Using GPIO Pins – Connecting to the Cloud.

UNIT V IOT APPLICATIONS 7

Business models for the internet of things, Smart city, Smart mobility and transport, Industrial IoT, Smart health, Environment monitoring and surveillance – Home Automation – Smart Agriculture

30 PERIODS

PRACTICAL EXERCISES: 30 PERIODS

1. Introduction to Arduino platform and programming
2. Interfacing Arduino to Zigbee module
3. Interfacing Arduino to GSM module
4. Interfacing Arduino to Bluetooth Module

5 Introduction to Raspberry PI platform and python programming

1. Interfacing sensors to Raspberry PI
2. Communicate between Arduino and Raspberry PI using any wireless medium
3. Setup a cloud platform to log the data
4. Log Data using Raspberry PI and upload to the cloud platform
5. Design an IOT based system

OUTCOMES:

CO 1: Explain the concept of IoT.

CO 2: Understand the communication models and various protocols for IoT.

CO 3: Design portable IoT using Arduino/Raspberry Pi /open platform

CO 4: Apply data analytics and use cloud offerings related to IoT.

CO 5: Analyze applications of IoT in real time scenario.

TEXTBOOKS

TOTAL PERIODS:60

1. Robert Barton, Patrick Grossetete, David Hanes, Jerome Henry, Gonzalo Salgueiro, "IoT Fundamentals: Networking Technologies, Protocols, and Use Cases for the Internet of Things", CISCO Press, 2017
2. Samuel Greengard, The Internet of Things, The MIT Press, 2015

REFERENCES

1. Perry Lea, "Internet of things for architects", Packt, 2018
2. Olivier Hersent, David Boswarthick, Omar Elloumi , "The Internet of Things – Key applications and Protocols", Wiley, 2012
3. IOT (Internet of Things) Programming: A Simple and Fast Way of Learning, IOT Kindle Edition.
4. Dieter Uckelmann, Mark Harrison, Michahelles, Florian (Eds), "Architecting the Internet of Things", Springer, 2011.
5. ArshdeepBahga, Vijay Madisetti, "Internet of Things – A hands-on approach", Universities Press, 2015
6. https://www.arduino.cc/
   https://www.ibm.com/smarterplanet/us/en/?ca=v_smarterplanet

21150OE61B AUGMENTED AND VIRTUAL REALITY

L	T	P	C
2	0	2	3

OBJECTIVES:

- To impart the fundamental aspects and principles of AR/VR technologies.
- To know the internals of the hardware and software components involved in the development of AR/VR enabled applications.
- To learn about the graphical processing units and their architectures.
- To gain knowledge about AR/VR application development.
- To know the technologies involved in the development of AR/VR based applications.

UNIT I INTRODUCTION 7

Introduction to Virtual Reality and Augmented Reality – Definition – Introduction to Trajectories and Hybrid Space-Three I's of Virtual Reality – Virtual Reality Vs 3D Computer Graphics – Benefits of Virtual Reality – Components of VR System – Introduction to AR-AR Technologies-Input Devices – 3D Position Trackers – Types of Trackers – Navigation and Manipulation Interfaces – Gesture Interfaces – Types of Gesture Input Devices – Output Devices – Graphics Display – Human Visual System – Personal Graphics Displays – Large Volume Displays – Sound Displays – Human Auditory System**.**

UNIT II VR MODELING 6

Modeling – Geometric Modeling – Virtual Object Shape – Object Visual Appearance – Kinematics Modeling – Transformation Matrices – Object Position – Transformation Invariants –Object Hierarchies – Viewing the 3D World – Physical Modeling – Collision Detection – Surface Deformation – Force Computation – Force Smoothing and Mapping – Behavior Modeling – Model Management.

UNIT III VR PROGRAMMING 6

VR Programming – Toolkits and Scene Graphs – World ToolKit – Java 3D – Comparison of World ToolKit and Java 3D

UNIT IV APPLICATIONS 6

Human Factors in VR – Methodology and Terminology – VR Health and Safety Issues – VR and Society-Medical Applications of VR – Education, Arts and Entertainment – Military VR Applications – Emerging Applications of VR – VR Applications in Manufacturing – Applications of VR in Robotics – Information Visualization – VR in Business – VR in Entertainment – VR in Education.

UNIT V AUGMENTED REALITY 5

Introduction to Augmented Reality-Computer vision for AR-Interaction-Modelling and Annotation-Navigation-Wearable devices

30 PERIODS

PRACTICAL EXERCISES: 30 PERIODS

1. Study of tools like Unity, Maya, 3DS MAX, AR toolkit, Vuforia and Blender.
2. Use the primitive objects and apply various projection types by handling camera.
3. Download objects from asset store and apply various lighting and shading effects.
4. Model three dimensional objects using various modelling techniques and apply textures over them.
5. Create three dimensional realistic scenes and develop simple virtual reality enabled mobile applications which have limited interactivity.
6. Add audio and text special effects to the developed application.
7. Develop VR enabled applications using motion trackers and sensors incorporating full haptic interactivity.
8. Develop AR enabled applications with interactivity like E learning environment, Virtual walkthroughs and visualization of historic places.
9. Develop AR enabled simple applications like human anatomy visualization, DNA/RNA structure visualization and surgery simulation.
10. Develop simple MR enabled gaming applications.

TOTAL PERIODS:60

OUTCOMES:

On completion of the course, the students will be able to: CO1: Understand the basic concepts of AR and VR **CO2:**Understand the tools and technologies related to AR/VR **CO3**:Know the working principle of AR/VR related Sensor devices **CO4:**Design of various models using modeling techniques **CO5:**Develop AR/VR applications in different domains

TEXTBOOKS:

1. Charles Palmer, John Williamson, “Virtual Reality Blueprints: Create compelling VR experiences for mobile”, Packt Publisher, 2018
2. Dieter Schmalstieg, Tobias Hollerer, “Augmented Reality: Principles & Practice”, Addison Wesley, 2016
3. John Vince, “Introduction to Virtual Reality”, Springer-Verlag, 2004.
4. William R. Sherman, Alan B. Craig: Understanding Virtual Reality – Interface, Application, Design”, Morgan Kaufmann, 2003

CO's – PO's & PSO's MAPPING

COs	POs													PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	
1	3	2	2	-	3	-	-	-	2	2	1	2	2	1	2	
2	3	2	2	1	3	-	-	-	3	2	2	3	3	1	2	
3	3	3	2	2	3	-	-	-	3	2	1	2	3	2	2	
4	3	3	3	2	3	-	-	-	3	2	2	3	3	2	2	
5	3	3	3	3	3	-	-	-	3	3	3	3	3	3	3	
AVg.	3.00	2.60	2.40	2.00	3.00	-	-	-	2.80	2.20	1.80	2.60	2.80	1.80	2.20	

OPEN ELECTIVE II(VII SEM)

21150OE74A **ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING FUNDAMENTALS**

L T P C
2 0 2 3

OBJECTIVES:

The main objectives of this course are to:

6. Understand the importance, principles, and search methods of AI
7. Provide knowledge on predicate logic and Prolog.
8. Introduce machine learning fundamentals
9. Study of supervised learning algorithms.
10. Study about unsupervised learning algorithms.

UNIT I INTELLIGENT AGENT AND UNINFORMED SEARCH 6

Introduction - Foundations of AI - History of AI - The state of the art - Risks and Benefits of AI -- **Intelligent Agents** - Nature of Environment - Structure of Agent - Problem Solving Agents --- Formulating Problems - **Uninformed Search** - Breadth First Search -- Dijkstra's algorithm or uniform-cost search--Depth First Search Depth Limited Search

UNIT II PROBLEM SOLVING WITH SEARCH TECHNIQUES 6

Informed Search - Greedy Best First - A* algorithm - Adversarial Game and Search ---**Game theory** - Optimal decisions in game - Min Max Search algorithm - Alpha-beta pruning ---**Constraint Satisfaction Problems (CSP)** - Examples - Map Coloring - Job Scheduling -- Backtracking Search for CSP

UNIT III LEARNING 6

Machine Learning: Definitions – Classification - Regression --- approaches of machine learning models - Types of learning - Probability - Basics Linear Algebra – Hypothesis space and inductive bias, Evaluation. Training and test sets, cross validation, Concept of over fitting, under fitting, Bias and Variance - **Regression**: Linear Regression --Logistic Regression

UNIT IV SUPERVISED LEARNING 6

Neural Network: Introduction, Perceptron Networks – Adaline - Back propagation networks -- **Decision Tree:** Entropy – Information gain - Gini Impurity - classification algorithm---Rule based Classification - **Naïve Bayesian classification** **Support Vector Machines** (SVM)

UNIT V UNSUPERVISED LEARNING 6

Unsupervised Learning – Principle Component Analysis **Neural Network**: Fixed Weight Competitive Nets - Kohonen Self-Organizing Feature Maps – **Clustering**: Definition----Types of Clustering – Hierarchical clustering algorithms – k-means algorithm

TOTAL : 30 PERIODS

PRACTICAL EXERCISES: **30 PERIODS**

Programs for Problem solving with Search

1. Implement breadth first search

2. Implement depth first search
3. Analysis of breadth first and depth first search in terms of time and space
4. Implement and compare Greedy and A* algorithms.

Supervised learning

5. Implement the non-parametric locally weighted regression algorithm in order to fit data points. Select appropriate data set for your experiment and draw graphs
6. Write a program to demonstrate the working of the decision tree based algorithm.
7. Build an artificial neural network by implementing the back propagation algorithm and test the same using appropriate data sets.
8. Write a program to implement the naïve Bayesian classifier.

Unsupervised learning

9. Implementing neural network using self-organizing maps
10. Implementing k-Means algorithm to cluster a set of data.
11. Implementing hierarchical clustering algorithm.

Note:

- Installation of gnu-prolog, Study of Prolog (gnu-prolog).
- The programs can be implemented in using C++/JAVA/ Python or appropriate tools can be used by designing good user interface
- Data sets can be taken from standard repositories (https://archive.ics.uci.edu/ml/datasets.html) or constructed by the students.

OUTCOMES:

CO1: Understand the foundations of AI and the structure of Intelligent Agents
CO2: Use appropriate search algorithms for any AI problem
CO3: Study of learning methods
CO4: Solving problem using Supervised learning
CO5: Solving problem using Unsupervised learning

TOTAL PERIODS: 60

TEXT BOOK

1. S. Russell and P. Norvig, "Artificial Intelligence: A Modern Approach", Prentice Hall, Fourth Edition, 2021
2. S.N.Sivanandam and S.N.Deepa, Principles of soft computing-Wiley India.3 rd ed,

REFERENCES

2. Machine Learning. Tom Mitchell. First Edition, McGraw- Hill, 1997.
3. I. Bratko, "Prolog: Programming for Artificial Intelligence‖, Fourth edition, Addison-Wesley Educational Publishers Inc., 2011.
4. C. Muller & Sarah Alpaydin, Ethem. Introduction to machine learning. MIT press, 2020.

21150OE74B DATA SCIENCE FUNDAMENTALS

L T P C
2 0 2 3

COURSE OBJECTIVES:

- Familiarize students with the data science process.
- Understand the data manipulation functions in Numpy and Pandas.
- Explore different types of machine learning approaches.
- Understand and practice visualization techniques using tools.
- Learn to handle large volumes of data with case studies.

UNIT I INTRODUCTION 6

Data Science: Benefits and uses – facets of data---Data Science Process: Overview – Defining research goals – Retrieving data – data preparation --Exploratory Data analysis – build the model – presenting findings and building applications - Data Mining---Data Warehousing – Basic statistical descriptions of Data.

UNIT II DATA MANIPULATION 9

Python Shell - Jupyter Notebook - IPython Magic Commands NumPy Arrays-Universal Functions

– Aggregations – Computation on Arrays – Fancy Indexing – Sorting arrays – Structured data – Data manipulation with Pandas – Data Indexing and Selection – Handling missing data – Hierarchical indexing – Combining datasets – Aggregation and Grouping – String operations – Working with time series – High performance

UNIT III MACHINE LEARNING 5

The modeling process - Types of machine learning - Supervised learning - Unsupervised learning Semi-supervised learning- Classification, regression Clustering – Outliers and Outlier Analysis

UNIT IV DATA VISUALIZATION 5

Importing Matplotlib – Simple line plots – Simple scatter plots – visualizing errors – density and contour plots – Histograms – legends – colors – subplots – text and annotation – customization – three dimensional plotting Geographic Data with Basemap Visualization with Seaborn

UNIT V HANDLING LARGE DATA 5

Problems -techniques for handling large volumes of data programming tips for dealing with large data sets- Case studies: Predicting malicious URLs, Building a recommender system---Tools and techniques needed - Research question - Data preparation---Model building – Presentation and automation.

30 PERIODS

PRACTICAL EXERCISES: 30 PERIODS

LAB EXERCISES

1. Download, install and explore the features of Python for data analytics.
2. Working with Numpy arrays
3. Working with Pandas data frames
4. Basic plots using Matplotlib
5. Statistical and Probability measures
    a) Frequency distributions
    b) Mean, Mode, Standard Deviation
    c) Variability
    d) Normal curves
    e) Correlation and scatter plots
    f) Correlation coefficient
    g) Regression

6. Use the standard benchmark data set for performing the following:

a) Univariate Analysis: Frequency, Mean, Median, Mode, Variance, Standard Deviation, Skewness and Kurtosis.

b) Bivariate Analysis: Linear and logistic regression modelling.

7. Apply supervised learning algorithms and unsupervised learning algorithms on any data set.
8. Apply and explore various plotting functions on any data set.

Note: Example data sets like: UCI, Iris, Pima Indians Diabetes etc. COURSE

OUTCOMES:

At the end of this course, the students will be able to:

CO1: Gain knowledge on data science process.

CO2: Perform data manipulation functions using Numpy and Pandas.

CO3 Understand different types of machine learning approaches.

CO4: Perform data visualization using tools.

CO5: Handle large volumes of data in practical scenarios.

TOTAL PERIODS:60

TEXT BOOKS

1. David Cielen, Arno D. B. Meysman, and Mohamed Ali, “Introducing Data Science”, Manning Publications, 2016.
2. Jake VanderPlas, “Python Data Science Handbook”, O’Reilly, 2016.

REFERENCES

2. Robert S. Witte and John S. Witte, “Statistics”, Eleventh Edition, Wiley Publications, 2017.
3. Allen B. Downey, “Think Stats: Exploratory Data Analysis in Python”, Green Tea Press,2014.

OPEN ELECTIVE III (VIISEM)

21147OE73A ENGLISH FOR COMPETITIVE EXAMINATIONS **L T P C**
3 0 0 3

Course Description:

Students aspiring to take up competitive exams of which the English language is a vital component will find this course useful. Designed for students in the higher semesters, the course will help students to familiarise themselves with those aspects of English that are tested in these examinations.

Objectives:

- To train the students in the language components essential to face competitive examinations both at the national (UPSC, Banking, Railway, Defence) and the international level (GRE, TOEFL, IELTS).
- To enhance an awareness of the specific patterns in language testing and the respective skills to tackle verbal reasoning and verbal ability tests.
- To inculcate effective practices in language-learning in order to improve accuracy in usage of grammar and coherence in writing.
- To improve students’ confidence to express their ideas and opinions in formal contexts
- To create awareness of accuracy and precision in communication

UNIT I **9**

Orientation on different formats of competitive exams Vocabulary – Verbal ability – Verbal reasoning - Exploring the world of words - Essential words - Meaning and their usage - Synonyms-antonyms - Word substitution - Word analogy - Idioms and phrases - Commonly confused words - Spellings - Word expansion - New words in use.

UNIT II **9**

Grammar - Sentence improvement -Sentence completion - Rearranging phrases into sentences - Error identification -Tenses - Prepositions - Adjectives - Adverbs - Subject-verb agreement - Voice - Reported speech - Articles - Clauses - Speech patterns.

UNIT III **9**

Reading Specific information and detail - Identifying main and supporting ideas - Speed reading techniques - Improving global reading skills - Linking ideas - Summarising - Understanding argument - Identifying opinion/attitude and making inferences -- Critical reading.

UNIT IV **9**

Writing - Pre-writing techniques - Mindmap - Describing pictures and facts Paragraph structure - organising points - Rhetoric writing - Improving an answer - Drafting, writing and developing an argument - Focus on cohesion - Using cohesive devices -Analytic writing - Structure and types of essay - Mind maps - Structure of drafts, letters, memos, emails - Statements of Purpose - Structure, Content and Style.

UNIT V 9

Listening and Speaking – Contextual listening – Listening to instructions – Listening for specific information – Identifying detail, main ideas – Following signpost words – Stress, rhythm and intonation - Speaking to respond and elicit ideas – Guided speaking – Opening phrases – Interactive communication – Dysfluency Sentence stress – Speaking on a topic – Giving opinions – Giving an oral presentation – Telling a story or a personal anecdote – Talking about oneself Utterance – Speech acts- Brainstorming ideas – Group discussion.

TOTAL: 45 PERIODS

Learning Outcomes:

At the end of the course, learners will be able

- xpand their vocabulary and gain practical techniques to read and comprehend a wide range of texts with the emphasis required
- identify errors with precision and write with clarity and coherence
- understand the importance of task fulfilment and the usage of task-appropriate vocabulary
- communicate effectively in group discussions, presentations and interviews
- write topic based essays with precision and accuracy

Teaching Methods:

Instructional methods will involve discussions, taking mock tests on various question papers – Objective, multiple-choice and descriptive. Peer evaluation, self-check on improvement and peer feedback - Practice sessions on speaking assessments, interview and discussion – Using multimedia.

Evaluative Pattern:

Internal Tests – 50%

End Semester Exam - 50%

TEXTBOOKS:

1.R.P.Bhatnagar - *General English for Competitive Examinations.* Macmillan India Limited, 2009.

REFERENCEBOOKS:

1. Educational Testing Service - The Official Guide to the GRE Revised General Test, Tata McGraw Hill, 2010.
2. The Official Guide to the TOEFL Test, Tata McGraw Hill, 2010.
3. R Rajagopalan- General English for Competitive Examinations, McGraw Hill Education (India) Private Limited, 2008.

Websites

http://www.examenglish.com/, http://www.ets.org/ , http://www.bankxams.com/

http://civilservicesmentor.com/, http://www.educationobserver.com

http://www.cambridgeenglish.org/in/

CO-PO & PSO MAPPING

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	1	3	3	1	3	3	3	3	1	3	1	3	-	-	-
2	2	3	3	2	3	3	3	3	1	3	3	3	-	-	-
3	3	3	3	3	3	3	3	3	3	3	3	3	-	-	-
4	2	2	2	2	2	2	2	2	3	3	3	3	-	-	-
5	2	2	2	2	2	2	2	2	2	3	2	3	-	-	-
AVg.	2	2.6	2.6	2	2.6	2.6	2.6	2.6	2	3	2.4	3	-	-	-

- 1-low, 2-medium, 3-high, '-"- no correlation

Note: The average value of this course to be used for program articulation matrix.

21154OE73A **INDUSTRIAL MANAGEMENT** **L T P C**
3 0 0 3

COURSE OBJECTIVES:

- To introduce fundamental concepts of industrial management
- To understand the approaches to the study of Management
- To learn about Decision Making, Organizing and leadership
- To analyze the Managerial Role and functions
- To know about the Supply Chain Management'

UNIT I INTRODUCTION 9

Technology Management - Definition - Functions - Evolution of Modern Management ---Scientific Management Development of Management Thought. Approaches to the study of Management, Forms of Organization -Individual Ownership - Partnership - Joint Stock Companies Co-operative Enterprises - Public Sector Undertakings, Corporate Frame Work- Share Holders --- Board of Directors - Committees -- Chief Executive Line and Functional Managers,-Financial-Legal-Trade Union

UNIT II FUNCTIONS OF MANAGEMENT 9

Planning - Nature and Purpose - Objectives - Strategies – Policies and Planning Premises --- Decision Making - Organizing - Nature and Process - Premises - Departmentalization ---Line and staff - Decentralization -Organizational culture, Staffing - selection and training .Placement --- Performance appraisal - Career Strategy – Organizational Development. Leading ----Managing human factor - Leadership .Communication, Controlling - Process of Controlling ---Controlling techniques, productivity and operations management Preventive control, Industrial Safety.

UNIT III ORGANIZATIONAL BEHAVIOUR 9

Definition - Organization - Managerial Role and functions -- Organizational approaches, Individual behaviour - causes - Environmental Effect - Behaviour and Performance, Perception ---- Organizational Implications. Personality - Contributing factors - Dimension – Need Theories --- Process Theories Job Satisfaction, Learning and Behaviour-Learning Curves, Work Design and approaches.

UNIT IV GROUPDYNAMICS 9

Group Behaviour - Groups - Contributing factors - Group Norms, Communication - Process --- Barriers to communication - Effective communication, leadership-- formal and informal characteristics – Managerial Grid - Leadership styles Group Decision Making Leadership Role in

Group Decision, Group Conflicts - Types -Causes - Conflict Resolution ---Inter group relations and conflict, Organization centralization and decentralization - Formal and informal ---Organizational Structures Organizational Change and Development -Change Process – Resistance to Change --- Culture and Ethics.

UNIT V MODERN CONCEPTS 9

Management by Objectives (MBO) - Management by Exception (MBE),Strategic Management -- Planning for Future direction - SWOT Analysis --- Evolving development strategies, information technology in management Decisions support system-Management Games Business Process Re-engineering(BPR) -Enterprises Resource Planning (ERP) - Supply Chain Management (SCM) -- Activity Based Management (AM) - Global Perspective---Principles and Steps Advantages and disadvantage

TOTAL: 45 PERIODS

COURSE OUTCOMES:

CO1: Understand the basic concepts of industrial management
CO2: Identify the group conflicts and its causes.
CO3: Perform swot analysis
CO4 : Analyze the learning curves

CO5 : Understand the placement and performance appraisal

REFERENCES:

1. Maynard H.B, “Industrial Engineering Hand book”, McGraw-Hill, sixth 2008

CO’s – PO’s & PSO’s MAPPING

COs	POs												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	2	1											2	1	
2		3	2	3											2
3	2	3	2	3									1	2	3
4	2	2	3	3										3	3
5	2	2											2		
AVg.	2	2.2	2.3	3									1.8	2	2.6

ELECTIVE–VIII(VIISEMESTER)

21154OE73B INTRODUCTION TO NON-DESTRUCTIVE TESTING **L T P C**
3 0 0 3

COURSE OBJECTIVES:

The main learning objective of this course is to prepare the students for:

- Understanding the basic importance of NDT in quality assurance.
- Imbibing the basic principles of various NDT techniques, its applications, limitations, codes and standards.
- Equipping themselves to locate a flaw in various materials, products.
- Applying apply the testing methods for inspecting materials in accordance with industry specifications and standards.
- Acquiring the knowledge on the selection of the suitable NDT technique for a given application

UNIT I INTRODUCTION TO NDT & VISUAL TESTING 9

Concepts of Non-destructive testing-relative merits and limitations-NDT Versus mechanical testing, Fundamentals of Visual Testing – vision, lighting, material attributes, environmental factors, visual perception, direct and indirect methods – mirrors, magnifiers, boroscopes and fibroscopes – light sources and special lighting.

UNIT II LIQUID PENETRANT & MAGNETIC PARTICLE TESTING 9

Liquid Penetrant Inspection: principle, applications, advantages and limitations, dyes, developers and cleaners, Methods & Interpretation.

Magnetic Particle Inspection: Principles, applications, magnetization methods, magnetic particles, Testing Procedure, demagnetization, advantages and limitations, – Interpretation and evaluation of test indications.

UNIT III EDDY CURRENT TESTING & THERMOGRAPHY 9

Eddy Current Testing: Generation of eddy currents– properties– eddy current sensing elements, probes, Instrumentation, Types of arrangement, applications, advantages, limitations – Factors affecting sensing elements and coil impedance, calibration, Interpretation/Evaluation.

Thermography- Principle, Contact & Non-Contact inspection methods, Active & Passive methods, Liquid Crystal – Concept, example, advantages & limitations. Electromagnetic spectrum, infrared thermography- approaches, IR detectors, Instrumentation and methods, applications.

UNIT IV ULTRASONIC TESTING & AET 9

Ultrasonic Testing: Types of ultrasonic waves, characteristics, attenuation, couplants, probes, EMAT. Inspection methods-pulse echo, transmission and phased array techniques, types of scanning and displays, angle beam inspection of welds, time of flight diffraction (TOFD) technique, Thickness determination by ultrasonic method, Study of A, B and C scan presentations, calibration. Acoustic Emission Technique – Introduction, Types of AE signal, AE wave propagation, Source location, Kaiser effect, AE transducers, Principle, AE parameters, AE instrumentation, Advantages & Limitations, Interpretation of Results, Applications.

UNIT V RADIOGRAPHY TESTING 9

Sources-X-rays and Gamma rays and their characteristics-absorption, scattering. Filters and screens, Imaging modalities-film radiography and digital radiography (Computed, Direct, Real Time, CT scan). Problems in shadow formation, exposure factors, inverse square law, exposure charts, Penetrameters, safety in radiography.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

After completion of this course, the students will be able to

1. Realize the importance of NDT in various engineering fields.
2. Have a basic knowledge of surface NDE techniques which enables to carry out various inspection in accordance with the established procedures.
3. Calibrate the instrument and inspect for in-service damage in the components by means of Eddy current testing as well as Thermography testing.
4. Differentiate various techniques of UT and AET and select appropriate NDT methods for better evaluation.
5. Interpret the results of Radiography testing and also have the ability to analyse the influence of various parameters on the testing.

TEXT BOOKS:

1. Baldev Raj, T. Jayakumar and M. Thavasimuthu, Practical Non Destructive Testing, Alpha Science International Limited, 3rd edition, 2002.
2. J. Prasad and C. G. K. Nair, Non-Destructive Test and Evaluation of Materials, Tata McGraw-Hill Education, 2nd edition, 2011.
3. Ravi Prakash, “Non-Destructive Testing Techniques”, 1st revised edition, New Age International Publishers, 2010.

REFERENCES:

1. ASM Metals Handbook, V-17, "Nondestructive Evaluation and Quality Control", American Society of Metals, USA, 2001.
2. Barry Hull and Vernon John,"Nondestructive Testing", Macmillan, 1989.
3. Chuck Hellier, “Handbook of Nondestructive Evaluation”, Mc Graw Hill, 2012.
4. Louis Cartz, "Nondestructive Testing", ASM International, USA, 1995.

CO’s- PO’s & PSO’s MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
C01	2	2	2	3			2	2				2	1	2	
C02	3	1	2	2			2	2				2	2	2	1
C03	3	2	1	2			2	2				2	2	2	
CO4	3	1	2	2			2	2				2	2	2	2
CO5	3	2	2	2			2	2				2	2	2	1
Avg	2.8	1.6	1.8	2.2			2	2				2	1.8	2	1.3

21155OE73A **REMOTE SENSING CONCEPTS** **L T P C**
3 0 0 3

OBJECTIVES:

- To introduce the concepts of remote sensing processes and its components.
- To expose the various remote sensing platforms and sensors and to introduce the elements of data interpretation

UNIT I REMOTE SENSING AND ELECTROMAGNETIC RADIATION 9

Definition – components of RS – History of Remote Sensing – Merits and demerits of data collation between conventional and remote sensing methods --- Electromagnetic Spectrum – Radiation principles -- Wave theory, Planck's law, Wien's Displacement Law, Stefan's Boltzmann law, Kirchoff's law – Radiation sources: active & passive -- Radiation Quantities

UNIT II EMR INTERACTION WITH ATMOSPHERE AND EARTH MATERIAL 9

Standard atmospheric profile – main atmospheric regions and its characteristics – interaction of radiation with atmosphere – Scattering, absorption and refraction – Atmospheric windows Energy balance equation – Specular and diffuse reflectors – Spectral reflectance & emittance – Spectroradiometer – Spectral Signature concepts – Typical spectral reflectance curves for vegetation, soil and water – solid surface scattering in microwave region.

UNIT III ORBITS AND PLATFORMS 9

Motions of planets and satellites – Newton's law of gravitation - Gravitational field and potential -- Escape velocity - Kepler's law of planetary motion -- Orbit elements and types – Orbital perturbations and maneuvers – Types of remote sensing platforms --- Ground based, Airborne platforms and Space borne platforms – Classification of satellites – Sun synchronous and Geosynchronous satellites – Lagrange Orbit.

UNIT IV SENSING TECHNIQUES 9

Classification of remote sensors – Resolution concept : spatial, spectral, radiometric and temporal resolutions - Scanners --Along and across track scanners – Optical-infrared sensors – Thermal sensors – microwave sensors – Calibration of sensors - High Resolution Sensors ---LIDAR , UAV – Orbital and sensor characteristics of live Indian earth observation satellites

UNIT V DATA PRODUCTS AND INTERPRETATION 9

Photographic and digital products – Types, levels and open source satellite data products ---- selection and procurement of data– Visual interpretation: basic elements and interpretation keys -- Digital interpretation – Concepts of Image rectification, Image enhancement and Image classification

TOTAL:45 PERIODS

COURSE OUTCOMES:

- On completion of the course, the student is expected to

CO 1 Understand the concepts and laws related to remote sensing
CO 2 Understand the interaction of electromagnetic radiation with atmosphere and earth material
CO3 Acquire knowledge about satellite orbits and different types of satellites
CO4 Understand the different types of remote sensors
CO5 Gain knowledge about the concepts of interpretation of satellite imagery

TEXTBOOKS:

1. Thomas M.Lillesand, Ralph W. Kiefer and Jonathan W. Chipman, Remote Sensing and Image interpretation, John Wiley and Sons, Inc, New York,2015.
2. George Joseph and C Jeganathan, Fundamentals of Remote Sensing,Third Edition Universities Press (India) Private limited, Hyderabad, 2018

REFERENCES:

1. Janza, F.Z., Blue H.M. and Johnson,J.E. Manual of Remote Sensing. Vol.1, AmericanSociety of Photogrametry, Virginia, USA, 2002.
2. Verbyla, David, Satellite Remote Sensing of Natural Resources. CRC Press, 1995
3. Paul Curran P.J. Principles of Remote Sensing. Longman, RLBS, 1988.
4. Introduction to Physics and Techniques of Remote Sensing , Charles Elachi and JacobVan Zyl, 2006 Edition II, Wiley Publication.
5. Basudeb Bhatta, Remote Sensing and GIS, Oxford University Press, 2011

CO's- PO's & PSO's MAPPING

PO	Graduate Attribute	Course Outcome					Average
		CO1	CO2	CO3	CO4	CO5	
PO1	Engineering Knowledge	3	3	3	3	3	3
PO2	Problem Analysis				3	3	3
PO3	Design/Development of Solutions				3	3	3
PO4	Conduct Investigations of Complex Problems				3	3	3
PO5	Modern Tool Usage				3	3	3
PO6	The Engineer and Society						
PO 7	Environment and Sustainability						
PO 8	Ethics						
PO 9	Individual and Team Work						
PO 10	Communication						
PO 11	Project Management and Finance						
PO 12	Life-long Learning	3		3	3	3	3
PSO 1	Knowledge of Geoinformatics discipline	3	3	3	3	3	3
PSO 2	Critical analysis of Geoinformatics Engineering problems and innovations	3	3	3	3	3	3
PSO 3	Conceptualization and evaluation of Design solutions	3	3	3	3	3	3

21155OE73B DRINKING WATER SUPPLY AND TREATMENT L T P C

3 0 0 3

OBJECTIVE:

- To equip the students with the principles and design of water treatment units and distribution system.

UNIT I SOURCES OF WATER 9

Public water supply system – Planning, Objectives, Design period, Population forecasting; Water demand – Sources of water and their characteristics, Surface and Groundwater – Impounding Reservoir – Development and selection of source – Source Water quality – Characterization – Significance – Drinking Water quality standards.

UNIT II CONVEYANCE FROM THE SOURCE 9

Water supply – intake structures – Functions; Pipes and conduits for water – Pipe materials – Hydraulics of flow in pipes – Transmission main design – Laying, jointing and testing of pipes – appurtenances – Types and capacity of pumps – Selection of pumps and pipe materials.

UNIT III WATER TREATMENT 9

Objectives – Unit operations and processes – Principles, functions, and design of water treatment plant units, aerators of flash mixers, Coagulation and flocculation –- sand filters Disinfection Construction, Operation and Maintenance aspects.

UNIT IV ADVANCED WATER TREATMENT 9

Water softening – Desalination- R.O. Plant – demineralization – Adsorption ---Ion exchange– Membrane Systems - Iron and Manganese removal - Defluoridation ---Construction and Operation and Maintenance aspects

UNIT V WATER DISTRIBUTION AND SUPPLY 9

Requirements of water distribution – Components – Selection of pipe material – Service reservoirs -- Functions – Network design – Economics Computer applications – Appurtenances – Leak detection - Principles of design of water supply in buildings – House service connection – Fixtures and fittings, systems of plumbing and types of plumbing.

TOTAL: 45 PERIODS

OUTCOMES

CO1: an understanding of water quality criteria and standards, and their relation to public health

CO2: the ability to design the water conveyance system

CO3: the knowledge in various unit operations and processes in water treatment

CO4: an ability to understand the various systems for advanced water treatment

CO5: an insight into the structure of drinking water distribution system

TEXTBOOKS :

1. Garg. S.K., "Water Supply Engineering", Khanna Publishers, Delhi, September 2008.
2. Punmia B.C, Arun K.Jain, Ashok K.Jain, " Water supply Engineering" Lakshmi publication private limited, New Delhi, 2016.
3. Rangwala "Water Supply and Sanitary Engineering", February 2022
4. Birdie.G.S., "Water Supply and Sanitary Engineering", Dhanpat Rai and sons, 2018.

REFERENCES :

1. Fair. G.M., Geyer.J.C., "Water Supply and Wastewater Disposal", John Wiley and Sons, 1954.
2. Babbit.H.E, and Donald.J.J, "Water Supply Engineering" , McGraw Hill book Co, 1984.
3. Steel. E.W.et al., "Water Supply Engineering" , Mc Graw Hill International book Co, 1984.
4. Duggal. K.N., "Elememts of public Health Engineering", S.Chand and Company Ltd, New Delhi, 1998.

COs- POs & PSOs MAPPING

COs	POs												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1		3						3		3			3		
2		3		2		2				3			3		
3				2		2				3			3		
4			3	2				3	2	3			3		
5			3	2			1		2	3		1			

Avg.		3	3	2		2	1	3	2	3		1	3		

1. low, 2-medium, 3-high, '-"- no correlation
Note: The average value of this course to be used for program articulation matrix.

21152OE73A **NANO TECHNOLOGY** **L T P C**
3 0 0 3

UNIT I INTRODUCTION 8

General definition and size effects-important nano structured materials and nano particles- importance of nano materials- Size effect on thermal, electrical, electronic, mechanical, optical and magnetic properties of nanomaterials- surface area - band gap energy and applications. Photochemistry and Electrochemistry of nanomaterials -Ionic properties of nanomaterials- Nano catalysis.

UNIT II SYNTHESIS OF NANOMATERIALS 8

Bottom up and Top-down approach for obtaining nano materials Precipitation methods – sol gel technique – high energy ball milling, CVD and PVD methods, gas phase condensation, magnetron sputtering and laser deposition methods – laser ablation, sputtering.

UNIT III NANO COMPOSITES 10

Definition- importance of nanocomposites- nano composite materials-classification of composites- metal/metal oxides, metal-polymer- thermoplastic based, thermoset based and elastomer based- influence of size, shape and role of interface in composites applications.

UNIT IV NANO STRUCTURES AND CHARACTERIZATION TECHNIQUES 10

Classifications of nanomaterials - Zero dimensional, one-dimensional and two-dimensional nanostructures- Kinetics in nanostructured materials- multilayer thin films and superlattice- clusters of metals, semiconductors and nanocomposites. Spectroscopic techniques, Diffraction methods, thermal analysis method, BET analysis method.

UNIT V APPLICATIONS OF NANO MATERIALS 9

Overview of nanomaterials properties and their applications, nano painting, nano coating, nanomaterials for renewable energy, Molecular Electronics and Nanoelectronics – Nanobots- Biological Applications. Emerging technologies for environmental applications- Practice of nanoparticles for environmental remediation and water treatment.

TOTAL : 45 PERIODS

OUTCOMES:

CO1 understand the basic properties such as structural, physical, chemical properties of nanomaterials and their applications.
CO2 able to acquire knowledge about the different types of nano material synthesis
CO3 describes about the shape, size,structure of composite nano materials and their interference
CO4 understand the different characterization techniques for nanomaterials
CO5 develop a deeper knowledge in the application of nanomaterials in different fields.

TEXT BOOKS

1. Mick Wilson, Kamali Kannangara,Geoff Smith, Michelle Simmom, Burkhard Raguse, " Nano Technology: Basic Science & Engineering Technology", 2005, Overseas Press
2. G. Cao, "Nanostructures & Nanomaterials: Synthesis, Properties &Applications" Imperial College Press, 2004
3. William A Goddard "Handbook of Nanoscience, Engineering and Technology", 3rd Edition, CRC Taylor and Francis group 2012.

REFERENCES

1. R.H.J.Hannink & A.J.Hill, Nanostructure Control, Wood Head Publishing Ltd.,Cambridge, 2006.
2. C.N.R.Rao, A.Muller, A.K.Cheetham, The Chemistry of Nanomaterials: Synthesis, Properties and Applications Vol. I & II, 2nd edition, 2005, Wiley VCH Verlag Gibtl & Co
3. Ivor Brodie and Julius J.Muray,'The physics of Micro/Nano – Fabrication',Springer International Edition,2010

CO's- PO's & PSO's MAPPING

Course Outcomes	Statement	Program Outcome														
		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
CO1	understand the basic properties such as structural, physical, chemical properties of nanomaterials and their applications	2	3	2	3	3	-	-	-	1	1	-	3	1	1	3
CO2	acquire knowledge about the different types of nano material synthesis	2	3	1	3	3	-	-	-	1	1	-	3	2	1	3
CO3	describes about the shape, size,structure of composite nano materials and their interference	2	2	2	3	3	1	1	-	1	1	-	3	2	1	3
CO4	understand the different characterization techniques for nanomaterials	2	2	1	3	3	1	1	1	1	-	1	3	1	1	3
CO5	develop a deeper knowledge in the application of nanomaterials in different fields	2	2	1	3	3	1	1	1	1	-	1	3	2	1	3
	Overall CO	3	2	2	1	3	3	1	1	1	1	1	1	3	2	1

21152OE73B SIGNALS AND SYSTEMS

L T P C
3 0 0 3

COURSE OBJECTIVES :

- To understand the basic properties of signal & systems
- To know the methods of characterization of LTI systems in time domain
- To analyze continuous time signals and system in the Fourier and Laplace domain
- To analyze discrete time signals and system in the Fourier and Z transform domain

UNIT I CLASSIFICATION OF SIGNALS AND SYSTEMS 9

Standard signals- Step, Ramp, Pulse, Impulse, Real and complex exponentials and Sinusoids_Classification of signals – Continuous time (CT) and Discrete Time (DT) signals, Periodic & Aperiodic signals, Deterministic & Random signals, Energy & Power signals Classification of systems- CT systems and DT systems- – Linear & Nonlinear, Time-variant& Time-invariant,Causal & Non-causal, Stable & Unstable.

UNIT II ANALYSIS OF CONTINUOUS TIME SIGNALS 9

Fourier series for periodic signals Fourier Transform – properties- Laplace Transforms and Properties

UNIT III LINEAR TIME INVARIANT CONTINUOUS TIME SYSTEMS 9

Impulse response --- convolution integrals- Differential Equation- Fourier and Laplace transforms in Analysis of CT systems Systems connected in series / parallel.

UNIT IV ANALYSIS OF DISCRETE TIME SIGNALS 9

Baseband signal Sampling-Fourier Transform of discrete time signals (DTFT)- Properties of DTFT Z Transform & Properties

UNIT V LINEAR TIME INVARIANT-DISCRETE TIME SYSTEMS 9

Impulse response-Difference equations-Convolution sum- Discrete Fourier Transform and Z Transform Analysis of Recursive & Non-Recursive systems-DT systems connected in series and parallel.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of the course, the student will be able to:

CO1:determine if a given system is linear/causal/stable

CO2: determine the frequency components present in a deterministic signal

CO3:characterize continuous LTI systems in the time domain and frequency domain

CO4:characterize discrete LTI systems in the time domain and frequency domain

CO5:compute the output of an LTI system in the time and frequency domains

TEXT BOOKS:

1. Oppenheim, Willsky and Hamid, “Signals and Systems”, 2nd Edition, Pearson Education, New Delhi, 2015.(Units I - V)
2. Simon Haykin, Barry Van Veen, “Signals and Systems”, 2nd Edition, Wiley, 2002

REFERENCES :

1. B. P. Lathi, “Principles of Linear Systems and Signals”, 2nd Edition, Oxford, 2009.
2. M. J. Roberts, “Signals and Systems Analysis using Transform methods and MATLAB”, McGraw- Hill Education, 2018.
3. John Alan Stuller, “An Introduction to Signals and Systems”, Thomson, 2007.

CO’s- PO’s & PSO’s MAPPING

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	-	3	-	3	2	-	-	-	-		3	-	-	1
2	3	-	3	-	-	2	-	-	-	-		3	-	3	-
3	3	3	-	-	3	2	-	-	-	-		3	2	-	-
4	3	3	-	-	3	2	-	-	-	-		3	-	3	1
5	3	3	-	3	3	2	-	-	-	-		3	-	3	1
CO	**3**	**3**	**3**	**3**	**3**	**2**	**-**	**-**	**-**	**-**	**-**	**3**	**2**	**3**	**1**

OPENELECTIVEIV(VIISEM)

21154OE74A **ADDITIVE MANUFACTURING** **L T P C**
3 0 0 3

COURSE OBJECTIVES:

- To introduce the development, capabilities, applications, of Additive Manufacturing (AM), and its business opportunities.
- To be acquainted with vat polymerization and material extrusion processes
- To be familiar with powder bed fusion and binder jetting processes.
- To gain knowledge on applications of direct energy deposition, and material jetting processes.
- To impart knowledge on sheet lamination and direct write technologies.

UNIT I INTRODUCTION 9

Overview - Need --Development of Additive Manufacturing (AM) Technology: Rapid Prototyping- Rapid Tooling - Rapid Manufacturing - Additive Manufacturing. AM Process Chain ---ASTM/ISO 52900 Classification - Benefits - AM Unique Capabilities AM File formats: STL, AMF Applications: Building Printing, Bio Printing, Food Printing, Electronics Printing, Automobile, Aerospace, Healthcare. Business Opportunities in AM.

UNIT II VAT POLYMERIZATION AND MATERIAL EXTRUSION 9

Photo polymerization: Stereolithography Apparatus (SLA)- Materials -Process ---top down and bottom up approach - Advantages - Limitations - Applications. Digital Light Processing (DLP) --- Process - Advantages Applications.
Material Extrusion: Fused Deposition Modeling (FDM) - Process-Materials --- Applications and Limitations.

UNIT III POWDER BED FUSION AND BINDER JETTING 9

Powder Bed Fusion: Selective Laser Sintering (SLS): Process - Powder Fusion Mechanism --- Materials and Application. Selective Laser Melting (SLM), Electron Beam Melting (EBM): Materials - Process Advantages and Applications.
Binder Jetting: Three-Dimensional Printing - Materials - Process - Benefits - Limitations ----- Applications.

UNIT IV MATERIAL JETTING AND DIRECTED ENERGY DEPOSITION 9

Material Jetting: Multijet Modeling- Materials - Process - Benefits Applications.
Directed Energy Deposition: Laser Engineered Net Shaping (LENS) - Process-- Material Delivery Materials -Benefits --Applications.

UNIT V SHEET LAMINATION AND DIRECT WRITE TECHNOLOGY 9

Sheet Lamination: Laminated Object Manufacturing (LOM)- Basic Principle- Mechanism: Gluing or

Adhesive Bonding - Thermal Bonding - Materials - Application and Limitation.
Ink-Based Direct Writing (DW): Nozzle Dispensing Processes, Inkjet Printing Processes, Aerosol DW - Applications of DW.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of this course students shall be able to:

CO1: Recognize the development of AM technology and how AM technology propagated into various businesses and developing opportunities.

CO2: Acquire knowledge on process vat polymerization and material extrusion processes and its applications.

CO3: Elaborate the process and applications of powder bed fusion and binder jetting.

CO4: Evaluate the advantages, limitations, applications of material jetting and directed energy deposition processes.

CO5: Acquire knowledge on sheet lamination and direct write technology.

TEXT BOOKS:

1. Ian Gibson, David Rosen, Brent Stucker, Mahyar Khorasani "Additive manufacturing technologies". 3rd edition Springer Cham, Switzerland. (2021). ISBN: 978-3-030-56126-0
2. Andreas Gebhardt and Jan-Steffen Hötter "Additive Manufacturing: 3D Printing for Prototyping and Manufacturing", Hanser publications, United States, 2015, ISBN: 978-1- 56990-582-1.

REFERENCES:

1. Andreas Gebhardt, "Understanding Additive Manufacturing: Rapid Prototyping, Rapid Manufacturing", Hanser Gardner Publication, Cincinnati., Ohio, 2011, ISBN :9783446425521.
2. Milan Brandt, "Laser Additive Manufacturing: Materials, Design, Technologies, and Applications", Woodhead Publishing., United Kingdom, 2016, ISBN: 9780081004333.
3. Amit Bandyopadhyay and Susmita Bose, "Additive Manufacturing", 1st Edition, CRC Press., United States, 2015, ISBN-13: 978-1482223590.
4. Kamrani A.K. and Nasr E.A., "Rapid Prototyping: Theory and practice", Springer., United States ,2006, ISBN: 978-1-4614-9842-1.
Liou, L.W. and Liou, F.W., "Rapid Prototyping and Engineering applications: A tool box for prototype development", CRC Press., United States, 2011, ISBN: 9780849334092

21154OE74B	**INDUSTRIAL SAFETY**	**L T P C**
		3 0 0 3

OBJECTIVES:

- To educate about the health hazards and the safety measures to be followed in the industrial environment.
- Describe industrial legislations (Factories Acts, Workmen's Compensation and other laws) enacted for the protection of employees health at work settings
- Describe methods of prevention and control of Occupational Health diseases, accidents / emergencies and other hazards

UNIT I INTRODUCTION 9

Need for developing Environment, Health and Safety systems in work places --- Accident Case Studies - Status and relationship of Acts--Regulations and Codes of Practice Role of trade union safety representatives. International initiatives Ergonomics and work place.

UNIT II OCCUPATIONAL HEALTH AND HYGIENE 9

Definition of the term occupational health and hygiene - Categories of health hazards----Exposure pathways and human responses to hazardous and toxic substances---Advantages and limitations of environmental monitoring and occupational exposure limits---Hierarchy of control measures for occupational health risks Role of personal protective equipment and the selection criteria Effects on humans control methods and reduction strategies for noise, radiation and excessive stress.

UNIT III WORKPLACE SAFETY AND SAFETY SYSTEMS 9

Features of Satisfactory and Safe design of work premises – good housekeeping lighting and colour, Ventilation and Heat Control – Electrical Safety – Fire Safety – Safe Systems of work for manual handling operations – Machine guarding – Working at different levels – Process and System Safety.

UNIT IV HAZARDS AND RISK MANAGEMENT 9

Safety appraisal analysis and control techniques – plant safety inspection – Accident investigation - Analysis and Reporting – Hazard and Risk Management Techniques – major accident hazard control – Onsite and Offsite emergency Plans.

UNIT V ENVIRONMENTAL HEALTH AND SAFETY MANAGEMENT 9

Concept of Environmental Health and Safety Management – Elements of Environmental Health and Safety Management Policy and methods of its effective implementation and review – Elements of Management Principles – Education and Training – Employee Participation.

TOTAL: 45 PERIODS

OUTCOMES:

After completion of this course, the student is expected to be able to:

- Describe, with example, the common work-related diseases and accidents in occupational setting
- Name essential members of the Occupational Health team
- What roles can a community health practitioners play in an Occupational setting to ensure the protection, promotion and maintenance of the health of the employee

21155OE74A **GEOGRAPHICAL INFORMATION SYSTEM** **L T P C**
3 0 0 3

OBJECTIVES:

- To impart the knowledge on basic components, data preparation and implementation of Geographical Information System.

UNIT I FUNDAMENTALS OF GIS 9

Introduction to GIS - Basic spatial concepts - Coordinate Systems --GIS and Information Systems – Definitions – History of GIS Components of a GIS – Hardware, Software, Data, People, Methods – Proprietary and open source Software --Types of data – Spatial, Attribute data- types of attributes – scales/ levels of measurements.

UNIT II SPATIAL DATA MODELS 9

Database Structures – Relational, Object Oriented – Entities – ER diagram - data models ---conceptual, logical and physical models --spatial data models – Raster Data Structures – Raster Data Compression - Vector Data Structures---Raster vs Vector Models- TIN and GRID data models.

UNIT III DATA INPUT AND TOPOLOGY 9

Scanner--Raster Data Input – Raster Data File Formats – Georeferencing – Vector Data Input – Digitizer – Datum Projection and reprojection -Coordinate Transformation – Topology---Adjacency, connectivity and containment – Topological Consistency – Non topological file formats ---Attribute

Data linking – Linking External Databases – GPS Data Integration

UNIT IV DATA QUALITY AND STANDARDS 9

Data quality - Basic aspects--completeness, logical consistency, positional accuracy, temporal accuracy, thematic accuracy and lineage – Metadata – GIS Standards –Interoperability - OGC --- Spatial Data Infrastructure

UNIT V DATA MANAGEMENT AND OUTPUT 9

Import/Export – Data Management functions- Raster to Vector and Vector to Raster Conversion --- Data Output -- Map Compilation – Chart/Graphs – Multimedia – Enterprise Vs. Desktop GIS- distributed GIS.

TOTAL:45 PERIODS

COURSE OUTCOMES:

- On completion of the course, the student is expected to

CO1 Have basic idea about the fundamentals of GIS.
CO2 Understand the types of data models.
CO3 Get knowledge about data input and topology
CO4 Gain knowledge on data quality and standards
CO5 Understand data management functions and data output

TEXTBOOKS:

1. Kang - Tsung Chang, Introduction to Geographic Information Systems, McGraw Hill Publishing, 2nd Edition, 2011.
2. Ian Heywood, Sarah Cornelius, Steve Carver, Srinivasa Raju, “An Introduction Geographical Information Systems, Pearson Education, 2nd Edition,2007.

REFERENCES:

1. Lo. C. P., Albert K.W. Yeung, Concepts and Techniques of Geographic Information Systems, Prentice-Hall India Publishers, 2006

CO’s- PO’s & PSO’s MAPPING

PO	Graduate Attribute	Course Outcome					Average
		CO1	CO2	CO3	CO4	CO5	
PO1	Engineering Knowledge	3	3	3	3	3	3
PO2	Problem Analysis				3	3	3
PO3	Design/Development of Solutions			3	3	3	3
PO4	Conduct Investigations of Complex Problems			3	3	3	3
PO5	Modern Tool Usage		3		3	3	3
PO6	The Engineer and Society						
PO 7	Environment and Sustainability						
PO 8	Ethics						
PO 9	Individual and Team Work						
PO 10	Communication						
PO 11	Project Management and Finance						

21155OE74B B ASICS OF INTEGRATED WATER RESOURCES MANAGEMENT **L T P C**
3 0 0 3

OBJECTIVES

- To introduce the interdisciplinary approach of water management.
- To develop knowledge base and capacity building on IWRM.

UNIT I OVERVIEW OF IWRM 9

Facts about water - Definition – Key challenges - Paradigm shift - Water management Principles --- Social equity - Ecological sustainability – Economic efficiency - SDGs --World Water Forums.

UNIT II WATER USE SECTORS: IMPACTS AND SOLUTION 9

Water users: People, Agriculture, ecosystem and others --Impacts of the water use sectors on water resources - Securing water for people, food production, ecosystems and other uses IWRM relevance in water resources management.

UNIT III WATER ECONOMICS 9

Economic characteristics of water good and services – Economic instruments – Private sector involvement in water resources management---PPP experiences through case studies.

UNIT IV RECENT TREANDS IN WATER MANAGEMENT 9

River basin management - Ecosystem Regeneration – 5 Rs - WASH - Sustainable livelihood --- Water management in the context of climate change.

UNIT V IMPLEMENTATION OF IWRM 9

Barriers to implementing IWRM - Policy and legal framework---Bureaucratic reforms and inclusive development - Institutional Transformation - Capacity building -- Case studies on conceptual framework of IWRM.

TOTAL: 45 PERIODS

OUTCOMES

- On completion of the course, the student will be able to apply appropriate management techniques towards managing the water resources.

CO1 Describe the context and principles of IWRM; Compare the conventional and integrated ways of water management.
CO2 Discuss on the different water uses; how it is impacted and ways to tackle these impacts.
CO3 Explain the economic aspects of water and choose the best economic option among the alternatives; illustrate the pros and cons of PPP through case studies.
CO4 Illustrate the recent trends in water management.
CO5 Understand the implementation hitches and the institutional frameworks.

TEXT BOOKS

1. Cech Thomas V., Principles of water resources: history, development, management and policy. John Wiley and Sons Inc., New York. 2003.
2. Mollinga P. *et al.* " Integrated Water Resources Management", Water in South Asia Volume I, Sage Publications, 2006.

REFERENCES

1. Technical Advisory Committee, Background Papers No: 1, 4 and 7, Stockholm, Sweden. 2002.
2. IWRM Guidelines at River Basin Level (UNESCO, 2008).
3. Tutorial on Basic Principles of Integrated Water Resources Management ,CAP-NET. http://www.pacificwater.org/userfiles/file/IWRM/Toolboxes/introduction%20to%20iwrm/Tutorial

_text.pdf
4. Pramod R. Bhave, 2011, Water Resources Systems, Narosa Publishers.
5. The 17 Goals, United Nations, https://sdgs.un.org/goals.

21152OE74A **WEARABLE DEVICES** **L T P C**
3 0 0 3

OBJECTIVES:

The student should be made to:

- To know the hardware requirement of wearable systems
- To understand the communication and security aspects in the wearable devices
- To know the applications of wearable devices in the field of medicine

UNIT I INTRODUCTION TO WEARABLE SYSTEMS AND SENSORS 9

Wearable Systems- Introduction, Need for Wearable Systems, Drawbacks of Conventional Systems for Wearable Monitoring, Applications of Wearable Systems, Types of Wearable Systems, Components of wearable Systems. Sensors for wearable systems -Inertia movement sensors, Respiration activity sensor, Impedance plethysmography, Wearable ground reaction force sensor.

UNIT II SIGNAL PROCESSING AND ENERGY HARVESTING FOR WEARABLE DEVICES 9

Wearability issues physical shape and placement of sensor, Technical challenges sensor design, signal acquisition, sampling frequency for reduced energy consumption, Rejection of irrelevant information. Power Requirements- Solar cell, Vibration based, Thermal based, Human body as a heat source for power generation, Hybrid thermoelectric photovoltaic energy harvests, Thermopiles.

UNIT III WIRELESS HEALTH SYSTEMS 9

Need for wireless monitoring, Definition of Body area network, BAN and Healthcare, Technical Challenges- System security and reliability, BAN Architecture – Introduction, Wireless communication Techniques.

UNIT IV SMART TEXTILE 9

Introduction to smart textile- Passive smart textile, active smart textile. Fabrication Techniques- Conductive Fibres, Treated Conductive Fibres, Conductive Fabrics, Conductive Inks.Case study smart fabric for monitoring biological parameters ECG, respiration.

UNIT V APPLICATIONS OF WEARABLE SYSTEMS 9

Medical Diagnostics, Medical Monitoring-Patients with chronic disease, Hospital patients, Elderly patients, neural recording, Gait analysis, Sports Medicine.

OUTCOMES:

On successful completion of this course, the student will be able to
CO1: Describe the concepts of wearable system.
CO2: Explain the energy harvestings in wearable device.
CO3: Use the concepts of BAN in health care.
CO4: Illustrate the concept of smart textile
CO5: Compare the various wearable devices in healthcare system

TOTAL: 45 PERIODS

TEXT BOOKS

1. Annalisa Bonfiglo and Danilo De Rossi, Wearable Monitoring Systems, Springer, 2011
2. Zhang and Yuan-Ting, Wearable Medical Sensors and Systems,Springer, 2013
3. Edward Sazonov and Micheal R Neuman, Wearable Sensors: Fundamentals, Implementation and Applications, Elsevier, 2014
4. Mehmet R. Yuce and JamilY.Khan, Wireless Body Area Networks Technology, Implementation applications,Pan Stanford Publishing Pte.Ltd, Singapore, 2012

REFERENCES

1. Sandeep K.S, Gupta, Tridib Mukherjee and Krishna Kumar Venkatasubramanian, Body Area Networks Safety, Security, and Sustainability, Cambridge University Press, 2013.
2. Guang-Zhong Yang, Body Sensor Networks, Springer, 2006.

COs- POs & PSOs MAPPING

COs	POs												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	3	2	1	1	2			1					1		1
2	3	2	1	1	2			1					1		1
3	3	2	1	1	2			1					1		1
4	3	2	1	1	2			1					1		1
5	3	2	1	1	2			1					1		1
AVg.															

21152OE74B MEDICAL INFORMATICS

L T P
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Preamble:

1. To study the applications of information technology in health care management.
2. This course provides knowledge on resources, devices, and methods required to optimize the acquisition, storage, retrieval, and use of information in health and biomedicine.

UNIT I INTRODUCTION TO MEDICAL INFORMATICS 9

Introduction - Structure of Medical Informatics -Internet and Medicine -Security issues , Computer based medical information retrieval, Hospital management and information system, Functional capabilities of a computerized HIS, Health Informatics – Medical Informatics, Bioinformatics

UNIT II COMPUTERS IN CLINICAL LABORATORY AND MEDICAL IMAGING 9

Automated clinical laboratories-Automated methods in hematology, cytology and histology, Intelligent Laboratory Information System - Computer assisted medical imaging- nuclear medicine, ultrasound imaging, computed X-ray tomography, Radiation therapy and planning, Nuclear Magnetic Resonance.

UNIT III COMPUTERISED PATIENT RECORD 9

Introduction conventional patient record, Components and functionality of CPR, Development tools, Intranet, CPR in Radiology- Application server provider, Clinical information system, Computerized prescriptions for patients.

UNIT IV COMPUTER ASSISTED MEDICAL DECISION-MAKING 9

Neuro computers and Artificial Neural Networks application, Expert system -General model of CMD, Computer-assisted decision support system-production rule system cognitive model, semantic networks, decisions analysis inclinical medicine-computers in the care of critically ill patients, Computer aids for the handicapped.

UNIT V RECENT TRENDS IN MEDICAL INFORMATICS 9

Virtual reality applications in medicine, Virtual endoscopy, Computer assisted surgery, Surgical simulation, Telemedicine Tele surgery, Computer assisted patient education and health- Medical education and healthcare information, computer assisted instruction in medicine.

TOTAL : 45 PERIODS

Course Outcomes:

Upon completion of the course, students will be able to:

1. Explain the structure and functional capabilities of Hospital Information System.
2. Describe the need of computers in medical imaging and automated clinical laboratory.
3. Articulate the functioning of information storage and retrieval in computerized patient record system.
4. Apply the suitable decision support system for automated clinical diagnosis.
5. Discuss the application of virtual reality and telehealth technology in medical industry.

TEXT BOOKS:

1. Mohan Bansal, “Medical informatics”, Tata McGraw Hill Publishing Ltd, 2003.
2. R.D.Lele, “Computers in medicine progress in medical informatics”, Tata Mcgraw Hill,2005

REFERENCES:

1. Kathryn J. Hannah, Marion J Ball, “Health Informatics”, 3rd Edition, Springer, 2006.

COs- POs & PSOs MAPPING

COs	POs												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	3	2	1	1	2			1					1	1	1
2	3	2	1	1	2			1					1	1	1
3	3	2	1	1	2			1					1	1	1
4	3	2	1	1	2			1					1	1	1
5	3	2	1	1	2			1					1	1	1
AVg.															

PO 12	Life-long Learning						
PSO 1	Knowledge of Geoinformatics discipline	3	3	3	3	3	3
PSO 2	Critical analysis of Geoinformatics Engineering problems and innovations	3	3	3	3	3	3
PSO 3	Conceptualization and evaluation of Design solutions	3	3	3	3	3	3