PRIST
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UNIVERSITY
NAAC ACCREDITED
THANJAVUR – 613 403 - TAMIL NADU

SCHOOL OF ENGINEERING AND TECHNOLOGY

DEPARTMENT OF
MECHANICAL ENGINEERING

PROGRAMME HANDBOOK

M.Tech. - Manufacturing Technology – Full Time

Regulations 2022

M.Tech. - Manufacturing Technology – Full Time
Regulations 2022

CHOICE BASED CREDIT SYSTEM

1. PROGRAMME EDUCATIONALOBJECTIVES (PEOs):

I.	Topreparestudentstoknowandutilizethemodernmanufacturingfacilityinorderto improve productivity.
II.	To impart skills to use smart machines and apply latest technology in manufacturing field to innovate production process that will be useful to the Society
III.	To imbibe skills for integrated problem-solving techniques to optimize the Manufacturing resources for sustainable development
IV.	To develop research attitude, new product, and process to solve problems in the field of manufacturing and to prepare the necessary reports.

2. PROGRAMME OUTCOMES(POs):

PO	Programme Outcomes
1.	Anabilitytoindependentlycarryoutresearch/investigationanddevelopmentwork to Solve practical problems
2.	An ability to write and present a substantial technical report/document
3.	Studentsshouldbeabletodemonstrateadegreeofmasteryoverthareaasper the specialization of the program. The mastery should be at a level higher than the requirements in the appropriate bachelor program
4.	An ability to design systems, components ,or processes meeting specified needs for the manufacturing industry and to improve its efficiency.
5.	To use modern equipment and problem- solving tools for improving the manufacturing systems and processes in all aspects including technical, financial and management
6.	To pursue higher studies / pursue their career or entrepreneur in manufacturing and allied industries

3. PEO/ POMapping:

PEO	PO					
	1	**2**	**3**	**4**	**5**	**6**
I	-	-	3	-	3	2
II	2	2	-	3	3	-
III	1	-	2	3	3	-
IV	3	2	-	-	-	2

Semester - 1

Course Code	Title of Paper	Hours / Per Week			
		L	T	P	C
22248S11	Advanced Engineering Mathematics	3	1	-	4
22254C12	Theory of Metal Cutting	3	1	-	4
22254C13	Advanced Manufacturing Processes	4	-	-	4
22254C14	Advances in Casting & Welding	4	-	-	4
22254C15	Automated Computer Integrated Manufacturing Systems	4	-	-	4
22254E16 (A To C)	Elective – I	3	-	-	3
22254L17	CAD/CAM Laboratory	-	-	6	3
TOTAL NO. OF CREDITS					**26**

Semester – 2

Course Code	Title of Paper	Hours / Per Week			
		L	T	P	C
22254C21	Tooling for Manufacturing	4	-	-	4
22254C22	MEMS and Nano Technology	4	-	-	4
22254C23	Manufacturing Metrology and Quality Control	4	-	-	4
22254E24 (A to C)	Elective – II	3	-	-	3
22254E25 (A to C)	Elective – III	3	-	-	3
22254L26	Automation Lab	-	-	6	3
222TECWR	Technical Writing/Seminar	-	-	6	3
TOTAL NO. OF CREDITS					**24**

Semester - 3

Course Code	Title of Paper	Hours / Per Week			
		L	T	P	C
22254C31	Metal Forming Process	4	-	-	4
22254E32 (A to C)	Elective – IV	3	-	-	3
22254E33 (A to B)	Elective - V	3	-	-	3
22254E34 (A to B)	Elective - VI	3	-	-	3
22254P35	Project Work Phase I	-	-	10	10
TOTAL NO. OF CREDITS					**23**

Semester – 4

Course Code	Title of Paper	Hours / Per Week			
		L	T	P	C
22254P41	Project Work Phase II	-	-	15	15
TOTAL NO. OF CREDITS					**15**

ELECTIVE –I

Course Code	Title of Paper	Hours / Per Week			
		L	T	P	C
22254E16A	Materials Management and Logistics	3	-	-	3
22254E16B	Quality And Reliability Engineering	3	-	-	3
22254E16C	Manufacturing Information Systems	3	-	-	3

ELECTIVE –II

Course Code	Title of Paper	Hours / Per Week			
		L	T	P	C
22254E24A	Finite Element Application in Manufacturing	3	-	-	3
22254E24B	Lean Manufacturing	3	-	-	3
22254E24C	Material management	3	-	-	3

ELECTIVE –III

Course Code	Title of Paper	L	T	P	C
22254E25A	Non-Destructive Testing And Evaluation	3	-	-	3
22254E25B	Maintenance Management	3	-	-	3
22254E25C	Optimization Techniques	3	-	-	3

ELECTIVE –IV

22254E32A	Process Planning And Cost Estimation	3	-	-	3
22254E32B	Instrumentation and Control Engineering	3	-	-	3
22254E32C	Research Methodology	3	-	-	3

ELECTIVE -V

Course Code	Title of Paper	Hours / Per Week			
		L	T	P	C
22254E33A	Product Design and Development	3	-	-	3
22254E33B	Fluid Power Automation	3	-	-	3
22254E33C	Internet Of Things For Manufacturing	3	-	-	3

ELECTIVE -VI

22254E34A	Advanced Material Technology	3	-	-	3
22254E34B	Industrial Safety	3	-	-	3
22254E34C	Additive Manufacturing	3	-	-	3

Total No of Credits - 88

SEMESTER I

22248S11E - ADVANCED ENGINEERING MATHEMATICS L T P C

3 1 0 4

COURSE OBJECTIVES:

1. To understand the basics of random variables with emphasis on the standard discrete and continuous distributions.
2. To understand the basic probability concepts with respect to two dimensional random variables along with the relationship between the random variables.
3. To apply the small and large sample tests through test of hypothesis.
4. To understand the basic concepts of sampling distributions and statistical properties of point estimators.
5. To understand the concept of analysis of variance and use it to investigate factorial dependence.

LAPLACE TRANSFORM: **9+3**

Laplace transform methods for one-dimensional wave equation – Displacement in a long string – longitudinal vibration of an elastic bar – Laplace equation – properties of harmonic functions.

FOURIER TRANSFORM: **9+3**

Fourier transforms methods for one – dimensional heat conduction problems in infinite and semi infinite rod – Fourier transform methods for Laplace equation.

PROBABILITY OF DISTRIBUTION: **9+3**

Probability – definition and introduction – random variable – probability density functions – study of standard distributions: Binomial, poisson, normal exponential and weibull distributions – Applications – Baye's theorem.

TESTING OF HYPOTHESIS: **9+3**

Testing of Hypothesis – Parametric test – Small samples – Test related proportion, Means, Standard deviation – Test based on chi-square, Goodness of fit and test of independence.

THEORY OF ESTIMATION **9+3**

Principles of least squares – Multiple and partial correlation and regression – Estimation of parameters – Method of moments.

TOTAL: 45+30 = 75 PERIODS

BOOKS FOR REFERENCES:

1. Sankar Rao.K., Introduction to partial differential equations, Pnentile Hall of India, New Delhi – 1995.

2. Sneddon.I.N., Elements of partial differential equations, MC Graw Hill, 1996
3. Engineering Statistics, Bowher and LIberman
4. Gupta.S.C. & Kappor, V.K. Fundamentals of Mathematical Statistics, Sultan Chand & Sons, Reprint 1999.

COURSE OUTCOMES :

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

- Analyze the performance in terms of probabilities and distributions achieved by the determined solutions.
- Be familiar with some of the commonly encountered two dimensional random variables and be equipped for a possible extension to multivariate analysis.
- Apply the basic principles underlying statistical inference(hypothesis testing).
- Demonstrate knowledge of applicable large sample theory of estimators and tests.
- Obtain a better understanding of the importance of the methods in modern industrial processes.

Co Po Mapping

CO	PO					
	1	**2**	**3**	**4**	**5**	**6**
1	2	-	-	-	-	2
2	-	-	-	-	-	-
3	2	-	-	-	1	2
4	-	-	3	1	-	-
5	-	-	3	-	-	2
Avg.	2	-	3	1	1	2

22254C12 - THEORY OF METAL CUTTING **L T P C**
4 0 0 4

OBJECTIVES:
1. To make the students to familiar with the basic principles of metal cutting
2. To familiarise the students various cutting tool materials and its wear mechanisms during the machining operation.
3. Differentiate between single point and multi point cutting tools
4. To study the heat generation during machining and the necessity for cutting fluid
5. To study the effect of vibrations during machining

UNIT- I: Orthogonal Cutting: **12**

Orthogonal Cutting – Theories of merchant – Lee and Shaffer – Merchant's circle diagram – shear angle relationship – chip velocity – force – velocity relationships

UNIT-II: Chip Formation: **12**

Mechanism of chip formation – Types of Chips – discontinuous,continuous continuous with BUE – Chip Formation in drilling and Milling – effect of cutting variables of chip reduction coefficient.

UNIT-III : Tool Life and Machinability: **12**

Tool Failure:Mode of Plastic failure – Measurement of tool wear – tool life tests – tool life equation for variable theories – variables affecting tool life – machinability – machinability index – problems.

UNIT-IV: Thermal Analysis in Metal Cutting: **12**

Thermodynamics of orthogonal cutting – analysis of temperature at shear plane and tool face – experimental methods for temperature measurement.

UNIT-V: Chatter: **12**

Chatter - Importance of Chatter in machining – types of chatter – avoidance of chatter.Tools materials – requirements – alloy tools - HSS – carbides –PCD and CBN- properties and application.

TOTAL: 60 PERIODS

BOOKS FOR REFERENCES:

1.
2. Juneja .B.L, "Fundamentals of Metal cutting and Machine tools", New Age International, 1995.
3. Bhattacharya.A, "Metal Cutting Theory and Practice", Central book publications.
4. Kuppusamy .G, "Principle of Metal Cutting", University Press,1996.
5. Shaw .M.C, "Metal Cutting Principles",I BH Publications,1992.
6. Armarego E.J.A and Brown R.H, "The Machining of Metals", Prentice Hall,1969

COURSE OUTCOMES:

At the end of the course students will be familiar with

- Basics of orthogonal cutting, oblique cutting and chip formation
- Different tool materials, tool life and tool wear mechanisms
- Necessity for a cutting fluid and cutting efficiency
- Single and Multipoint cutting tools
- Effect of vibrations and surface roughness during machining

Co po mapping

CO	PO					
	1	2	3	4	5	6
1	2	-	-	-	-	2
2	-	-	-	-	-	-
3	2	-	-	-	1	2
4	-	-	3	1	-	-
5	-	-	3	-	-	2
Avg.	2	-	3	1	1	2

22254C13 ADVANCED MANUFACTURING PROCESSES L T P C
4 0 0 4

OBJECTIVES:

1. To inculcate specialized knowledge and skill in advanced manufacturing processes using the principles and methods of engineering analysis and design.
2. Toimpartknowledgeaboutthesignificanceofcontrollingprocessparametersfortheoptimal performance for newly developed engineering materials used in industries and research organizations.
3. Toimpartknowledgeaboutprinciplesandcriteriaofyieldingduringformingofmetals,analysis of different bulk metal forming processes following different analysis approach.
4. TogiveawarenessofdifferenttechniquesusedinMicroandNanomanufacturing.
5. Tointroducestudentsthebasicsof/rapidprototypinganditsapplicationsinvariousfields,revers e engineering techniques

UNIT I NEWER MACHINING PROCESSES - I 12

(Non thermal energy) – Abrasive machining – water jet machining - ultrasonic machining – chemical machining – electro chemical machining – construction working principle – steps - types – process parameters – derivations – problems, merits, demerits and applications .

UNIT II NEWER MACHINING PROCESS – II 12

Wire cut EDM - Electro chemical machining – ECG - Electric discharge machining – construction – principle – types – control - circuits – tool design – merits, demerits & applications.

UNIT III NEWER MACHINING PROCESS – III 12

Laser beam machining – Electron beam machining – Plasma arc machining – Ion beam machining – construction working principle types – process parameter – derivations – problems, merits, demerits and applications.

UNIT IV FABRICATION OF MICRO DEVICES 12

Semiconductors – films and film depurification – Oxidation - diffusion – ion implantation – etching – metallization – bonding – surface and bulk machining – LIGA Process – Solid free form fabrication.

UNIT V MICROFABRICATION TECHNOLOGY 12

Wafer preparation – monolithic processing – moulding – PCB board hybrid & mcm technology – programmable devices & ASIC – electronic material and processing.–
steriolithography SAW devices, Surface Mount Technology,

TOTAL: TOTAL: 60 PERIODS

BOOKS FOR REFERENCES:

1. Serope kelpekijian & stevan r. schmid- manufacturing process engg material – 2003
2. Micro senors Mems & smart devices- Julian W.Hardner – 2002
3. Brahem T. Smith, Advanced machining I.F.S. UK 1989.

4. Jaeger R.C., Introduction to microelectronic fabrication Addison Wesley, 1988.
5. Nario Taniguchi – Nano technology – Oxford University Press 1996.
6. Pandey P.C. & Shan HS Modern Machining Processes, Standard Publishing Co., 1980
7.More Madon, Fundamentals of Micro fabrication, CRC Press

OUTCOMES:

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

1. Analyze the processes and evaluate the role of each process parameter during machining of various advanced materials.
2. Understand requirements to achieve maximum material removal rate and best quality of machined surface while machining various industrial engineering materials.
3. Analyze the different bulk metal forming process mechanics using different analysis
4. Acquire the knowledge in mechanical micromachining processes.
5. Demonstrate the knowledge of Additive Manufacturing and Rapid Prototyping Technologies

CO-PO Mapping

CO	PO					
	1	**2**	**3**	**4**	**5**	**6**
1	1	-	-	-	-	-
2	-	-	-	-	2	-
3	-	-	3	-	-	2
4	1	-	-	-	2	-
5	-	-	-	1	-	-
Avg.	1	-	3	1	2	2

22254C14

ADVANCES IN CASTING AND WELDING **L T P C**

3 0 0 3

COURSE OBJECTIVES:

1. To study the metallurgical concepts and applications of casting and welding process.
2. To acquire knowledge in CAD of casting and automation of the welding process.
3. To know various solid state and special welding processes.
4. To introduce metallurgy of welding.
5. To design the weldments for various materials. To gain knowledge on various welding defects and inspection methods.

UNIT I CASTING DESIGN **8**

Heat transfer between metal and mould — Design considerations in casting – Designing for directional solidification and minimum stresses - principles and design of gating and risering

UNIT II CASTING METALLURGY **8**

Solidification of pure metal and alloys – shrinkage in cast metals – progressive and directional solidification – – Degasification of the melt-casting defects – Castability of steel , Cast Iron, Al alloys, Babbit alloy and Cu alloy.

UNIT III RECENT TRENDS IN CASTING AND FOUNDRY LAYOUT **8**

Shell moulding, precision investment casting, CO2 moulding, centrifugal casting, Die casting, Continuous casting, Counter gravity low pressure casting, Squeeze casting and semisolid processes. Layout of mechanized foundry – sand reclamation – material handling in foundry pollution control in foundry — Computer aided design of casting.

UNIT IV WELDING METALLURGY AND DESIGN **10**

Heat affected Zone and its characteristics – W eldability of steels, cast iron, stainless steel, aluminum, Mg , Cu , Zirconium and titanium alloys – Carbon Equivalent of Plain and alloy steels Hydrogen embrittlement – Lamellar tearing – Residual stress – Distortion and its control . Heat transfer and solidification - Analysis of stresses in welded structures – pre and post welding heat treatments – weld joint design – welding defects – Testing of weldment.

. **UNIT V RECENT TRENDS IN WELDING** **11**

Friction welding, friction stir welding – explosive welding – diffusion bonding – high frequency induction welding – ultrasonic welding – electron beam welding – Laser beam welding –Plasma welding – Electro slag welding- narrow gap, hybrid twin wire active TIG – Tandem MIG- modern brazing and soldering techniques – induction, dip resistance, diffusion processes – Hot gas, wave and vapour phase soldering. Overview of automation of welding in aerospace, nuclear, surface transport vehicles and under water welding.

OUTCOMES:

At the end of this course the students are expected to impart knowledge on basic concepts and advances in casting and welding processes.

TOTAL: 45 PERIODS

REFERENCES:

1. ASM Handbook vol.6, welding Brazing & Soldering, 2003
2. ASM Handbook, Vol 15, Casting, 2004
3. Carrry B., Modern Welding Technology, Prentice Hall Pvt Ltd., 2002
4. CORNU.J. Advanced welding systems – Volumes I, II and III, JAICO Publishers, 1994.
5. HEINELOPER & ROSENTHAL, Principles of Metal Casting, Tata McGraw Hill, 2000.
6. IOTROWSKI – Robotic welding – A guide to selection and application – Society of mechanical Engineers, 1987.
7. Jain P.L., Principles of Foundry Technology, Tata McGraw Hill Publishers, 2003
8. LANCASTER.J.F. – Metallurgy of welding – George Alien & Unwin Publishers, 1980
9. Parmer R.S., Welding Engineering and Technology, Khanna Publishers,2002
10. SCHWARIZ, M.M. – Source book on innovative welding processes – American Society for Metals (OHIO), 1981
11. Srinivasan N.K., Welding Technology, Khanna Tech Publishers, 2002

COURSE OUTCOMES:

- At the end of this course the students are expected to impart knowledge on basic concepts and advances in casting and welding processes.
- Know and perform solid state and special welding processes.
- Understand and analyze the material structures after welding.
- Design the weldments for various materials.
- Attain the knowledge about various welding defects and inspection methods.

CO-POMapping

CO	PO					
	1	**2**	**3**	**4**	**5**	**6**
1	1	-	-	-	-	1
2	-	-	2	3	2	-
3	1	-	-	-	2	1
4	-	-	-	-	-	2
5	2	-	3	-	-	-
Avg.	**1.33**	**-**	**2.5**	**3**	**2**	**1.33**

22254C15 AUTOMATED COMPUTER INTEGRATED MANUFACTURING SYSTEMS

L T P C
4 0 0 4

COURSE OBJECTIVES:

1. To introduce the evolution of CAD, CAM, CIM, engineering product specification and interpreting geometric specifications.
2. To train the candidates on the integration of Computer Aided Design and Computer Aided Manufacturing.
3. To impart knowledge on manual part program and generation of CNC part program using Computer Aided Manufacturing packages.
4. To introduce with the implementation of CAD and CAM in manufacturing process.
5. To introduce the importance of Internet of Things in Computer Aided Manufacturing.

AIM:

To stress the role of computers in production.

OBJECTIVE:

To teach the role of computers in processing the information knowing across the various Stages and various departments in a manufacturing concern.

UNIT I INTRODUCTION **10**

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 – Impact of CIM on personnel – CIM status.

UNIT II AUTOMATED MANUFACTURING SYSTEMS **14**

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 of vehicles and AGVs 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.

UNIT III GROUP TECHNOLOGY AND FMS **14**

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 12

Process planning – Activities in process planning, Information's required. From design to process planning – classification of manufacturing processes – Selection of primary manufacturing processes – selecting among casting process, forming process and machining process. 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.

UNIT V TYPES OF PROCESS CONTROL AND AUTOMATIC DATA CAPTURE 10

Introduction to process model formulation – linear feedback control systems – Optimal control – Adaptive control –Sequence control and PLC. Computer process control – Computer process interface – Interface hardware – Computer process monitoring – Direct digital control and Supervisory computer control. Overviews of Automatic identification methods – Bar code technology – Other Automatic data capture technologies.

TOTAL: 60 PERIODS

BOOKS FOR REFERENCES:

1. Mikell P.Groover, "Automation, Production system and Computer integrated Manufacturing", Prentice Hall of India Pvt. Ltd., 2008.
2. Radhakrishnan,P., Subramanian,S., and Raju,V., "CAD/CAM/CIM" New Age International Publishers, 2000.
3. James A.Retrg, Herry W.Kraebber, "Computer Integrated Manufacturing", Pearson Education, Asia, 2001.
4. Viswanathan,N., and Narahari,Y., "Performance Modeling and Automated Manufacturing Systems", Prentice Hall of India Pvt. Ltd., 2000.
5. Alavudeen and Venkateshwaran, "Computer Integrated Manufacturing", PHI Learning Pvt. Ltd., New Delhi, 2008.

COURSE OUTCOMES:

At the end of this course, the students shall be able to:
CO1: Recognize the importance of CAD, CAM, CIM, Engineering product specification and interpreting geometric specifications.
CO2: Improve knowledge on the integration of CAD and CAM.
CO3: Exhibit competency in manual part program and generation of CNC part program using CAM packages.
CO4: Describe the implementation of CAD and CAM in manufacturing processes.
CO5: Explain applications of IOT in computer aided manufacturing.

CO-POMapping

CO	PO					
	1	2	3	4	5	6
1	-	-	-	2	2	-
2	-	-	-	-	2	1
3	1	2	-	3	-	-
4	2	-	-	-	1	2

22254L19 CAD / CAM LABORATORY **L T P C**
0 0 6 3

COURSE OBJECTIVES:

1. To introduce components and assemblies used in machines and use of 3D parametric CAD, CAM software for mechanical design.

2. To provide an experiential learning environment using projects done by student groups, while applying CAD, CAE software tools to design mechanisms and structures for mechanical design evaluation, optimization of mass properties, static-stresses, deformations, etc. with experimental validation of simulation models.

3. To do some exercises in tool pre-setting and work piece referencing on CNC machine tools, manual part programming for CNC turning and milling centres.

4. Use of software for simulation of turned and milled parts and simple surfaces, Automatic Cutter location data generation from CAD Models in APT format and post-processing for machining on CNC machines using standard CAD/CAM software

5. To produce an industrial component and measure to verify its conformity with the design

CAM LABORATORY

1. Exercise on CNC Lathe: Plain Turning, Step turning, Taper turning, Threading, Grooving & canned cycle
2. Exercise on CNC Milling Machine: Profile Milling, Mirroring, Scaling & canned cycle.
3. Study of Sensors, Transducers & PLC: Hall-effect sensor, Pressure sensors, Strain gauge, PLC, LVDT, Load cell, Angular potentiometer, Torque, Temperature & Optical Transducers.
4. Mini project on any one of the CIM elements is to be done. This can be either a software or hardware simulating a CIM element. At the end of the semester, the students has to submit a mini report and present his work before a Committee.

CAD LABORATORY

2D modeling and 3D modeling of components such as

1. Bearing
2. Couplings
3. Gears
4. Sheet metal components
5. Jigs, Fixtures and Die assemblies.

TOTAL: 30 PERIODS.

COURSE OUTCOMES:

At the end of this course the students are expected to

1. Interpret mechanical drawings for components, assemblies and use parametric 3D CAD software tools in the correct manner for creating their geometric part models, assemblies and automated drawings.
2. Apply the concepts of machining for the purpose of selection of appropriate machining centres, machining parameters, select appropriate cutting tools for CNC milling and turning equipment, set-up, program, and operate CNC milling and turning equipment.

3. Create and validate NC part program data using manual data input (MDI) and automatically using standard commercial CAM package for manufacturing of required component using CNC milling or turning applications.
4. Produce an industrial component by interpreting 3D part model/ part drawings using Computer Aided Manufacturing technology through programming, setup, and ensuring safe operation of Computer Numerical Control (CNC) machine tools.
5. Create and demonstrate the technical documentation for design/ selection of suitable drive technologies, precision components and an overall CNC machine tool system for automation of machining operations using appropriate multi-axis CNC technology.

CO-POMapping

CO	PO					
	1	**2**	**3**	**4**	**5**	**6**
1	1	-	-	-	2	1
2	-	-	-	3	2	1
3	-	-	-	-	2	1
4	-	2	-	2	3	-
5	-	-	-	-	-	2
Avg.	1	2	-	2.5	2.25	1.25

SEMESTER II

22254C21 TOOLING FOR MANUFACTURING L T P C
4 0 0 4

COURSE OBJECTIVES:

(1) To apply various design rules in manufacturing processes
(2) To evaluate the process by design guidelines for optimum design
(3) To analyze the rules of concepts of GD& T
(4) To make the students to learn about tolerance analysis and allocation, geometrical tolerances
(5) Guidelines for design for manufacturing and assembly with suitable examples.

UNIT I INTRODUCTION 12

Manufacturing Processes-objectives of manufacturing processes-classification of manufacturing process-Objectives of Tool design-tool design process-Nature and scope of Tool engineering-principles of economy for tooling-problems of economy in tooling-planning and tooling for economy-Manufacturing principles applicable to process and tool planning-tool control-tool maintenance-tool materials and its selection

UNIT II TOOLING FOR METAL REMOVAL PROCESSES 12

Traditional machining processes -work and tool holding devices-tool nomenclatures-Mechanism of machining-force temperature and tool life of single point tool-multipoint tools -tool design-tool wear-special processes-capstan and turret lathe-tooling layout of automats-tooling in NC and CNC machines-tooling for machining centres-CAD in tool design-Jigs and fixtures-design-Non-traditional material removal processes-mechanical, electrical thermal and chemical energy processes-principles-operation-equipment-tooling parameters and limitations

UNIT III TOOLING FOR METAL FORMING PROCESSES 12

Classification of Forming processes-Types of presses-design of -blanking and piercing dies-simple, compound, combination and progressive dies-Drawing dies-Bending dies-forging dies-plastic moulding dies

UNIT IV TOOLING FOR METAL CASTING AND METAL JOINING PROCESSES 12

Tools and Equipment for moulding-patterns –pattern allowances – pattern construction-die casting tools-mechanization of foundries. Tooling for Physical joining processes Design of welding fixtures – Arc welding, Gas welding, Resistance welding, laser welding fixtures-Tooling for Soldering and Brazing Tooling for Mechanical joining processes

UNIT V TOOLING FOR INSPECTION AND GAUGING 12

Survey of linear and angular measurements-standards of measurement-design and manufacturing of gauges-measurement of form-Inspection bench centre-co-ordinate measuring machine-tooling in CMM.

TOTAL: 60 PERIODS

COURSE OUTCOMES

After successful completion of this course, the students should be able to
(1) Design and analyze, an identified problem using scientific tools
(2) Simulation/ Theoretical analysis of a physical system
(3) Integrate various domain knowledge for a sustainable solution.

(4) Set Goals, Targets, timeline, plan and execute activities of the project
(5) Disseminate work both in oral and written format.

REFERENCES:

1. Cyril Donaldson Tool Design, Tata McGraw Hill, 1976
2. Hoffman E.G Fundamentals of tool design SME 1984.
3. Kalpak Jian S., Manufacturing Engineering and Technology Addison Wesley 1995.
4. L E Doyle Tool Engineering Prentice Hall 1950
5. Wellar, J Non-Traditional Machining Processes, SME, 1984

Co Po Mapping

CO	PO					
	1	2	3	4	5	6
1	2	-	-	-	-	-
2	-	-	-	3	-	1
3	1	-	2	-	-	-
4	-	-	2	3	2	-
5	1	-	1	2	-	2
Avg.	1.33	-	1.66	2.66	2	1.5

22254C22	MEMS AND NANO TECHNOLOGY	L T P C
		4 0 0 4

AIM:

To inspire the students to expect to the trends in manufacturing micro components and measuring systems to nano scale.

OBJECTIVES:

(1) To inspire the students to expect to the trends in manufacturing of micro components
(2) Familiarise the students with various fabrication techniques for micro components.
(3) Acquaint them with various sensors and actuators
(4) Introduce them the various methods of developing nano materials
(5) Make them understand characterization tools

UNIT I OVER VIEW OF MEMS AND MICROSYSTEMS 10

Definition – historical development – fundamentals – properties, micro fluidics, design and fabrication micro-system, microelectronics, working principle and applications of micro system.

UNIT II MATERIALS, FABRICATION PROCESSES AND MICRO SYSTEM PACKAGING 14

Substrates and wafers, silicon as substrate material, mechanical properties of Si, Silicon Compounds silicon piezo resistors, Galium arsenide, quartz, polymers for MEMS, conductive polymers. Photolithography, photo resist applications, light sources, in implantation, diffusion process exudation – thermal oxidation, silicon diode, chemical vapour deposition, sputtering - deposition by epitoxy – etching – bulk and surface machining – LIGA process Micro system packaging – considerations packaging – levels of micro system packaging die level, device level and system level.

UNIT III MICRO DEVICES AND MATERIALS 12

Sensors – classification – signal conversion ideal characterization of sensors micro actuators, mechanical sensors – measurands displacement sensors, pressure and flow sensors, micro actuators – smart materials – applications.

UNIT IV SCIENCE OF NANO MATERIALS 12

Classification of nano structures – effect of the nanometer length scale effects of nano scale dimensions on various properties – structural, thermal, chemical, mechanical, magnetic, optical and electronic properties – effect of nanoscale dimensions on biological systems. Fabrication methods – Top down processes – bottom up process.

UNIT V CHARACTERIZATION OF NANO MATERIALS 12

Nano-processing systems – Nano measuring systems – characterization – analytical imaging techniques – microscopy techniques, electron microscopy scanning electron microscopy, transmission electron microscopy, transmission electron microscopy, scanning tunneling microscopy, atomic force microscopy, diffraction techniques – spectroscopy techniques – Raman spectroscopy, 3D surface analysis – Mechanical, Magnetic and thermal properties – Nano positioning systems.

TOTAL: 60 PERIODS

BOOKS FOR REFERENCES:

1. Tai – Ran Hsu, MEMS and Microsystems Design and Manufacture, Tata-McGraw Hill, New Delhi, 2002.
2. Mark Madou Fundamentals of Microfabrication, CRC Press, New York, 1997.
3. Norio Taniguchi, Nano Technology, Oxford University Press, New York, 2003
4. The MEMS Hand book, Mohamed Gad-el-Hak, CRC Press, New York, London.
5. Charles P Poole, Frank J Owens, Introduction to Nano technology, John Wiley and Sons, 2003
6. Julian W. Hardner Micro Sensors, Principles and Applications, CRC Press 1993.

COURSE OUTCOMES:
At the end of this course the students are expected
(1) Realise the need of micro electromechanical systems.
(2) Develop a knowledge to select a sensor for an application
(3) Develop a nano material
(4) characterize the Nano material
(5) Develop an Electromechanical systems

CO	PO					
	1	2	3	4	5	6
1	1	-	-	2	-	1
2	1	-	-	2	2	-
3	-	-	3	2	-	-
4	-	-	3	2	-	-
5	-	-	-	2	2	2
Avg	1	-	3	2	2	1.5

22254C23 MANUFACTURING METROLOGY AND QUALITY CONTROL L T P C
4 0 0 4

AIM:

To expose the students, the importance of measurement and the various latest measuring techniques using Laser, Coordinate measuring machines and Optoelectronics devices. Also to stress upon the Importance of quality in manufacturing.

OBJECTIVES:

1) To teach the students basic concepts in various methods of engineering measurement techniques and applications
2) To make them understand the importance of measurement and inspection in manufacturing industries.
3) To understand the use of Light rays and Laser beams for measurement and their merits
4) To make the students capable of learning to operate and use advanced metrological devices with ease in industrial environments.
5) To teach the use of computer for measuring and processing of measured quantity

UNIT – I LASER METROLOGY 11

Introduction – types of lasers – laser in engineering metrology – metrological laser methods for applications in machine systems – Interferometry applications – speckle interferometry – laser interferometers in manufacturing and machine tool alignment testing – calibration systems for industrial robots laser Doppler technique – laser Doppler anemometry.

UNIT – II PRECISION INSTRUMENTS BASED ON LASER 11

Laser telemetric systems – detection of microscopic imperfections on high quality surface Pitter NPL gauge interferometer – classification of optical scanning systems – high inertia laser scan technique – rotating mirror technique – laser gauging – bar coding – laser dimensional measurement system.

UNIT – III CO-ORDINATE MEASURING MACHINE 14

Co-ordinate metrology – CMM configurations – hardware components – software – Probe sensors – displacement devices – Performance Evaluations – Software – Hardware – Dynamic errors – Thermal effects diagram – temperature variations environment control – applications.

UNIT – IV OPTO ELECTRONICS AND VISION SYSTEM 12

Opto electronic devices – CCD – On-line and in-process monitoring in production – applications image analysis and computer vision – Image analysis techniques – spatical feature – Image extraction – segmentation – digital image processing – Vision system for measurement – Comparison laser scanning with vision system.

UNIT – V QUALITY IN MANUFACTURING ENGINEERING 12

Importance of manufacturing planning for quality – concepts of controllability – need for quality management system and models – quality engineering tools and techniques – statistical process control – six sigma concepts – Poka Yoke – Computer controlled systems used in inspection.

TOTAL: 60 PERIODS

REFERENCES:

1. John A. Bosch, Giddings and Lewis Dayton, Co-ordinate Measuring Machines and Systems, Marcel Dekker, Inc, 1999.

2. Juran J.M. and Gyna F.M., Quality Planning and Analysis, Tata-McGraw Hill, New Delhi

3. Zuech, Nello Understanding and Applying Machine Vision, Marcel Dekker, Inc, 2000

4. Elanchezhian.C, Vijaya Ramnath.B and Sunder Selwyn, T., Engineering Metrology, Eswar Press, Chennai, 2004.

Co Po Mapping

CO	PO					
	1	**2**	**3**	**4**	**5**	**6**
1	3	2	-	2	2	2
2	3	-	2	2	-	2
3	2	-	1	-	-	-
4	1	-	-	3	3	1
5	-	2	2	2	2	3
AVG	2.25	2	1.66	2.25	2.3	2

22254L26 AUTOMATION LAB **L T P C**
0 0 6 3

AIM:

To impart knowledge in the area of hydraulic and pneumatic components and its functions.

COURSE OBJECTIVES

1) To train the students on the basic concepts of metal forming processes
2) To determine metal forming parameters for a given shape.
3) To learn the automation systems using fluid power control systems
4) To learn and use automation studio software
5) To learn PLC and its importance in Fluid power applications

EXPERIMENTS:

1. Simulation of single and double acting cylinder circuits
2. Simulation of Hydraulic circuits
3. Simulation of electro pneumatic circuits
4. Simulation of electro hydraulic circuits
5. Simulation of PLC circuits
6. Exercises on linear and angular measurements
7. Exercises on speed measurements
8. Exercises on Vibration measurements
9. Exercises on Motion controller using servo motors, encoders, etc.
10. Exercises on fiber optics transducers.
11. Exercises on stepper motor.
12. Exercises on microprocessor based data acquisition system.
13. Software simulation of fluid power circuits using Automation studio.

TOTAL : 30 PERIODS

COURSE OUTCOME:

Students able to
CO1: Relate with the smart resources, smart meters and other smart devices.
CO2: Explain the function of Smart Grid.
CO3: Experiment the issues of Power Quality in Smart Grid.
CO4: Analyze the performance of Smart Grid.
CO5**:** Recommend suitable communication networks for smart grid applications

Co Po Mapping

CO	PO					
	1	**2**	**3**	**4**	**5**	**6**
1	3	2	-	2	2	2
2	3	-	2	2	-	2
3	2	-	1	-	-	-
4	1	-	-	3	3	1
5	-	2	2	2	2	3
AVG	2.25	2	1.66	2.25	2.3	2

222TECWR **Technical Writing/Seminar** **L T P C**

0 0 6 3

OBJECTIVES:

(1) To enrich the communication skills of the student through presentation of topics in recent advances in engineering/technology

(2) To ensure that students possess a comprehensive understanding of the latest development in his chosen area

(3) To ensure that students are getting updated with latest technology

Seminar should be based on the literature survey on any topic relevant to CAD/CAM/CAE. It may be leading to selection of a suitable topic of dissertation. The report shall contain some contribution by the candidate in the form of experimental results, deductions, compilation and inferences etc.

• Each student has to prepare a write-up of about 25 pages. The report typed on A4 sized sheets and bound in the necessary format should be submitted after approved by the guide and endorsement of the Head of Department.

• The student has to deliver a seminar talk in front of the teachers of the department and his classmates. The Guide based on the quality of work and preparation and understanding of the candidate shall do an assessment of the seminar.

COURSE OUTCOMES:

At the end of this course the students are expected;

(1) To develop skills to search, read, write, comprehend and present research papers in the areas of manufacturing engineering.

(2) Updated with the latest technology in the field of Manufacturing Engineering

(3) Able to plot graph, sketch, bring out the visual about his understanding on various topics

Co po mapping

CO	PO					
	1	2	3	4	5	6
1	1	1	-	-	2	-
2	1	2	3	-	2	-
3	1	2	3	-	2	-
4	-	-	-	-	-	-
5	-	-	-	-	-	-
Avg.	1	1.66	3	-	2	-

SEMESTER III

22254C31	METAL FORMING PROCESS	L T P C 4 0 0 4

OBJECTIVES:

1. To make the students to familiar with the basic principles of metal cutting
2. To familiarise the students various cutting tool materials and its wear mechanisms during the machining operation.
3. Differentiate between single point and multi point cutting tools
4. To study the heat generation during machining and the necessity for cutting fluid
5. To study the effect of vibrations during machining

UNIT-I: Stress and Strain: 10

Stress-State of stress in two dimensions – three dimensions – stress tensor-Mohr's circles – 2D and 3D state of stress – Description of strain at a point – Mohr's circle of strain- Hydrostatic and stress deviator component of stress- Plasticity- flow curve- true and true strain yield criteria for ductile loads combined stress test-plastic stress and strain relations- Levy Mises equations-Prandyl_Resus equations.

UNIT-II: Analysis of Metal Forming: 14

Work Load analysis – work formula for homogeneous deformation- rolling, rod drawing and extrusion processes -Determination of load by stress evaluation method-Determination of drawing load – strip drawing with wedge shaped dies and cylindrical rod drawing with a conical die.

UNIT-III: Stress Evaluation: 12

Stress evaluation method-Determination of forging load-plane strain forging of a thin strip and a flat circular disc- Determination of extrusion load for round band flat strip- upper bound analysis – plane strain indentation with frictionless interface

UNIT-IV: High velocity Forming: 12

Study of effect of high speed on stress strain relationships- High velocity forming equipment-Description of high speed forming machine – hot forging, pneumatic-mechanical, high velocity forging – Fuel combustion process- Electro magnetic forming –Introduction- Procedure - process variables- Applications

UNIT-V: Advanced Forming process: 12

Explosive Forming – Explosives – characteristics- stand off and contact operations- stress waves and their effects- process variables – properties of formed components- applications- Electro hydraulic forming – principles, requirements and characteristics – process variables- water hammer forming- principles and parameters- governing the process.

BOOKS FOR REFERENCES:

1. George E.Dieter, "Mechanical Metallurgy", Mc Graw Hill International Edition, New York,1988
2. Rowe G.W,Edward , "An Introduction to the Principles of Metal Working", Edward Arnold publications.
3. Davies.R and Austin.E.R, "Developments in High Metal Forming", The Machinery Publishing Co.Ltd

4. Robert H.Wagoner and Jean Loup Chenot, "Fundamentals of Metal Forming", John Wiley and Sons Inc, New York,1992

COURSE OUTCOMES:
At the end of the course students will be familiar with
- Basics of orthogonal cutting, oblique cutting and chip formation
- Different tool materials, tool life and tool wear mechanisms
- Necessity for a cutting fluid and cutting efficiency
- Single and Multipoint cutting tools
- Effect of vibrations and surface roughness during machining

Co Po Mapping

CO	PO					
	1	2	3	4	5	6
1	1	-	-	-	-	-
2	-	1	-	3	2	1
3	-	-	3	2	2	1
4	-	-	-	2	-	-
5	1	1	-	2	-	2
Avg.	1	1	3	2.25	2	1.33

List of Electives - Elective I

22254E16A MATERIALS MANAGEMENT AND LOGISTICS L T P C
3 0 0 3

AIM:

To introduce to the students the various functions of materials management and logistics

COURSE OBJECTIVES:

To introduce the students
(1) the various concepts of materials management
(2) familiarize them with vendor development and rating
(3) the various aspects of Logistics and storage
(4) Planning and Forecasting of the need
(5) Various aspects of Inventory management

UNIT I INTRODUCTION 6

Introduction to materials management – Objectives – Functions – Operating Cycle – Value analysis – Make or buy decisions.

UNIT II MANAGEMENT OF PURCHASE 7

Purchasing policies and procedures – Selection of sources of supply – Vendor development – Vendor evaluation and rating – Methods of purchasing – Imports – Buyer – Seller relationship – Negotiations.

UNIT III MANAGEMENT OF STORES AND LOGISTICS 12

Stores function – Location – Layout – Stock taking – Materials handling – Transportation – Insurance – Codification – Inventory pricing – stores management – safety – warehousing – Distribution linear programming – Traveling Salesman problems – Network analysis – Logistics Management.

UNIT IV MATERIALS PLANNING 10

Forecasting – Materials requirements planning – Quantity – Periodic – Deterministic models – Finite production.

UNIT V INVENTORY MANAGEMENT 10

ABC analysis – Aggregate planning – Lot size under constraints – Just in Time (JIT) system.

TOTAL: 45 periods

BOOKS FOR REFERENCES:

1. Lamer Lee and Donald W.Dobler, Purchasing and Material Management, Text and cases, Tata McGraw Hill, 1996.
2. Gopalakrishnan.P, Handbook of Materials Management, Prentice Hall of India, 1996.
3. Guptha P.K. and Manmohan, Problems in Operations Research, Suttan Chand & Sons, 2003.

4. Dr.R. Kesavan, C.Elanchezian and B.Vijaya Ramnath, Production Planning and Control, Anuratha Publications, Chennai, 2008.
5. G. Reghuram, N. Rangaraj, Logistics and supply chain management – cases and concepts, Macmillan India Ltd., 2006.

OUTCOMES:
At the end of this course the students are
(1) Familiarized with the various concepts and functions of material management
(2) Able to handle the purchase and stores Independently
(3) Understand Logistics and inventory pricing
(4) Materials planning and periodic replenishment of material
(5) Just in time techniques and inventory management

Co Po mapping

CO	PO					
	1	2	3	4	5	6
1	1	-	-	-	-	2
2	-	-	3	-	-	-
3	-	-	3	-	-	-
4	-	-	-	2	-	-
5	-	-	-	3	2	2
Avg.	1	-	3	2.5	2	2

COURSE OBJECTIVES

- To Study about Smart Grid technologies, different smart meters and advanced metering infrastructure.
- To know about the function of smart grid.
- To familiarize the power quality management issues in Smart Grid.
- To familiarize the high performance computing for Smart Grid applications
- To get familiarized with the communication networks for Smart Grid applications

UNIT I QUALITY & STATISTICAL PROCESS CONTROL 8

Quality – Definition – Quality Assurance – Variation in process – Factors – process capability – control charts – variables X, R and X, - Attributes P, C and U-Chart tolerance design. Establishing and interpreting control charts – charts for variables – Quality rating – Short run SPC.

UNIT II ACCEPTANCE SAMPLING 8

Lot by lot sampling – types – probability of acceptance in single, double, multiple sampling plans – OC curves – Producer's risk and consumer's risk. AQL, LTPD, AOQL, Concepts – standard sampling plans for AQL and LTPD – use of standard sampling plans.

UNIT III EXPERIMENTAL DESIGN AND TAGUCHI METHOD 9

Fundamentals – factorial experiments – random design, Latin square design – Taguchi method – Loss function – experiments – S/N ratio and performance measure – Orthogonal array.

UNIT IV CONCEPT OF RELIABILITY 9

Definition – reliability vs quality, reliability function – MTBF, MTTR, availability, bathtub curve – time dependent failure models – distributions – normal, weibull, lognormal – Reliability of system and models – serial, parallel and combined configuration – Markove analysis, load sharing systems, standby systems, covarient models, static models, dynamic models.

UNIT V DESIGN FOR RELIABILITY AND MAINTAINABILITY 11

Reliability design process, system effectiveness, economic analysis and life cycle cost, reliability allocation, design methods, parts and material selection, derating, stress-strength and analysis, failure analysis, identification determination of causes, assessments of effects, computation of criticality index, corrective action, system safety – analysis of down-time – the repair time distribution, stochastic point processes system repair time, reliability under preventive maintenance state dependent system with repair. MTTR – mean system down time, repair vs replacement, replacement models, proactive, preventive, predictive maintenance maintainability and availability, optimization techniques for system reliability with redundancy heuristic methods applied to optimal system reliability.

TOTAL: 45 PERIODS

Text Books:

1. Statistical Process Control, by Eugene Grant, Richard Leavenworth, McGraw Hill.
2. Quality Engineering in Production Systems, by G Taguchi , McGraw Hill, 1989.
3. Optimization &Variation Reduction in Quality, byW.A. Taylor,Tata McGraw Hill,

1991.

Reference Books:

1. Jurans Quality Planning and Analysis, by Frank. M.Gryna Jr. McGrawHill
2. Taguchi Techniques for Quality Engineering, (2ndEdition) by Philipposs,
McGraw Hill, 1996,.
3. Reliability Engineering, (3rdEdition), by LS Srinath, Affiliated East West Pvt Ltd,
1991.
4. Reliability Engineering, by E.Bala Guruswamy, Tata McGraw Hill, 1994

OUTCOMES :

At the end of this course the students are exposed to the various quality control techniques , to understand the importance and concept of reliability and maintainability in industries.

REFERENCES:

1. Amata Mitra "Fundamentals of Quality Control and improvement" Pearson Education, 2002.
2. Bester field D.H., "Quality Control" Prentice Hall, 1993.
3. Charles E Ebling, An Introduction to Reliability and Maintability Engineering, Tata-McGraw Hill, 2000.
4. David J Smith, Reliability, Maintainability and Risk: Practical Methods for Engineers, Butterworth 2002.
5. Dhillon, Engineering Maintainability – How to design for reliability and easy maintenance, PHI, 2008.
6. Patrick D To' corner, Practical Reliability Engineering, John-Wiley and Sons Inc, 2002

COURSE OUTCOME:

Students able to
CO1: Relate with the smart resources, smart meters and other smart devices.
CO2: Explain the function of Smart Grid.
CO3: Experiment the issues of Power Quality in Smart Grid.
CO4: Analyze the performance of Smart Grid.
CO5**:** Recommend suitable communication networks for smart grid applications

Co Po Mapping

CO	PO					
	1	**2**	**3**	**4**	**5**	**6**
1	3	2	-	2	2	2
2	3	-	2	2	-	2
3	2	-	1	-	-	-
4	1	-	-	3	3	1
5	-	2	2	2	2	3
AVG	2.25	2	1.66	2.25	2.3	2

22254E16C **MANUFACTURING INFORMATION SYSTEMS** **L T P C**
3 0 0 3

AIM:

To impart the knowledge in manufacturing information system.

COURSE OBJECTIVES

1. Students will be able to study the concepts in facility planning.
2. Students will be able to study types of plant layout and capacity planning methods.
3. Students will be able to study the concepts of Project management.
4. Students will be able to study the concepts and methods in production planning and control.
5. Students will be able to study the concepts in Inventory and maintenance management.

UNIT I INTRODUCTION **5**

The Evolution of order policies, from MRP to MRP II, the role of Production organization, Operations control.

UNIT II DATABASE **7**

Terminologies – Entities and attributes – Data models, schema and subschema - Data Independence – ER Diagram – Trends in database.

UNIT III DESIGNING DATABASE **13**

Hierarchical model – Network approach- Relational Data model concepts, principles, keys, relational operations – functional dependence – Normalization types – Query.

UNIT IV MANUFACTURING CONSIDERATION **10**

The product and its structure, inventory and process flow – Shop floor control Data structure and procedure – various model – the order scheduling module, Input/output analysis module the stock status database – the complete IOM database.

UNIT V INFORMATION SYSTEM FOR MANUFACTURING **10**

Parts oriented production information system – concepts and structure –Computerized production scheduling, online production control systems; Computer based production management system, computerized manufacturing information system – case study.

TOTAL: 45 PERIODS

BOOKS FOR REFERENCES:

1. Luca G.Sartori, “Manufacturing Information Systems”, Addison-Wesley Publishing Company, 1988.
2. Date.C.J.,”An Introduction to Database Systems” Addison Wesley, 8th Edn,.2003
3. Orlicky.G., “Material Requirements Planning”, McGraw-Hill, 1994.
4. Kerr.R, “Knowledge based Manufacturing Management”, Addison-Wesley,1991.
5. Manufacturing Information & Data Systems Analysis, Design & Practice,CECELJA FRANJO, 2002.

COURSE OUTCOMES:
On Completion of the course the student will be able to
1. Able to acquire knowledge on facility, and problems associated with it.
2. Ability to learn the various capacity and layout planning models
3. Understand the concepts of demand forecasting and project management with relevant case studies.
4. Able to understand the concepts of production planning and scheduling.
5. Understand the various inventory and maintenance management techniques

Co po mapping

CO	PO					
	1	2	3	4	5	6
1	1	-	-	-	-	2
2	-	-	3	-	-	-
3	-	-	3	-	-	-
4	-	-	-	2	-	-
5	-	-	-	3	2	2
Avg.	1	-	3	2.5	2	2

22254E24A FINITE ELEMENT APPLICATIONS IN MANUFACTURING 3 0 0 3

AIM:

To impart knowledge in the area of finite element methods and its application in manufacturing.

OBJECTIVES:
(1) To familiarize the students with fundamentals of finite element method,
(2) To study the fundamentals of one dimensional and two dimensional problems using FEA in manufacturing.
(3) Acquaint students with finite element formulations and theories
(4) Develop the ability to perform finite element analyses and evaluate the results of a select set of manufacturing processes,
(5) Provide exposure to practical problems and their solutions, through simulations using the finite element software

UNIT I INTRODUCTION 6

Fundamentals – Initial, boundary and eigen value problems – weighted residual, Galerkin and Raleigh Ritz methods - Integration by parts – Basics of variational formulation – Polynomial and Nodal approximation.

UNIT II ONE DIMENSIONAL ANALYSIS 10

Steps in FEM – Discretization. Interpolation, derivation of elements characteristic matrix, shape function, assembly and imposition of boundary conditions-solution and post processing – One dimensional analysis in solid mechanics and heat transfer.

UNIT III SHAPE FUNCTIONS AND HIGHER ORDER FORMULATIONS 10

Shape functions for one and two dimensional elements- Three noded triangular and four nodded quadrilateral element Global and natural co-ordinates—Non linear analysis – Isoparametric elements – Jacobian matrices and transformations – Basics of two dimensional, plane stress, plane strain and axisymmetric analysis.

UNIT IV COMPUTER IMPLEMENTATION 9

Pre Processing, mesh generation, elements connecting, boundary conditions, input of material and processing characteristics – Solution and post processing – Overview of application packages – Development of code for one dimensional analysis and validation.

UNIT V ANALYSIS OF PRODUCTION PROCESSES 10

FE analysis of metal casting – special considerations, latent heat incorporation, gap element – Time stepping procedures – Crank – Nicholson algorithm – Prediction of grain structure – Basic concepts of plasticity and fracture – Solid and flow formulation – small incremental deformation formulation – Fracture

criteria – FE analysis of metal cutting, chip separation criteria, incorporation of strain rate dependency – FE analysis of welding.

TOTAL: 45 PERIODS

BOOKS FOR REFERENCES:

1. Reddy, J.N. An Introduction to the Finite Element Method, McGraw Hill,1985.
2. Rao, S.S., Finite Element method in engineering, Pergammon press, 1989.
3. Lewis R.W.Morgan, K, Thomas, H.R. and Seetharaman, K.N. The Finite Element Method in Heat Transfer Analysis, John Wiley, 1994.

OUTCOMES :

At the end of this course the students are highly confident in

(1) Fundamentals of Finite Element Methods.

(2) Perform one dimensional and Two-dimensional analysis using FEA

(3) Perform finite element formulations to solve problems

(4) perform finite element analyses and evaluate the results of a select set of manufacturing processes,

(5) Provide simulations through FE Software

Co po mapping

CO	PO					
	1	2	3	4	5	6
1	1	-	-	-	-	2
2	2	-	-	3	-	-
3	-	-	3	2	-	-
4	2	-	-	3	-	-
5	-	-	-	-	2	1
Avg.	1.66	-	3	2.66	2	1.5

22254E24B	LEAN MANUFACTURING	L T P C
		3 0 0 3

AIM:

To introduce the concepts of lean manufacturing system.

OBJECTIVE:

(1) To implement lean manufacturing concepts in the factories.
(2) Understand the distinction between mass and lean production and to be able to assess the difference in a manufacturing environment
(3) Understand the various elements of Lean systems
(4) Learn the importance of JIT
(5) Understand the various Inspection systems and effectively plan for a Lean system

UNIT – I INTRODUCTION TO LEAN MANUFACTURING 7

Conventional Manufacturing versus Lean Manufacturing – Principles of Lean Manufacturing – Basic elements of lean manufacturing – Introduction to LM Tools.

UNIT – II CELLULAR MANUFACTURING, JIT, TPM 9

Cellular Manufacturing – Types of Layout, Principles of Cell layout, Implementation. JIT – Principles of JIT and Implementation of Kanban. TPM – Pillars of TPM, Principles and implementation of TPM.

UNIT – III SET UP TIME REDUCTION, TQM, 5S, VSM 10

Set up time reduction – Definition, philosophies and reduction approaches. TQM – Principles and implementation. 5S Principles and implementation - Value stream mapping - Procedure and principles.

UNIT – IV SIX SIGMA 9

Six Sigma – Definition, statistical considerations, variability reduction, design of experiments – Six Sigma implementation.

UNIT – V CASE STUDIES 10

Various case studies of implementation of lean manufacturing at industries.

TOTAL: 45 PERIODS

BOOKS FOR REFERENCES:

1. Design and Analysis of Lean Production Systems, Ronald G. Askin & Jeffrey B. Goldberg, John Wiley & Sons, 2003
2. Rother M. and Shook J, 1999 ‘Learning to See: Value Stream Mapping to Add Value and Eliminate Muda’ , Lean Enterprise Institute, Brookline, MA.
1. Mikell P. Groover (2002) ‘Automation, Production Systems and CIM.

OUTCOMES:

The student will be competent

(1) To know the necessity for a Lean Manufacturing system

(2) To Differentiate between the conventional Mass production system with Lean system

(3) In effectively implement the principles of JIT

(4) To apply the Inspection tools effectively in the Lean systems

(5) To apply Hoshin planning system to create a Lean culture in Industry

Co Po Mapping

CO	PO					
	1	2	3	4	5	6
1	1	-	-	-	-	-
2	-	1	3	-	1	-
3	-	-	3	-	-	-
4	1	-	-	2	-	1
5	1	2	-	-	2	2
Avg.	1	1.5	3	2	1.5	1.5

22254E24C	Materials Management	L T P C
		3 0 0 3

COURSE OBJECTIVES:

To introduce the students
(1) the various concepts of materials management
(2) familiarize them with vendor development and rating
(3) the various aspects of Logistics and storage
(4) Planning and Forecasting of the need
(5) Various aspects of Inventory management

UNIT I INTRODUCTION **6**

Introduction to materials management – Objectives – Functions – Operating Cycle – Value analysis – Make or buy decisions.

UNIT II MANAGEMENT OF PURCHASE **7**

Purchasing policies and procedures – Selection of sources of supply – Vendor development – Vendor evaluation and rating – Methods of purchasing – Imports – Buyer – Seller relationship – Negotiations.

UNIT III MANAGEMENT OF STORES AND LOGISTICS **12**

Stores function – Location – Layout – Stock taking – Materials handling – Transportation – Insurance – Codification – Inventory pricing – stores management – safety – warehousing – Distribution linear programming – Traveling Salesman problems – Network analysis – Logistics Management.

UNIT IV MATERIALS PLANNING **10**

Forecasting – Materials requirements planning – Quantity – Periodic – Deterministic models – Finite production.

UNIT V INVENTORY MANAGEMENT **10**

ABC analysis – Aggregate planning – Lot size under constraints – Just in Time (JIT) system.

TOTAL: 45 PERIODS

OUTCOMES:

At the end of this course the students are
(1) Familiarized with the various concepts and functions of material management
(2) Able to handle the purchase and stores Independently
(3) Understand Logistics and inventory pricing
(4) Materials planning and periodic replenishment of material
(5) Just in time techniques and inventory management

REFERENCES

1. Dr. R. Kesavan, C.Elanchezian and T.SundarSelwyn, Engineering Management – Eswar Press – 2005.
2. Dr.R. Kesavan, C.Elanchezian and B.Vijaya Ramnath, Production Planning and Control, Anuratha Publications, Chennai, 2008.

3. G. Reghuram, N. Rangaraj, Logistics and supply chain management – cases and concepts, Macmillan India Ltd., 2006.
4. Gopalakrishnan.P, Handbook of Materials Management, Prentice Hall of India, 2005.
5. Guptha P.K. and Heera, Operations Research, Suttan Chand & Sons, 2007.
6. Lamer Lee and Donald W.Dobler, Purchasing and Material Management, Text and cases, Tata McGraw Hill, 2006.

Co Po Mapping

CO	PO					
	1	2	3	4	5	6
1	1	-	-	-	-	-
2	-	1	3	-	1	-
3	-	-	3	-	-	-
4	1	-	-	2	-	1
5	1	2	-	-	2	2
Avg.	1	1.5	3	2	1.5	1.5

List of Electives - Elective III

22254E25A NON-DESTRUCTIVE TESTING AND EVALUATION L T P C
3 0 0 3

OBJECTIVES:

(1) To stress the importance of NDT in Engineering.
(2) To select the appropriate NDT Technique
(3) To familiarize with different NDT Technique
(4) To impart various knowledge to check the weld quality of various structures, pressure vessels
(5) Compare the merits of various NDT Techniques

UNIT I NON-DESTRUCTIVE TESTING: AN INTRODUCTION, VISUAL INSPECTION & LIQUID PENETRANT TESTING 6

Introduction to various non-destructive methods, Comparison of Destructive and Non destructive Tests, Visual Inspection, Optical aids used for visual inspection, Applications.
Physical principles, procedure for penetrant testing, Penetrant testing materials, Penetrant testing methods- water washable, Post – Emulsification methods, Applications

UNIT II EDDY CURRENT TESTING & ACOUSTIC EMISSION 10

Principles, Instrumentation for ECT, Absolute, differential probes, Techniques – High sensitivity techniques, Multi frequency, Phased array ECT, Applications.
Principle of AET, Instrumentation, Applications - testing of metal pressure vessels, Fatigue crack detection in aerospace structures.

UNIT III MAGNETIC PARTICLE TESTING & THERMOGRAPHY 10

Principle of MPT, procedure used for testing a component, Equipment used for MPT, Magnetizing techniques, Applications.
Principle of Thermography, Infrared Radiometry, Active thermography measurements, Applications – Imaging entrapped water under an epoxy coating, Detection of carbon fiber contaminants.

UNIT IV ULTRASONIC TESTING 10

Principle, Ultrasonic transducers, Ultrasonic Flaw detection Equipment, Modes of display A- scan, B-Scan, C- Scan, Applications, Inspection Methods - Normal Incident Pulse-Echo Inspection, Normal Incident Through-transmission Testing, Angle Beam Pulse-Echo testing, TOFD Technique, Applications of Normal Beam Inspection in detecting fatigue cracks, Inclusions, Slag, Porosity and Intergranular cracks - Codes, standards, specification and procedures and case studies in ultrasonics test.

UNIT V RADIOGRAPHY 9

Principle of Radiography, x-ray and gamma ray sources- safety procedures and standards, Effect of radiation on Film, Radiographic imaging, Inspection Techniques – Single wall single image, Double wall Penetration, Multiwall Penetration technique, Real Time Radiography - Codes, standards, specification and procedures and case studies in Radiography test.
Case studies on defects in cast, rolled, extruded, welded and heat treated components - Comparison and selection of various NDT techniques

TOTAL: 45 PERIODS

OUTCOMES:

At the end of this course the students
(1) Realize the importance of various NDT Techniques
(2) Are expected to have hands on experience on all types of NDT techniques
(3) Will choose appropriate technique for testing
(4) Will Compare the merits of various NDT Techniques
(5) Characterize the flaws and defects and provide solutions

REFERENCES:

1. Baldev Raj, Jeyakumar,T., Thavasimuthu,M., "Practical Non Destructive Testing" Narosa publishing house, New Delhi, 2002
2. Krautkramer. J., "Ultra Sonic Testing of Materials", 1st Edition, Springer – Verlag Publication, New York, 1996.
3. Peter J. Shull "Non Destructive Evaluation: Theory, Techniques and Application" Marcel Dekker, Inc., New York, 2002
4. www.ndt.net

Co Po Mapping

CO	PO					
	1	**2**	**3**	**4**	**5**	**6**
1	1	-	-	-	-	-
2	-	-	3	-	-	1
3	-	-	-	2	-	-
4	-	-	-	-	1	-
5	1	-	-	2	-	1
Avg.	1	-	3	2	1	1

22254E25B	MAINTENANCE MANAGEMENT	L T P C
		3 0 0 3

OBJECTIVES

1. Students will be able to study the concepts in facility planning.
2. Students will be able to study types of plant layout and capacity planning methods.
3. Students will be able to study the concepts of Project management.
4. Students will be able to study the concepts and methods in production planning and control.
5. Students will be able to study the concepts in Inventory and maintenance management.

UNIT I: Introduction to Maintenance Management: 7

Maintenance: Its role and scope in total Organizational contexts - role of Maintenance. Centralized and decentralized maintenance organization structures. Maintenance Economics – reliability and Availability – MTBF, MTTR.

UNIT II: Maintenance Categories: 10

Maintenance system– Categories - Design and its selection – Breakdown Maintenance –Routine Maintenance- Predictive Maintenance –Preventive Maintenance- Corrective Maintenance-Total Productive Maintenance –Maintenance Schedule – Repair Cycle.

UNIT III: Spare Parts Management: 8

Pareto's principles for repetitive breakdown analysis, spares management, planning considerations for each type of activities.

UNIT – IV: Condition Monitoring: 10

Condition Monitoring (CM) – Introduction- Economics of CM – On-load and off-load testing – Methods and instruments for CM – Temperature sensitive tapes – Pistol thermometers – wear-debris analysis.

UNIT V: Maintenance Manpower Cost, Performance Management: 10

Maintenance man power planning - Selection training - Scheduling maintenance costs - Budget preparation and budgetary control of maintenance expenditures Maintenance effectiveness various performance indices - evaluation, uses and limitations - Monitoring of Maintenance performance.

TEXT BOOKS FOR REFERENCES:

1. Gopalakrishnan P. and Sundarajan 1996. Maintenance Management. New Delhi, Prentice-Hall of India.
2. Srivastava S.K., "Industrial Maintenance Management", - S. Chand & Co.,1981.
3. Higgirs L.T and Morrow L.C., 1997, ``Maintenance Engineering Handbook``, McGraw Hill. Armstrong, "Condition Monitoring", BSIRSA, 1988.

COURSE OUTCOMES:

On Completion of the course the student will be able to

1. Able to acquire knowledge on facility, and problems associated with it.

2. Ability to learn the various capacity and layout planning models
3. Understand the concepts of demand forecasting and project management with relevant case studies.
4. Able to understand the concepts of production planning and scheduling.
5. Understand the various inventory and maintenance management techniques.

Co Po Mapping

CO	PO					
	1	2	3	4	5	6
1	1	-	-	-	-	2
2	-	-	3	-	-	-
3	-	-	3	-	-	-
4	-	-	-	2	-	-
5	-	-	-	3	2	2
Avg.	1	-	3	2.5	2	2

22254E25C **OPTIMIZATION TECHNIQUES** **L T P C**
3 0 0 3

OBJECTIVES:

1) To make use of the optimization techniques while modelling and solving the engineering problems of different fields.
2) To apply Linear Programming and Dynamic Programming to provide solutions for different problems
3) Learn classical optimization techniques and numerical methods of optimization.
4) Know the basics of different evolutionary algorithms.
5) To understand and differentiate traditional and non-traditional methods of Optimization

UNIT I - INTRODUCTION TO OPTIMIZATION **7**

Formulation of an optimization problem- Classification of optimization problem – optimization techniques-Classical optimization technique – Single variable optimization – Multi variable optimization algorithms

UNIT II - MINIMIZATION METHODS **8**

One dimensional minimization methods: unimodal function – elimination methods: unrestricted search, exhaustive search, Dichotomous search, Fibonacci methods, Golden section methods, Interpolation methods: Quadratic and cubic interpolation methods.

UNIT III - CONSTRAINED OPTIMIZATION TECHNIQUES **10**

Optimization with equality and inequality constraints - Direct methods – Indirect methods using penalty functions, Lagrange multipliers - separable programming and Geometric programming.

UNIT IV - UNCONSTRAINED OPTIMIZATION TECHNIQUES **10**

Multi variable unconstrained optimization techniques: Direct search methods: Random search method, unvaried method, pattern search method, steepest descent method and Conjugate gradient method.

UNIT V - APPLICATIONS OF HEURISTICS IN OPTIMIZATION **10**

Heuristics-Introduction-Multi objective optimization: Genetic algorithms and Simulated Annealing techniques; neural network & Fuzzy logic principles in optimization.

BOOKS FOR REFERENCES:

1. Rao, Singaresu, S., “Engineering Optimization – Theory & Practice”, New Age International (P) Limited, New Delhi, 2000.
2. Johnson Ray, C., “Optimum design of mechanical elements”, Wiley, John & Sons, 1990.
3. Kalyanamoy Deb, “Optimization for Engineering design algorithms and Examples”, Prentice Hall of India Pvt. 1995.
4. Goldberg, D.E., “Genetic algorithms in search, optimization and machine”, Barnen, Addison-Wesley, New York, 1989.

OUTCOMES:

1) At the end of this course the students will be expected to introduce the various optimization techniques and their advancements.
2) Ability to go in research by applying optimization techniques in problems of Engineering and Technology
3) Use classical optimization techniques and numerical methods of optimization.
4) Describe the basics of different evolutionary algorithms
5) Ability to solve the mathematical results and numerical techniques of optimization theory to concrete Engineering problems by using computer software

Co Po Mapping

CO	PO					
	1	2	3	4	5	6
1	2	-	-	3	2	-
2	1	-	-	2	3	-
3	1	-	-	2	2	-
4	-	2	-	-	-	-
5	1	-	-	3	-	2
Avg.	1.25	2	-	2.5	2.33	2

List of Electives - Elective IV

22254E32A PROCESS PLANNING AND COST ESTIMATION L T P C
3 0 0 3

OBJECTIVES:

1) To educate students with fundamental and advanced knowledge in the field of Additive manufacturing technology
2) Gain insights on the need, advantages and limitations of additive manufacturing (AM) versus traditional manufacturing
3) Find out the various applications of AM, Deployment levels, Innovative and optimized product design
4) To explore the potential of additive manufacturing in different industrial sectors.
5) To apply 3D printing technology for additive manufacturing.

UNIT I INTRODUCTION TO PROCESS PLANNING 10

Introduction- methods of process planning-Drawing interpretation-Material evaluation – steps in process selection-.Production equipment and tooling selection

UNIT II PROCESS PLANNING ACTIVITIES 10

Process parameters calculation for various production processes-Selection jigs and fixtures election of quality assurance methods – Set of documents for process planning-Economics of process planning- case studies

UNIT III INTRODUCTION TO COST ESTIMATION 8

Importance of costing and estimation –methods of costing-elements of cost estimation –Types of estimates – Estimating procedure- Estimation labor cost, material cost- allocation of over head charges- Calculation of depreciation cost

UNIT IV PRODUCTION COST ESTIMATION 8

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 this course the students are expected to use the concepts of process planning and cost estimation for various products.

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. Peter scalon, “Process planning, Design/Manufacture Interface”, Elsevier science technology Books, Dec 2002.
4. Russell R.S and Tailor B.W, “Operations Management”, 4th Edition, PHI, 2003.

OUTCOMES:

1) The students are expected to learn about a variety of Additive Manufacturing (AM) technologies.
2) Describe additive manufacturing and explain its advantages and disadvantages
3) Explain the processes used in additive manufacturing for a range of materials and applications
4) understand the role of additive manufacturing in the design process and their potential to support Design and manufacturing,

5) Case studies relevant to mass customized manufacturing, and some of the important research challenges associated with AM and its data processing tools

Co Po Mapping

CO	PO					
	1	2	3	4	5	6
1	2	-	-	3	-	1
2	1	-	3	1	1	1
3	-	-	-	2	2	1
4	1	-	3	3	2	1
5	1	-	-	-	2	2
Avg.	1.25	-	3	2.25	1.75	1.2

OBJECTIVES:

(1) To stress the importance of NDT in Engineering.
(2) To select the appropriate NDT Technique
(3) To familiarize with different NDT Technique
(4) To impart various knowledge to check the weld quality of various structures, pressure vessels
(5) Compare the merits of various NDT Techniques

UNIT–I: Introduction to Instrumentation: 8

Mechanical Instrumentation- General concepts, General measurement system. Classification of Instruments - indicators, recorders and integrators- working principles, Precision and Accuracy: Measurement Error and calibration.

UNIT–II: Measuring Devices 10

Measurement of speed, frequency, acceleration - Vibrometer, Accelerometer etc. Pressure measurement: Gravitational, Bourdon, elastic transducers, strain gauge, pressure cells, and measurement of high and low pressure. Temperature measurement: Bi-Metallic, Resistance Thermometer, Thermocouples, Pyrometer, thermostats, Magnetic flow meter , Ultrasonic flow meter.

UNIT – III: Transducers: 8

Transducers – Introduction – Types -Variable resistance Transducers-Variable reactive transducers- Piezo Electric transducers- Fibre optic transducers- Laser instrumentation-analogue and digital type -incremental and absolute measurement.

UNIT – IV: Machine Diagnostic and Condition Monitoring: 10

Machine Diagnostics – Basic Concepts - Analysis of failure in machines-Distribution of fault occurrences-Objectives of monitoring-Monitoring techniques applied to Machineries.

UNIT – V: Computer Control System: 9

Data acquisition system-Introduction-Direct Digital control-Programmable Logic Controls (PLC) - Ladder diagrams-Communication used in PLC.

BOOKS FOR REFERENCES:

1. Thomas Beckwith, Lewis Buck N.Ray, D. Maragoni, “Mechabical Measurements”, Narosia Publishing House, NewDelhi.
2. M.P.Groover - " Automation, Production Systems and computer Intergrated Manufacturing ", Prentice Hall.
3. A.K. Sawhney, “Elecrical and Electronics Measurements & Instrumentation”, Dhanpat Rai & Sons, 1993
4. C.S.Rangan,V.S.V.Mani and G.R.Sarma - " Instrumentation Devices and systems", Tata McGraw Hill,1983

OUTCOMES:

At the end of this course the students
(1) Realize the importance of various NDT Techniques
(2) Are expected to have hands on experience on all types of NDT techniques

(3) Will choose appropriate technique for testing
(4) Will Compare the merits of various NDT Techniques
(5) Characterize the flaws and defects and provide solutions

Co Po Mapping

CO	PO					
	1	2	3	4	5	6
1	2	-	-	3	-	1
2	1	-	3	1	1	1
3	-	-	-	2	2	1
4	1	-	3	3	2	1
5	1	-	-	-	2	2
Avg.	1.25	-	3	2.25	1.75	1.2

22254CRM RESEARCH METHODOLOGY L T P C
3 0 0 3

OBJECTIVES:

(1) To impart knowledge about different types of robots and configuration
(2) To gain fundamental knowledge on robot manipulators.
(3) To provide a brief knowledge on geometry, kinematics, dynamics, motion planning and control
(4) To impart knowledge in Robot designing and programming
(5) To familiarize with sensors and actuators used in robots

AIM:

To give an exposure to development of research questions and the various statistical methods suitable to address them through available literature, with basic computational operators.

UNIT I **9**

Introduction to Research — Criteria of Good Research, Research Problem: Definition of research problem, selecting the problem - Necessity of defining the problem - Techniques involved in defining the problem- Basic principles of experimental designs-Descriptive and experimental design – different types of experimental design – Validity of findings – internal and external validity – Variables in Research – Measurement and Scaling – Different scales. Ethics & Misconduct in research, Plagiarism,

UNIT II **9**

Formulation of Hypothesis – Sampling techniques –Sampling error and sample size-Methods of data collection – Primary and secondary data – observation – Collection of literature, manual collection from library, usage of library, collection of literature from Scopus, Science Direct etc., compiling literature, software utilization in literature collection- Processing and analysis of data – editing – coding – transcription – tabulation –outline of statistical analysis.

UNIT III **9**

Data Analysis using Excel- Tabulation of Data in excel (Creating Master Table and Sub Table), Formulas and Functions, Filters and Sort and Validation Lists, Data from External Sources. Data Analysis Using Charts and Graphs(Pivot Table & Charts), Time Value of Money, Measure of central tendency: mean, median, mode, Measure of dispersion: variance, standard deviation, Coefficient of variation. Correlation, regression lines. Z-test, t- test F-test, ANOVA one way classification, Chi square test, independence of attributes. Time series: forecasting Method of least squares, Moving average method, Introduction to presentation tool, features and functions, Creating Presentation, Customizing presentation.

UNIT IV **9**

Various research methods-Design of Experiments, Response Surface Methodology, Taguchi Methods- Modeling & Simulation of Engineering Systems, Artificial Neural Networks, Fuzzy Logic, MATLAB - Graph Theory- Finite Element Methods, Computational Fluid Dynamics -R programming in Statistics- open source software

UNIT V **9**

Review of literature, Report writing – target audience – types of reports – contents of reports – styles and Conventions in reporting – steps in drafting a report. Basic concept of research paper writing for Journals and formats of publications in Journals, Report Structure - writing research abstract - introduction, review of literature, result, conclusions, Concepts of Bibliography and references

References:

1. C. R. Kothari, Research Methodology, New Age International Publishers. New Delhi, 2004.
2. Rajammal.P. Devadas, 1976, A hand book of methodology of research, RMM Vidyalaya Press.
3. R.A Day and A.L. Underwood, Quantitative analysis, Prentice Hall, 1999.
4. R. Gopalan, Thesis writing, Vijay Nicole Imprints Private Ltd., 2005.
5. W.J. DeCoursey, Statistics and Probability for Engineering Applications With Microsoft® Excel, Newnes, 2003.
6. Archibald Fripp, Jon Fripp, Michael Fripp; Just-in-Time Math for Engineers, Elsevier Science & Technology Books, 2003.

OUTCOMES:

At the end of this course the students are expected
(1) Classify and configure robots
(2) Apply the kinematic arrangement of robots and its applications in the area of manufacturing sectors
(3) To select sensors for different application
(4) To build a robot for any type of application
(5) To develop and Expert system

Co po mapping

CO	PO					
	1	2	3	4	5	6
1	1	-	2	-	-	-
2	-	-	-	3	3	-
3	-	-	3	2	-	-
4	1	-	-	2	-	-
5	1	-	2	-	-	2
Avg	1	-	2.33	2.33	3	1

List of Electives - Elective V

22254E33A PRODUCT DESIGN AND DEVELOPMENT L T P C
3 0 0 3

OBJECTIVES:

To introduce the students
(1) the various concepts of materials management
(2) familiarize them with vendor development and rating
(3) the various aspects of Logistics and storage
(4) Planning and Forecasting of the need
(5) Various aspects of Inventory management

UNIT I - INTRODUCTION 7

Significance of product design, product design and development process, sequential engineering design method, the challenges of product development.

UNIT II - PRODUCT PLANNING AND PROJECT SELECTION 8

Identifying opportunities evaluate and prioritize projects, allocation of resources Identifying Customer Needs, Interpret raw data in terms of customers need, organize needs in hierarchy and establish the relative importance of needs.

UNIT III - PRODUCT SPECIFICATIONS 8

Establish target specifications, setting final specifications, Concept Generation: Activities of concept generation, clarifying problem, search both internally and externally.

UNIT IV - INDUSTRIAL DESIGN AND CONCEPT SELECTION 10

Assessing need for industrial design, industrial design process, management, assessing quality of industrial design, Overview, concept screening and concept scoring, methods of selection.

UNIT V - THEORY OF INVENTIVE PROBLEM SOLVING (TRIZ) AND CONCEPT TESTING 12

Fundamentals, methods and techniques, General Theory of Innovation and TRIZ, Value engineering Applications in Product development and design, Model-based technology for generating innovative ideas Elements of testing: qualitative and quantitative methods including survey, measurement of customers' response, Intellectual Property: Elements and outline, patenting procedures.

BOOKS FOR REFERENCES:

1. Ulrich K. T, and Eppinger S.D, Product Design and Development, Tata McGraw Hill
2. Otto K, and Wood K, Product Design, Pearson
3. Engineering of creativity: introduction to TRIZ methodology of inventive Problem Solving, By Semyon D. Savransky, CRC Press.
4. Inventive thinking through TRIZ: a practical guide, By Michael A. Orloff, Springer.
5. Systematic innovation: an introduction to TRIZ ; (theory of inventive Problem Solving), By John Terninko, Alla Zusman, CRC Press.

OUTCOMES:

At the end of this course the students are

(1) Familiarized with the various concepts and functions of material management

(2) Able to handle the purchase and stores Independently

(3) Understand Logistics and inventory pricing

(4) Materials planning and periodic replenishment of material

(5) Just in time techniques and inventory management

Co po mapping

CO	PO					
	1	2	3	4	5	6
1	1	-	2	-	-	-
2	-	-	-	3	3	-
3	-	-	3	2	-	-
4	1	-	-	2	-	-
5	1	-	2	-	-	2
Avg	1	-	2.33	2.33	3	1

22254E33B FLUID POWER AUTOMATION L T P C
3 0 0 3

OBJECTIVES:

1) To make the students to learn the basic concepts of hydraulics and pneumatics and their controlling elements in the area of manufacturing process.
2) To train the students in designing the hydraulic and pneumatic circuits using various design procedures.
3) To understand the concept and principle operation of automation systems and their controls.
4) To provide knowledge levels needed for PLC programming and operating
5) Ability to implement automation systems in Industry

UNIT I INTRODUCTION 5

Need for Automation, Hydraulic & Pneumatic Comparison – ISO symbols for fluid power elements, Hydraulic, pneumatics – Selection criteria.

UNIT II FLUID POWER GENERATING/UTILIZING ELEMENTS 8

Hydraulic pumps and motor gears, vane, piston pumps-motors-selection and specification-Drive characteristics – Linear actuator – Types, mounting details, cushioning – power packs – construction. Reservoir capacity, heat dissipation, accumulators – standard circuit symbols, circuit (flow) analysis.

UNIT III CONTROL AND REGULATION ELEMENTS 8

Direction flow and pressure control valves-Methods of actuation, types, sizing of ports pressure and temperature compensation, overlapped and under lapped spool valves operating characteristics-electro hydraulic servo valves-Different types-characteristics and performance.

UNIT IV CIRCUIT DESIGN 10

Typical industrial hydraulic circuits-Design methodology – Ladder diagram-cascade, method-truth table-Karnaugh map method-sequencing circuits-combinational and logic circuit.

UNIT V ELECTRO PNEUMATICS & ELECTRONIC CONTROL OF HYDRAULIC AND PNEUMATIC CIRCUITS 7

Electrical control of pneumatic and hydraulic circuits-use of relays, timers, counters, Ladder diagram. Programmable logic control of Hydraulics Pneumatics circuits, PLC ladder diagram for various circuits, motion controllers, use of field busses in circuits. Electronic drive circuits for various Motors.

TOTAL: 45 PERIODS

BOOKS FOR REFERENCES:

1. Antony Esposito, Fluid Power Systems and control Prentice-Hall, 1988.

2. Peter Rohner, Fluid Power logic circuit design. The Macmillan Press Ltd.,London, 1979

3. E.C.Fitch and J.B.Suryaatmadyn. Introduction to fluid logic, McGraw Hill, 1978.

4. W.Bolton, Mechatronics, Electronic control systems in Mechanical and Electrical Engineering Pearson Education, 2003.

5. Peter Rohner, Fluid Power Logic Circuit Design, Mcmelan Prem, 1994.

OUTCOMES:

1) At the end of this course the students are familiarized in the area of hydraulics, pneumatic and fluid power components and its functions.
2) Recognize the standard symbols used in fluid power circuits and assess the suitable component for a particular application
3) Construct the hydraulic circuits for an industrial application.
4) Build a pneumatic circuit and apply them to real life problems.
5) Design and develop a PLC controlled pneumatic circuit for industrial application

Co Po Mapping

CO	PO					
	1	2	3	4	5	6
1	1	-	-	-	-	-
2	1	-	3	-	-	2
3	-	-	3	2	-	-
4	1	-	-	2	3	-
5	-	-	-	-	-	3
Avg.	1	-	3	2	3	2.5

22254E33C INTERNET OF THINGS FOR MANUFACTURING L T P C
3 0 0 3

OBJECTIVES:

- To discover key IoT concepts including identification, sensors, localization, wireless protocols
- To explore IoT technologies, architectures, standards, and regulation
- To realize the value created by collecting, communicating, coordinating, and leveraging data
- To examine developments that will likely shape the industrial landscape in the future;

UNIT I INTRODUCTION 9

Technology of the IoT and applications,. IoT data management requirements, Architecture of IoT, Security issues Opportunities for IoT -Issues in implementing IoT. Technological challenges, RFID and the Electronic Product Code (EPC) network, the web of things.

UNIT II DESIGN OF IoT 9

Design challenges in IoT -Standardization, Security and privacy, Infrastructure, Analytics. Design steps for implementing IoT.

UNIT III PROTOTYPING OF IoT 9

Design principles for connected devices -Embedded devices, physical design, online components, embedded coding system. Informed Manufacturing plant – Elements, IoT implementation in Transportation and logistics, Energy and utilities, Automotive Connected supply chain, Plant floor control automation, remote monitoring, Management of critical assets, Energy management and resource optimization, proactive maintenance.

UNIT IV PREREQUISITES FOR IoT 9

IOT Technologies Wireless protocols low-power design (Bluetooth Low Energy), range extension techniques (data mining and mesh networking), and data-intensive IoT for continuous recognition applications Data storage and analysis Localization algorithms Localization for mobile systems

UNIT V APPLICATION IN MANUFACTURING 9

Applications HCI and IoT world -Multilingual interactions Robotics and Autonomous Vehicles Sensing and data processing-Simultaneous mapping and localization-Levels of autonomy, Smart factories, Future research challenges

TOTAL : 45 PERIODS

OUTCOMES:

- At the end of this course the students are expected to
- Utilizing sensors to gain greater visibility and real-time situational awareness
- Vertical applications that provide a clear business case and a pressing opportunity
- Emerging technologies to address IoT challenges

REFERENCES:

1. Adrian McEwan and Hakim Cassimally, “Designing the internet of things”, Wiley, 2013

2. Code Halos: How the Digital Lives of People, Things, and Organizations are Changing the Rules of Business, by Malcolm Frank, Paul Roehrig and Ben Pring, published by John Wiley & Sons.

3. Internet of Things: A Hands-On Approach by Vijay Madisetti, Arshdeep Bahga, VPT; 1st edition 2014.

4. Jan Holler, Vlasios Tsiatsis, Catherine Mulligan, Stamatis Karnouskos, Stefan Avesand, David Boyle, “From Machine-to-Machine to the Internet of Things -Introduction to a New Age of Intelligence” Elsevier

5. Meta Products -Building the Internet of Things by Wimer Hazenberg, Menno Huisman, BIS Publishers 2014.

Co Po Mapping

CO	**PO**					
	1	2	3	4	5	6
1	1		2	1		
2	1		2			3
3	1		2			3
4	1		2			3
5	1		2			3
Avg	**(5/5)=1**		**(10/5)=2**	**(1/1)=1**		**(12/4)=3**

List of Electives - Elective VI

22254E34A ADVANCED MATERIAL TECHNOLOGY **L T P C**
3 0 0 3

OBJECTIVES:

1. To inculcate specialized knowledge and skill in advanced manufacturing processes using the principles and methods of engineering analysis and design.
2. To impart knowledge about the significance of controlling process parameters for the optimal performance for newly developed engineering materials used in industries and research organizations.
3. To impart knowledge about principles and criteria of yielding during forming of metals, analysis of different bulk metal forming processes following different analysis approach.
4. To give awareness of different techniques used in Micro and Nano manufacturing.
5. To introduce students the basics of /rapid prototyping and its applications in various fields, reverse engineering techniques

UNIT I ELASTIC AND PLASTIC BEHAVIOR **10**

Elasticity in metals and polymers Anelastic and visco-elastic behaviour – Mechanism of plastic deformation and non metallic shear strength of perfect and real crystals – Strengthening mechanisms, work hardening, solid solutioning, grain boundary strengthening, poly phase mixture, precipitation, particle, fibre and dispersion strengthening. Effect of temperature, strain and strain rate on plastic behaviour – Super plasticity – Deformation of non crystalline materials.

UNIT II FRACTURE BEHAVIOUR **10**

Griffith's theory, stress intensity factor and fracture toughness – Toughening mechanisms – Ductile, brittle transition in steel – High temperature fracture, creep – Larson Miller parameter – Deformation and fracture mechanism maps – Fatigue, low and high cycle fatigue test, crack initiation and propagation mechanisms and Paris law. Effect of surface and metallurgical parameters on fatigue – Fracture of non metallic materials – Failure analysis, sources of failure, procedure of failure analysis.

UNIT III SELECTION OF MATERIALS **10**

Motivation for selection, cost basis and service requirements – Selection for mechanical properties, strength, toughness, fatigue and creep – Selection for surface durability corrosion and wear resistance – Relationship between materials selection and processing – Case studies in materials selection with relevance to aero, auto, marine, machinery and nuclear applications – Computer aided materials selection.

UNIT IV MODERN METALLIC MATERIALS **8**

Dual phase steels, High strength low alloy (HSLA) steel, Transformation induced plasticity (TRIP) Steel, Maraging steel, Nitrogen steel – Intermetallics, Ni and Ti aluminides – smart materials, shape memory alloys – Metallic glass and nano crystalline materials.

UNIT V NON METALLIC MATERIALS **7**

Polymeric materials – Formation of polymer structure – Production techniques of fibers, foams, adhesives and coating – structure, properties and applications of engineering polymers – Advanced structural ceramics, WC, TIC, TaC, Al2O3, SiC, Si3N4 CBN and diamond – properties, processing and applications.

TOTAL: 45 PERIODS

BOOKS FOR REFERENCES:

1. George E.Dieter, Mechanical Metallurgy, McGraw Hill, 1988.
2. Thomas H. Courtney, Mechanical Behaviour of Materials, (2nd edition), McGraw Hill, 2000.
3. Flinn, R.A., and Trojan, P.K., Engineering Materials and their Applications, (4^{th} Edition) Jaico, 1999.
4. ASM Hand book, Vol.11, Failure Analysis and Prevention, (10th Edition), ASM, 2002.
5. Ashby M.F., Material Selection in Mechanical Design, 3rd Edition, Butter Worth 2005.

OUTCOMES:

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

1. Analyze the processes and evaluate the role of each process parameter during machining of various advanced materials.
2. Understand requirements to achieve maximum material removal rate and best quality of machined surface while machining various industrial engineering materials.
3. Analyze the different bulk metal forming process mechanics using different analysis
4. Acquire the knowledge in mechanical micromachining processes.
5. Demonstrate the knowledge of Additive Manufacturing and Rapid Prototyping Technologies

Co po MApping

CO	PO					
	1	2	3	4	5	6
1	1	-	-	-	-	-
2	-	-	-	-	2	-
3	-	-	3	-	-	2
4	1	-	-	-	2	-
5	-	-	-	1	-	-
Avg.	1	-	3	1	2	2

22254E34B INDUSTRIAL SAFETY L T P C
3 0 0 3

OBJECTIVES:

(1) To develop and strengthen the safety ideas and motivate the students to impart basic safety skills
(2) To know about Industrial safety programs, Industrial laws, regulations and source models
(3) To understand about fire and explosion, preventive methods, relief and its sizing methods
(4) To assess the safety of human beings from toxic substances
(5) To analyse industrial hazards and its risk assessment.

UNIT I OPERATIONAL SAFETY 9

Hot metal operation, boiler, pressure vessels – heat treatment shop – gas furnace operation – electroplating – hot bending pipes – safety in welding and cutting, Cold – metal operation – safety in machine shop – cold bending and chamfering of pipesmetal cutting – shot blasting, grinding, painting – power press and other machines. Management of toxic gases and chemicals – industrial fires and prevention – road safety – highway and urban safety – safety of sewage disposal and cleaning – control of environmental pollution – managing emergencies in industries – planning security and risk assessments, on – site and off site. Control of major industrial hazards.

UNIT II SAFETY APPRAISA L AND ANALYSIS 9

Human side of safety – personal protective equipment – causes and cost of accidents. Accidents prevention program – specific hazard control strategies – HAZOP training and development of employees – first aid – fire fight devices – accident reporting, investigation. Measurement of safety performance, accident reporting and investigation – plant safety inspection, job safety analysis – safety permit procedures. Product safety – plant safety rules and procedures – safety sampling – safety inventory systems. Determining the cost effectiveness of safety measurement.

UNIT III OCCUPATIONAL HEALTH 9

Concept and spectrum of health functional units and activities of operational health service – occupational and related disease – levels of prevention of diseases – notifiable occupational diseases Toxicology Lead – Nickel, chromium and manganese toxicity – gas poisoning (such as CO, Ammonia Chlorise, So2, H2s.) their effects and prevention – effects of ultra violet radiation and infrared radiation on human system.

UNIT IV SAFETY AND HEALTH REGULATIONS 9

Safety and health standards – industrial hygiene – occupational diseases prevention welfare facilities. The object of factories act 1948 with special reference to safety provisions, model rules 123a, history of legislations related to safety – pressure vessel act – Indian boiler act – the environmental protection act – electricity act – explosive act.

UNIT V SAFETY MANAGEMENT 9

Evaluation of modern safety concepts – safety management functions – safety organization, safety department- safety committee, safety audit – performance measurements and motivation – employee participation in safety - safety and productivity.

TOTAL: 45 PERIODS

REFERENCES:

1. John V Grimaldi, Safety Management. AITB publishers, 2003.
2. John.V .Grimaldi and Rollin. H Simonds, “Safety Managenent”, All India traveler book seller, New Delhi – 1989.
3. Krishnan N.V, “Safety in Industry”, Jaico Publisher House, 1996.
4. Singh, U.K and Dewan, J.M., “Sagety, Security And Risk Management”, APH publishing company, New Delhi, 1996.

OUTCOMES:

At the end of this course the students are
(1) Expected to gain knowledge and skills needed to run an industry with utmost safety precautions.
(2) Understand the industrial laws, regulations and source models.
(3) Apply the methods of prevention of fire and explosions.
(4) Analyse the effect of release of toxic substances
(5) Understand the methods of hazard identification and preventive measures.

Co Po Mapping

CO	PO					
	1	2	3	4	5	6
1	1	-	-	-	-	-
2	-	-	-	-	2	-
3	-	-	3	-	-	2
4	1	-	-	-	2	-
5	-	-	-	1	-	-
Avg.	1	-	3	1	2	2

22254E34C ADDITIVE MANUFACTURING L T P C
3 0 0 3

OBJECTIVES:

1) To educate students with fundamental and advanced knowledge in the field of Additive manufacturing technology
2) Gain insights on the need, advantages and limitations of additive manufacturing (AM) versus traditional manufacturing
3) Find out the various applications of AM, Deployment levels, Innovative and optimized product design
4) To explore the potential of additive manufacturing in different industrial sectors.
5) To apply 3D printing technology for additive manufacturing.

UNIT I INTRODUCTION: 8

Need - Development of AM systems – AM process chain - Impact of AM on Product Development - Virtual Prototyping- Rapid Tooling – RP to AM -Classification of AM processes-Benefits- Applications.

UNIT II REVERSE ENGINEERING AND CAD MODELING: 10

Basic concept- Digitization techniques – Model reconstruction – Data Processing for Rapid Prototyping: CAD model preparation, Data requirements – Geometric modeling techniques: Wire frame, surface and solid modeling – data formats - Data interfacing, Part orientation and support generation, Support structure design, Model Slicing, Tool path generation-Software for AM- Case studies.

UNIT III LIQUID BASED AND SOLID BASED ADDITIVE MANUFACTURING SYSTEMS 10

Stereolithography Apparatus (SLA): Principle, pre-build process, part-building and post-build processes, photo polymerization of SL resins, part quality and process planning, recoating issues, materials, advantages, limitations and applications.
Solid Ground Curing (SGC): working principle, process, strengths, weaknesses and applications. Fused deposition Modeling (FDM): Principle, details of processes, process variables, types, products, materials and applications. Laminated Object Manufacturing (LOM): Working Principles, details of processes, products, materials, advantages, limitations and applications - Case studies.

UNIT IV POWDER BASED ADDITIVE MANUFACTURING SYSTEMS: 10

Selective Laser Sintering (SLS): Principle, process, Indirect and direct SLS- powder structures, materials, post processing, surface deviation and accuracy, Applications. Laser Engineered Net Shaping (LENS): Processes, materials, products, advantages, limitations and applications– Case Studies.

UNIT V OTHER ADDITIVE MANUFACTURING SYSTEMS: 7

Three dimensional Printing (3DP): Principle, basic process, Physics of 3DP, types of printing, process capabilities, material system. Solid based, Liquid based and powder based 3DP systems, strength and weakness, Applications and case studies. Shape Deposition Manufacturing (SDM), Ballastic Particle Manufacturing (BPM), Selective Laser Melting, Electron Beam Melting.

TOTAL: 45 PERIODS

OUTCOMES:

1) The students are expected to learn about a variety of Additive Manufacturing (AM) technologies.
2) Describe additive manufacturing and explain its advantages and disadvantages
3) Explain the processes used in additive manufacturing for a range of materials and applications
4) understand the role of additive manufacturing in the design process and their potential to support Design and manufacturing,
5) Case studies relevant to mass customized manufacturing, and some of the important research challenges associated with AM and its data processing tools

REFERENCES:

1. Chua, C.K., Leong K.F. and Lim C.S., "Rapid prototyping: Principles and applications", second edition, World Scientific Publishers, 2010.

2. Gebhardt, A., "Rapid prototyping", Hanser Gardener Publications, 2003.

3. Gibson, I., Rosen, D.W. and Stucker, B., "Additive Manufacturing Methodologies: Rapid Prototyping to Direct Digital Manufacturing", Springer, 2010.

4. Hilton, P.D. and Jacobs, P.F., Rapid Tooling: Technologies and Industrial Applications, CRC press, 2005.

5. Kamrani, A.K. and Nasr, E.A., "Rapid Prototyping: Theory and practice", Springer, 2006.

6. Liou, L.W. and Liou, F.W., "Rapid Prototyping and Engineering applications : A tool box for prototype development", CRC Press, 2011.

Co Po Mapping

CO	PO					
	1	2	3	4	5	6
1	2	-	2	-	-	-
2	1	-	-	-	-	2
3	-	-	3	-	2	-
4	-	-	-	3	-	-
5	-	-	-	-	2	3
Avg.	1.5	-	2.5	3	2	2.5