PONNAIYAH RAMAJAYAM INSTITUTE OF SCIENCE & TECHNOLOGY (PRIST)
Declared as DEEMED-TO-BE-UNIVERSITY
U/s 3 of UGC Act, 1956
Vallam, Thanjavur-613403

M.Sc.,

MATHEMATICS

Syllabus

FROM THE ACADMIC YEAR 2023-2024

CONTENTS

Three domains:

(i) Cognitive Domain

(Lower levels: K1: Remembering ; K2: Understanding ; K3: Applying;

Higher levels: K4: Analysing ; K5: Evaluating; K6: Creating)

(ii) Affective Domain

(iii) Psychomotor Domain

TANSCHE REGULATIONS ON LEARNING OUTCOMES-BASED CURRICULUM FRAMEWORK FOR POSTGRADUATE EDUCATION	
Programme	**M.Sc., Mathematics**
Programme Code	**23PGMATGE**
Duration	**PG - 2 years**
Programme Outcomes (Pos)	**PO1: Problem Solving Skill** Apply knowledge of Management theories and Human Resource practices to solve business problems through research in Global context. **PO2: Decision Making Skill** Foster analytical and critical thinking abilities for data-based decision-making. **PO3: Ethical Value** Ability to incorporate quality, ethical and legal value-based perspectives to all organizational activities. **PO4: Communication Skill** Ability to develop communication, managerial and interpersonal skills. **PO5: Individual and Team Leadership Skill** Capability to lead themselves and the team to achieve organizational goals. **PO6: Employability Skill** Inculcate contemporary business practices to enhance employability skills in the competitive environment. **PO7: Entrepreneurial Skill** Equip with skills and competencies to become an entrepreneur. **PO8: Contribution to Society** Succeed in career endeavours and contribute significantly to society. **PO 9 Multicultural competence** Possess knowledge of the values and beliefs of multiple cultures and a global perspective. **PO 10: Moral and ethical awareness/reasoning** Ability to embrace moral/ethical values in conducting one's life.
Programme Specific Outcomes (PSOs)	**PSO1 – Placement** To prepare the students who will demonstrate respectful engagement with others' ideas, behaviors, beliefs and apply diverse frames of reference to decisions and actions. **PSO 2 - Entrepreneur**

	To create effective entrepreneurs by enhancing their critical thinking, problem solving, decision making and leadership skill that will facilitate startups and high potential organizations. **PSO3 – Research and Development** Design and implement HR systems and practices grounded in research that comply with employment laws, leading the organization towards growth and development. **PSO4 – Contribution to Business World** To produce employable, ethical and innovative professionals to sustain in the dynamic business world. **PSO 5 – Contribution to the Society** To contribute to the development of the society by collaborating with stakeholders for mutual benefit.

Credit Distribution for PG Programme

Semester–I	Credit	Semester-II	Credit	Semester-III	Credit	Semester–IV	Credit
1.1. Core-I	4	2.1. Core-IV	4	3.1. Core-VII	4	4.1. Core-X	4
1.2 Core-II	4	2.2 Core-V	4	3.2 Core-VII	4	4.2 Core-XI	4
1.3 Core – III	4	2.3 Core – VI	4	3.3 Core – IX	4	4.3 Core – XII	4
1.4 Elective (Generic / Discipline Centric)- I	3	2.4 Elective (Generic / Discipline Centric) – III	3	3.4 Elective (Generic / Discipline Centric) – V	3	4.4 Elective (Generic / Discipline Centric) – VI	3
1.5 Elective (Generic / Discipline Centric)-II	3	2.5 Elective (Generic / Discipline Centric)-IV	3	3.5 Core Industry Module	3	4.5 Project with Viva-Voce	3
1.6Ability Enhancement Course- Soft Skill -1	2	2.6 Ability Enhancement Course - Soft Skill -2	2	3.6 Ability Enhancement Course- Soft Skill -3	2	4.6 Ability Enhancement Course- Soft Skill -4	2
Skill Enhancement Course SEC 1	2	2.7 Skill Enhancement Course SEC 2	2	3.7 Skill Enhancement Course – Term Paper and Seminar Presentation SEC 3	2	4.7 Skill Enhancement Course - Professional Competency Skill	2
				3.8 Internship/ Industrial Activity	2	4.8 Extension Activity	1
	22		**22**		**24**		**23**
						Total Credit Points	**91**

Core- Papers	**12 x 4 = 48**
Elective (Generic / Discipline Centric)	**8 x 3 = 24**
Ability Enhancement Course- Soft Skill -	**8 x 2 = 16**
Internship/ Industrial Activity	**1 x 2 = 2**
Extension Activity	**1 x 1 = 1**
Total Credits	**91**

Component wise Credit Distribution

Credits	Sem I	Sem II	Sem III	Sem IV	Total
Part A	**18**	**18**	**18**	**18**	**72**
Part B (i) Discipline – Centric / Generic Skill	**2**	**2**	**2**	**2**	**8**
(ii) Soft Skill	**2**	**2**	**2**	**2**	**10**
(iii) Summer Internship / Industrial Training			**2**		
Part C				**1**	**1**
Total	**22**	**22**	**24**	**23**	**91**

Part A component and Part B (i) will be taken into account for CGPA calculation for the postgraduate programme and the other components Part B and Part C have to be completed during the duration of the programme as per the norms, to be eligible for obtaining the PG degree

M.Sc., Mathematics

Programme Specific Outcomes:

PSO1: Acquire good knowledge and understanding, to solve specific theoretical & applied problems in different area of mathematics & statistics.

PSO2: Understand, formulate, develop mathematical arguments, logically and use quantitative models to address issues arising in social sciences, business and other context /fields.

PSO3: To prepare the students who will demonstrate respectful engagement with other's ideas, behaviors, beliefs and apply diverse frames of references to decisions and actions.

To create effective entrepreneurs by enhancing their critical thinking, problem solving, decision making and leadership skill that will facilitate startups and high potential organizations.

To encourage practices grounded in research that comply with employment laws, leading the organization towards growth and development.

Mapping of Course Learning Outcomes (CLOs) with Programme Outcomes (POs) and Programme Specific Outcomes (PSOs) can be carried out accordingly, assigning the appropriate level in the grids

	Pos							PSOs		
	1	2	3	4	5	6	…	1	2	…
CLO1										
CLO2										
CLO3										
CLO4										
CLO5										

2 b. Structure of Course

Course Code	**Course Name**		**Credits**
Lecture Hours: (L) per week	**Tutorial Hours : (T) per week**	**Lab Practice Hours: (P)per week**	**Total: (L+T+P) per week**
Course Category :	**Year & Semester:**	**Admission Year:**	
Pre-requisite			
Links to other Courses			
Learning Objectives: (for teachers: what they have to do in the class/lab/field)			
Course Outcomes: (for students: To know what they are going to learn) **CO1:** **CO2:** **CO3:** **CO4:** **CO5:**			
Recap: (not for examination) Motivation/previous lecture/ relevant portions required for the course) [This is done during 2 Tutorial hours)			
Units	**Contents**		**Required Hours**
I			**18**
II			**18**
III			**18**
IV			**18**
V			**18**
Extended Professional Component (is a part of internal component only, Not to be included in the External Examination question paper)	Questions related to the above topics, from various competitive examinations UPSC / TRB / NET / UGC – CSIR / GATE / TNPSC / others to be solved (To be discussed during the Tutorial hour)		
Skills acquired from the	Knowledge, Problem Solving, Analytical		

course	ability, Professional Competency, Professional Communication and Transferrable Skill	
Learning Resources: • **Recommended Texts** • **Reference Books** • **Web resources**		
Board of Studies Date:		

3. Learning and Teaching Activities

3.1 Topic wise Delivery method

Hour Count	Topic	Unit	Mode of Delivery

3.2 Work Load

The information below is provided as a guide to assist students in engaging appropriately with the course requirements.

Activity	Quantity	Workload periods
Lectures	60	60
Tutorials	15	15
Assignments	5	5
Cycle Test or similar	2	4
Model Test or similar	1	3
University Exam Preparation	1	3
	Total	90 periods

1. **Tutorial Activities**

Tutorial Count	Topic

2. **Laboratory Activities**
3. **Field Study Activities**
4. **Assessment Activities**

Assessment Principles:

Assessment for this course is based on the following principles

1. Assessment must encourage and reinforce learning.
2. Assessment must measure achievement of the stated learning objectives.

3. Assessment must enable robust and fair judgments about student performance.
4. Assessment practice must be fair and equitable to students and give them the opportunity to demonstrate what they learned.
5. Assessment must maintain academic standards.

Assessment Details:

Assessment Item	Distributed Due Date	Weightage	Cumulative Weightage
Assignment 1	3rd week	2%	2%
Assignment 2	6th Week	2%	4%
Cycle Test – I	7th Week	6%	10%
Assignment 3	8th Week	2%	12%
Assignment 4	11th Week	2%	14%
Cycle Test – II	12th Week	6%	20%
Assignment 5	14th Week	2%	22%
Model Exam	15th Week	13%	35%
Attendance	All weeks as per the Academic Calendar	5%	40%
University Exam	17th Week	60%	100%

CONTENTS

m. Home Assignment Questions
n. Tutorial Sheets
o. Remedial Class Record, if any.
p. Projects related to the Course
q. Laboratory Experiments related to the Courses
r. Internal Question Paper
s. External Question Paper
t. Sample Home Assignment Answer Sheets
u. Three best, three middle level and three average Answer sheets
v. Result Analysis (CO wise and whole class)
w. Question Bank for Higher studies Preparation (GATE/Placement)
x. List of mentees and their academic achievements

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SCHOOL OF ARTS AND SCIENCE

DEPARTMENT OF MATHEMATICS

M.Sc- CURRICULUM- 2023-REGULATION

COURSE STRUCTURE

Credit Distribution for PG Programme in Mathematics

	Course Code	Course Title	L	T	P	C
		SEMESTER I				
Part-A	23212AEC11	Algebraic Structures	4	1	0	4
	23212AEC12	Real Analysis I	4	1	0	4
	23212AEC13	Ordinary Differential Equations	4	1	0	4
	23212SEC14_	**Elective-I** (Generic/Discipline Specific) (One from Group A) Programming in C++	4	1	0	3
	23212GSC15_	**Elective-II** (Generic / Discipline Specific) (One from Group B) Discrete Mathematics	4	1	0	3
Part-B	23212 AECC1	Ability Enhancement Compulsory Course (AECC 1) Soft Skill-1	2	-	-	2
	23212SEC1	Skill Enhancement Course-SEC1 Research Methodology	3			2
		Total	**25**	**5**	**0**	**22**
		SEMESTER II				
Part-A	23212AEC21	Advanced Algebra	4	1	0	4
	23212AEC22	Real Analysis II	4	1	0	4
	23212AEC23	Partial Differential Equations	4	1	0	4
	23212GSC24_	**Elective-III** (Generic / Discipline Specific) (One from Group C) Mathematical Statistics	4	1	0	3
	23212MSE25-	**Elective-IV** (Computer / IT related) (One from Group D) Modelling and Simulation with Excel	3	2	0	3
Part-B	23212 SEC2-	Skill Enhancement Course-SEC2 Numerical analysis using SCILAB	3	-	-	2
	23212AECC2-	Ability Enhancement Compulsory Course(AECC 2) Soft Skill-2	2	-	-	2
		Total	**24**	**06**		**22**

		SEMESTER III				
Part-A	23212AEC31	Topology	4	1	0	4
	23212AEC32	Probability Theory	4	1	0	4
	23212AEC33	Complex Analysis	4	1	0	4
	23212AEC34	Core Industry Module	4	1	0	3
	23212GSC35_	**Elective-V** (Generic / Discipline Specific) (One from Group E) Python	4	1	0	3
Part-B	2321IVEV36	**Internship / Industrial Activity** (Carried out in Summer Vacation at the end of I year – 30 hours)	-	-	-	2
	23212SEC3	Skill Enhancement Course-SEC-3 Professional Communication Skill - Term paper & Seminar presentation	3	-	-	2
	23212AECC3-	Ability Enhancement Compulsory Course(AECC 3) Soft Skill-3	2	-	-	2
		Total	**25**	**05**		**24**
		SEMESTER IV				
Part-A	23212AEC41	Functional Analysis	4	1	0	4
	23212AEC42	Differential Geometry	4	1	0	4
	23212AEC43	Mechanics	4	1	0	4
	23212PRW44	Core Project with viva voce	4	-	0	3
	23212GSC45_	**Elective-VI** (Generic / Discipline Specific) (One from Group F) Resource Management Techniques	4	1	0	3
Part-B	23212TCE-	Professional Competency Skill Enhancement Course Training for Competitive Examinations A. Mathematics for NET / UGC - CSIR/ SET / TRB Competitive Examinations (2 hours) B. General Studies for UPSC / TNPSC / Other Competitive Examinations (2 hours) OR C. Mathematics for Advanced Research Studies (4 hours)	4	-	-	2
	23212AECC4-	Ability Enhancement Compulsory Course(AECC 4) Soft Skill-4	2	0	0	2
Part-C	23212EA	Extension Activity	-	-	-	1
		Total	**26**	**04**	**0**	**23**
		Total Credits for the Programme				**91**

Consolidated Table for Credits Distribution

	Category of Courses	Credits for each Course	Number of Courses	Number of Credits in each Category of Courses	Total Credits	Total Credits for the Programme
PART A	Core	4	12	48	72	80 (CGPA)
	Project with viva voce	3	1	3		
	Industry aligned Programmes-	3	1	3		
	Elective (Generic and Discipline Centric)	3	6	18		
PART B (i)	Skill Enhancement (Term paper and Seminar & Generic / Discipline - Centric Skill Courses) (Internal Assessment Only)	2	4	8	8	
PART B (ii)	Ability Enhancement (Soft skill)	2	4	8	10	11 (Non CGPA)
(iii)	Summer Internship	1	2	2		
PART C	Extension Activity	1	1	1	1	
						91

Template for Semester

Code	Category	Title of the Paper	Marks (Max 100)		Duration for UE	Credits
			CIA	UE		
Semester –I						
Part A	Core I		25	75	3 Hrs	4
	Core II		25	75	3 Hrs	4
	Core III		25	75	3 Hrs	4
	Elective I	Elective-I (Choose one from Group-A)	25	75	3 Hrs	3
	Elective II	Elective-I I (Choose one from Group-B)	25	75	3 Hrs	3
Part B	Skill Enhancement Course -SEC 1	(Choose One from group G)	Internal Assessment			2
	Ability Enhancement Course (AECC 1)	Soft Skill I	Performance based assessment			2
Semester-II						
Part A	Core IV		25	75	3 Hrs	4
	Core V		25	75	3 Hrs	4
	Core VI		25	75	3 Hrs	4
	Elective III	Elective-III (Choose one from Group-C)	25	75	3 Hrs	3
	Elective IV	Elective-IV (Choose one from Group-D)	25	75	3 Hrs	3
Part B	Skill Enhancement Course -SEC 2	(Choose one from Group-G)	Internal Assessment			2
	Ability Enhancement Course (AECC 2)	Soft Skill II	Performance based assessment			2
Semester-III						
Part A	Core VII		25	75	3 Hrs	4
	Core VIII		25	75	3 Hrs	4
	Core IX		25	75	3 Hrs	4
	Elective / ED V	Elective-VI /ED-V (Choose one from Group-E)	25	75	3 Hrs	3

	Core Industry Module	ED-IV (Choose from outside the Department)	25	75	3 Hrs	3
Part B						
	Skill based (Term paper and Seminar)	Assignment of problem by the faculty Lecture -I (by the student) 25% Lecture-II (by the student) 25% Lecture-III (by the student) 25% Submission of a write-up (10-15 pages using LaTeX) 25% Marks / Grade Point/ Letter Grade as per the Regulation)				2
	Ability Enhancement Course (AECC 3)	Soft Skill III	Performance based assessment			2
	Internship / Industrial - Vacation Activity					2
Semester-IV						
Part A	Core X		25	75	3 Hrs	4
	Core XI		25	75	3 Hrs	4
	Core XII		25	75	3 Hrs	4
	Project with viva voce XIII		25	75	3 Hrs	3
	Elective VI	Elective-VI (Choose one from Group – F)	25	75	3 Hrs	3
Part B	Skill Enhancement Course -SEC 4	Professional Competency Skill Enhancement Course	Internal Assessment			2
	Ability Enhancement Course (AECC4)	Soft Skill IV	Performance based assessment			2
Part C	Extension Activity	Performance based assessment				1
					Total Credits	**91**

DISCIPLINE SPECIFIC ELECTIVES

Courses are grouped (Group A to Group F) so as to include topics from Pure Mathematics (PM), Applied Mathematics (AM), Industrial Components (IC) and IT Oriented (ITC) courses for flexibility of choice by the stakeholders / institutions.

Semester	Discipline Specific Elective Courses
I	**Elective I** to be chosen from Group A and **Elective II** to be chosen from Group B **Group A: (PM/AP/IC/ITC)** A. Number Theory and Cryptography B. Graph Theory and Applications C. Formal Languages and Automata Theory D. Programming in C++ and Numerical Methods **Group B: (PM/AP/IC/ITC)** A. Lie Groups and Lie Algebras B. Mathematical Programming C. Fuzzy Sets and Their Applications D. Discrete Mathematics
II	**Elective III** to be chosen from **Group C** and **Elective IV** to be chosen from **Group D** **Group C:(PM/AP/IC/ITC)** A. Algebraic Topology B. Mathematical Statistics C. Statistical Data Analysis using R Programming D. Tensor Analysis and Relativity **Group D:(PM/AP/IC/ITC)** A. Wavelets B. Modelling and Simulation with Excel C. Machine Learning and Artificial Intelligence D. Neural Networks
III	**Elective V** to be chosen from Group E. **Group E: (PM/AP/IC/ITC)** A. Algebraic Number Theory B. Fluid Dynamics C. Stochastic Processes D. Python
IV	**Elective VI** to be chosen from Group F. **Group F: (PM/AP/IC/ITC)** A. Algebraic Geometry B. Financial Mathematics C. Resource Management Techniques D. Mathematical Python

SKILL ENHANCEMENT COURSES

Skill Enhancement Courses are chosen so as to keep in pace with the latest developments in the academic / industrial front and provides flexibility of choice by the stakeholders / institutions.

Group G (Skill Enhancement Courses) SEC:

A. Computational Mathematics using SageMath
B. Mathematical documentation using LATEX / other packages
C. Office Automation and ICT Tools
D. Numerical analysis using SCILAB
E. Differential equations using SCILAB
F. Industrial Mathematics /Statistics using latest programming packages
G. Research Tools and Techniques

Ability Enhancement Courses

- Soft Skill courses

Extra Disciplinary Courses for other Departments (not for Mathematics students)

Students from other Departments may also choose any one of the following as Extra Disciplinary Course.

ED-I: Mathematics for Life Sciences

ED-II: Mathematics for Social Sciences

ED-III: Statistics for Life and Social Sciences

ED-IV: Game Theory and Strategy

ED-V: History of Mathematics

Instructions for Course Transaction

Courses	Lecture hrs	Tutorial hrs	Lab Practice	Total hrs
Core	75	15	--	90
Electives	75	15	--	90
ED	75	15	--	90
Lab Practice Courses	45	15	30	90
Project	20	--	70	90

Testing Pattern (25+75)

INTERNAL ASSESSMENT

Theory Course:

For theory courses there shall be three tests conducted by the faculty concerned and the average of the best two can be taken as the Continuous Internal Assessment (CIA) for a maximum of 25 marks. The duration of each test shall be one / one and a half hour.

Computer Laboratory Courses:

For Computer Laboratory oriented Courses, there shall be two tests in Theory part and two tests in Laboratory part. Choose one best from Theory part and other best from the two Laboratory part. The average of the best two can be treated as the CIA for a maximum of 25 marks. The duration of each test shall be one / one and a half hour.

There is no improvement for CIA of both theory and laboratory, and, also for University End Semester Examination.

Written Examination : Theory Paper (Bloom's Taxonomy based)

Question paper Model

Intended Learning Skills	**Maximum 75 Marks** **Passing Minimum: 50%** **Duration : Three Hours**
	Part –A (10x 2 = 20 Marks) Answer ALL questions **Each Question carries 2mark**
Memory Recall / Example/ Counter Example / Knowledge about the Concepts/ Understanding	Two questions from each UNIT
	Question 1 to Question 10
	Part – B (5 x 5 = 25 Marks) **Answer ALL questions** **Each questions carries 5 Marks**
Descriptions/ Application (problems)	**Either-or Type** Both parts of each question from the same UNIT
	Question 11(a) or 11(b) To **Question 15(a) or 15(b)**
	Part-C (3x 10 = 30 Marks) **Answer any THREE questions** Each question carries 10 Marks
Analysis /Synthesis / Evaluation	There shall be FIVE questions covering all the five units
	Question 16 to Question 20

Each question should carry the course outcome and cognitive level

For instance,

1. [CO1 : K2] Question xxxx
2. [CO3 : K1] Question xxxx

Different Types of Courses

(i) Core Courses (Illustrative)

1. Algebra
2. Real Analysis
3. Ordinary Differential Equations
4. Partial Differential Equations
5. Topology
6. Complex Analysis
7. Mechanics
8. Functional Analysis
9. Differential Geometry and more

(ii) Elective Courses (ED within the Department Experts) (Illustrative)

1. Discrete Mathematics
2. Number Theory and Cryptography
3. Formal Languages and Automata Theory
4. Programming in C++ and Numerical Methods
5. Fuzzy Sets and Their Applications
6. Mathematical Programming
7. Algebraic Number Theory
8. Java Programming
9. Analytical Number Theory
10. Tensor Analysis and Relativity
11. Stochastic Processes
12. Algebraic Geometry
13. Fluid Dynamics
14. Financial Mathematics
15. Wavelets
16. Mathematical Statistics and more

(iii)Elective Courses (ED from other Department Experts)

(iv) Skill Development Courses

(v) Institution-Industry-Interaction (Industry aligned Courses)

Programmes /course work/ field study/ Modelling the Industry Problem/ Statistical Analysis / Commerce-Industry related problems / MoU with Industry and the like activities.

FIRST YEAR - SEMESTER I
Part-I
Core Paper
ALGEBRAIC STRUCTURES

Subject Code	Category	L	T	P	S	Credits	Inst. Hours	Marks		
								CIA	External	Total
23212AEC11	CORE	4	1	-	-	4	5	25	75	100

Learning Objectives	
LO1	To introduce the concepts and to develop working knowledge on class equation, solvability of groups, finite abelian groups, linear transformations, real quadratic forms
LO2	Algebra is necessary to help you understand what is important in a sequence of events.
LO3	This course aims to provide a first approach to the subject of algebra, which is one of the basic pillars of modern mathematics.
LO4	The focus of the course will be the study certain structures called groups and some related structures and Application of matrices
LO5	Algebra gives to student a good mathematical maturity and enables to build mathematical thinking and skill.
UNIT	**DETAILS**
I	**UNIT-I :** Counting Principle - Class equation for finite groups and its applications - Sylow's theorems (For theorem 2.12.1, First proof only). **Chapter 2: Sections 2.11 and 2.12 (Omit Lemma 2.12.5)**
II	**UNIT-II :** Solvable groups - Direct products - Finite abelian groups- Modules **Chapter 5 : Section 5.7 (Lemma 5.7.1, Lemma 5.7.2, Theorem 5.7.1)** **Chapter 2: Section 2.13 and 2.14 (Theorem 2.14.1 only)** **Chapter 4: Section 4.5**
III	**UNIT-III :** Linear Transformations: Canonical forms –Triangular form - Nilpotent transformations. **Chapter 6: Sections 6.4, 6.5**
IV	**UNIT-IV :** Jordan form - rational canonical form. **Chapter 6 : Sections 6.6 and 6.7**
V	**UNIT-V:** Trace and transpose - Hermitian, unitary, normal transformations, real quadratic form. **Chapter 6 : Sections 6.8, 6.10 and 6.11 (Omit 6.9)**

Course Outcomes		
CO1	Recall basic counting principle, define class equations to solve problems, explain Sylow's theorems and apply the theorem to find number of Sylow subgroups	PO1
CO2	Define Solvable groups, define direct products, examine the properties of finite abelian groups, define modules	PO1,PO2
CO3	Define similar Transformations, define invariant subspace, explore the properties of triangular matrix, to find the index of nilpotence to decompose a space into invariant subspaces, to find invariants of linear transformation, to explore the properties of nilpotent transformation relating nilpotence with invariants	PO4,PO6
CO4	Define Jordan, canonical form, Jordan blocks, define rational canonical form, define companion matrix of polynomial, find the elementary devices of transformation, apply the concepts to find characteristic polynomial of linear transformation	PO4,PO5, PO6
CO5	Define trace, define transpose of a matrix, explain the properties of trace and transpose, to find trace, to find transpose of matrix, to prove Jacobson lemma using the triangular form, define symmetric matrix, skew symmetric matrix, adjoint, to define Hermitian, unitary, normal transformations and to verify whether the transformation in Hermitian, unitary and normal	PO3,PO8

Text Books (Latest Editions)	
1	I. N. Herstein , Topics in Algebra, Wiley Eastern Ltd. New Delhi, 1975
2	D.T. Finkbeiner, Introduction to Matrices and Linear transformations, CBS Publishers, New Delhi, 1986.
References Books (Latest editions, and the style as given below must be strictly adhered to)	
1	M.Artin, *Algebra,* Prentice Hall of India, 1991
2	P.B.Bhattacharya, S.K.Jain, and S.R.Nagpaul, *Basic Abstract Algebra* (II Edition) Cambridge University Press, 1997. (Indian Edition)
3	I.S.Luther and I.B.S.Passi, *Algebra,* Vol. I –Groups(1996); Vol. II Rings, Narosa Publishing House , New Delhi, 1999
4	D.S.Malik, J.N. Mordeson and M.K.Sen, *Fundamental of Abstract Algebra*, McGraw Hill (International Edition), New York. 1997
5	N.Jacobson, *Basic Algebra*, Vol. I & II W.H.Freeman (1980); also published by Hindustan Publishing Company, New Delhi
Web Resources	
	http://mathforum.org, http://ocw.mit.edu/ocwweb/Mathematics
	http://www.opensource.org, www.algebra.com

Mapping with Programme Outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	3	1	3	2	3	3	3	2	1	3
CO2	2	1	3	1	3	3	3	2	1	2
CO3	3	2	3	1	3	3	3	2	1	3
CO4	1	2	3	2	3	3	3	2	1	1
CO5	3	1	2	3	3	3	3	2	1	3

3 – Strong, 2 – Medium, 1 - Low

Mapping with Programme Specific Outcomes

CO /PSO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	3	3	3
CO2	3	3	3	3	3
CO3	3	3	3	3	3
CO4	3	3	3	3	3
CO5	3	3	3	3	3
Weightage	15	15	15	15	15
Weighted percentage of Course Contribution to POs	3.0	3.0	3.0	3.0	3.0

FIRST YEAR - SEMESTER I
Part-I
Core Paper
REAL ANALYSIS - I

Subject Code	Category	L	T	P	S	Credits	Inst. Hours	Marks		
								CIA	External	Total
23212 AEC 12	CORE	4	1	-	-	4	5	25	75	100

Learning Objectives	
LO1	To work comfortably with functions of bounded variation, Riemann-Stieltjes Integration, convergence of infinite series, infinite product and uniform convergence and its interplay between various limiting operations
LO2	Have the knowledge of basic properties of the field of real numbers.
LO3	Have the knowledge of the series of real numbers and convergence
LO4	Studying the differentiability of real functions and related theorems
LO5	Studying the notion of continuous functions and their properties
UNIT	**DETAILS**
I	**UNIT-I : Functions of bounded variation** - Introduction - Properties of monotonic functions - Functions of bounded variation - Total variation - Additive property of total variation - Total variation on [a, x] as a function of x - Functions of bounded variation expressed as the difference of two increasing functions - Continuous functions of bounded variation. **Chapter – 6 : Sections 6.1 to 6.8** **Infinite Series :** Absolute and conditional convergence - Dirichlet's test and Abel's test - Rearrangement of series - Riemann's theorem on conditionally convergent series. Chapter 8 : Sections 8.8, 8.15, 8.17, 8.18
II	**UNIT-II : The Riemann - Stieltjes Integral** - Introduction - Notation - The definition of the Riemann - Stieltjes integral - Linear Properties - Integration by parts- Change of variable in a Riemann - Stieltjes integral - Reduction to a Riemann Integral – Euler's summation formula - Monotonically increasing integrators, Upper and lower integrals - Additive and linearity properties of upper, lower integrals - Riemann's condition - Comparison theorems. Chapter - 7 : Sections 7.1 to 7.14
III	**UNIT-III : The Riemann-Stieltjes Integral** - Integrators of bounded variation-Sufficient conditions for the existence of Riemann-Stieltjes integrals-Necessary conditions for the existence of RS integrals- Mean value theorems -integrals as a function of the interval – Second fundamental theorem of integral calculus-Change of variable -Second Mean Value Theorem for Riemann integral- Riemann-Stieltjes integrals depending on a parameter- Differentiation under integral sign-Lebesgue criteriaon for existence of Riemann integrals. Chapter - 7 : 7.15 to 7.26

IV	**UNIT-IV : Infinite Series and infinite Products** - Double sequences - Double series - Rearrangement theorem for double series - A sufficient condition for equality of iterated series - Multiplication of series – Cesaro summability - Infinite products. **Chapter - 8 Sec, 8.20, 8.21 to 8.26** **Power series** - Multiplication of power series - The Taylor's series generated by a function - Bernstein's theorem - Abel's limit theorem - Tauber's theorem **Chapter 9 : Sections 9.14 9.15, 9.19, 9.20, 9.22, 9.23**
V	**UNIT-V: Sequences of Functions** – Pointwise convergence of sequences of functions - Examples of sequences of real - valued functions - Uniform convergence and continuity - Cauchy condition for uniform convergence - Uniform convergence of infinite series of functions - Riemann - Stieltjes integration – Non-uniform Convergence and Term-by-term Integration - Uniform convergence and differentiation - Sufficient condition for uniform convergence of a series - Mean convergence. **Chapter -9 Sec 9.1 to 9.6, 9.8,9.9,9.10,9.11, 9.13**

Course Outcomes		
CO1	Analyze and evaluate functions of bounded variation and Rectifiable Curves	PO1
CO2	Describe the concept of Riemann-Stieltjes integral and its properties.	PO1,PO2
CO3	Demonstrate the concept of step function, upper function, Lebesgue function and their integrals.	PO4,PO6
CO4	Construct various mathematical proofs using the properties of Lebesgue integrals and establish the Levi monotone convergence theorem	PO4,PO5, PO6
CO5	Formulate the concept and properties of inner products, norms and measurable functions	PO3,PO8

Text Books (Latest Editions)	
1	Rudin,W. *Principles of Mathematical Analysis*, 3rd Edition. McGraw Hill Company, New York, 1976
2	Tom M.Apostol : *Mathematical Analysis*, 2nd Edition, Addison-Wesley Publishing Company Inc. New York, 1974.
3	R. G. Bartle, "Introduction to Real Analysis", 3rd Ed, 2000, John Wiley & Sons, Inc., New York, NY.

References Books **(Latest editions, and the style as given below must be strictly adhered to)**	
1	Bartle, R.G. *Real Analysis*, John Wiley and Sons Inc., 1976.
2	R.Bartle and D.Sherbert : Introduction to Real Analysis ,John –Wiely and sons , New York
3	Malik,S.C. and Savita Arora. *Mathematical Anslysis*, Wiley Eastern Limited.New Delhi, 1991
4	Sanjay Arora and Bansi Lal, *Introduction to Real Analysis*, Satya

	Prakashan, New Delhi, 1991
5	Gelbaum, B.R. and J. Olmsted, *Counter Examples in Analysis*, Holden day, San Francisco, 1964
6	A.L.Gupta and N.R.Gupta, *Principles of Real Analysis*, Pearson Education, (Indian print) 2003.
Web Resources	
1	http://mathforum.org, http://ocw.mit.edu/ocwweb/Mathematics,
2.	http://www.opensource.org, www.mathpages.com

Mapping with Programme Outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	3	1	3	2	3	3	3	2	3	1
CO2	2	1	3	1	3	3	3	2	3	1
CO3	3	2	3	1	3	3	3	2	3	1
CO4	1	2	3	2	3	3	3	2	3	1
CO5	3	1	2	3	3	3	3	2	2	1

3 – Strong, 2 – Medium, 1 - Low

Mapping with Programme Specific Outcomes

CO /PSO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	3	3	3
CO2	3	3	3	3	3
CO3	3	3	3	3	3
CO4	3	3	3	3	3
CO5	3	3	3	3	3
Weightage	15	15	15	15	15
Weighted percentage of Course Contribution to POs	3.0	3.0	3.0	3.0	3.0

PONNAIYAH RAMAJAYAM INSTITUTE OF SCIENCE & TECHNOLOGY (PRIST)

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FIRST YEAR - SEMESTER I
Part-I
Core Paper
ORDINARY DIFFERENTIAL EQUATIONS

Subject Code	Category	L	T	P	S	Credits	Inst. Hours	Marks		
								CIA	External	Total
23212 AEC 13	CORE	4	1	-	-	4	5	25	75	100

Learning Objectives	
LO1	To develop strong background on finding solutions to linear differential equations with constant and variable coefficients and also with singular points, to study existence and uniqueness of the solutions of first order differential equations
LO2	To model mechanical systems using differential equations.
LO3	To analyse and solve ordinary differential equations.
LO4	To understand numerical methods for solving ordinary differential equations.
LO5	Solve the ordinary differential equations using variation of parameters, undetermined coefficients and by numerical technique.
UNIT	**DETAILS**
I	**UNIT-I : Linear equations with constant coefficients** Second order homogeneous equations-Initial value problems-Linear dependence and independence-Wronskian and a formula for Wronskian-Non-homogeneous equation of order two. **Chapter 2: Sections 1 to 6**
II	**UNIT-II : Linear equations with constant coefficients** Homogeneous and non-homogeneous equation of order n –Initial value problems- Annihilator method to solve non-homogeneous equation- Algebra of constant coefficient operators. **Chapter 2 : Sections 7 to 12**.
III	**UNIT-III : Linear equation with variable coefficients** Initial value problems -Existence and uniqueness theorems – Solutions to solve a non-homogeneous equation – Wronskian and linear dependence – reduction of the order of a homogeneous equation – homogeneous equation with analytic coefficients-The Legendre equation. **Chapter : 3 Sections 1 to 8 (Omit section 9)**
IV	**UNIT-IV :Linear equation with regular singular points** Euler equation – Second order equations with regular singular points – Exceptional cases – Bessel Function. **Chapter 4 : Sections 1 to 4 and 6 to 8 (Omit sections 5 and 9)**
V	**UNIT-V** : Existence and uniqueness of solutions to first order equations: Equation with variable separated – Exact equation – method of successive approximations – the Lipschitz condition – convergence of the successive approximations and the existence theorem. **Chapter 5 : Sections 1 to 6 (Omit Sections 7 to 9)**

Course Outcomes		
CO1	Establish the qualitative behavior of solutions of systems of differential equations	PO1
CO2	Recognize the physical phenomena modeled by differential equations and dynamical systems.	PO1,PO2
CO3	Analyze solutions using appropriate methods and give examples	PO4,PO6
CO4	Formulate Green's function for boundary value problems	PO4,PO5, PO6
CO5	Understand and use various theoretical ideas and results that underlie the mathematics in this course.	PO3,PO8

Text Books (Latest Editions)	
1	. Advanced Engineering Mathematics, E Kreyszig, John Wiley and Sons, Tenth Edition, 2018.
2	. E.A.Coddington, *A introduction to ordinary differential equations* (3rd Printing) Prentice-Hall of India Ltd., New Delhi, 1987.
3	George F Simmons, *Differential equations with applications and historical notes,* Tata McGraw Hill, New Delhi, 1974.

References Books (Latest editions, and the style as given below must be strictly adhered to)	
1	Williams E. Boyce and Richard C. DI Prima, *Elementary differential equations and boundary value problems*, John Wiley and sons, New York, 1967
2	N.N. Lebedev, *Special functions and their applications*, Prentice Hall of India, New Delhi, 1965
3	W.T. Reid. *Ordinary Differential Equations*, John Wiley and Sons, New York, 1971
4	M.D.Raisinghania, *Advanced Differential Equations*, S.Chand & Company Ltd. New Delhi 2001
5	B.Rai, D.P.Choudary and H.I. Freedman, *A Course in Ordinary Differential Equations,* Narosa Publishing House, New Delhi, 2002

Web Resources	
	http://mathforum.org, http://ocw.mit.edu/ocwweb/Mathematics
	http://www.opensource.org, www.mathpages.com

Mapping with Programme Outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	3	1	3	2	3	3	3	2	1	2
CO2	2	1	3	1	3	3	3	2	1	1
CO3	3	2	3	1	3	3	3	2	1	1
CO4	1	2	3	2	3	3	3	2	1	2
CO5	3	1	2	3	3	3	3	2	1	3

3 – Strong, 2 – Medium, 1 - Low

Mapping with Programme Specific Outcomes

CO /PSO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	3	3	3
CO2	3	3	3	3	3
CO3	3	3	3	3	3
CO4	3	3	3	3	3
CO5	3	3	3	3	3
Weightage	15	15	15	15	15
Weighted percentage of Course Contribution to POs	3.0	3.0	3.0	3.0	3.0

FIRST YEAR - SEMESTER I
Part-I
Core Paper
PROGRAMMING IN C++

Subject Code	Category	L	T	P	S	Credits	Inst. Hours	Marks		
								CIA	External	Total
23212SEC14	ELECTIVE-I	4	1	-	-	3	5	25	75	100

Learning Objectives	
LO1	Utilize Object Oriented techniques to design C++ programs
LO2	Use the standard C++ library.
LO3	Exploit advanced C++ techniques
LO4	Constructors and destructors in C++
LO5	Files management and templates in C++
UNIT	**DETAILS**
I	Beginning with C++ - what is C++ - applications — simple program — structure of C program — creating the source file — compiling and linking — tokens, expressions and control structures — user defined data types — derived data types — declarations of variables — reference — variables
II	Operations in C++ - Manipulators — types cast operator — expressions and implicit conversions — operator over loading — operator precedence — control structures — Functions in C — the main function — functions prototyping. call by reference — return by reference — function overloading
III	Class and object — introduction — C structures revisited — C++ program with class — arrays with in class — static member function — arrays of objects — returning objects — returning objects — constant member functions — pointers to members
IV	Constructors and destructors — introduction — constructors — parameterized constructors — multiple constructors in a class — copy constructor — dynamic constructor — two dimensional Arrays — destructors — operators over loading and type conversions — defining operator loading — manipulation strings using operations — type conversions.
V	Inheritance: extending classes — introduction — defining derived classes — single in heritance — multiple inheritance — virtual base classes — abstract classes — nesting classes

Course Outcomes		
CO1	Creating simple programs using classes and objects in C++	PO1
CO2	Implement Object Oriented Programming Concepts in C++	PO1,PO2
CO3	Develop applications using stream I/O and file I/O.	PO4,PO6
CO4	Implement simple graphical user interfaces	PO4,PO5, PO6
CO5	Implement Object Oriented Programs using templates and exceptional handling concepts.	PO3,PO8

Text Books (Latest Editions)	
1	Object Oriented Programming with C++ - E.Balagurusamy
2	C++ Pocket Reference 1st Edition, Kyle Loudon
References Books (Latest editions, and the style as given below must be strictly adhered to)	
1	Object Oriented Programming with C++ - E.Balagurusamy
2	C++ All-in-One For Dummies 3rd Edition, Jeffrey M. Cogswel
Web Resources	
1	*http://www.lmpt.univ-tours.fr/~volkov/C++.pdf*
2.	https://faculty.ksu.edu.sa/sites/default/files/ObjectOrientedProgramminginC4thEdition.pdf

Mapping with Programme Outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	3	1	3	2	3	3	3	2	1	2
CO2	2	1	3	1	3	3	3	2	1	1
CO3	3	2	3	1	3	3	3	2	1	1
CO4	1	2	3	2	3	3	3	2	1	2
CO5	3	1	2	3	3	2	3	2	1	3

3 – Strong, 2 – Medium, 1 - Low

Mapping with Programme Specific Outcomes

CO /PSO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	3	3	3
CO2	3	3	3	3	3
CO3	3	3	3	3	3
CO4	3	3	3	3	3
CO5	3	3	3	3	3
Weightage	15	15	15	15	15
Weighted percentage of Course Contribution to POs	3.0	3.0	3.0	3.0	3.0

FIRST YEAR - SEMESTER I
Part-I
Core Paper
DISCRETE MATHEMATICS

Subject Code	Category	L	T	P	S	Credits	Inst. Hours	Marks		
								CIA	External	Total
23212GSC15	ELECTIVE-II	4	1	-	-	3	5	25	75	100

Learning Objectives	
LO1	Use mathematically correct terminology and notation.
LO2	Construct correct direct and indirect proofs
LO3	Use division into cases in a proof.
LO4	Use counterexamples
LO5	Apply logical reasoning to solve a variety of problems.
UNIT	**DETAILS**
I	**RELATIONS:** Cartesian Product of Two sets – Relations – Representation of Relation-Operations Relations-Equivalence Relation **FUNCTIONS:** Function and Operators- One-to-One , Onto Functions-Special Types of Functions-Invertible Functions- Compositions of Functions
II	**LOGIC:** Introduction-TF –Statements-Connectives-Atomic and Compound Statements-Well Formed (Statements) Formulae-Truth Table of a Formula- Tautology-Tautological Implications and Equivalence of Formulae
III	**LATTICES AND BOOLEAN ALGEBRA** Lattices – Some Properties of Lattices – New Lattices – Modular and Distributive Lattices- Boolean Algebra
IV	**RECURRENCE RELATIONS AND GENERATING FUNCTIONS:** Recurrence an introduction – Polynomials and their Evaluations- Recurrence Relations-Solution of Finite Order Homogeneous (liner) Relations-Solution of Non- homogeneous-Relations-Generating Functions-Some Common Recurrence Relations-Primitive- Recursive Functions- Recursive and Partial Recursive Functions
V	**AUTOMATA,LANUAGES AND COMPUTATIONS:** Introduction-Finite Automata- Definition of Finite Automaton – Representation of Finite Automaton-Acceptability of a string by a Finite Automaton-Languages accepted by a Finite Automaton-Non-deterministic Finite Automata- Acceptability of a String by Non- Deterministic Finite Automata –Equivalence of FA and NFA

Course Outcomes		
CO1	A knowledge of Relations and functions	PO1
CO2	A knowledge of logical reasoning is used in mathematics to prove theorems, in computer science to verify the correctness of programs and to prove theorems in physical science to draw the conclusions..	PO1,PO2
CO3	An ability to find the solutions of Recurrence relations.	PO4,PO6
CO4	A knowledge of to study on ordering relations.	PO4,PO5, PO6
CO5	Determine properties of relations, identify equivalence and partial order relations, sketch relations.	PO3,PO8
Text Books (Latest Editions)		
1	**Dr.M.K. Venkataraman and N. Sridharan.N.Chandrasekaran** **For UNIT 1 -** .Chapter 2: Section 2.1 to 2.21& Chapter 3 Section 3.1 to 3.13 **For UNIT 2 -** Chapter 9: Section 9.1 to 9.30 **For UNIT 3 -** Chapter 10: Section 10.1 to 10.34 **For UNIT 4 -** Chapter 5: Section 5.1 to 5.33 **For UNIT 5 -** Chapter 12: Section 12.1 to 12.18	
References Books (Latest editions, and the style as given below must be strictly adhered to)		
1	Discrete Mathematics by Oscar Levin, 3rd Edition, 3rd Edition	
2	A Textbook of Discrete Mathematics, 9th Edition, By Sarkar, Swapan Kumar	
Web Resources		
	https://discrete.openmathbooks.org/pdfs/dmoi3-tablet.pdf	

Mapping with Programme Outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	3	3	3	3	3	3	3	2	1	2
CO2	2	3	3	3	2	3	3	2	1	2
CO3	3	3	3	2	3	3	3	2	1	2
CO4	3	3	3	3	3	3	3	2	1	2
CO5	3	2	3	3	3	3	3	2	1	3

3 – Strong, 2 – Medium, 1 - Low

Mapping with Programme Specific Outcomes

CO /PSO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	3	3	3
CO2	3	3	3	3	3
CO3	3	3	3	3	3
CO4	3	3	3	3	3
CO5	3	3	3	3	3
Weightage	15	15	15	15	15
Weighted percentage of Course Contribution to POs	3.0	3.0	3.0	3.0	3.0

FIRST YEAR - SEMESTER I

PONNAIYAH RAMAJAYAM INSTITUTE OF SCIENCE & TECHNOLOGY (PRIST)

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FIRST YEAR - SEMESTER I
Part-II
Skill Enhancement Course
RESEARCH TOOLS AND TECHNIQUES

Subject Code	Category	L	T	P	S	Credits	Inst. Hours	Marks		
								CIA	External	Total
23212SEC1	SEC1	3	-	-	-	2	3	25	75	100

Learning Objectives	
LO1	Research methodology is a way of explaining how a researcher intends to carry out their research.
LO2	It's a logical, systematic plan to resolve a research problem.
LO3	A methodology details a researcher's approach to the research to ensure reliable, valid results that address their aims and objectives.
LO4	To inform the students about the basics of how research problems are defined, research methods are adopted and/or developed, research is undertaken, and how research results are communicated to the peers.
LO5	The lectures will cover research methods, some of which are general in nature and the remaining specific to the field of computer science.

UNIT	DETAILS
I	**INTRODUCTION TO RESEARCH METHODOLOGY** Research Methodology- Definition and significance- Types of research - Exploratory research, Conclusive research, Modeling research, Algorithmic research, Casual research, Theoretical and Empirical research, Cross-Sectional research and Time Series research, Research process-, Research problem- Objectives, Characteristics, Hypothesis and research in evolutionary perspective. Research Design- Definition, Types- Descriptive and Experimental Questionnaire preparation- prerequisites of a good questionnaire, Data Collection methods in research -Primary data and Secondary data.
II	**MEASUREMENT, SCALING AND SAMPLING TECHNIQUES AND RESEARCH REPORT PRESENTATION** Validity and Reliability-Definition, importance, types of validity, types of reliability-- Construction and Validation of questionnaire, Cronbach alpha test, Measurement – definition- significance – types Nominal, Ordinal, Interval and Ratio ,Scaling- Importance, Scaling techniques. Sampling methods- Probability sampling methods and Non - Probability sampling methods, Report writing – importance , guideline to write an academic report, Basics of report presentation- Content of an Academic Research report, Content on a Research Article, Steps to publish an article,

	Research Metrics: Significance of Journal Impact Factor, SNIP, SJR, IPP, Cite Score, Metrics: h-index, g index, i10 index,
III	**APPLICATION OF MATHEMATICAL TOOLS FOR ANALYSIS AND RESEARCHREPORT WRITING** Non parametric tests- One sample tests- one sample sign test. Kolmogorov- Smirnov test , Run test for randomness, two sample tests- tow sample sign test, Mann-Whitney U test, K sample test- Kruskal Wallis test (H- test). Hypothesis testing – Testing of hypothesis concerning means (one mean and difference between two means – one tailed and two tailed tests), Concerning Variance – One tailed Chi square test, Analysis of Variance(anova) , Introduction to Discriminant , Factor analysis, cluster analysis, multi-dimensional scaling , conjoint analysis, multiple regression and correlation, application for statistical software for data analysis
IV	**PHILOSOPHY,ETHICS AND SCIENTIFIC CONDUCT** Introduction to philosophy: definition, nature and scope, concept, branches, Ethics: definition, moral philosophy, nature of moral judgments and reactions', Ethics with respect to science and research, Intellectual honest and research integrity, Scientific misconduct: falsification, fabrication, and plagiarism, Redundant publications: duplicate and overlapping publications, salami slicing, Selective reporting and misrepresentation of data.
V	**PUBLICATION ETHICS** Publication ethics: definition, introduction and importance, Best practices/standards setting initiatives and guidelines: COPE, WAME, etc. Conflicts of interest, Publication misconduct: definition, concept, problems that lead to unethical behavior and vice verse, types, Violation of publication ethics, authorship and contributor ship, Identification of publication misconduct, complaints and appeals, Predatory publishers and journals

Course Outcomes		
CO1	Demonstrate the ability to choose methods appropriate to research aims and objectives.	PO1
CO2	Understand the limitations of particular research methods.	PO1,PO2
CO3	Develop skills in qualitative and quantitative data analysis and presentation.	PO4,PO6
CO4	Develop advanced critical thinking skills.	PO4,PO5, PO6
CO5	It helps the researcher achieve goals and save time	PO3,PO8
Text Books (Latest Editions)		

1	Ana smith Iltis," Research Ethics", Publisher: Routledge, ISBN: 0415701589 ,2016 by HAN LUO - 2012
2	Dr.Tripathi, P.C, Research Methodology, 1st Edition, Prentice Hall Inc., 2009
References Books (Latest editions, and the style as given below must be strictly adhered to)	
1	Introducing Research Methodology: A Beginner's Guide to Doing a Research Project by FLICK, UWE. HAN LUO. Northwestern University
2	Kothari, K.C. and Gaurav Garg Research Methodology: Methods And Techniques (Multi Colour Edition,
3	Mr.Suber Peter, Open Access (MIT Press Essential Knowledge series), New age international publishers, 2019
Web Resources	
1	*https://euacademic.org/BookUpload/9.pdf*
2.	https://ccsuniversity.ac.in/bridge-library/pdf/Research-Methodology-CR-Kothari.pdf

Mapping with Programme Outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	3	3	3	3	3	3	3	2	3	2
CO2	2	3	3	3	2	3	3	2	2	2
CO3	3	3	3	2	3	3	3	2	3	2
CO4	3	3	3	3	3	3	3	2	2	2
CO5	3	2	3	3	3	3	3	2	2	3

3 – Strong, 2 – Medium, 1 - Low

Mapping with Programme Specific Outcomes

CO /PSO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	3	3	3
CO2	3	3	3	3	3
CO3	3	3	3	3	3
CO4	3	3	3	3	3
CO5	3	3	3	3	3
Weightage	15	15	15	15	15
Weighted percentage of Course Contribution to POs	3.0	3.0	3.0	3.0	3.0

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FIRST YEAR - SEMESTER II

Part-I

Core Paper

ADVANCED ALGEBRA

Subject Code	Category	L	T	P	S	Credits	Inst. Hours	Marks		
								CIA	External	Total
23212 AEC 21	CORE	4	1	-	-	4	5	25	75	100

Learning Objectives	
LO1	To study field extension, roots of polynomials, Galois Theory, finite fields, division rings, solvability by radicals and to develop computational skill in abstract algebra
LO2	Make sense of problems and persevere in solving them
LO3	Reason abstractly and quantitatively
LO4	Construct viable arguments and critique the reasoning of others
LO5	Look for and make use of structure.

UNIT	DETAILS
I	**UNIT-I :**Extension fields – Transcendence of e. **Chapter 5: Section 5.1 and 5.2**
II	**UNIT-II** : Roots or Polynomials.- More about roots **Chapter 5: Sections 5.3 and 5.5**
III	**UNIT-III :** Elements of Galois theory. **Chapter 5 : Section 5.6**
IV	**UNIT-IV :** Finite fields - Wedderburn's theorem on finite division rings. **Chapter 7: Sections 7.1 and 7.2 (Theorem 7.2.1 only)**
V	**UNIT-V :**Solvability by radicals - A theorem of Frobenius - Integral Quaternions and the Four - Square theorem. **Chapter 5: Section 5.7 (omit Lemma 5.7.1, Lemma 5.7.2 and Theorem 5.7.1)** **Chapter 7 : Sections 7.3 and 7.4**

Course Outcomes		
CO1	Prove theorems applying algebraic ways of thinking.	PO1
CO2	Connect groups with graphs and understanding about Hamiltonian graphs	PO1,PO2
CO3	Compose clear and accurate proofs using the concepts of Galois Theory	PO4,PO6
CO4	Bring out insight into Abstract Algebra with focus on axiomatic theories	PO4,PO5, PO6
CO5	Demonstrate knowledge and understanding of fundamental concepts including extension fields, Algebraic extensions, Finite fields, Class equations and Sylow's theorem	PO3,PO8

Text Books (Latest Editions)

1. D.S.Malik, J.N. Mordeson and M.K.Sen, *Fundamental of Abstract Algebra*, McGraw Hill (International Edition), New York. 1997
2. I.N. Herstein. *Topics in Algebra* (II Edition) Wiley EasternLimited, New Delhi, 1975.
3. N.Jacobson, *Basic Algebra*, Vol. I & II Hindustan Publishing Company, New Delhi

References Books (Latest editions, and the style as given below must be strictly adhered to)	
1	M.Artin, *Algebra*, Prentice Hall of India, 1991
2	P.B.Bhattacharya, S.K.Jain, and S.R.Nagpaul, *Basic Abstract Algebra* (II Edition) Cambridge University Press, 1997. (Indian Edition)
3	I.S.Luther and I.B.S.Passi, *Algebra*, Vol. I –Groups(1996); Vol. II *Rings*,Narosa Publishing House , New Delhi, 1999
4	D.S.Malik, J.N. Mordeson and M.K.Sen, *Fundamental of Abstract Algebra*, McGraw Hill (International Edition), New York. 1997
Web Resources	
	http://mathforum.org, http://ocw.mit.edu/ocwweb/Mathematics
	http://www.opensource.org, www.algebra.com

Mapping with Programme Outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	3	1	3	2	3	3	3	2	1	3
CO2	2	1	3	1	3	3	3	2	1	3
CO3	3	2	3	1	3	3	3	2	1	3
CO4	1	2	3	2	3	3	3	2	1	3
CO5	3	1	2	3	3	3	3	2	1	2

3 – Strong, 2 – Medium, 1 - Low

Mapping with Programme Specific Outcomes

CO /PSO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	3	3	3
CO2	3	3	3	3	3
CO3	3	3	3	3	3
CO4	3	3	3	3	3
CO5	3	3	3	3	3
Weightage	15	15	15	15	15
Weighted percentage of Course Contribution to POs	3.0	3.0	3.0	3.0	3.0

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FIRST YEAR - SEMESTER II
Part-I
Core Paper
REAL ANALYSIS - II

Subject Code	Category	L	T	P	S	Credits	Inst. Hours	Marks		
								CIA	External	Total
23212 AEC 22	CORE	4	1	-	-	4	5	25	75	100

Learning Objectives	
LO1	To introduce measure on the real line, Lebesgue measurability and integrability, Fourier Series and Integrals, in-depth study in multivariable calculus
LO2	This course aims to provide students with the specialist knowledge necessary for basic concepts in Real Analysis
LO3	It strives to enable students to learn basic concepts about functions of bounded variation, grasp basic concepts about the total variation
LO4	To learn about Riemann-Stieltjes integrals ,
LO5	To learn about sequences and series of functions
UNIT	**DETAILS**
I	**UNIT-I :Measure on the Real line** - Lebesgue Outer Measure - Measurable sets - Regularity - Measurable Functions - Borel and Lebesgue Measurability **Chapter - 2 Sec 2.1 to 2.5 (de Barra)**
II	**UNIT-II : Integration of Functions of a Real variable** - Integration of Non- negative functions - The General Integral - Riemann and Lebesgue Integrals **Chapter - 3 Sec 3.1,3.2 and 3.4 (de Barra)**
III	**UNIT-III : Fourier Series and Fourier Integrals** - Introduction - Orthogonal system of functions - The theorem on best approximation - The Fourier series of a function relative to an orthonormal system - Properties of Fourier Coefficients - The Riesz-Fischer Thorem - The convergence and representation problems in for trigonometric series - The Riemann - Lebesgue Lemma - The Dirichlet Integrals - An integral representation for the partial sums of Fourier series - Riemann's localization theorem - Sufficient conditions for convergence of a Fourier series at a particular point –Cesarosummability of Fourier series- Consequences of Fejes's theorem - The Weierstrass approximation theorem **Chapter 11 : Sections 11.1 to 11.15 (Apostol)**
IV	**UNIT-IV : Multivariable Differential Calculus** - Introduction - The Directional derivative - Directional derivative and continuity - The total derivative - The total derivative expressed in terms of partial derivatives - The matrix of linear function - The Jacobian matrix - The chain rule - Matrix form of chain rule - The mean - value theorem for differentiable functions - A sufficient condition for differentiability - A sufficient condition for equality of mixed partial derivatives - Taylor's theorem for functions of R^n to R^1

	Chapter 12 : Section 12.1 to 12.14 (Apostol)
V	**UNIT-V : Implicit Functions and Extremum Problems :** Functions with non-zero Jacobian determinants – The inverse function theorem-The Implicit function theorem-Extrema of real valued functions of severable variables-Extremum problems with side conditions. **Chapter 13 : Sections 13.1 to 13.7 (Apostol)**

Course Outcomes		
CO1	Understand and describe the basic concepts of Fourier series and Fourier integrals with respect to orthogonal system	PO1
CO2	Analyze the representation and convergence problems of Fourier series.	PO1,PO2
CO3	Analyze and evaluate the difference between transforms of various functions	PO4,PO6
CO4	Formulate and evaluate complex contour integrals directly and by the fundamental theorem.	PO4,PO5, PO6
CO5	Apply the Cauchy integral theorem in its various versions to compute contour integration.	PO3,PO8

Text Books (Latest Editions)	
1	Textbook - H.L. Royden , Real Analysis, J Prentice Hall, New Jersey, 1963.

References Books (Latest editions, and the style as given below must be strictly adhered to)	
1	Burkill,J.C.*The Lebesgue Integral*, Cambridge University Press, 1951
2	Munroe,M.E.*Measure and Integration*. Addison-Wesley, Mass.1971
3	Roydon,H.L.*Real Analysis*, Macmillan Pub. Company, New York, 1988.
4	Rudin, W. *Principles of Mathematical Analysis*, McGraw Hill Company, New York,1979
5	Malik,S.C. and Savita Arora. *Mathematical Analysis*, Wiley Eastern Limited. New Delhi, 1991
6	Sanjay Arora and Bansi Lal, *Introduction to Real Analysis*, Satya Prakashan, New Delhi, 1991

Web Resources	
1	http://mathforum.org, http://ocw.mit.edu/ocwweb/Mathematics
2.	http://www.opensource.org

Mapping with Programme Outcomes

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**
CO1	3	1	3	2	3	3	3	2	1	3
CO2	2	1	3	1	3	3	3	2	1	3
CO3	3	2	3	1	3	3	3	2	1	3
CO4	1	2	3	2	3	3	3	2	1	3
CO5	3	1	2	3	3	3	3	2	1	3

3 – Strong, 2 – Medium, 1 - Low

Mapping with Programme Specific Outcomes

CO /PSO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	3	3	3
CO2	3	3	3	3	3
CO3	3	3	3	3	3
CO4	3	3	3	3	3
CO5	3	3	3	3	3
Weightage	15	15	15	15	15
Weighted percentage of Course Contribution to POs	3.0	3.0	3.0	3.0	3.0

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FIRST YEAR - SEMESTER II
Part-I
Core Paper
PARTIAL DIFFERENTIAL EQUATIONS

Subject Code	Category	L	T	P	S	Credits	Inst. Hours	Marks		
								CIA	External	Total
23212 AEC 23	CORE	4	1	-	-	4	5	25	75	100

Learning Objectives	
LO1	To classify the second order partial differential equations and to study Cauchy problem, method of separation of variables, boundary value problems
LO2	A partial differential equation (PDE) is a differential equation that contains an unknown function and its partial derivatives.
LO3	PDEs are used to describe a wide range of natural processes.
LO4	PDEs also play an important role in other areas of mathematics such as analysis and differential geometry.
LO5	To give an introduction to the basic properties of PDEs and to the basic analytical techniques to solve them.

UNIT	DETAILS
I	**UNIT-I :Mathematical Models and Classification of second order equation :**Classical equations-Vibrating string – Vibrating membrane – waves in elastic medium – Conduction of heat in solids – Gravitational potential – Second order equations in two independent variables – canonical forms – equations with constant coefficients – general solution **Chapter 2 : Sections 2.1 to 2.6** **Chapter 3 : Sections 3.1 to 3.4 (Omit 3.5)**
II	**UNIT-II :Cauchy Problem :** The Cauchy problem – Cauchy-Kowalewsky theorem – Homogeneous wave equation – Initial Boundary value problem-Non-homogeneous boundary conditions – Finite string with fixed ends – Non-homogeneous wave equation – Riemann method – Goursat problem – spherical wave equation – cylindrical wave equation. **Chapter 4 : Sections 4.1 to 4.11**
III	**UNIT-III :Method of separation of variables:** Separation of variable-Vibrating string problem – Existence and uniqueness of solution of vibrating string problem - Heat conduction problem – Existence and uniqueness of solution of heat conduction problem – Laplace and beam equations **Chapter 6 : Sections 6.1 to 6.6 (Omit section 6.7)**
IV	**UNIT-IV : Boundary Value Problems :** Boundary value problems – Maximum and minimum principles – Uniqueness and continuity theorem – Dirichlet Problem for a circle , a circular annulus, a rectangle – Dirichlet problem involving Poisson equation – Neumann problem for a circle and a rectangle. **Chapter 8 : Sections 8.1 to 8.9**
V	**UNIT-V : Green's Function:** The Delta function – Green's function – Method of Green's function – Dirichlet Problem for the Laplace and Helmholtz operators – Method of images and eigen functions – Higher

	dimensional problem – Neumann Problem. **Chapter 10 : Section 10.1 to 10.9**

Course Outcomes		
CO1	To understand and classify second order equations and find general solutions	PO1
CO2	To analyse and solve wave equations in different polar coordinates	PO1,PO2
CO3	To solve Vibrating string problem, Heat conduction problem, to identify and solve Laplace and beam equations	PO4,PO6
CO4	To apply maximum and minimum principle's and solve Dirichlet, Neumann problems for various boundary conditions	PO4,PO5, PO6
CO5	To apply Green's function and solve Dirichlet, Laplace problems, to apply Helmholtz operation and to solve Higher dimensional problem	PO3,PO8

Text Books (Latest Editions)	
1	An Introduction of Partial Differential Equations by Walter A Strauss
2	TynMyint-U and Lokenath Debnath, *Partial Differential Equations for Scientists and Engineers* (Third Edition), North Hollan, New York, 1987.

References Books (Latest editions, and the style as given below must be strictly adhered to)	
1	M.M.Smirnov, *Second Order partial Differential Equations*, Leningrad, 1964
2	I.N.Sneddon, *Elements of Partial Differential Equations*, McGraw Hill, New Delhi, 1983
3	R. Dennemeyer, *Introduction to Partial Differential Equations and Boundary Value Problems*, McGraw Hill, New York, 1968.
4	M.D.Raisinghania, *Advanced Differential Equations*, S.Chand & Company Ltd., New Delhi, 2001
5	S, Sankar Rao, *Partial Differential Equations*, 2nd Edition, Prentice Hall of India, New Delhi. 2004

Web Resources	
	http://mathforum.org, http://ocw.mit.edu/ocwweb/Mathematics
	http://www.opensource.org, www.mathpages.com
	https://s2pnd-matematika.fkip.unpatti.ac.id/wp-content/uploads/2019/03/Walter-A-Strauss-Partial-differential-equations-_-an-introduction-Wiley-2009.pdf

Mapping with Programme Outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	3	1	3	2	3	3	3	2	1	3
CO2	2	1	3	1	3	3	3	2	1	3
CO3	3	2	3	1	3	3	3	2	1	3
CO4	1	2	3	2	3	3	3	2	1	3
CO5	3	1	2	3	3	3	3	2	1	3

3 – Strong, 2 – Medium, 1 - Low

Mapping with Programme Specific Outcomes

CO /PSO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	3	3	3
CO2	3	3	3	3	3
CO3	3	3	3	3	3
CO4	3	3	3	3	3
CO5	3	3	3	3	3
Weightage	15	15	15	15	15
Weighted percentage of Course Contribution to POs	3.0	3.0	3.0	3.0	3.0

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FIRST YEAR - SEMESTER II
Part-I
Elective Paper
MATHEMATICAL STATISTICS

Subject Code	Category	L	T	P	S	Credits	Inst. Hours	Marks		
								CIA	External	Total
23212GSC24	ELECTIVE-III	4	1	-	-	3	5	25	75	100

Learning Objectives	
LO1	Statistics provides the methodology for the planning and execution for any scientific enquiry, which has been accepted as a valid tool in this content. In this course Central Limit Theorem, Discrete and Continuous Distributions, Small and Large Sampling would be taught.
LO2	In this course Central Limit Theorem, Discrete and Continuous Distributions, Small and Large Sampling would be taught.
LO3	To understand the basic principles underlying statistical inference
LO4	It will formulate complete, concise, and correct mathematical proofs.
LO5	It will frame problems using multiple mathematical and statistical representations of relevant structures and relationships and solve using standard techniques.
UNIT	**DETAILS**
I	Chebychev's inequality and weak law of large numbers — Simple form of central limit theorem for i.i.d random variables
II	Binomial, Poisson, Negative binomial, geometric distribution — Constants, moment generating function, Cumulant generating function.
III	Continuous distribution — rectangular, exponential, beta, gamma distributions, Normal Distributions.
IV	Test of Hypothesis—Null and alternative hypothesis(Concept only) One tail and two tail tests, tests of significance based on normal and t distribution for mean, simple correlation and properties.
V	Test of significance based on chi square and F distributions for variance, test for goodness of fit and independence of attributes Analysis of variance — One way and two — way classifications with simple problems.

Course Outcomes		
CO1	Understand the concept of Tchebychev's inequality and Applications of Central Limit Theorem.	PO1
CO2	Understand the concept of Bivariate Distribution.	PO1,PO2
CO3	A knowledge of test of significance based on parametric and non – parametric test.	PO4,PO6
CO4	Understood the concept of sampling theory.	PO4,PO5, PO6
CO5	Learned the concept of chi square, F-Test and ANOVA.	PO3,PO8
Text Books (Latest Editions)		
1	Fundamentals of Mathematical Statistics — S.C.Gupta and V.K.Kapoor, Sultan Chand & Sons, New Delhi	
References Books (Latest editions, and the style as given below must be strictly adhered to)		
1	Fundamentals of Applied Statistics - S.C.Gupta and V.K.Kapoor. Sultan Chand & Sons.	
2	Elementary Statistical Methods – S.P.Gupta, Sultan Chand & Sons, New Delhi.	
Web Resources		
	https://www.dcpehvpm.org/E-Content/Stat/FUNDAMENTAL%20OF%20MATHEMATICAL%20STATISTICS-S%20C%20GUPTA%20&%20V%20K%20KAPOOR.pdf	

Mapping with Programme Outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	3	3	3	3	3	3	3	2	3	1
CO2	2	3	3	3	2	3	3	2	3	1
CO3	3	3	3	2	3	3	3	2	3	1
CO4	3	3	3	3	3	3	3	2	3	1
CO5	3	2	3	3	3	3	3	2	3	2

3 – Strong, 2 – Medium, 1 - Low

Mapping with Programme Specific Outcomes

CO /PSO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	3	3	3
CO2	3	3	3	3	3
CO3	3	3	3	3	3
CO4	3	3	3	3	3
CO5	3	3	3	3	3
Weightage	15	15	15	15	15
Weighted percentage of Course Contribution to POs	3.0	3.0	3.0	3.0	3.0

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FIRST YEAR - SEMESTER II

Part-I

Elective Paper

MODELLING AND SIMULATION WITH EXCEL

Subject Code	Category	L	T	P	S	Credits	Inst. Hours	Marks		
								CIA	External	Total
23212MSE25	ELECTIVE-IV	3	2	-	-	3	5	25	75	100

Learning Objectives	
LO1	Define the basics of simulation modeling and replicating the practical situations in organizations
LO2	Generate random numbers and random variates using different techniques.
LO3	Develop simulation model using heuristic methods.
LO4	Analysis of Simulation models using input analyzer, and output analyzer
LO5	Explain Verification and Validation of simulation model.
UNIT	**DETAILS**
I	**Introduction to Simulation:** Simulation, Advantages, Disadvantages, Areas of application, System environment, components of a system, Model of a system, types of models, steps in a simulation study. Simulation Examples: Simulation of Queuing systems, Simulation of Inventory System, Other simulation examples.
II	**General Principles:** Concepts in discrete - event simulation, event scheduling/ Time advance algorithm, simulation using event scheduling. Random Numbers: Properties, Generations methods, Tests for Random number- Frequency test, Runs test, Autocorrelation test.
III	**Random Variate Generation:** Inverse Transform Technique- Exponential, Uniform, Weibull, Triangular distributions, Direct transformation for Normal and log normal Distributions, convolution methods- Erlang distribution, Acceptance Rejection Technique Optimisation Via Simulation: Meaning, difficulty, Robust Heuristics, Random Search.
IV	**Analysis of Simulation Data Input Modelling:** Data collection, Identification and distribution with data, parameter estimation, Goodness of fit tests, Selection of input models without data, Multivariate and time series analysis. Verification and Validation of Model – Model Building, Verification, Calibration and Validation of Models.
V	**Output Analysis** – Types of Simulations with Respect to Output Analysis, Stochastic Nature of output data, Measures of Performance and their estimation, Output analysis of terminating simulation, Output analysis of steady state simulations. Simulation Softwares: Selection of Simulation Software, Simulation packages, Trend in Simulation Software.

Course Outcomes		
CO1	Describe the role of important elements of discrete event simulation and modeling paradigm.	PO1
CO2	Conceptualize real world situations related to systems development decisions, originating from source requirements and goals.	PO1,PO2
CO3	Develop skills to apply simulation software to construct and execute goal-driven system models.	PO4,PO6
CO4	Interpret the model and apply the results to resolve critical issues in a real world environment.	PO4,PO5, PO6

Text Books (Latest Editions)	
1	Jerry Banks, John S Carson, II, Berry L Nelson, David M Nicol, Discrete Event system Simulation, Pearson Education, Asia, 4th Edition, 2007, ISBN: 81-203-2832-9.
2	Geoffrey Gordon, System Simulation, Prentice Hall publication, 2nd Edition, 1978, ISBN: 81-203-0140-4.
References Books (Latest editions, and the style as given below must be strictly adhered to)	
1	Averill M Law, W David Kelton, Simulation Modelling & Analysis, McGraw Hill International Editions – Industrial Engineering series, 4th Edition, ISBN: 0-07-100803-9.
2	Narsingh Deo, Systems Simulation with Digital Computer, PHI Publication (EEE), 3rd Edition, 2004, ISBN : 0-87692-028-8.
Web Resources	
	https://industri.fatek.unpatti.ac.id/wp-content/uploads/2019/03/108-Simulation-Modeling-and-Analysis-Averill-M.-Law-Edisi-5-2014.pdf
	https://faculty.ksu.edu.sa/sites/default/files/index.pdf

Mapping with Programme Outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	3	3	3	3	3	3	3	2	3	2
CO2	2	3	3	3	2	3	3	2	2	2
CO3	3	3	3	2	3	3	3	2	3	2
CO4	3	3	3	3	3	3	3	2	2	2
CO5	3	2	3	3	3	3	3	2	2	3

3 – Strong, 2 – Medium, 1 - Low

Mapping with Programme Specific Outcomes

CO /PSO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	3	3	3
CO2	3	3	3	3	3
CO3	3	3	3	3	3
CO4	3	3	3	3	3
CO5	3	3	3	3	3
Weightage	15	15	15	15	15
Weighted percentage of Course Contribution to POs	3.0	3.0	3.0	3.0	3.0

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FIRST YEAR - SEMESTER II
Part-II
Skill Enhancement Course
NUMERICAL ANALYSIS USING SCIAB

Subject Code	Category	L	T	P	S	Credits	Inst. Hours	Marks		
								CIA	External	Total
23212SEC2	SEC2	3	-	-	-	2	3	25	75	100

Learning Objectives	
LO1	To make the students aware for SCILAB programming environment.
LO2	Students will understand the basics of SCILAB software and codes development.
LO3	Students able to Perform basic mathematical operations using Scilab software.
LO4	Students able to Perform Execute loops and conditional statements using Scilab software.
LO5	Analyze different types of data using plotting functions in Scilab software.
UNIT	**DETAILS**
I	**Introduction of scilab** About Scilab and its benefits-Scilab is reliable-Use of Scilab in CNES-Use of Scilab for space mission analysis and flight dynamics- Industrial application of scilab-Matrix calculation inScilab-Installing Scilab-Expression: Show Mathematical Expressions with numbers- Variables-Dairy command-Define Symbolic constants- Basic functions-Suppressing output-conditional branching- 'if 'and 'then' with the example-use of the 'Else' keyword-use of the 'else if' keyword-example of select- iteration-symbol of 'for' statement-Scripts and functions
II	**Vector Operations and Matrix Operations** Define vector- Calculate length of a vector- Perform mathematical operations on Vectors such as Addition, Subtraction and Multiplication. Define a matrix- Calculate Size of matrix –perform mathematical operations on matrices-such as addition, subtraction and multiplication-matrix operation-Access the elements of matrix, Determine the determinant, inverse and eigen values of the matrix-Define special matrices- Perform Elementary row operations-Solve the system of linear equations.
III	Ordinary Differential Equations Solving ODEs using eulers metheds-solve ODEs using Euler and Modified Euler Methods Develop Scilab code to solve ODEs-Plot the Solution
IV	**Solving linear Equations** Explain Gauss Elimination Method algorithm-Explain code for Gauss Elimination method and solve an Example using this code-Explain Gauss Jordon method algorithm –Explain code for gauss Jordon method algorithm-Explain code of Gauss Jordon method and solve an example using this code-Solve system of linear equations using iterative methods- Use Jacobi and

	Gauss Seidal Non-linear Methods
V	**Solving Non-Linear Equations** Numerical Methods-Solving non-linear Equations-Learn How to Solve Nonlinear equations using numerical methods- Learn Bisection Method- Learn Secant Method- Learn how to develop Scilab code for solving nonlinear equations

Course Outcomes		
CO1	The Course content will enable the students to learn basics of SCILAB codes for vectors, matrix, ordinary differential equations, Linear and Non-Linear Equations	PO1
CO2	The study of approximation techniques for numerically solving mathematical problems.	PO1,PO2
CO3	Scilab is based on methods of numerical computation: Data analysis. Algorithm development.	PO4,PO6
CO4	Students will able to design various system models using the Xcos simulator.	PO4,PO5, PO6
CO5	Students will able to design applications with Scilab GUI toolbox.	PO3,PO8

Text Books (Latest Editions)	
1	SCILAB –A Beginner's Approach 1st Edition, by Anil Kumar Verma
References Books (Latest editions, and the style as given below must be strictly adhered to)	
1	Scilab Textbook Companion for Numerical Methods For Scientific And Engineering Computation by M. K. Jain, S. R. K. Iyengar And R. K. Jain
2	Scilab Textbook Companion for Numerical Methods: Principles, Analysis, And Algorithms by S. Pal
3	
Web Resources	
	https://cdn-cms.f-static.com/uploads/1707486/normal_5c5eb5e3d9e91.pdf

Mapping with Programme Outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	3	3	3	3	3	3	3	2	3	2
CO2	2	3	3	3	2	3	3	2	2	2
CO3	3	3	3	2	3	3	3	2	3	2
CO4	3	3	3	3	3	3	3	2	2	2
CO5	3	2	3	3	3	3	3	2	2	3

3 – Strong, 2 – Medium, 1 - Low

Mapping with Programme Specific Outcomes

CO /PSO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	3	3	3
CO2	3	3	3	3	3
CO3	3	3	3	3	3
CO4	3	3	3	3	3
CO5	3	3	3	3	3
Weightage	15	15	15	15	15
Weighted percentage of Course Contribution to POs	3.0	3.0	3.0	3.0	3.0

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SECOND YEAR - SEMESTER III
Part-I
Core Paper
TOPOLOGY

Subject Code	Category	L	T	P	S	Credits	Inst. Hours	Marks		
								CIA	External	Total
23212 AEC 31	CORE	4	1	-	-	4	5	25	75	100

Learning Objectives	
LO1	To explore the foundations of mathematics (logic and set theory) at a level and depth appropriate for someone aspiring to study higher-level mathematics and/or to become a professional mathematician.
LO2	To present an introduction to the field of topology, with emphasis on those aspects of the subject that are basic to higher mathematics.
LO3	To introduce the student to what it means to do mathematics, as opposed to learning about mathematics or to learning to do computational exercises.
LO4	To help the student learn how to write mathematical text according to the standards of the profession.
LO5	Demonstrate an understanding of the concepts of metric spaces and topological spaces, and their role in mathematics.
UNIT	**DETAILS**
I	**TOPOLOGICAL SPACES:** Topological spaces'- Basis for a topology- The order topology -The product topology on $\boldsymbol{X \times Y}$ - The subspace topology - Closed sets and limit points
II	**CONTINUOUS FUNCTIONS:** Continuous functions - the product topology -The metric topology
III	**CONNECTEDNESS:** Connected spaces- connected subspaces of the Real line -Components and local connectedness.
IV	**COMPACTNESS:** Compact spaces -compact subspaces of the Real line - Limit Point Compactness -Local Compactness.
V	**COUNTABILITY AND SEPERATION AXIOMS**: The Countability Axioms - The separation Axioms - Normal spaces -The Urysohn Lemma -The Urysohn metrization Theorem - The Tietz extension theorem.'

Course Outcomes		
CO1	Understand terms, definitions and theorems related to topology	PO1
CO2	Demonstrate knowledge and understanding of concepts such as open and closed sets, interior, closure and boundary.	PO1,PO2
CO3	Create new topological spaces by using subspace, product and quotient topologies	PO4,PO6
CO4	Use continuous functions and homeomorphisms to understand structure of topological spaces.	PO4,PO5, PO6
CO5	Demonstrate knowledge and understanding of metric spaces.	

		PO3,PO8
Text Books (Latest Editions)		
1	Topology 2nd edition, James Munkres, Pearson publishing, ISBN-13: 9780131816299	
References Books (Latest editions, and the style as given below must be strictly adhered to)		
1	Topology by J.Dugundji 1975. Prentice Hall of India, New Delhi.	
2	Introduction to Topology and Modern Analysis by George F.Sinmon 1963. McGraw Hill Book Co	
3	General Topology by J.L.Kelly . Van Nostrand, Reinhold Co., New York	
Web Resources		
1	http://mathforum.org, http://ocw.mit.edu/ocwweb/Mathematics	
2.	http://www.opensource.org , http://en.wikipedia.org	

Mapping with Programme Outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	3	1	3	2	3	3	3	2	3	3
CO2	2	1	3	1	3	3	3	2	2	3
CO3	3	2	3	1	3	3	3	2	3	3
CO4	1	2	3	2	3	3	3	2	2	3
CO5	3	1	2	3	3	3	3	2	2	3

3 – Strong, 2 – Medium, 1 - Low

Mapping with Programme Specific Outcomes

CO /PSO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	3	3	3
CO2	3	3	3	3	3
CO3	3	3	3	3	3
CO4	3	3	3	3	3
CO5	3	3	3	3	3
Weightage	15	15	15	15	15
Weighted percentage of Course Contribution to POs	3.0	3.0	3.0	3.0	3.0

SECOND YEAR - SEMESTER III
Part-I
Core Paper
PROBABILITY THEORY

Subject Code	Category	L	T	P	S	Credits	Inst. Hours	Marks		
								CIA	External	Total
23212 AEC 32	CORE	4	1	-	-	4	5	25	75	100

Learning Objectives	
LO1	To introduce axiomatic approach to probability theory, to study some statistical characteristics, discrete and continuous distribution functions and their properties, characteristic function and basic limit theorems of probability
LO2	The probability estimate is computed using mathematical equations that manipulate the data to determine the likelihood of an independent event occurring
LO3	An independent event is an event whose outcome is not influenced by prior events.
LO4	The probability theory is very much helpful for making prediction
LO5	Estimates and predictions form an important part of research investigation.
UNIT	**DETAILS**
I	**UNIT-I : Random Events and Random Variables:** Random events – Probability axioms – Combinatorial formulae – conditional probability – Bayes Theorem – Independent events – Random Variables – Distribution Function – Joint Distribution – Marginal Distribution – Conditional Distribution – Independent random variables – Functions of random variables. **Chapter 1: Sections 1.1 to 1.7** **Chapter 2 : Sections 2.1 to 2.9**
II	**UNIT-II : Parameters of the Distribution :** Expectation- Moments – The Chebyshev Inequality – Absolute moments – Order parameters – Moments of random vectors – Regression of the first and second types. **Chapter 3 : Sections 3.1 to 3.8**
III	**UNIT-III: Characteristic functions :** Properties of characteristic functions – Characteristic functions and moments – semi0invariants – characteristic function of the sum of the independent random variables – Determination of distribution function by the Characteristic function – Characteristic function of multidimensional random vectors – Probability generating functions. **Chapter 4 : Sections 4.1 to 4.7**
IV	**UNIT-IV : Some Probability distributions:** One point , two point , Binomial – Polya – Hypergeometric – Poisson (discrete) distributions – Uniform – normal gamma – Beta – Cauchy and Laplace (continuous) distributions. **Chapter 5 : Section 5.1 to 5.10 (Omit Section 5.11)**
V	**UNIT-V: Limit Theorems :** Stochastic convergence – Bernaulli law of large numbers – Convergence of sequence of distribution functions – Levy-Cramer Theorems – de Moivre-Laplace Theorem – Poisson, Chebyshev, Khintchine Weak law of large numbers – Lindberg Theorem – Lapunov Theroem – Borel-Cantelli Lemma - Kolmogorov Inequality and Kolmogorov Strong Law of

	large numbers. **Chapter 6 : Sections 6.1 to 6.4, 6.6 to 6.9 , 6.11 and 6.12. (Omit Sections 6.5, 6.10,6.13 to 6.15)**

Course Outcomes		
CO1	To define Random Events, Random Variables, to describe Probability, to apply Bayes, to define Distribution Function, to find Joint Distribution function, to find Marginal Distribution and Conditional Distribution function, to solve functions on random variables.	PO1
CO2	To define Expectation, Moments and Chebyshev Inequality, to solve Regression of the first and second types	PO1,PO2
CO3	To define Characteristic functions, to define distribution function, to find probability generating functions, to solve problems applying characteristic functions	PO4,PO6
CO4	To define One point, two-point, Binomial distributions, to solve problems of Hypergeometric and Poisson distributions, to define Uniform, normal, gamma, Beta distributions, to solve problems on Cauchy and Laplace distributions	PO4,PO5, PO6
CO5	To discuss Stochastic convergence, Bernaulli law of large numbers, to elaborate Convergence of sequence of distribution functions, to prove Levy-Cramer Theorems and de Moivre-Laplace Theorems, to explain Poisson, Chebyshev, Khintchine Weak law of large numbers, to explain and solve problems on Kolmogorov Inequality and Kolmogorov Strong Law of large numbers	PO3,PO 8

Text Books (Latest Editions)	
1	**An Introduction to Probability Theory and Its Applications, Volume 1 (Hardcover)** by William Feller
2	BASIC PROBABILITY THEORY Robert B. Ash Department of Mathematics University of Illinois DOVER PUBLICATIONS, INC. Mineola, New York

References Books **(Latest editions, and the style as given below must be strictly adhered to)**	
1	R.B. Ash, *Real Analysis and Probability*, Academic Press, New York, 1972
2	K.L.Chung, *A course in Probability*, Academic Press, New York, 1974.
3	R.Durrett, *Probability : Theory and Examples*, (2nd Edition) Duxbury Press, New York, 1996.
4	V.K.Rohatgi*An Introduction to Probability Theory and Mathematical Statistics*, Wiley Eastern Ltd., New Delhi, 1988(3rd Print).
5	S.I.Resnick, *A Probability Path*, Birhauser, Berlin,1999
6	B.R.Bhat , *Modern Probability Theory* (3rd Edition), New Age International (P)Ltd, New Delhi, 1999

Web Resources	
1	http://mathforum.org, http://ocw.mit.edu/ocwweb/Mathematics
2.	http://www.opensource.org, http://www.probability.net
3	https://faculty.math.illinois.edu/~r-ash/BPT/BPT.pdf

Mapping with Programme Outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	3	1	3	2	3	3	3	2	1	2
CO2	2	1	3	1	3	3	3	2	1	1
CO3	3	2	3	1	3	3	3	2	1	1
CO4	1	2	3	2	3	3	3	2	1	2
CO5	3	1	2	3	3	3	3	2	1	3

3 – Strong, 2 – Medium, 1 - Low

Mapping with Programme Specific Outcomes

CO /PSO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	3	3	3
CO2	3	3	3	3	3
CO3	3	3	3	3	3
CO4	3	3	3	3	3
CO5	3	3	3	3	3
Weightage	15	15	15	15	15
Weighted percentage of Course Contribution to POs	3.0	3.0	3.0	3.0	3.0

SECOND YEAR - SEMESTER III
Part-I
Core Paper
COMPLEX ANALYSIS

Subject Code	Category	L	T	P	S	Credits	Inst. Hours	Marks		
								CIA	External	Total
23212 AEC 33	CORE	4	1	-	-	4	5	25	75	100

Learning Objectives	
LO1	To Study Cauchy integral formula, local properties of analytic functions, general form of Cauchy's theorem and evaluation of definite integral and harmonic functions
LO2	This course is aimed to provide an introduction to the theories of functions of complex variables;
LO3	To study the techniques of complex variables and functions together with their derivatives, Contour integration and transformations.
LO4	To study complex power series, classification of singularities,
LO5	To study calculus of residues and its applications in the evaluation of integrals, and other concepts and properties.
UNIT	**DETAILS**
I	**UNIT-I : Cauchy's Integral Formula:** The Index of a point with respect to a closed curve – The Integral formula – Higher derivatives. Local Properties of analytical Functions: Removable Singularities-Taylors's Theorem – Zeros and poles – The local Mapping – The Maximum Principle. **Chapter 4 : Section 2 : 2.1 to 2.3** **Chapter 4 : Section 3 : 3.1 to 3.4**
II	**UNIT-II :The general form of Cauchy's Theorem :** Chains and cycles- Simple Continuity - Homology - The General statement of Cauchy's Theorem - Proof of Cauchy's theorem - Locally exact differentials- Multiply connected regions - Residue theorem - The argument principle. **Chapter 4 : Section 4 : 4.1 to 4.7** **Chapter 4 : Section 5: 5.1 and 5.2**
III	**UNIT-III :Evaluation of Definite Integrals and Harmonic Functions** Evaluation of definite integrals - Definition of Harmonic function and basic properties - Mean value property - Poisson formula. **Chapter 4 : Section 5 : 5.3** **Chapter 4 : Sections 6 : 6.1 to 6.3**
IV	**UNIT-IV :Harmonic Functions and Power Series Expansions:** Schwarz theorem - The reflection principle - Weierstrass theorem – Taylor's Series – Laurent series . **Chapter 4 : Sections 6.4 and 6.5** **Chapter 5 : Sections 1.1 to 1.3**
V	**UNIT-V: Partial Fractions and Entire Functions:** Partial fractions - Infinite products – Canonical products – Gamma Function- Jensen's formula – Hadamard's Theorem

	Chapter 5 : Sections 2.1 to 2.4 **Chapter 5 : Sections 3.1 and 3.2**

Course Outcomes		
CO1	Analyze and evaluate local properties of analytical functions and definite integrals.	PO1
CO2	Describe the concept of definite integral and harmonic functions	PO1,PO2
CO3	Demonstrate the concept of the general form of Cauchy's theorem	PO4,PO6
CO4	Develop Taylor and Laurent series .	PO4,PO5, PO6
CO5	Explain the infinite products, canonical products and jensen's formula	PO3,PO8

Text Books (Latest Editions)	
1	Lars V. Ahlfors, *Complex Analysis*, (3rd edition) McGraw Hill Co., New York, 1979
References Books (Latest editions, and the style as given below must be strictly adhered to)	
1	H.A. Presfly, *Introduction to complex Analysis*, Clarendon Press, oxford, 1990
2	J.B. Conway, *Functions of one complex variables* Springer - Verlag, International student Edition, Naroser Publishing Co.1978
3	E. Hille, *Analytic function Thorey* (2 vols.), Gonm& Co, 1959.
4	M.Heins, *Complex function Theory*, Academic Press, New York,1968
Web Resources	
	http://mathforum.org, http://ocw.mit.edu/ocwweb/Mathematics
	http://www.opensource.org , http://en.wikipedia.org

Mapping with Programme Outcomes

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**
CO1	3	1	3	2	3	3	3	2	1	3
CO2	2	1	3	1	3	3	3	2	1	3
CO3	3	2	3	1	3	3	3	2	1	3
CO4	1	2	3	2	3	3	3	2	1	3
CO5	3	1	2	3	3	3	3	2	1	3

3 – Strong, 2 – Medium, 1 - Low

Mapping with Programme Specific Outcomes

CO /PSO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	3	3	3
CO2	3	3	3	3	3
CO3	3	3	3	3	3
CO4	3	3	3	3	3
CO5	3	3	3	3	3
Weightage	15	15	15	15	15
Weighted percentage of Course Contribution to POs	3.0	3.0	3.0	3.0	3.0

PONNAIYAH RAMAJAYAM INSTITUTE OF SCIENCE & TECHNOLOGY (PRIST)

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SECOND YEAR - SEMESTER III
Part-I
Core Paper
INDUSTRY MODULES

Subject Code	Category	L	T	P	S	Credits	Inst. Hours	Marks		
								CIA	External	Total
23212 AEC 34	CORE	4	1	-	-	3	5	25	75	100

Learning Objectives	
LO1	The course aims at building capabilities in the students for analysing different situations in the industrial/ business scenario involving limited resources and finding the optimal solution within constraints.
LO2	To enable the student to understand and analyse managerial and engineering problems to equip him to use the resources such as capitals, materials, productions, controlling, directing, staffing, and machines more effectively and Statistics provides the methodology for the planning and execution for any scientific enquiry, which has been accepted as a valid tool in this content.
LO3	In this course Central Limit Theorem, Discrete and Continuous Distributions, Small and Large Sampling would be taught.
LO4	The course discusses the basic statistical theory that is frequently used in econometric analysis.
LO5	Students will frame problems using multiple mathematical and statistical representations of relevant structures and relationships and solve using standard techniques.
UNIT	**DETAILS**
I	Introduction to OR-Meaning and scope of O.R, Definition of O.R, LPP (Linear Programming Problem). Formulation of LPP, graphical solution of LPP-Problems.
II	Transportation problem- Its definition, feasible solution by North-West corner rule, matrix minima VAM methods. Optimal solution through MODI & stepping stone method for balanced and unbalanced transportation problem..
III	PERT and CPM network - critical and sub critical jobs -Determining the critical path. Network calculation PERT networks probability aspect of PERT- PERT time -PERT cist (omitting Crashing)
IV	Test of Hypothesis-Null and alternative hypothesis(Concept only) One tail and two tail tests, tests of significance based on normal and t-distribution for mean, simple correlation and properties.
V	Test of significance based on chi square and F-distributions for variance, test for goodness of fit and independence of attributes Analysis of variance -One way and two - way classifications with simple problems.

Course Outcomes		
CO1	Students using OR techniques in business tools for decision making	PO1
CO2	Students develop PERT and CPM networks and finding the shortest	PO1,PO2

	path	
CO3	Understand the concept of sequencing problems and game theory	PO4,PO6
CO4	Students gets the knowledge about inventory theory	PO4,PO5, PO6
CO5	Understand the concept of Bivariate Distribution.	PO3, PO8
Text Books (Latest Editions)		
1	Operations Research by Kantiswarup, P.K. Gupta and Manmohan.	
2	Fundamentals of Mathematical Statistics — S.C.Gupta and V.K.Kapoor, Sultan Chand & Sons, New Delhi.	
References Books (Latest editions, and the style as given below must be strictly adhered to)		
1	Fundamentals of Applied Statistics — S.C.Gupta and V.K.Kapoor. Sultan Chand & Sons.	
2	Resource Management Techniques (Operations Research) V.Sundaresan, K.S. Ganapathy Subramanian, K. Ganesan.	
Web Resources		
1	*https://mdu.ac.in/UpFiles/UpPdfFiles/2021/Jun/4_06-11-2021_16-06-34_OPERATIONS%20RESEARCH%20TECHNIQUES(20MAT22C5).pdf*	
2.	https://www.amirajcollege.in/wp-content/uploads/2020/10/3151910-operations-research-theory-and-applications-by-j.-k.-sharma-z-lib.org_.pdf	
	https://www.dcpehvpm.org/E-Content/Stat/FUNDAMENTAL%20OF%20MATHEMATICAL%20STATISTICS-S%20C%20GUPTA%20&%20V%20K%20KAPOOR.pdf	

Mapping with Programme Outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	3	1	3	2	3	3	3	2	1	2
CO2	2	1	3	1	3	3	3	2	1	1
CO3	3	2	3	1	3	3	3	2	1	1
CO4	1	2	3	2	3	3	3	2	1	2
CO5	3	1	2	3	3	3	3	2	1	3

3 – Strong, 2 – Medium, 1 - Low

Mapping with Programme Specific Outcomes

CO /PSO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	3	3	3
CO2	3	3	3	3	3
CO3	3	3	3	3	3
CO4	3	3	3	3	3
CO5	3	3	3	3	3
Weightage	15	15	15	15	15
Weighted percentage of Course Contribution to POs	3.0	3.0	3.0	3.0	3.0

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SECOND YEAR - SEMESTER III

Part-I

Elective Paper

To make students understand the concepts of Python programming.

PYTHON

Subject Code	Category	L	T	P	S	Credits	Inst. Hours	Marks		
								CIA	External	Total
23212GSC35	ELECTIVE -V	4	1	-	-	3	5	25	75	100

Learning Objectives	
LO1	To make students understand the concepts of Python programming.
LO2	To apply the OOPs concept in PYTHON programming.
LO3	To impart knowledge on demand and supply concepts
LO4	To make the students learn best practices in PYTHON programming
LO5	To know the costs and profit maximization
UNIT	**DETAILS**
I	**Basics of Python Programming:** History of Python-Features of Python-Literal-Constants-Variables - Identifiers–Keywords-Built-in Data Types-Output Statements – Input Statements-Comments – Indentation- Operators-Expressions-Type conversions. **Python Arrays:** Defining and Processing Arrays – Array methods.
II	**Control Statements:** Selection/Conditional Branching statements: if, if-else, nested if and if-elif-else statements. Iterative Statements: while loop, for loop, else suite in loop and nested loops. **Jump Statements:** break, continue and pass statements**.**
III	**Functions:** Function Definition – Function Call – Variable Scope and its Lifetime-Return Statement. **Function Arguments**: Required Arguments, Keyword Arguments, Default Arguments and Variable Length Arguments- Recursion. **Python Strings:** String operations- Immutable Strings - Built-in String Methods and Functions - String Comparison. **Modules**: import statement- The Python module – dir() function – Modules and Namespace – Defining our own modules.
IV	**Lists:** Creating a list -Access values in List-Updating values in Lists-Nested lists -Basic list operations-List Methods. Tuples: Creating, Accessing, Updating and Deleting Elements in a tuple – Nested tuples– Difference between lists and tuples. **Dictionaries:** Creating, Accessing, Updating and Deleting Elements in a Dictionary – Dictionary Functions and Methods - Difference between Lists and Dictionaries.
V	**Python File Handling:** Types of files in Python - Opening and Closing files-Reading and Writing files: write() and writelines() methods- append() method – read() and readlines() methods – with

	keyword – Splitting words – File methods - File Positions- Renaming and deleting files.

Course Outcomes		
On completion of this course, students will		
CO1	Learn the basics of python, Do simple programs on python, Learn how to use an array.	PO1
CO2	Develop program using selection statement, Work with Looping and jump statements, Do programs on Loops and jump statements.	PO1,PO2
CO3	Concept of function, function arguments, Implementing the concept strings in various application, Significance of Modules, Work with functions, Strings and modules.	PO4,PO6
CO4	Work with List, tuples and dictionary, Write program using list, tuples and dictionary.	PO4,PO5, PO6
CO5	Usage of File handlings in python, Concept of reading and writing files, Do programs using files.	PO3,PO8
Text Books (Latest Editions)		
1	ReemaThareja, "Python Programming using problem solving approach", First Edition, 2017, Oxford University Press.	
2	Dr. R. NageswaraRao, "Core Python Programming", First Edition, 2017, Dream tech Publishers.	
References Books (Latest editions, and the style as given below must be strictly adhered to)		
1	VamsiKurama, "Python Programming: A Modern Approach", Pearson Education.	
2	Mark Lutz, "Learning Python", Orielly.	
3	Adam Stewarts, "Python Programming", Online.	
4	Fabio Nelli, "Python Data Analytics", APress.	
5	Kenneth A. Lambert, "Fundamentals of Python – First Programs", CENGAGE Publication.	
Web Resources		
1	https://www.programiz.com/python-programming	
2.	https://www.guru99.com/python-tutorials.html	
3	https://www.w3schools.com/python/python_intro.asp	
4	https://www.geeksforgeeks.org/python-programming-language/	
5	https://en.wikipedia.org/wiki/Python_(programming_language)	

Mapping with Programme Outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	3	1	3	2	3	3	3	2	1	3
CO2	2	1	3	1	3	3	3	2	1	3
CO3	3	2	3	1	3	3	3	2	1	3
CO4	1	2	3	2	3	3	3	2	1	3
CO5	3	1	2	3	3	3	3	2	1	2

3 – Strong, 2 – Medium, 1 - Low

Mapping with Programme Specific Outcomes

CO /PSO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	3	3	3
CO2	3	3	3	3	2
CO3	3	3	3	3	2
CO4	3	3	3	3	2
CO5	3	2	3	3	3
Weighted percentage of Course Contribution to POs	15	14	15	15	13

PONNAIYAH RAMAJAYAM INSTITUTE OF SCIENCE & TECHNOLOGY (PRIST)

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FIRST YEAR - SEMESTER IV
Part-I
Core Paper
FUNCTIONAL ANALYSIS

Subject Code	Category	L	T	P	S	Credits	Inst. Hours	Marks		
								CIA	External	Total
23212AEC41	CORE	4	1	-	-	4	5	25	75	100

Learning Objectives	
LO1	To study about Converges, Hilbert spaces and Bessels's inequality
LO2	To study about Spectral Theory
LO3	To study about convergences in L(X,Y) – Uniform boundedness and Banach Algebra
LO4	To study certain topological-algebraically structures and the methods by which the knowledge of these methods can be applied to analytic problems.
LO5	The objectives of the course is the study of the main properties of bounded operators between Banach and Hilbert spaces, the basic results associated to different types of convergences in normed spaces and the spectral theorem and some of its applications.
UNIT	**DETAILS**
I	**BANACH SPACES :** The definition and some examples - Continu transformations-The Hahn - Banach theorem
II	**BANACH SPACE & HILBERT SPACES:** The natural imbedding of N in N** - The open mapping theorem- The conjugate of a operator. **Hilbert Spaces:** The definition and some simple properties
III	**HILBERT SPACES :** Orthogonal complements - Orthonormal sets -The conjugate space H* - The adjoint of an operator
IV	**OPERATORS ON HILBERT SPACES:** Self-adjoint operators -Normal and unitary operators - Projections
V	**BANACH ALGEBRAS:** Banach Algebra- General Preliminaries on Banach Algebras: The definition and some examples -Regular and simple elements - Topological divisors of zero -The spectrum -The formula for the spectral radius -The radical and semi- simplicity

Course Outcomes		
CO1	Understand the Banach spaces and Transformations on Banach Spaces	PO1
CO2	Prove Hahn Banach theorem and open mapping theorem	PO1,PO2
CO3	Describe operators and fundamental theorems	PO4,PO6
CO4	Validate orthogonal and orthonormal sets	PO4,PO5, PO6
CO5	Analyze and establish the regular and singular elements	PO3,PO8

Text Books (Latest Editions)	
1	Functional Analysis , by Walter Rudin, Second Edition. McGraw-Hill, Inc.
2	G.F.Simmons, Introduction to Topology and Modern Analysis, McGraw Hill Education (India)Private Limited, New Delhi
References Books (Latest editions, and the style as given below must be strictly adhered to)	
1	Functional Analysis by Walter Rudin 1974. TMH Edition
2	Functional Analysis by B.V.Limaye 1985. Wiley Eastern Limited
Web Resources	
	http://mathforum.org, http://ocw.mit.edu/ocwweb/Mathematics
	http://www.opensource.org, http://en.wikiepedia.org
	https://www.ddegjust.ac.in/2019/4/mal%20641_19042019.pdf

Mapping with Programme Outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	3	1	3	2	3	3	3	2	1	3
CO2	2	1	3	1	3	3	3	2	1	3
CO3	3	2	3	1	3	3	3	2	1	3
CO4	1	2	3	2	3	3	3	2	1	3
CO5	3	1	2	3	3	3	3	2	1	3

3 – Strong, 2 – Medium, 1 - Low

Mapping with Programme Specific Outcomes

CO /PSO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	3	3	3
CO2	3	3	3	3	3
CO3	3	3	3	3	3
CO4	3	3	3	3	3
CO5	3	3	3	3	3
Weightage	15	15	15	15	15
Weighted percentage of Course Contribution to POs	3.0	3.0	3.0	3.0	3.0

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FIRST YEAR - SEMESTER IV

Part-I
Core Paper

DIFFERENTIAL GEOMETRY

Subject Code	Category	L	T	P	S	Credits	Inst. Hours	Marks		
								CIA	External	Total
23212 AEC 42	CORE	4	1	-	-	4	5	25	75	100

Learning Objectives	
LO1	To Understand the concept of curvature of a space curve and signed curvature of a plane curve
LO2	To get introduced to the concept of a regular parameterized curve in n
LO3	To get introduced to the notion of Serret-Frenet frame for space curves and the involutes and evolutes of space curves with the help of examples
LO4	To be able to compute the curvature and torsion of space curves
LO5	To be able to understand the fundamental theorem for space curves.
UNIT	**DETAILS**
I	**UNIT-I : Space curves:** Definition of a space curve – Arc length – tangent – normal and binormal – curvature and torsion – contact between curves and surfaces- tangent surface- involutes and evolutes- Intrinsic equations – Fundamental Existence Theorem for space curves- Helies. **Chapter I : Sections 1 to 9.**
II	**UNIT-II :Intrinsic properties of a surface:** Definition of a surface – curves on a surface – Surface of revolution – Helicoids – Metric- Direction coefficients – families of curves- Isometric correspondence- Intrinsic properties. **Chapter II: Sections 1 to 9.**
III	**UNIT-III : Geodesics:** Geodesics – Canonical geodesic equations – Normal property of geodesics- Existence Theorems – Geodesic parallels – Geodesics curvature- Gauss- Bonnet Theorem – Gaussian curvature- surface of constant curvature. **Chapter II: Sections 10 to 18.**
IV	**UNIT-IV : Non Intrinsic properties of a surface:** The second fundamental form- Principle curvature – Lines of curvature – Developable - Developable associated with space curves and with curves on surface - Minimal surfaces – Ruled surfaces. **Chapter III: Sections 1 to 8.**
V	**UNIT-V :Differential Geometry of Surfaces :** Compact surfaces whose points are umblics- Hilbert's lemma – Compact surface of constant curvature – Complete surface and their characterization – Hilbert's Theorem – Conjugate points on geodesics. **Chapter IV : Sections 1 to 8 (Omit 9 to 15).**

Course Outcomes		
CO1	Explain space curves, Curves between surfaces, metrics on a surface, fundamental form of a surface and Geodesics	PO1
CO2	Evaluate these concepts with related examples.	PO1,PO2
CO3	Compose problems on geodesics	PO4,PO6
CO4	Recognize applicability of developable	PO4,PO5, PO6
CO5	Construct and analyze the problems on curvature and minimal surfaces	PO3,PO8

Text Books (Latest Editions)	
1	T.J.Willmore, *An Introduction to Differential Geometry*, Oxford University Press,(17th Impression) New Delhi 2002. (Indian Print)
References Books (Latest editions, and the style as given below must be strictly adhered to)	
1	Struik, D.T. *Lectures on Classical Differential Geometry*, Addison – Wesley, Mass. 1950.
2	Kobayashi. S. and Nomizu. K. *Foundations of Differential Geometry*, Inter science Publishers, 1963.
3	Wilhelm Klingenberg: *A course in Differential Geometry*, Graduate Texts in Mathematics, Springer-Verlag 1978
4	J.A. Thorpe *Elementary topics in Differential Geometry*, Under- graduate Texts in Mathematics, Springer - Verlag 1979
Web Resources	
	http://mathforum.org, http://ocw.mit.edu/ocwweb/Mathematics
	http://www.opensource.org, www.physicsforum.com

Mapping with Programme Outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	3	1	3	2	3	3	3	2	1	2
CO2	2	1	3	1	3	3	3	2	1	1
CO3	3	2	3	1	3	3	3	2	1	1
CO4	1	2	3	2	3	3	3	2	1	2
CO5	3	1	2	3	3	3	3	2	1	3

3 – Strong, 2 – Medium, 1 - Low

Mapping with Programme Specific Outcomes

CO /PSO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	3	3	3
CO2	3	3	3	3	3
CO3	3	3	3	3	3
CO4	3	3	3	3	3
CO5	3	3	3	3	3
Weightage	15	15	15	15	15
Weighted percentage of Course Contribution to POs	3.0	3.0	3.0	3.0	3.0

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FIRST YEAR - SEMESTER IV

Part-I

Core Paper

FLUID MECHANICS

Subject Code	Category	L	T	P	S	Credits	Inst. Hours	Marks		
								CIA	External	Total
23212 AEC 43	CORE	4	1	-	-	4	5	25	75	100

Learning Objectives	
LO1	To understand the properties of fluids and fluid statics
LO2	To derive the equation of conservation of mass and its application
LO3	To solve kinematic problems such as finding particle paths and stream lines
LO4	To use important concepts of continuity equation, Bernoulli's equation and turbulence, and apply the same to problems
LO5	To analyze laminar and turbulent flows and understand the various flow measuring devices

UNIT	DETAILS
I	**INTRODUCTION** - Note to Students - Definition of a Fluid - Scope of Fluid Mechanics - Basic Equations -Methods of Analysis - System and Control Volume - Differential versus Integral Approach Methods of Description - Dimensions and Units -TO Systems of Dimensions - Systems of Units -Preferred Systems of Units - Summary - Problems
II	**INTRODUCTION** : Note to Students /l Definition of a Fluid - Scope of Fluid Mechanics - Basic Equations - Methods of Analysis 15 System and Control Volume - Differential versus Integral Approach Methods of Description /8 Dimensions and Units-TO Systems of Dimensions -Systems of Units - Preferred Systems of Units - Summary - Problems - FUNDAMENTAL CONCEPTS - Fluid as a Continuum - Velocity Field - One-, Two-, and Three- Dimensional Flows - Timelines, Pathlines, Streaklines, and Streamlines - Stress Field - Viscosity /26 Newtonian Fluid - Non-Newtonian Fluids - Surface Tension - Description and Classification of Fluid Motion - Viscous and Inviscid Flows - Laminar and Turbulent Flows - Compressible and Incompressible Flows - Internal and External Flows - Summary - References - Problems
III	**INTRODUCTION** : Note to Students - Definition of a Fluid - Scope of Fluid Mechanics - Basic Equations - Methods of Analysis - System and Control Volume - Differential versus Integral Approach Methods of Description - Dimensions and Units -TO Systems of Dimensions - Systems of Units - Preferred Systems of Units - Summary - Problems - **FUNDAMENTAL CONCEPTS** - Fluid as a Continuum - Velocity Field - One-, Two-, and Three- Dimensional Flows - Timelines, Pathlines, Streaklines, and Streamlines - Stress Field - Viscosity - Newtonian Fluid - Non-Newtonian Fluids - Surface Tension - Description and Classification of Fluid Motion - Viscous and Inviscid Flows - Laminar and Turbulent Flows - Compressible and Incompressible Flows - Internal and External Flows - Summary - References - Problems **FLUID STATICS** - The Basic Equation of Fluid Statics -The Standard Atmosphere - Pressure Variation in a Static Fluid - Incompressible Liquids:

	Manometers - Gases - Hydraulic Systems - Hydrostatic Force on Submerged Surfaces - Hydrostatic Force on a Plane Submerged Surface - Hydrostatic Force on a Curved Submerged Surface Buoyancy and Stability Fluids in Rigid-Body Motion (CD-ROM) - Summary - References - Problems -
IV	**BASIC EQUATIONS IN INTEGRAL FOR M F OR A CONTRO L VOLUME** : Basic Laws for a System -Conservation of Mass - Newton's Second Law - The Angular-Momentum Principle - The First Law of Thermodynamics - The Second Law of Thermodynamics - Relation of System Derivatives to the Control Volume Formulation - Derivation - Physical Interpretation - Conservation of Mass - Special Cases - Momentum Equation for Inertial Control Volume - Differential Control Volume Analysis - Control Volume Moving with Constant Velocity - Momentum Equation for Control Volume with Rectilinear Acceleration - Momentum Equation for Control Volume with Arbitrary Acceleration (CD-ROM) - The Angular-Momentum Principle - Equation for Fixed Control Volume - •Equation for Rotating Control Volume (CD-ROM) - The First Law of Thermodynamics -Rate of Work Done by a Control Volume -Control Volume Equation - The Second Law of Thermodynamics - Summary - Problems
V	**INTRODUCTION TO DIFFERENTIAL ANALYSIS O F FLUID MOTION** : Conservation of Mass Rectangu lar Coordinate System Cylindrical Coordinate System - Stream Function for Two-Dimensional Incompressible Flow - Motion of a Fluid Particle (Kinematics) - Fluid Translation: Acceleration of a Fluid Particle in a Velocity Field - Fluid Rotation - Fluid Deformation - Momentum Equation - Forces Acting on a Fluid Particle - Differential Momentum Equation - Newtonian Fluid: Navier-Stokes Equations - Summary - References - Problems

Course Outcomes		
CO1	Understand the various properties of fluids and their influence on fluid motion and analyse a variety of problems in fluid statics and dynamics	PO1
CO2	Calculate the forces that act on submerged planes and curves	PO1,PO2
CO3	Identify and analyse various types of fluid flows. • Apply the integral forms of the three fundamental laws of fluid mechanics to turbulent and laminar flow through pipes and ducts in order to predict relevant pressures, velocities and forces. • Draw simple hydraulic and energy gradient lines.	PO4,PO6
CO4	Apply the integral forms of the three fundamental laws of fluid mechanics to turbulent and laminar flow through pipes and ducts in order to predict relevant pressures, velocities and forces.	PO4,PO5, PO6
CO5	Draw simple hydraulic and energy gradient lines	PO3,PO8

Text Books (Latest Editions)	
1	Fluid Mechanics, P. N. Modi and S. M. Seth, Standard book house, New Delhi
2	A text of Fluid mechanics and hydraulic machines, R. K. Bansal - Laxmi Publications (P) ltd., New Delhi
References Books (Latest editions, and the style as given below must be strictly adhered to)	
1	Mechanics of Fluids, Merle C. Potter, David C. Wiggert and Bassem H. Ramadan, CENGAGE Learning
2	Fluid Mechanics and Machinery, C.S.P. Ojha, R. Berndtsson and P.N. Chandramouli, Oxford Higher Education.
Web Resources	
	https://home.iitk.ac.in/~nikhilk/Book.pdf

Mapping with Programme Outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	3	3	3	3	3	3	3	2	3	2
CO2	2	3	3	3	2	3	3	2	2	2
CO3	3	3	3	2	3	3	3	2	3	2
CO4	3	3	3	3	3	3	3	2	2	2
CO5	3	2	3	3	3	3	3	2	2	3

3 – Strong, 2 – Medium, 1 - Low

Mapping with Programme Specific Outcomes

CO /PSO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	3	3	3
CO2	3	3	3	3	3
CO3	3	3	3	3	3
CO4	3	3	3	3	3
CO5	3	3	3	3	3
Weightage	15	15	15	15	15
Weighted percentage of Course Contribution to POs	3.0	3.0	3.0	3.0	3.0

SECOND YEAR - SEMESTER IV
Part-I
Elective -VI
RESOURCE MANAGEMENT TECHNIQUES

Subject Code	Category	L	T	P	S	Credits	Inst. Hours	Marks		
								CIA	External	Total
23212GSC45	ELECTIVE-VI	4	1	-	-	3	5	25	75	100

Learning Objectives	
LO1	To understand the methodology of OR problem solving and formulate linear programming problem
LO2	To develop formulation skills in transportation models and finding solutions
LO3	To understand the basics in the field of game theory and assignment problems
LO4	To know how project management techniques help in planning and scheduling a project
LO5	To know the basics of dynamic programming and simulation.
UNIT	**DETAILS**
I	Linear Programming : Definition and Scope of Operations Research, Mathematical formulation of the problem, graphical method, Simplex method, artificial basis technique, dual Simplex method. Degeneracy, alternative optima, unbounded solution, infeasible solution.
II	Transportation Problem : Introduction to the problem, LP formulation of a transportation problem. Basic feasible solution by north-west corner method, Vogel's approximation method, least cost method. Finding optimal solution by MODI method, degeneracy, unbalanced transportation problem and Maximization in transportation model.
III	Assignment Problem : One to one assignment problem, optimal solutions, unbalanced assignment matrix, travelling sales man problem, maximization in A.P
IV	Sequencing Problems – Introduction – Step-wise procedure for determing the optimal sequence for n jobs on 2 machines (Johnson's method) – Processing n jobs on three machines – Processing n jobs on m machines – Processing of two jobs on 'n ' machines.
V	Project Planning through Networks : Introduction, Basic steps in PERT/CPM techniques, Network diagram representation, Rules of drawing network diagram, Fulkerson's rule, Time estimates and Critical path in network analysis, floats, Project evaluation and review technique, Application areas of PERT/CPM techniques.

Course Outcomes		
CO1	Recognize the importance and value of Operations Research and linear programming in solving practical problems in industry	PO1
CO2	Interpret the transportation models' solutions and infer solutions to the real-world problems.	PO1,PO2
CO3	Recognize and solve game theory and assignment problems.	PO4,PO6
CO4	Gain knowledge of drawing project networks for quantitative analysis of projects	PO4,PO5, PO6
CO5	To know when simulation and dynamic programming can be applied in real world problems.	PO3,PO8

Text Books (Latest Editions)	
1	Operations Research - S.D.Sharma, Kedar nath Ram nath & Co, 2008
2	Operations Research - Theory and Applications, J.K Sharma, Macmillan Publications India Ltd, 2013
References Books (Latest editions, and the style as given below must be strictly adhered to)	
1	Operations Research by Kantiswarup
2	Resource Management Techniques (Operations Research) V.Sundaresan
3	Operations Research Methods and Applications
Web Resources	
	http://www2.informs.org/Resources/
	http://www.ieor.columbia.edu/
	http://www.universalteacherpublications.com/univ/ebooks/or/Ch1/origin.htm
	http://www.mit.edu/~orc

Mapping with Programme Outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	3	3	3	3	3	3	3	2	1	3
CO2	2	3	3	3	2	3	3	2	1	3
CO3	3	3	3	2	3	3	3	2	1	3
CO4	3	3	3	3	3	3	3	2	1	3
CO5	3	2	3	3	3	3	3	2	1	3

3 – Strong, 2 – Medium, 1 - Low

Mapping with Programme Specific Outcomes

CO /PSO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	3	3	3
CO2	3	3	3	3	3
CO3	3	3	3	3	3
CO4	3	3	3	3	3
CO5	3	3	3	3	3
Weightage	15	15	15	15	15
Weighted percentage of Course Contribution to POs	3.0	3.0	3.0	3.0	3.0

PONNAIYAH RAMAJAYAM INSTITUTE OF SCIENCE & TECHNOLOGY (PRIST)

Declared as DEEMED-TO-BE-UNIVERSITY
U/s 3 of UGC Act, 1956

SECOND YEAR - SEMESTER IV
Part-II
Skill Enhancement Course
PROFESSIONAL COMPETENCY SKILL

Subject Code	Category	L	T	P	S	Credits	Inst. Hours	Marks		
								CIA	External	Total
23212TCE-	SEC	4	-	-	-	2	4	25	75	100

Learning Objectives	
LO1	To categorize, apply and use thought process to distinguish between concepts of Quantitative methods.
LO2	To prepare and explain the fundamentals related to various possibilities and probabilities related to quantitative aptitude.
LO3	To critically evaluate numerous possibilities related to puzzles
LO4	To categorize and explain various principles of grammar in order to help students to minimize errors in English
LO5	To critically evaluate a given reading material for improving ones' reading skills and comprehension

UNIT	DETAILS
I	**Arithmetic:** Profit, Loss and Discount Simple Interest and Compound Interest Time and Work Work and wages
II	**Problem Solving:** Puzzle Number series Inequalities Missing number Arithmetic problems
III	**Analogy:** Semantic Symbolic Number Figural
IV	**Series:** Semantic Number Figural
V	**Coding and Decoding:** Alphabetic codes Word-group Meaning words Symbolic coding and decoding

Course Outcomes		
CO1	Use their logical thinking and analytical abilities to solve Quantitative aptitude questions from company specific and other competitive tests	PO1

CO2	Solve questions related to Time and distance and time and work etc. from company specific and other competitive tests.	PO1,PO2
CO3	Understandandsolvepuzzlerelatedquestionsfromspecificandothercompetitivetests	PO4,PO6
CO4	Detect errors of grammar and usage in a given sentence/text and rectify them by making appropriate changes	PO4,PO5, PO6
CO5	Solve questions based on critical reasoning	PO3,PO8

Text Books (Latest Editions)	
1	Quantitative Aptitude by Arihant
2	Quantitative Aptitude by Dr. R.S Aggarwal, S. Chand Publication
3	Verbal & Non-verbal by Dr. R.S Aggarwal, S. Chand Publication
References Books (Latest editions, and the style as given below must be strictly adhered to)	
1	Competitive Exam Book by Rakesh Yadav
Web Resources	
	https://drive.google.com/file/d/1-K4w9JrDY3jA4trHGEhpFssBOh1Flp9D/view?pli=1

Mapping with Programme Outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	3	3	3	3	3	3	3	2	3	2
CO2	2	3	3	3	2	3	3	2	2	2
CO3	3	3	3	2	3	3	3	2	3	2
CO4	3	3	3	3	3	3	3	2	2	2
CO5	3	2	3	3	3	3	3	2	2	3

3 – Strong, 2 – Medium, 1 - Low

Mapping with Programme Specific Outcomes

CO /PSO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	3	3	3
CO2	3	3	3	3	3
CO3	3	3	3	3	3
CO4	3	3	3	3	3
CO5	3	3	3	3	3
Weightage	15	15	15	15	15
Weighted percentage of Course Contribution to POs	3.0	3.0	3.0	3.0	3.0