
SRI SARADA COLLEGE FOR WOMEN (AUTONOMOUS)

Reaccredited with “B++” Grade by NAAC

(Affiliated to Periyar University)

SALEM - 16



PG & RESEARCH DEPARTMENT OF MATHEMATICS

CHOICE BASED CREDIT SYSTEM (CBCS)

LEARNING OUTCOME BASED CURRICULUM FRAME WORK

(LOCF)

M.Sc. MATHEMATICS

2026 - 2028 BATCH

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INTRODUCTION

Mathematics is the study of quantity, structure, space, and change, providing the logical framework and analytical tools essential for solving complex problems. It plays a vital role in advancing science, engineering, technology, economics, and the social sciences. By fostering rigorous reasoning and abstract thinking, Mathematics sharpens intellectual capacity and nurtures creativity in modelling and problem-solving.

The M.Sc. Mathematics programme is designed to expand the knowledge gained at the undergraduate level and provide deeper insights into both pure and applied branches. Core areas such as Algebra, Real and Complex Analysis, Differential Equations, Geometry, and Mechanics are complemented by advanced topics like Topology, Functional Analysis, Probability Theory, Differential Geometry, Cryptography, Fluid Dynamics, Machine Learning, and Mathematical Modelling. This ensures a balanced curriculum integrating theory with applications.

The programme follows the Outcome Based Education (OBE) model, focusing on developing disciplinary knowledge, critical thinking, problem-solving ability, analytical reasoning, research aptitude, professional communication, and lifelong learning skills. Tutorials, professional components, and exposure to competitive examinations further strengthen students' confidence and competence.

Learners also gain opportunities through electives, interdisciplinary courses, internships, and project work, connecting Mathematics with fields such as computer science, economics, and data science. The final semester project enables students to demonstrate research skills and problem-solving capacity.

Graduates will be able to present mathematical ideas precisely, apply concepts to real-world problems, communicate abstract ideas effectively, and uphold research ethics and professional values. Career opportunities span teaching, research, government services, banking, insurance, actuarial science, data analytics, and IT sectors, along with enhanced prospects in competitive examinations.

Overall, the programme provides a solid foundation for higher studies, research, and professional practice, reflecting the intrinsic beauty of Mathematics while preparing learners for dynamic careers in a rapidly evolving world.

LEARNING OUTCOME-BASED CURRICULUM FRAMEWORK GUIDELINES BASED REGULATIONS FOR POST GRADUATE PROGRAMME	
Programme:	M.Sc. Mathematics
Programme Code:	PMA
Duration:	2 Years [PG]
Programme Outcomes:	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. PO9: Multicultural competence Possess knowledge of the values and belief so multiple cultures and a global perspective. PO10: 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. PSO2 - 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. PSO5 - Contribution to the Society To contribute to the development of the society by collaborating with stake holders for mutual benefit.
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Highlights of the Revamped Curriculum

- The curriculum is student-centric, designed to meet the growing demands of industry, academia, and society. It integrates hands-on training, skill enhancement modules, industrial components, and exposure to entrepreneurial skills, ensuring holistic development.
- Core subjects cover the latest developments in Mathematics and allied fields, blending theory with application-oriented content. Emphasis is laid on advanced computational tools, programming packages, and real-life problem-solving skills that prepare students for research and industry needs.
- The curriculum fosters peer learning and collaborative study, while electives in the later semesters strengthen research aptitude and interdisciplinary connections, particularly with computer science, statistics, finance, and data science.
- A strong Industry–Academia interface is maintained to enhance career opportunities and provide students with relevant exposure to emerging fields.
- The internship during the first-year vacation connects classroom learning with workplace practice, offering valuable insights into professional environments and helping learners identify their career path.
- The project with viva-voce in the fourth semester trains students to apply conceptual knowledge to practical challenges, engage in independent research, and present findings systematically.
- Emphasis is given to the use of state-of-the-art technologies and mathematical software tools in conducting analysis, experiments, and simulations, enabling precise and efficient problem-solving.
- Innovative provisions such as industrial training, projects, and internships provide students with a competitive advantage in the job market.
- The curriculum incorporates multi-disciplinary, cross-disciplinary, and inter-disciplinary elective courses, broadening perspectives and ensuring adaptability to diverse professional fields.
- Overall, the revamped curriculum ensures a balance of core knowledge, applied skills, research aptitude, and professional competence, equipping graduates for higher studies, teaching, research, industry, and global career opportunities.

Value additions in the Revamped Curriculum:

Semester	Newly introduced Components	Outcomes/ Benefits
I, II, III & IV	Elective course An open choice of topics categorized under Discipline Centric	• Strengthens domain knowledge through advanced and applied areas of Mathematics. • Introduces learners to state-of-the-art multi-disciplinary and inter-disciplinary techniques. • Provides exposure to emerging fields like Machine Learning, Cryptography, and Mathematical Modelling. • Connects classroom learning with industry applications, moulding students as solution providers. • Produces industry-ready graduates equipped with analytical and computational skills. • Enhances employability and research prospects across academia, industry, finance, IT, and public sectors.
Extra Credits: For Advanced Learners		• To cater to the needs of peer learners / research aspirants.
Skills acquired from the Courses		• Knowledge, Problem Solving, Analytical ability, and Professional Competency.

Credit Distribution for PG Programme

Sem I	Credit	Hr.	Sem II	Credit	Hr.	Sem III	Credit	Hr.	Sem IV	Credit	Hr.
1.1 Core Course – CC I	5	7	2.1 Core Course – CC IV	5	6	3.1 Core Course – CC VII	5	6	4.1 Core Course – CC XI	5	6
1.2 Core Course – CC II	5	7	2.2 Core Course – CC V	5	5	3.2 Core Course – CC VIII	5	6	4.2 Core Course – CC XII	5	6
1.3 Core Course – CC III	4	6	2.3 Core Course – CC VI	4	5	3.3 Core Course – CC IX	5	6	4.3 Elective (Discipline Centric) – VI	3	4
1.4 Elective (Discipline Centric) – I	3	5	2.4 Elective (Discipline Centric) – III	3	4	3.4 Core Course – CC X	4	6	4.4 Core -Project	7	10
1.5 Elective (Discipline Centric) – II	3	5	2.5 Elective (Discipline Centric) – IV	3	4	3.5 Elective (Discipline Centric) – V	3	3	4.5 Professional Competency Skill	2	4
	-	-	2.6 EDC – I	2	4	3.6 EDC – II	2	3	4.6 Extension Activity	1	-
	-	-	2.7 Human Rights	1	2	3.7 Internship/Industrial Activity	2	-			
	20	30		23	30		26	30		23	30

Consolidated Semester wise and Component wise Credit distribution

Credits	Sem I	Sem II	Sem III	Sem IV	Total Credits
PART A	20	20	22	20	82
PART B					
(i)Extra Disciplinary Course	-	2	2	-	4
(ii)Human Rights	-	1	-	-	1
(iii) Internship/Industrial Activity	-	-	2	-	2
(iv) Professional Competency Skill	-	-	-	2	2
PART C					
(i) Extension Activity	-	-	-	1	1
Total	20	23	26	23	92

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 Chaveto be completed during the duration of the programme as per the norms, to be eligible for obtaining the PG degree.

Total Credits : 92

EXTRA CREDITS FOR EXTRA SKILLS

Total Extra Credits - 16(17% of the total credits)

M.Sc. MATHEMATICS
CURRICULUM DESIGN AND SCHEME OF EXAMINATION

(APPLICABLE TO STUDENTS ADMITTED DURING THE ACADEMIC YEAR 2026 -27)

SEMESTER-I

Part	Course Code	Course Title	Course Type	Hrs. /Week L/T/P	Credits	CIA	ESE	TOTAL
Part A	26PMACC1	Algebraic Structures	Core Course -I	7	5	30	70	100
	26PMACC2	Real Analysis I	Core Course-II	7	5	30	70	100
	26PMACC3	Ordinary Differential Equations with AI Applications	Core Course - III	6	4	30	70	100
	26PMADSEC1A/ 26PMADSEC1B	Number Theory and Cryptography / Graph Theory and Applications	Elective -I	5	3	30	70	100
	26PMADSEC2A/ 26PMADSEC2B	Fuzzy Sets and their Applications / Discrete Mathematics	Elective - II	5	3	30	70	100
Total				30	20			
*Extra Skills (Out of College Hours)						*Credits	*Marks	
Value Education						-	-	
Physical Fitness Practice						-	-	
Productive Preparation for CSIR - UGC NET/SET/JRF/TRB Competitive Examinations - I(26PMASCI)						1	100	

***Extra credits are given for extra skills and courses qualified in MOOC/ NPTEL**

SEMESTER-II

Part	Course Code	Course Title	Course Type	Hrs. / Week L/T/P	Credits	CIA	ESE	TOTAL
Part A	26PMACC4	Advanced Algebra	Core Course - IV	6	5	30	70	100
	26PMACC5	Real Analysis II	Core Course - V	5	5	30	70	100
	26PMACC6	Partial Differential Equations	Core Course - VI	5	4	30	70	100
	26PMADSEC3A/ 26PMADSEC3B	Classical Dynamics / Numerical Analysis	Elective - III	4	3	30	70	100
	26PMADSEC4A/ 26PMADSEC4B	Modeling and Simulation with Excel / Mathematical Modeling	Elective - IV	4	3	30	70	100
Part B	26PMAEDC1	Game Theory and Strategy	Extra Disciplinary course - I	4	2	30	70	100
	26PHRS	Human Rights	Common subject	2	1	30	70	100
Total				30	23			
*Extra Skills (Out of College Hours)						*Credits	*Marks	
Value Education						1	100	
Physical Fitness Practice						1	-	
Productive Preparation for CSIR –UGC NET/SET/JRF/TRB Competitive Examinations– II (<i>26PMASC2</i>)						1	100	

***Extra credits are given for extra skills and courses qualified in MOOC/ NPTEL**

SEMESTER-III

Part	Course Code	Course Title	Course Type	Hrs. /Week L/T/P	Credits	CIA	ESE	TOTAL
Part A	26PMACC7	Complex Analysis	Core Course - VII	6	5	30	70	100
	26PMACC8	Probability Theory	Core Course -VIII	6	5	30	70	100
	26PMACC9	Topology	Core Course - IX	6	5	30	70	100
	26PMACC10	Machine Learning (Industry Module)	Core Course - X	6	4	40	60	100
	26PMADSEC5A / 26PMADSEC5B	Fluid Dynamics / Stochastic Processes	Elective - V	3	3	30	70	100
Part B	26PMAEDC2	Statistics for Life and Social Sciences	Extra Disciplinary Course - II	3	2	-	-	-
	26PMAI	(Carried out in summer vacation at the end of 1 st year-30 hours)		-	2	-	-	-
Total				30	26			
*Extra Skills (Out of College Hours)						*Credits	*Marks	
Value Education						-	-	
Physical Fitness Practice						-	-	
Productive Preparation for CSIR –UGC NET/SET/JRF/TRB Competitive Examinations– III (<i>26PMASC3</i>)						1	100	

***Extra credits are given for extra skills and courses qualified in MOOC/ NPTEL**

SEMESTER-IV

Part	Course Code	Course Title	Course Type	Hrs./ Week L/T/P	Credits	CIA	ESE	TOTAL
Part A	26PMACC11	Functional Analysis	Core Course - XI	6	5	30	70	100
	26PMACC12	Differential Geometry	Core Course - XII	6	5	30	70	100
	26PMADSEC6A/ 26PMADSEC6B	Resource Management Techniques/ Representation Theory	Elective - VI	4	3	40	60	100
	26PMAPC	Project with Viva - Voce	Core Project	10	7	30	70	100
Part B	26PMAPCSQ	Advanced Computational Mathematics using Python – Practical	Professional Competency Skill	4	2	40	60	100
Part C	26PSCA	Society Connect Activity	Extension Activity	-	1	30	70	100
Total				30	23			
*Extra Skills (Out of College Hours)						*Credits	*Marks	
Value Education						1	100	
Physical Fitness Practice						1	-	
Productive Preparation for CSIR - UGC NET/SET/JRF/TRB Competitive Examinations- IV (<i>26PMASCA</i>)						1	100	

***Extra credits are given for Extra Skills and courses qualified in MOOC/ NPTEL**

PEDAGOGICAL APPROACHES TEACHING

LEARNING STRATEGIES

- a) Chalk and talk
- b) Group-Learning and Teaching
- c) Individual Learning/ Self-Study
- d) Game Based Learning
- e) Technology Based Learning
- f) Peer Teaching
- g) Learning Through Problem solving
- h) Project Based Learning

METHODS OF EVALUATION AND ASSESSMENT

Methods of Evaluation - Theory		
Internal Evaluation	Continuous Internal Assessment Test	30 Marks
	Assessment Components	
	Model Examination and Attendance	
External Evaluation	End Semester Examination	70 Marks
	Total	100 Marks
Methods of Evaluation - Practical		
Internal Evaluation	Laboratory work assessment (best 2 out of 3)	40 Marks
	Viva-voce/ Lab quiz, Class Performance	
External Evaluation	End Semester Examination	60 Marks
	Record	
	Total	100 Marks
REVISED BLOOMS LEVEL		
BL1	Exhibits memory of previously learned material by recalling fundamental facts, terms, basic concept and answers about the selection.	
BL2	Demonstrate understanding of parts and Idea free organizing, comparing, translating, interpreting, giving descriptors and stating main ideas.	
BL3	Solve problems in new situation by applying acquired knowledge, facts, techniques and rules in different or new way.	
BL4	Examine and break information into parts by identifying motives or causes. Make inference and find evidence to support generalizations.	
BL5	Present and defend opinion by making judgement about information, Validity of ideas or quality of work based on a set of criteria.	
BL6	Compile information together into different way by combining elements in A new pattern or proposing alternative solutions.	

Evaluation Pattern

An academic year is divided into two semesters. The first semester is from June/ July to November/ December and the second semester is from November/ December to April/ May. Each semester consists of 90 working days.

Evaluation consists of both Continuous Internal Assessment (CIA) and End Semester Examinations (ESE). The entire Undergraduate and Postgraduate Programmes offered by our college have various assessments for continuous internal evaluation. Relevant types of internal assessment are developed suiting the needs and requirements of each specific course. The various assessment components are quiz, snap test, viva-voce, seminar, listening comprehension, reading comprehension, problem solving, map reading, group discussion, panel discussion, assignment, field visit, poster presentation, open book test, writing composition, case study, online test, Book Review, Projects etc.

The CIA marks are read out and signed by the students in the respective classes on the day specified in the calendar. CIA is mandatory for all the students.

Internal Assessment Modes (Theory Course)

Any six of the assessment components	15 marks
Cycle Test (1) & Cycle Test (2)	5 marks
Model Examination	5 marks
Attendance	5 marks
Total	30 marks

Internal Assessment Modes (Practical Course)

Laboratory work assessment (best 2 out of 3)	20 marks
Viva-voce/ Lab quiz	10 marks
Class Performance	10 marks
Total	40 marks

Society Connect Project

Project Assessment	10 marks
Presentation and feedback from the society	10 marks
Participation in discussion	10 marks
Total	30 marks

Internal Assessment Modes (Project)

Project Assessment	15 marks
Participation in discussion	10 marks
Presentation	5 marks
Total	30 marks

PASSING MINIMUM

The candidate shall be declared to have passed the examination if the candidates secure not less than 35 marks out of 70 marks in the semester examination in each theory course and in total (CIA mark + Theory ESE) not less than 50 marks.

The candidates shall be declared to have passed the examination if she secures not less than 50 marks in total (CIA mark + Practical Exam mark) with minimum of 30 marks out of 60 marks in the Practical exam conducted by the University. There is no passing minimum for the record notebook. However, submission of the record notebook is necessary. Candidate who does not obtain the required minimum marks for a pass in a Course/Practical shall be declared Reappear (RA) and the candidate has to appear and pass the same at a subsequent appearance.

Theory Course (Revised Bloom's Taxonomy)

Question Paper Model for PG

Intended Learning Skills	Maximum 70 marks Passing Minimum:50% Duration: Three hours
Memory Recall / Example / Counter Example / Knowledge about the Concept / Understanding	Part-A ($15 \times 1 = 15$ marks) Answer ALL questions Each question carries 1 marks
	Three questions from each UNIT
	Questions 1 to Questions 15
Description / Application (problem)	Part-B ($5 \times 5 = 25$ marks) Answer ALL questions Each question carries 5 marks
	Either-or-Type Both parts of each question from the same Unit
	Questions 16 (a) or 16(b) to Questions 20(a) to 20(b)
Analysis / Create / Evaluation	Part- C ($3 \times 10 = 30$ marks) Answer ANY THREE questions Each question carries 10 marks
	There shall be FIVE questions covering all the five units
	Question 21 to Question 25

Each question should carry course outcomes and cognitive level

For instance:

1. [CO1: BL₂] Question
2. [CO3: BL₁] Question

SEMETER WISE INDEX

Semester	Course	Course Code	Page No.
I	Algebraic Structures	26PMACC1	17
I	Real Analysis I	26PMACC2	20
I	Ordinary Differential Equations with AI Applications	26PMACC3	23
I	Number Theory and Cryptography / Graph Theory and Applications	26PMADSEC1A/ 26PMADSEC1B	25/27
I	Fuzzy Sets and their Applications / Discrete Mathematics	26PMADSEC2A/ 26PMADSEC2B	29/31
II	Advanced Algebra	26PMACC4	33
II	Real Analysis II	26PMACC5	35
II	Partial Differential Equations	26PMACC6	37
II	Classical Dynamics / Numerical Analysis	26PMADSEC3A/ 26PMADSEC3B	39/41
II	Modeling and Simulation with Excel / Mathematical Modeling	26PMADSEC4A/ 26PMADSEC4B	44/46
II	Game Theory and Strategy	26PMAEDC1	49
II	Human Rights	26PHRS	51
III	Complex Analysis	26PMACC7	52
III	Probability Theory	26PMACC8	54
III	Topology	26PMACC9	57
III	Machine Learning (Industry Module)	26PMACC10	59
III	Fluid Dynamics / Stochastic Processes	26PMADSEC5A/ 26PMADSEC5B	61/63
III	Statistics for Life and Social Sciences	26PMAEDC2	65
III	Internship/Industrial Visit-Vacation Activity	26PMAI	
IV	Functional Analysis	26PMACC11	67
IV	Differential Geometry	26PMACC12	69
IV	Resource Management Techniques/ Representation Theory	26PMADSEC6A/ 26PMADSEC6B	71/74
IV	Project with Viva - Voce	26PMAPC	76
IV	Advanced Computational Mathematics using Python - Practical	26PMAPCSQ	77
IV	Society Connect Activity	26PMASCA	

Title of the Course		ALGEBRAIC STRUCTURES					
Paper Number		CORE I					
Category	CORE	Year	I	Credits	5	Course Code	26PMACC1
		Semester	I				
Instructional Hours per week		Lecture	Tutorial		Lab Practice		Total
		6	1		-		7
Pre-requisite		UG level Modern Algebra					
Objectives of the Course		To introduce the concepts and to develop working knowledge on class equation, solvability of groups, finite Abelian groups, linear transformations, real quadratic forms.					
Course Outcomes: Students will be able to CO1: apply the class equation and Sylow's theorems to analyze the structure of finite groups. CO2: analyze the properties of finite Abelian groups, modules, and solvable groups. CO3: construct triangular and nilpotent canonical forms for linear transformations. CO4: determine the Jordan and Rational canonical forms of linear transformations. CO5: evaluate matrix transformations and reduce real quadratic forms							
Course Outline	Unit - I (Hours: 21) Counting Principle - Class equation for finite groups and its applications - Sylow’s Theorem (for theorem 2.12.1, First proof only). Chapter 2 (Sections 2.11& 2.12) (Omit Lemma 2.12.5)						
	Unit - II (Hours: 21) Direct products - Finite Abelian Groups - Modules - Solvable groups Chapter 2 (Sections 2.13 & 2.14) (Theorem 2.14.1 only) Chapter 4 (Section 4.5), Chapter 5 (Section 5.7) (Lemma 5.7.1, Lemma 5.7.2 & Theorem, 5.7.1)						
	Unit - III (Hours: 21) Linear Transformations: Canonical Forms - Triangular form - Nilpotent Transformations. Chapter 6 (Sections 6.4 & 6.5)						
	Unit - IV(Hours:21) Jordan Form - Rational Canonical Form. Chapter 6 (Sections 6.6 & 6.7)						
	Unit - V(Hours:21) Trace and Transpose - Hermitian, Unitary and Normal						

	Transformations - Real Quadratic Forms Chapter 6 (Sections 6.8, 6.10 & 6.11(Omit 6.9))
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 course	Knowledge, Problem Solving, Analytical ability, Professional Competency, Professional Communication and Transferrable Skill
Recommended Text	I.N. Herstein. <i>Topics in Algebra</i> (II Edition) Wiley Eastern Limited, New Delhi, 1975.
Reference Books	1. M. Artin, <i>Algebra</i>, Prentice Hall of India, 1991. 2. P.B. Bhattacharya, S.K. Jain, and S.R. Nagpaul, <i>Basic Abstract Algebra</i> (II Edition) Cambridge University Press, 1997. (Indian Edition) 3. I.S. Luther and I.B.S. Passi, <i>Algebra</i>, Vol. I - Groups (1996); Vol.II Rings, Narosa Publishing House, New Delhi, 1999 4. D.S. Malik, J.N. Mordeson and M.K. Sen, <i>Fundamental of Abstract Algebra</i>, McGraw Hill (International Edition), NewYork. 1997. 5. N. Jacobson, <i>Basic Algebra</i>, Vol. I & II W.H. Freeman (1980); also published by Hindustan Publishing Company, NewDelhi.
Web resources	http://mathforum.org, http://ocw.mit.edu/ocwwweb/Mathematics, http://www.opensource.org, www.algebra.com

Mapping of Cos with Pos and PSOs:

	POs						PSOs		
	1	2	3	4	5	6	1	2	3
C01	3	1	3	2	3	3	3	2	1
C02	2	1	3	1	3	3	3	2	1
C03	3	2	3	1	3	3	3	2	1
C04	1	2	3	2	3	3	3	2	1
C05	3	1	2	3	3	3	3	2	1

Strong - 3; Medium-2; Low-1

Title of the Course		REAL ANALYSIS I					
Paper Number		CORE II					
Category	CORE	Year	I	Credits	5	Course Code	26PMACC2
		Semester	I				
Instructional Hours per week		Lecture	Tutorial		Lab Practice		Total
		6	1		-		7
Pre-requisite		UG level Real Analysis					
Objectives of the Course		To work comfortably with functions of bounded variation, Riemann-Stieltjes Integration, convergence of infinite series, infinite product and uniform convergence and its inter play between various limiting operations.					
Course Outcomes: Students will be able to C01: analyse and evaluate the functions of bounded variation and apply it in infinite series. C02: describe the concept of Riemann -Stieltjes integral and its properties. C03: demonstrate the theory of Riemann -Stieltjes integral, the mean value theorem, second fundamental theorem of calculus. C04: assess the convergence properties of sequence and series and study the related theorems including Bernstein’s theorem, Abel’s limit theorem and Tauber’s theorem. C05: understand the concept of sequence of functions, series of functions and their convergence.							
Course Outline		Unit – I (Hours:21) 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. Infinite Series - Absolute and conditional convergence-Dirichlet's test and Abel's test - Rearrangement of series - Riemann's theorem on conditionally convergent series. Chapter 6 (Sections 6.1 - 6.8) Chapter 8 (Sections 8.8, 8.15, 8.17 & 8.18)					
		Unit – II (Hours:21) 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 (Sections7.1 - 7.14)					
		Unit – III (Hours:21) 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 criterion for existence of Riemann integrals. Chapter 7 (Sections 7.15 - 7.26)
	Unit - IV(Hours:21) 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 –Cesarosummability - Infinite products. 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 8 (Sections 8.20, 8.21 - 8.26) Chapter 9 (Sections 9.14, 9.15, 9.19, 9.20, 9.22& 9.23)
	Unit - V(Hours:21) 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 ConvergenceandTerm-by-termIntegration-Uniformconvergenceanddifferentiation - Sufficient condition for uniform convergence of a series - Mean convergence. Chapter 9 (Sections 9.1 - 9.6, 9.8,9.9,9.10,9.11& 9.13)
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 course	Knowledge, Problem Solving, Analytical ability, Professional Competency, Professional Communication and Transferrable Skill
Recommended Text	Tom M. Apostol, Mathematical Analysis, 2 nd edition, Addison Wesley Publishing Company Inc. New York,1974
Reference Books	1. Bartle, R.G. Real Analysis, John Wiley and Sons Inc.,1976. 2. Rudin, W. Principles of Mathematical Analysis, 3rd Edition McGraw Hill Company, New York, 1976. 3. Malik S.C. and Savita Arora Mathematical Analysis, Wiley Eastern Limited New Delhi, 1991. 4. Sanjay Arora and Bansilal, Introduction to Real Analysis, SatyaPrakashan, 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 2. http://ocw.mit.edu/ocwweb/Mathematics 3. http://www.opensource.org , www.mathpages.com
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Mapping of Cos with POs and PSOs:

	POs						PSOs		
	1	2	3	4	5	6	1	2	3
C01	3	1	3	2	3	3	3	2	1
C02	2	1	3	1	3	3	3	2	1
C03	3	2	3	1	3	3	3	2	1
C04	1	2	3	2	3	3	3	2	1
C05	3	1	2	3	3	3	3	2	1

Strong - 3; Medium - 2; Low - 1

Title of the Course		ORDINARY DIFFERENTIAL EQUATIONS WITH AI APPLICATIONS					
Paper Number		CORE III					
Category	Core	Year	I	Credits	4	Course Code	26PMACC3
		Semester	I				
Instructional Hours per Week	Lecture		Tutorial		Lab Practice		Total
	5		1		--		6
Pre-requisite		UG level Calculus and Differential Equations					
Objectives of the Course		1. To understand the theory and solution methods of ordinary differential equations. 2. To analyze the existence and uniqueness of solutions. 3. To apply AI-assisted techniques to solve real-world problems.					
Course Outcomes Students will be able to CO1: explain second-order linear differential equations with constant coefficients and initial value problems. CO2: apply operator and annihilator methods to solve higher-order linear differential equations. CO3: analyze linear differential equations with variable coefficients using Wronskian and existence theorems. CO4: evaluate solutions of Euler equations and differential equations with regular singular points. CO5: design AI-assisted solutions for first-order differential equations to solve real-world problems.							
Course Outline		Unit - I: Linear Equations with Constant Coefficients Thesecondorderhomogeneousequation-Initialvalueproblemsforsecondorder equations - Linear dependence and independence - A formula for the Wronskian - The nonhomogeneous equation of order two. Chapter - 2 (Sections 1 to 6 only) 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 only) Unit - III: Linear Equations 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)) Unit - IV: Linear Equations 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)) 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. Evaluation of * Societal Problems * Environmental Sustainability * Economic Development and Smart Agriculture					

	through the lens of AI Tools Chapter 5: Sections 1 to 6 (Omit Sections 7 to 9)
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 course	Knowledge, Problem Solving, Analyticalability, Professional Competency, Professional Communication and Transferrable Skill
Recommended Texts	E.A.Coddington - <i>An Introduction to Ordinary Differential Equations</i> , Prentice-Hall of India Private Limited New Delhi - 2005. (Units I to V)
Reference Books	1. Williams E. Boyce and Richard C. DI Prima, Elementary differential equations and boundary value problems, John Wiley and sons, New York, 1967. 2. George F Simmons, Differential equations with applications and historical notes, Tata McGraw Hill, New Delhi, 1974. 3. N.N. Lebedev, Special functions and their applications, Prentice Hall of India, New Delhi, 1965. 4. W.T. Reid. Ordinary Differential Equations, John Wiley and Sons, New York, 1971 5. M.D.Raisinghania, Advanced Differential Equations, S.Chand & Company Ltd. New Delhi 2001 6. B.Rai, D.P.Choudary and H.I. Freedman, A Course in Ordinary Differential Equations, Narosa Publishing House, New Delhi, 2002. 7. https://www.unesco.org/en/artificial-intelligence?utm_source=chatgpt.com
Web resources and e-Learning Source	http://mathforum.org http://ocw.mit.edu/ocwweb/Mathematics http://www.opensource.org www.mathpages.com

Mapping of Cos with POs and PSOs:

	POs						PSOs		
	1	2	3	4	5	6	1	2	3
CO1	3	1	3	2	3	3	3	2	1
CO2	2	1	3	1	3	3	3	2	1
CO3	3	2	3	1	3	3	3	2	1
CO4	1	2	3	2	3	3	3	2	1
CO5	3	1	2	3	3	3	3	2	1

Strong - 3; Medium - 2; Low - 1

Title of the Course		NUMBER THEORY AND CRYPTOGRAPHY					
Paper Number		ECI (DISCIPLINE SPECIFIC)					
Category	ELECTIVE	Year	I	Credits	3	Course Code	26PMADSEC1A
		Semester	I				
Instructional Hours per week		Lecture	Tutorial		Lab Practice		Total
		4	1		-		5
Pre-requisite		UG Level Abstract and Linear Algebras					
Objectives of the Course		1. To know about the basic concepts of number theory and cryptography. 2. To get a complete grip of various concepts to present modern Mathematics in elementary terms. 3.To develop the skill of solving problems in number theory and cryptography					
Course Outcomes: Students will be able to C01: understand the notion of congruences, and solve congruences C02: apply chinese remainder theorem to obtain important properties in number theory C03: solve congruences using Quadratic residues C04: analyse important functions of number theory C05: understand the fundamental algorithms in cryptography and determine the number of keys in Chiper.							
Course Outline		Unit-I (Hours:15) Divisibility - Primes - Congruences - Solutions of Congruences - Congruences of degree 1. Chapter1 (Sections 1.2&1.3) Chapter2 (Sections 2.1-2.3)					
		Unit-II (Hours:15) The function $\varphi(n)$ -Congruences of higher degree - Prime power moduli-Prime modulus - Congruences of Degree Two, Prime Modulus - Power residues. Chapter2 (Sections 2.4-2.9)					
		Unit-III (Hours:15) Quadratic residues-Quadratic reciprocity-The Jacobi symbol-Greatest integer function. Chapter3 (Sections 3.1-3.3) Chapter4 (Section 4.1)					
		Unit-IV (Hours:15) Arithmetic functions-The Moebius Inversion formula-The multiplication of arithmetic functions. Chapter4 (Sections 4.2 - 4.4)					
		Unit-V (Hours:15) Classical Cryptography: Introduction: Some Simple Cryptosystems - Cryptanalysis. Chapter1 (Sections 1.1 & 1.2)					

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 course	Knowledge, Problem Solving, Analytical ability, Professional Competency, Professional Communication and Transferrable Skill
Recommended Text	1. Ivan Niven and Herbert S Zuckerman, An introduction to the Theory of numbers, 3rd edition, Wiley Eastern Limited, New Delhi, 1989, Sixth Wiley Eastern reprint, July 1991. (for Unit I to Unit IV) 2. Douglas R. Stinson, Cryptography- Theory and Practice, 3rd edition, Chapman & Hall/CRC, Taylor & Francis Group, Boca Raton, 2006. (for Unit V).
Reference Books	1. D. M. Burton, Elementary Number Theory, Universal Book Stall, New Delhi-2004. 2. Tom Apostol, Analytic Number Theory Springer-Verlag, New York, 1989. 3. Jonathan Katz and Yehuda Lindell, Introduction to Modern Cryptography, CRC Press, Taylor & Francis Group, Boca Raton, 2021
Web resources	https://nptel.ac.in/

Mapping of COs with POs and PSOs:

	POs						PSOs		
	1	2	3	4	5	6	1	2	3
C01	3	1	3	2	3	3	3	2	1
C02	2	1	3	1	3	3	3	2	1
C03	3	1	3	1	1	3	3	2	1
C04	3	1	3	2	1	3	3	2	2
C05	3	1	3	3	3	3	3	2	1

Strong - 3; Medium - 2; Low - 1

Title of the Course		GRAPH THEORY AND APPLICATIONS					
Paper Number		ECI (DISCIPLINE SPECIFIC)					
Category	Elective	Year	I	Credits	3	Course Code	26PMADSEC1B
		Semester	I				
Instructional Hours per week		Lecture	Tutorial		Lab Practice	Total	
		4	1		--	5	
Pre-requisite		UG level Graph Theory					
Objectives of the Course		1. To gain knowledge about graph theory 2. To inculcate knowledge about connectedness, trees, matching, coloring and planarity in graphs 3. To apply theoretical knowledge acquired to solve realistic problems					
Course Outcomes: Students will be able to CO1: understand the definition and basics of graphs and directed graphs with types and examples CO2: interpret the concepts of connectedness in graphs and trees CO3: apply Eulerian and Hamiltonian graphs to solve related problems CO4: apply graph coloring concepts to solve Kirkman’s Schoolgirl problems CO5: understand the concepts of planar, non-planar graphs, the four color theorem and Heawood five color theorem.							
Course Outline		Unit- I (Hours: 15) Basic Results: Introduction - Basic Concepts – Subgraphs - Degrees of Vertices - Paths and Connectedness - Automorphism of a Simple Graph. Directed Graphs: Introduction - Basic Concepts -Tournaments. Chapter 1 (Sections 1.1 - 1.6) Chapter 2 (Sections 2.1 - 2.3)					
		Unit- II (Hours: 15) Connectivity: Introduction - Vertex Cuts and Edges Cuts - Connectivity and Edge Connectivity. Trees: Introduction - Definition, Characterization, and Simple Properties - Centers and Centroids - Counting the Number of Spanning Trees – Cayley’s Formula. Chapter 3 (Sections 3.1- 3.3) Chapter 4 (Sections 4.1- 4.5)					
		Unit- III (Hours: 15) Independent Sets and Matchings: Introduction -Vertex-Independent Sets and Vertex Coverings - Edge-Independent Sets- Matchings and Factors - Matchings in Bipartite Graphs. Eulerian and Hamiltonian Graphs: Introduction - Eulerian Graphs - Hamiltonian Graphs.					

	Chapter 5 (Sections 5.1- 5.5) Chapter 6 (Sections 6.1- 6.3)
	Unit- IV (Hours: 15) Graph Colorings: Introduction -Vertex Colorings - Critical Graphs - Edge Colorings of Graphs – Kirkman’s Schoolgirl Problem - Chromatic Polynomials. Chapter 7 (Sections 7.1 ,7.2 ,7.3 (7.3.1 & 7.3.2 only) ,7.6, 7.8 & 7.9)
	Unit- V (Hours: 15) Planarity: Introduction - Planar and Nonplanar Graphs – Euler Formula and Its Consequences – K_5 and $K_{3,3}$ are Nonplanar Graphs - Dual of a Plane Graph - The Four-Color Theorem and the Heawood Five-Color Theorem - Hamiltonian Plane Graphs -Tait Coloring. Chapter 8 (Sections 8.1 - 8.6, 8.8 and 8.9)
Extended Professional Component	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 this course	Knowledge, Problem Solving, Analytical ability, Professional Competency, Professional Communication and Transferrable Skill
Recommended Text	1. R. Balakrishnan and K. Ranganathan, Text Book of Graph Theory, (2nd Edition), Springer, New York, 2012.
Reference Books	1. J. A. Bondy and U.S.R. Murty, Graph Theory with Applications, North Holland, New York, 1982. 2. Narasing Deo, Graph Theory with Application to Engineering and Computer Science, Prentice Hall of India, New Delhi. 2003. 3. F. Harary, Graph Theory, Addison – Wesley Pub. Co. The Mass. 1969. 4. L. R. Foulds, Graph Theory Application, Narosa Publ. House, Chennai, 1933.
Website and e-Learning Source	http://mathforum.org , http://ocw.mit.edu/ocwwweb/Mathematics , http://www.opensource.org , www.mathpages.com

Mapping of COs with POs and PSOs:

	POs						PSOs		
	1	2	3	4	5	6	1	2	3
C01	3	1	2	1	1	1	3	1	1
C02	3	2	1	1	1	1	3	1	1
C03	3	3	3	1	1	1	3	3	1
C04	3	2	3	2	2	3	3	3	2
C05	3	2	3	2	2	3	3	3	2

Strong - 3; Medium - 2; Low - 1

Title of the Course		FUZZY SETS AND THEIR APPLICATIONS					
Paper Number		EC II (DISCIPLINE SPECIFIC)					
Category	ELECTIVE	Year	I	Credits	3	Course Code	26PMADSEC2A
		Semester	I				
Instructional Hours per week		Lecture	Tutorial		Lab Practice		Total
		4	1		-		5
Pre-requisite		Basic concepts of Algebra					
Objectives of the Course		1. To gain knowledge about fuzzy sets and types of operations. 2. To know about fuzzy numbers and fuzzy morphisms. 3. To understand the concept of fuzzy logic with relevant examples					
Course Outcomes: Students will be able to CO1: gain knowledge about the basic types, basic concepts of fuzzy sets, apply the properties of α -cuts and representations of fuzzy sets CO2: learn and analyse the applications of Extension Principle and fuzzy complements CO3: understand and apply the fuzzy operations t-norms and t-conorms CO4: acquire knowledge about the concepts of fuzzy numbers, fuzzy arithmetic operations and solve the related problems CO5: create a fuzzy model and solve social, environmental and biological problems using fuzzy logics, fuzzy relations and FIM							
Course Outline		Unit - I (Hours:15) Fuzzy Sets: Basic types - Fuzzy Sets: Basic concepts - Additional properties of α -cuts - Representation of Fuzzy Sets Chapter 1 (Sections 1.3 and 1.4) Chapter 2 (Sections 2.1 and 2.2)					
		Unit - II(Hours:15) Extension principle for fuzzy sets. Types of operations - Fuzzy complements Chapter 2 (Section 2.3) Chapter 3(Sections 3.1 & 3.2)					
		Unit - III(Hours:15) Fuzzy intersections: t-Norms - Fuzzy unions t-conorms - Combinations of operations. Chapter 3(Sections 3.3 - 3.5)					
		Unit - IV(Hours:15) Fuzzy numbers - Arithmetic operations on intervals - Arithmetic operations on Fuzzy numbers. Chapter 4 (Sections 4.1-4.4)					
		Unit - V(Hours:15) Three valued logics - Infinite valued logics - Fuzzy logics - Fuzzy propositions and their interpretations in terms of fuzzy sets - Fuzzy rules and their interpretations in terms of fuzzy relation - Generalized modus ponens - Fuzzy inference mechanism (FIM) - Fuzzy modus tollens - Generalizations of fuzzy logics Chapter 8 (Sections 8.2, 8.4- 8.8, 8.9.1, 8.10)					

Extended Professional Component (is a part of Internal Component only, not to be included in the External Examination question paper)	Real life application related to the above topics in various fields. (To be discussed during the Tutorial hour)
Skills acquired from the course	Knowledge, Problem Solving, Analytical ability, Professional Competency, Professional Communication and Transferrable Skill.
Recommended Text	1.G. J. Klir and B. Yuan, Fuzzy Sets and Fuzzy Logic, Prentice Hall of India, NewDelhi. 2004. (Unit I, II, III and IV only) 2.M. Ganesh, Introduction to fuzzy sets and fuzzy logic, Introduction to fuzzy sets and fuzzy logic, Prentice Hall of India Private Limited, New Delhi (Unit V only)
Reference Books	1. Zimmermann, Hans-Jurgen, Fuzzy Set Theory and its Applications, Springer Publication
Web resources	https://giocher.wordpress.com/chapter-2-par-2-2-fuzzy-relations-and-the-extension-principle/

Mapping of COs with POs and PSOs:

	Pos						PSOs		
	1	2	3	4	5	6	1	2	3
CO1	3	1	2	2	1	1	1	1	1
CO2	3	2	2	2	1	1	2	1	1
CO3	3	3	3	2	2	2	3	2	2
CO4	3	3	3	3	3	2	3	2	2
CO5	3	3	3	3	3	3	3	3	3

Strong - 3; Medium - 2; Low - 1

Title of the Course		DISCRETE MATHEMATICS					
Paper Number		EC II (DISCIPLINE SPECIFIC)					
Category	Elective	Year	I	Credits	3	Course Code	26PMADSEC2B
		Semester	I				
Instructional Hours per week		Lecture	Tutorial		Lab Practice		Total
		4	1		--		5
Pre-requisite		UG Level Discrete Mathematics					
Objectives of the Course		1. To Introduce concepts of mathematical logic for analyzing propositions and proving theorems. 2. Investigate relations, functions and their properties. 3. Acquire skills in designing digital circuits using Boolean functions and logic gates to perform specific tasks or operations.					
Course Outcomes: Students will be able to C01: analyze logical propositions via truth tables. C02: evaluate combinations and permutations on sets. C03: determine properties of relations, identify equivalence and partial order relations, sketch relations. C04: apply Boolean algebraic laws and theorems to simplify Boolean expressions and optimize digital circuit designs for efficiency and functionality. C05: understand different computational models, including finite-state machines with output, finite-state machines with no output, and Turing machines							
Course Outline		Unit- I (Hours: 15) The Foundations: Logic and Proofs: Propositional Logic - Applications of Propositional Logic - Propositional Equivalences - Predicates and Quantifiers. Algorithms: The Growth of Functions. Chapter 1 (Sections 1.1 - 1.4) Chapter 3 (Section 3.2)					
		Unit- II (Hours: 15) Counting: The Basics of Counting- The Pigeonhole Principle - Permutations and Combinations - Generalized Permutations and Combinations - Generating Permutations and Combinations. Chapter 6 (Sections 6.1- 6.3, 6.5 and 6.6)					
		Unit- III (Hours: 15) Advanced Counting Techniques: Applications of Recurrence Relations - Solving Linear Recurrence Relations - Generating Functions. Chapter 8 (Sections 8.1, 8.2 and 8.4)					
		Unit- IV (Hours: 15) Boolean Algebra: Boolean Functions- Representing Boolean Functions - Logic Gates - Minimization of Circuits. Chapter 12 (Sections 12.1 -12.4)					

	Unit- V (Hours: 15) Modeling Computation: Finite-State machines with Output- Finite-State machines with No Output-Turing Machines. Chapter 13 (Sections 13.2, 13.3 and 13.5)
Extended Professional Component	Questions related to the above topics, from various competitive examinations UPSC / TNPSC / others to be solved (To be discussed during the Tutorial hour)
Skills acquired from this course	Knowledge, Problem Solving, Analytical ability, Professional Competency, Professional Communication and Transferrable Skill
Recommended Text	1. Kenneth H. Rosen, Discrete Mathematics and it's Applications, 7th Edition, WCB / McGraw Hill Education, New York, 2008.
Reference Books	1. J.P. Trembley and R. Manohar, Discrete Mathematical Structures applications to Computer Science, Tata McGraw Hills, New Delhi. 2. T. Veerarajan, Discrete Mathematics with Graph Theory and Combinatorics, Tata McGraw Hills Publishing Company Limited, 7th Reprint, 2008.
Website and e-Learning Source	http://mathforum.org , http://ocw.mit.edu/ocwwweb/Mathematics , http://www.opensource.org , www.mathpages.com

Mapping of COs with POs and PSOs:

	POs						PSOs		
	1	2	3	4	5	6	1	2	3
CO1	3	2	2	1	1	1	3	1	1
CO2	3	2	3	1	1	1	3	2	1
CO3	3	3	2	2	1	1	3	2	1
CO4	3	3	3	2	2	1	3	3	3
CO5	3	3	3	3	2	2	3	3	3

Strong - 3; Medium-2; Low-1

Title of the Course		ADVANCED ALGEBRA					
Paper Number		CORE IV					
Category	CORE	Year	I	Credits	5	Course Code	26PMACC4
		Semester	II				
Instructional Hours per week		Lecture	Tutorial		Lab Practice		Total
		5	1		-		6
Pre – requisite		Algebraic Structures					
Objectives of the Course		To study field extension, roots of polynomials, Galois theory, finite fields, division rings, solvability by radicals and to develop computational skill in abstract algebra.					
Course Outcomes: Students will be able to C01: prove theorems applying algebraic ways of thinking. C02: connect groups with graphs and understanding about Hamiltonian graphs. C03: compose clear and accurate proofs using the concepts of Galois theory. C04: bring out insight into abstract algebra with focus on axiomatic theories C05: demonstrate knowledge and understanding of fundamental concepts including extension fields, algebraic extensions, finite fields, class equations and Sylow’s theorem.							
Course Outline		Unit -I(Hours: 18) Extension Fields - Transcendence of e Chapter 5(Sections5.1&5.2)					
		Unit - II (Hours: 18) Roots of polynomials - More about roots Chapter 5 (Sections 5.3 &5.5)					
		Unit - III (Hours: 18) Elements of Galois theory Chapter 5 (Section 5.6)					
		Unit - IV(Hours:18) Finite fields - Wedderburn’s theorem on finite division rings Chapter 7 (Sections 7.1& 7.2(Theorem 7.2.1 only))					
		Unit - V(Hours:18) 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 & 7.4)					
		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 course		Knowledge, Problem Solving, Analytical ability, Professional Competency, Professional Communication and Transferrable Skill					

Recommended Text	I.N. Herstein, <i>Topics in Algebra</i> (II Edition) Wiley Eastern Limited, New Delhi, 1975.
Reference Books	1. M. Artin, <i>Algebra</i>, Prentice Hall of India, 1991. 2. P.B. Bhattacharya, S.K. Jain, and S.R. Nagpaul, <i>Basic Abstract Algebra</i> (II Edition) Cambridge University Press, 1997. (Indian Edition) 3. I.S. Luther and I.B.S. Passi, <i>Algebra</i>, Vol. I - Groups (1996); Vol.II Rings, Narosa Publishing House, New Delhi, 1999 4. D.S. Malik, J.N. Mordeson and M.K. Sen, <i>Fundamental of Abstract Algebra</i>, McGraw Hill (International Edition), New York. 1997. 5. N. Jacobson, <i>Basic Algebra</i>, Vol. I & II, Hindustan Publishing Company, New Delhi.
Web resources	http://mathforum.org , http://ocw.mit.edu/ocwweb/Mathematics , http://www.opensource.org , www.algebra.com

Mapping of Cos with POs and PSOs

	POs						PSOs		
	1	2	3	4	5	6	1	2	3
C01	3	1	3	2	3	3	3	2	1
C02	2	1	3	1	3	3	3	2	1
C03	3	2	3	1	3	3	3	2	1
C04	1	2	3	2	3	3	3	2	1
C05	3	1	2	3	3	3	3	2	1

Strong - 3; Medium - 2; Low - 1

Title of the Course		REAL ANALYSIS II					
Paper Number		CORE V					
Category	CORE	Year	I	Credits	5	Course Code	26PMACC5
		Semester	II				
Instructional Hours per week		Lecture	Tutorial		Lab Practice		Total
		4	1		-		5
Pre – requisite		Elements of Real Analysis					
Objectives of the Course		To introduce measure on the real line, Lebesgue measurability and integrability, Fourier Series and Integrals, in-depth study in multivariable calculus.					
Course Outcomes: Students will be able to C01: understand the concepts of Lebesgue outer measure, Lebesgue integral, Fourier series, Fourier integrals with respect to orthogonal system, directional derivative and continuity. C02: demonstrate the theorems derived from measure theory, integration theory, Fourier integrals and multivariable differential calculus. C03: analyze the representation and convergence problems of Fourier series. C04: distinguish the role of directional derivatives, total derivative and the partial derivative. C05: appraise the requisite of Inverse and Implicit function theorems.							
Course Outline		Unit - I (Hours:15) Measure on the Real line : Lebesgue outer measure – measurable sets – regularity-measurable functions- borel and Lebesgue measurability Chapter 2 (Sections 2.1 to 2.5)					
		Unit - II (Hours:15) Integration of Functions of a Real variable : Integration of non- negative functions - The General Integral - Riemann and Lebesgue Integrals Chapter 3 (Sections 3.1, 3.2 & 3.4)					
		Unit - III (Hours:15) 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 theorem - the convergence and representation problems 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 – Cesaro summability of Fourier series- Consequences of Fejes's theorem - the Weierstrass approximation theorem Chapter 11 (Sections 11.1 to 11.15)					
		Unit - IV (Hours:15) Multivariable Differential Calculus - Introduction - the directional derivative - directional derivative and continuity - the total derivative - the total derivative expressed in terms of partial derivatives - An application to complex- valued functions - 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 (Sections 12.1 to 12.14)					
		Unit - V (Hours:15)					

	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 one variable - extrema of real valued-functions of severable variables- extremum problems with side conditions. Chapter 13 (Sections 13.1 to 13.7)
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 course	Knowledge, Problem Solving, Analytical ability, Professional Competency, Professional Communication and Transferrable Skill
Recommended Text	1.G. de Barra, Measure Theory and Integration, Wiley Eastern Ltd., New Delhi, 1981. (for Units I and II) 2. Tom M. Apostol: Mathematical Analysis, 2nd Edition, Addison-Wesley Publishing Company Inc. New York, 1974. (for Units III, IV and V)
Reference Books	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 Bansilal, Introduction to Real Analysis, Satya Prakashan, New Delhi, 1991
Web resources	1.http://mathforum.org 2.http://ocw.mit.edu/ocwweb/Mathematics 3.http://www.opensource.org, www.mathpages.com

Mapping of Cos with POs and PSOs:

	POs						PSOs		
	1	2	3	4	5	6	1	2	3
C01	3	2	3	1	3	3	3	2	1
C02	3	2	3	1	3	3	3	2	1
C03	3	2	3	2	3	3	3	2	1
C04	3	2	3	2	3	3	3	2	1
C05	3	2	2	2	3	3	3	2	1

Strong - 3; Medium - 2; Low - 1

Title of the Course		PARTIAL DIFFERENTIAL EQUATIONS							
Paper Number		CORE VI							
Category	CORE	Year	I	Credits	4	Course Code	26PMACC6		
		Semester	II						
Instructional Hours per week		Lecture		Tutorial		Lab Practice		Total	
		4		1		--		5	
Pre-requisite		UG level partial differential equations							
Objectives of the Course		To classify the second order partial differential equations and to study Cauchy problem, method of separation of variables, boundary value problems.							
Course Outcomes: Students will be able to CO1: to understand and classify second order equations and find general solutions. CO2: to analyse and solve wave equations in different polar coordinates CO3: to solve vibrating string problem, Heat conduction problem, to identify and solve Laplace and beam equations. CO4: to apply maximum and minimum principle's and solve Dirichlet, Neumann problems for various boundary conditions. CO5: to apply Green's function and solve Dirichlet, Laplace problems, to apply Helmholtz operation and to solve higher dimensional problem.									
Course Outline		UNIT - I (Hours:15) 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 3 (Sections 3.1 to 3.6) Chapter 4 (Sections 4.1 to 4.4)							
		UNIT – II (Hours:15) 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 5 (Sections 5.1 to 5.11)							
		UNIT-III (Hours:15) 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 7 (Sections 7.1 to 7.7)							
		UNIT - IV(Hours:15) 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 9 (Sections 9.1 to 9.9) UNIT -V (Hours:15) 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 11 (Sections 11.1 to 11.9)
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 this course	Knowledge, Problem Solving, Analytical ability, Professional Competency, Professional Communication and Transferrable Skill
Recommended Text	TynMyint-U and Lokenath Debnath, <i>Partial Differential Equations for Scientists and Engineers</i> (Fourth Edition), North Hollan, New York, 1987.
Reference Books	1. M. M. Smirnov, <i>Second Order Partial Differential Equations</i>, Leningrad, 1964. 2. I. N. Sneddon, <i>Elements of Partial Differential Equations</i>, Mc Graw Hill, New Delhi, 1983. 3. R. Denne Meyer, <i>Introduction to Partial Differential Equations and Boundary Value Problems</i>, McGraw Hill, New York, 1968. 4. M.D. Rai Singhania, <i>Advanced Differential Equations</i>, S. Chand & Company Ltd., New Delhi, 2001. 5. S, Sankar Rao, <i>Partial Differential Equations</i>, 2nd Edition, Prentice Hall of India, New Delhi. 2004
Website and e-Learning Source	http://mathforum.org , http://ocw.mit.edu/ocwwweb/Mathematics , http://www.opensource.org , www.mathpages.com

Mapping of COs with POs and PSOs:

	Pos						PSOs		
	1	2	3	4	5	6	1	2	3
C01	3	1	3	2	3	3	3	2	1
C02	2	1	3	1	3	3	3	2	1
C03	3	2	3	1	3	3	3	2	1
C04	1	2	3	2	3	3	3	2	1
C05	3	1	2	3	3	3	3	2	1

Strong-3; Medium-2; Low-1

Title of the Course		CLASSICAL DYNAMICS					
Paper Number		EC III (DISCIPLINE SPECIFIC)					
Category	ELECTIVE	Year	I	Credits	3	Course Code	26PMADSEC3A
		Semester	II				
Instructional Hours Per week		Lecture	Tutorial		Lab Practice		Total
		4	-		--		4
Pre-requisite		UG level Calculus and Differential equations.					
Objectives of the Course		To study mechanical systems under generalized coordinate systems, virtual work, energy and momentum, to study mechanics developed by Newton, Lagrange, Hamilton Jacobi and theory of relativity due to Einstein.					
Course Outcomes: Students will be able to C01: demonstrate the knowledge of core principles in mechanics. C02: analyze the derivation of Lagrange’s Equations from Hamilton’s Principle and Extension of Hamilton’s Principle to Non-holonomic Systems. C03: apply the variation principle to solve the problems on real physical situations. C04: identify the existing symmetries and the corresponding integrals of motion and analyze the qualitative nature of dynamics C05: discuss the problem solving skills of classical dynamics in various contexts and distinguish the concept of the Hamilton Equations of Motion and the Principle of Least Action.							
Course Outline		UNIT- I (Hours :12) Mechanical Systems: The mechanical system - generalized coordinates - constraints - virtual work - energy and momentum Chapter 1 (Sections 1.1 to 1.5)					
		UNIT - II (Hours :12) Lagrange’s Equations: Derivation of Lagrange’s equations - examples - integrals of the motion. Chapter 2 (Sections 2.1 to 2.3)					
		UNIT - III (Hours :12) Hamilton's Equation: Hamilton’s Principle – Hamilton’s Equations - other variational principle. Chapter 4 (Sections 4.1 to 4.3)					
		UNIT -IV (Hours :12) Hamilton - Jacobi Theory: Hamilton’s principal function - The Hamilton - Jacobi equation - Separability. Chapter 5 (Sections 5.1 to 5.3)					

	UNIT- V (Hours :12) Canonical Transformation: Differential forms and generating functions - special transformations - Lagrange and Poisson brackets. Chapter 6 (Sections 6.1 and 6.3) Exclude the bilinear covariant.
Skills acquired from this course	Knowledge, Problem Solving, Analytical ability, Professional Competency, Professional Communication and Transferrable Skill
Extended Professional Component	Questions related to the above topics, from various competitive examinations UPSC/TNPSC/others to be solved
Recommended Text	D. Green wood, Classical Dynamics, Prentice Hall of India, New Delhi, 1985.
Reference Books	1. H. Goldstein, Classical Mechanics, (2 nd Edition) Narosa Publishing House, New Delhi. 2. N. C. Rane and P. S. C. Joag, Classical Mechanics, Tata McGraw Hill, 1991. 3. J. L. Synge and B. A. Griffith, Principles of Mechanics (3 rd Edition) McGraw Hill Book Co., New York, 1970
Website and e-Learning Source	http://mathforum.org , http://ocw.mit.edu/ocwweb/Mathematics , http://www.opensource.org , www.physicsforum.com

Mapping with Pos and PSOs

	Pos						PSOs		
	1	2	3	4	5	6	1	2	3
C01	3	1	3	2	3	3	3	2	1
C02	2	1	3	1	3	3	3	2	1
C03	3	2	3	1	3	3	3	2	1
C04	1	2	3	2	3	3	3	2	1
C05	3	1	2	3	3	3	3	2	1

Strong - 3; Medium - 2; Low - 1

Title of the Course		NUMERICAL ANALYSIS					
Paper Number		EC III (DISCIPLINE SPECIFIC)					
Category	ELECTIVE	Year	I	Credits	3	Course Code	26PMADSEC3B
		Semester	II				
Instructional Hours Per week		Lecture	Tutorial	Lab Practice	Total		
		4	-	--	4		
Pre-requisite		UG level Numerical methods.					
Objectives of the Course		1. To acquire knowledge about the methods of obtaining numerical solutions to various types of equations. 2. To develop problem solving skill applying different numerical methods.					
Course Outcomes: Students will be able to C01: understand and discuss efficient numerical methods for solving algebraic and transcendental equations, linear systems of equations, ordinary and partial differential equations, boundary and eigen value problems and for interpolating polynomials C02: analyse the methods of finding solutions using differentiation and integration methods, Taylor’s series, Euler’s methods, Runge kutta methods C03: apply Newton - Raphson method, Romberg integration method, differentiation and integration methods, direct and iterative methods to obtain solutions of linear systems, ordinary and partial differential equations C04: determine the solutions of initial and boundary value problems, Laplace equations, parabolic equations and hyperbolic equations C05: derive various rules, formulae and interpret their applications							
Course Outline		UNIT- I (Hours :12) Solution of algebraic and transcendental equations: Introduction, Newton - Raphson method, Generalized Newton’s method, The Secant method, Muller’s method, LIN - Bairstow’s method. Numerical differentiation and integration: Numerical differentiation, Errors in Numerical differentiation, Trapezoidal rule, Simpson’s 1/3 rule, Simpson’s 3/8 rule, Romberg integration (Errors in Trapezoidal rule, Simpson’s 1/3 rule, Simpson’s 3/8 rule are included). Chapter 2 (Sections2.1, 2.5, 2.7, 2.8, 2.10) Chapter 5 (Sections5.2, 5.2.1, 5.4, 5.4.1, 5.4.2, 5.4.3 and 5.4.6)					
		UNIT - II (Hours :12) Solution of linear systems : Gauss elimination method, Gauss - Jordan method, Lu decomposition, Lu decomposition from Gauss elimination, Iterative methods. Chapter 6 (Sections6.3.2, 6.3.3, 6.3.6, 6.3.7 and 6.4) Application of Gauss - Jordan method Web link : https://youtu.be/Wa6kaCwyYRk					
		UNIT - III (Hours :12) Numerical solution of ordinary differential equations: Solution by Taylor’s series, Euler’s method, Modified Euler’s methods, Runge - Kutta methods, Predictor - corrector methods, Adams - Moulton method, Milne’s method.					

	Interpolation: Interpolating polynomial, Errors in polynomial interpolation, Divided differences and their properties, Newton's General interpolation formula, Interpolation by Iteration. Chapter 7 (Sections 7.2, 7.4 (Omitting 7.4.1 only), 7.5, 7.6). Chapter 3 (Sections 3.1, 3.2, 3.10, 3.10.1, 3.10.2)
	UNIT -IV (Hours :12) Boundary - value problems: Finite difference method, The shooting method, The cubic spline method. The Eigen value problem: Eigen values of a symmetric tridiagonal matrix, House holder's method. Chapter 7 (Sections 7.10, 7.10.1, 7.10.2 and 7.10.3) Chapter 6 (Sections 6.5, 6.5.1, 6.5.2) Application of Eigen value problems Web link : https://youtu.be/juXth3CYKn4
	UNIT- V (Hours :12) Numerical solution of partial differential equations: Finite-difference approximation to derivatives, Laplace's equations, Jacobi's method, Gauss-Seidel method, Successive over - relaxation, Parabolic equations, Iterative methods for the solution of equations, Hyperbolic equations. Chapter 8 (Sections 8.2, 8.3, 8.3.1, 8.3.2, 8.3.3, 8.4, 8.5 and 8.6) Application of Finite difference approximation method Web link: https://youtu.be/_6z_XYpzuG4
Skills acquired from this course	Problem-solving abilities, Algorithmic thinking, critical thinking, and understanding and finding solutions using numerical concepts.
Extended Professional Component	Questions related to the above topics, from various competitive examinations UPSC/TNPSC/others to be solved
Recommended Text	S. S. Sastry, Introductory methods of Numerical Analysis, Fourth Edition, Prentice - Hall of India, New Delhi
Reference Books	1. Devi Prasad, Introduction to Numerical Analysis, Second Edition, Narosa Publishing House. 2. Rama B. Bhat, S. Chakravarthy, Numerical Analysis in Engineering, Narosa Publishing House.
Website and e-Learning Source	1. http://www.ece.mcmaster.ca/~xwu/part6.pdf 2. http://www.cis.upenn.edu/~cis515/cis515-12-sl2.pdf 3. https://wiki.math.ntnu.no/_media/tma4215/2012h/note.pdf 4. http://www.ehu.eus/aitor/irakas/fin/apuntes/pde.pdf

Mapping with POs and PSOs

	POs						PSOs		
	1	2	3	4	5	6	1	2	3
C01	3	3	3	2	1	2	3	2	2
C02	3	3	2	3	1	2	3	2	2
C03	3	3	3	3	2	1	3	2	2
C04	3	2	3	3	1	1	3	2	2
C05	3	2	3	3	2	2	3	2	2

Strong- 3; Medium - 2; Low - 1

Title of the Course		MODELING AND SIMULATION WITH EXCEL					
Paper Number		EC IV (DISCIPLINE SPECIFIC)					
Category	ELECTIVE	Year	I	Credits	3	Course Code	26PMADSEC4A
		Semester	II				
Instructional Hours per week		Lecture	Tutorial	Lab Practice		Total	
		4	-	-		4	
Pre-requisite		Basic Knowledge in Computer and Statistics					
Objectives of the Course		1. To acquire knowledge about model building with excel. 2. To know about modeling and simulation. 3. To build up the capacity of tackling this present reality issues through modeling and simulation via excel.					
Course Outcomes: Students will be able to C01: learn the importance of deterministic modeling. C02: understand the basic model, sensitivity analysis and scroll bars. C03: analyze the types of simulation and uncertainty. C04: examine the status of Autohaus model and variation in approaches to poisson arrivals. C05: formulate York River Archaeology Budgeting to solve social related problems.							
Course Outline		Unit - I (Hours:12)					
		Introduction - How do we classify models? - An example of deterministic modeling - understanding the important elements of a model.					
		Chapter 7 (Sections 7.1 to 7.4)					
		Unit – II (Hours:12)					
		Model Building with excel – Basic Model - sensitivity analysis - Controls from the Forms Control Tools- Scroll Bars.					
		Chapter 7 (Sections 7.5 to 7.5.3& 7.5.5)					
		Unit –III (Hours:12)					
		Modeling and Simulation - Types of simulation and uncertainty - incorporating uncertain processes in models - the Monte Carlo sampling methodology-Implementing Monte Carlo Simulation Methods-A Word About Probability Distributions -Modeling Arrivals with the Poisson Distribution-VLOOKUP and HLOOKUP Functions.					
		Chapter 8 (Sections 8.1 to 8.3)					
		Unit -IV(Hours:12)					
		A Financial Example - Income Statement -An Operations Example - autohaus -Status of Autohaus Model -Building the Brain Worksheet - building the Calculation Worksheet-Variation in Approaches to Poisson Arrival - Consideration of Modeling Accuracy					
		Chapter 8 (Sections 8.4 to 8. 5.4)					
		Unit -V(Hours:12)					

	Sufficient Sample Size - Building the Data Collection worksheet - solver- constrained optimization – example-York River Archaeology Budgeting –Scenarios. Chapter 8 (Sections 8.5.5 & 8.5.6)& Chapter 9 (Sections 9.1 to 9.4)
Extended Professional Component (is a part of Internal Component only, not to be included in the External Examination question paper)	Real life application related to the above topics in various fields.
Skills acquired from the course	Knowledge, Problem Solving, Analytical ability, Professional Competency, Professional Communication and Transferrable Skill.
Recommended Text	Hector Guerrero, Excel Data Analysis Modeling and Simulation, Springer Heidelberg Dordrecht London New York.
Reference Books	1. Averill M Law, W David Kelton, Simulation Modelling & Analysis, McGraw Hill Education, 2 Penn Plaza, New York, 5th Edition, 2015 2. Chandan Sengupta, Financial Modeling Using Excel, John Wiley & Sons, Inc., Hoboken, New Jersey, 2nd Edition, 2004.
Web resources	http://mathforum.org , http://ocw.mit.edu/ocwweb/Mathematics , http://www.opensource.org , www.mathpages.com

Mapping of Cos with POs and PSOs

	POs						PSOs		
	1	2	3	4	5	6	1	2	3
C01	3	3	3	3	3	3	3	3	3
C02	3	2	2	1	2	2	3	2	3
C03	3	3	3	2	3	3	3	3	3
C04	3	1	3	3	3	3	3	2	3
C05	3	2	3	3	3	3	3	3	3

Strong-3; Medium-2; Low-1

Title of the Course		MATHEMATICAL MODELING					
Paper Number		EC IV (DISCIPLINE SPECIFIC)					
Category	ELECTIVE	Year	I	Credits	3	Course Code	26PMADSEC4B
		Semester	II				
Instructional Hours per week		Lecture	Tutorial		Lab Practice		Total
		4	-		-		4
Pre-requisite		UG level differential equations					
Objectives of the Course		1. To comprehend mathematical modeling ideas 2. To acquire the knowledge of mathematical modeling through ordinary differential equations of first and second order. 3. To build up the capacity of tackling this present reality issues through mathematical modeling.					
Course Outcomes: Students will be able to C01: learn the importance of differential equations in solving mathematical models. C02: understand the Occurrence, classification and characteristics of Mathematical Models.							

C03: apply problem solving techniques in Mathematical Modeling to bring solutions to various real life situations. C04: examine the principles governing the motion of satellites through notions of Mathematical Modeling and interpret the techniques in Mathematical Models to analyse the motion of fluids. C05: construct suitable models for population dynamics, medicine and reducing various forms of Pollution.	
Course Outline	Unit - I (Hours:12) Mathematical Modeling: Need, Techniques, Classifications and Simple Illustrations: Simple Situations Requiring Mathematical Modeling - The Technique of Mathematical Modeling - Classification of Mathematical Models - Some Characteristics of Mathematical Models - Mathematical Modeling Through Ordinary Differential Equations of First Order - Mathematical Modeling Through Differential Equations Linear Growth and Decay Models - Non - Linear Growth and Decay Models - Compartment Models Chapter 1 (Sections 1.1 - 1.4), Chapter 2 (Sections 2.1 - 2.4)
	Unit - II (Hours:12) Mathematical Modeling Through Systems of Ordinary Differential Equations of First Order: Mathematical Modeling in Population Dynamics - Mathematical Modeling of Epidemics Through Systems of Ordinary Differential Equations of First Order - Compartment Models Through Systems of Ordinary Differential Equations - Mathematical Modeling in Economics Through Systems of Ordinary Differential Equations of First Order Chapter 3 (Sections 3.1 - 3.4)
	Unit -III (Hours:12) Mathematical Modeling Through Systems of Ordinary Differential Equations of First Order: Mathematical Models in Medicine, Arms Race, Battles and International Trade in Terms of Systems of Ordinary Differential Equations Mathematical Modeling Through Ordinary Differential Equations of Second Order: Mathematical Modeling of Planetary Motions - Mathematical Modeling of Circular Motion and motion of Satellites Chapter 3 (Section 3.5), Chapter 4 (Sections 4.1 & 4.2)
	Unit -IV (Hours:12) Models for blood flows: Some Basic Concepts of Fluid Dynamics - Basic Concepts about Blood, Cardiovascular System and Blood Flows - Steady Non - Newtonian Fluid Flows in Circular Tubes - Basic Equations for Fluid Flow - Flow of Power - law Fluid in Circular Tube - Flow of Herschel - Bulkley Fluid in Circular Tube - Flow of Casson Fluid in Circular Tube - Flow of m Immiscible Power - law Fluids in a Circular Tube - Blood Flow through Artery with Mild Stenosis. Chapter 11 (Sections 11.1, 11.2, 11.3 (11.3.1 - 11.3.5), 11.5)
	Unit -V (Hours:12) Models for Optimal Control of Water Pollution: Water Quality Management Models - Water Quality Management Model 1 - Water Quality Management Model 2 - Water Quality Management Model 3 - Water Quality Management Model 4 - Other Models for Water Quality

	Management - Other Optimal Pollution Control Models- Optimal Air Pollution Control Models - Control Models for Solid Waste Disposal - Noise Pollution Control Model Chapter 14 (Sections 14.3: 14.3.1 - 14.3.6) (Sections 14.4: 14.4.1 - 14.4.4)
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.
Skills acquired from the course	Knowledge, Problem Solving, Analytical ability, Professional Competency, Professional Communication and Transferrable Skill
Recommended Text	1.J. N. Kapur, Mathematical modeling, New Age International (P) Limited, Publishers, New Delhi, First Edition (For Unit I - Unit III) 2.J. N. Kapur, Mathematical Models in Biology & Medicine, Affiliated East - West Press Private Limited, New Delhi (For Unit IV and Unit V)
Reference Books	1.D.N. Burghes, Modeling through Differential Equation, Ellis Horwood and John Wiley. 2.C. Dyson and E. Levery, Principle of Mathematical Modeling, Academic Press New York. 3.Giordano, Weir, Fox, A First Course in Mathematical Modeling 2nd Edition, Brooks/Cole Publishing Company, 1997. 4.B. Barnes, G. R. Fulford, Mathematical Modeling with Case Studies, A Differential Equation Approach using Maple and Matlab, 2nd Ed., Taylor and Francis group, London and New York, 2009.
Web resources	1. https://www.mat.univie.ac.at/~neum/model.html 2. https://nptel.ac.in/courses/111/107/111107113/ 3. https://www.frontiersin.org/articles/10.3389/fgene.2015.00354/full

Mapping of COs with POs and PSOs:

CO	POs						PSOs		
	1	2	3	4	5	6	1	2	3
CO1	3	3	3	2	2	3	3	3	1
CO2	3	3	3	2	2	2	3	2	1
CO3	3	3	3	2	2	3	3	3	1

C04	3	3	3	2	2	3	3	2	1
C05	3	3	3	2	2	3	3	3	1

Strong - 3; Medium - 2; Low - 1

Title of the Course		GAME THEORY AND STRATEGY (FOR I M.Sc./M.A)							
Paper Number		EDC							
Category	EXTRA DISCIPLINARY	Year	I	Credits	2	Course Code	26PMAEDC1		
		Semester	II						
Instructional Hours per week		Lecture	Tutorial		Lab Practice		Total		
		4	-		-		4		
Pre-requisite		UG level Linear programming							
Objectives of the Course		1. It focuses on fundamentals of game theory including basic concepts and techniques, various ways of describing and solving games, and various applications in economics, political sciences, and business. 2. It will help students sharpen their understanding of strategic behavior in different situations involving many individuals.							

	3. The students will learn how to recognize and model strategic situations, to predict when and how their action will have an influence on others, and to exploit strategic situations for the benefit of their own.
Course Outcomes: Students will be able to C01: distinguish a game situation from a pure individual's decision problem C02: explain graphical representation of mixed strategies. C03: explain concepts of dominant, dominated, and rationalizable strategies, pure and mixed strategies, and best responses C04: analyse economic situations using game theoretic techniques C05: Solve simple games using mapping method.	
Course Outline	Unit - I (Hours:12) Game, Strategy and Saddle Point: Introduction- Description of a game of strategy- Relations among expectations - saddle points- game with perfect information. Chapter 1 (Sections 1.1 to 1.6)
	Unit - II (Hours:12) The Fundamentals: Game without saddle points-mixed strategies - graphical representation of mixed strategies - the minimax theorem - optimal mixed strategies- graphical representation of minimax theorem and proof of minimax theorem. Chapter 2 (Sections 2.1 to 2.8)
	Unit -III (Hours:12) Properties of Optimal Strategies: Many optimal strategies - some properties of an optimal strategies - convex set of optimal strategies- operation on games - dominated strategies - all strategies active. Chapter 3 (Sections 3.1 to 3.6)
	Unit - IV (Hours:12) Method of Solving games: Solving for optimal strategies - Guess and verify - Examination of submatrices- Successive approximations - Graphical solutions of 3 x 3 games. Chapter 5 (Sections 5.1 to 5.5)
	Unit -V (Hours:12) Mapping method for solving games with constraints - Mapping method for solving games - solution of reconnaissance game by mapping method. Chapter 5 (Sections 5.6 to 5.8)
Extended Professional Component (is a part of Internal Component only, not to be included in the	Questions related to the above topics, from various competitive examinations UPSC/TRB/NET/UGC - CSIR/ GATE/ TNPSC/ others to be solved.

External Examination question paper)	
Skills acquired from the course	Knowledge, Problem Solving, Analytical ability, Professional Competency, Professional Communication and Transferrable Skill
Recommended Text	Melvin Dresher, Game of Strategy Theory and Application, Prentice Hall-Inc, USA, 1961
Reference Books	1.KantiSwarup, P.K. Gupta and Man Mohan, Operations Research, Eighth Edition , Sultan Chand & Sons, New Delhi, 1999. 2. S. Hillier and J. Liebermann, Operations Research, Sixth Edition, McGraw Hill Company, 1995. 3. J. K. Sharma, Operations Research problems and solution, Third edition, Macmillan Publishers India Ltd, India, 2012. 4. Guillermo Owen, Game Theory, 2nd edition, Academic Press, 1982. 5.Philip D. Straffin, Game Theory and Strategy, The Mathematical Association of America, USA, 1993.
Web resources	1. https://nptel.ac.in/courses/110101133 2. https://archive.nptel.ac.in/courses/110/104/110104063/

Mapping of COs with POs and PSOs:

	POs						PS Os		
	1	2	3	4	5	6	1	2	3
CO1	3	2	3	2	3	3	3	2	3
CO2	3	2	3	3	3	3	3	3	3
CO3	3	2	3	3	3	3	3	2	2
CO4	3	2	3	2	3	3	3	3	2
CO5	3	2	2	3	3	3	3	3	2

Strong - 3; Medium - 2; Low - 1

Title of the Course	HUMAN RIGHTS						
Course No.							
Category	Common subject	Year	I	Credit	1	Course Code	26PHRS
		Semester	II				
Instructional hours per week	Lecture	Tutorial		Lab Practice		Total	
	2	0		-		2	
Prerequisites	Basic desire to learn about rights						
Objectives of the course	To enlighten the students about the different rights.						

Course Outline	UNIT- I Human rights – Definition – characteristics of human rights classification of rights-The Universal declaration of human rights-international covenants one economic, social and cultural rights. UNIT- II Constitutional guarantee on human rights - Fundamental rights –Part III of constitution-Directive principles Part IV of the constitution. UNIT-III Civil and political rights- right to work, right to personal freedom, right to freedom of expression, right to property, right to education, right to equality, right to religion, right to form association and unions, right to family, right to contract, right to constitutional remedies, right to contest in election, right to hold public office, right to petition, right to criticize government. UNIT- IV Economic rights: Right to work, right to adequate wages, right to reasonable hours of work, right to self-government in industry. UNIT- V Women’s rights: Right to inheritance, right to divorce, right to remarry, right to education, right to employment and career advancement.				
Extended Professional Component (is apart 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/TNPSC others to be solved (To be discussed during the Tutorial hours)				
Skills acquired from this course	Knowledge, Problem solving, awareness of fundamental rights and duties				
Recommended Text	1. <i>Humanrights</i> -UNESCO, 1982 2. Desai A R- <i>Violation of democratic rightsinIndia</i> , 1986 . 3. Pandey- <i>Constitutional Law</i> . 4. <i>Humanrights</i> – A selected bibliography, USIS. 5. Singh K S, <i>Indian Social Institution</i> , 1983 .				

Title of the Course		COMPLEX ANALYSIS					
Paper Number		CORE VII					
Category	CORE	Year	II	Credits	5	Course Code	26PMACC7
		Semester	III				
Instructional Hours per week		Lecture	Tutorial		Lab Practice		Total
		5	1		-		6
Pre-requisite		UG level Complex Analysis					
Objectives of the Course		To Study Cauchy integral formula, local properties of analytic functions, general form of Cauchy's theorem and evaluation of definite integral and harmonic functions					

Course Outcomes: Students will be able to C01: learn the concepts of Cauchy's Integral Formula and analyze the local properties of analytical functions. C02: evaluate contour integrals using Cauchy's theorem, homology and the residue theorem. C03: describe the concept of harmonic functions and residue techniques to evaluate definite integrals. C04: analyze harmonic functions and power series expansions. C05: explain the infinite products, canonical products and Jensen's formula.	
Course Outline	UNIT-I (Hours:21) 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-Taylor'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
	UNIT-II (Hours:21) 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
	Unit – III (Hours:21) 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
	Unit – IV (Hours:21) 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
	Unit – V (Hours:21) 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
Extended Professional Component (is a part of Internal Component only, not to be included in the	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)

External Examination question paper)	
Skills acquired from the course	Knowledge, Problem Solving, Analytical ability, Professional Competency, Professional Communication and Transferrable Skill
Recommended Text	Lars V. Ahlfors, <i>Complex Analysis</i> , (3 rd edition) McGraw Hill Co., New York, 1979
Reference Books	1. H.A. Presfly, <i>Introduction to Complex Analysis</i>, Clarendon Press, oxford, 1990. 2. J.B. Conway, <i>Functions of one complex variables</i> Springer - Verlag, International student Edition, Naroser Publishing Co.1978 3. E. Hille, <i>Analytic function Theory</i> (2 vols.), Gonm & Co, 1959. 4. M. Heins, <i>Complex function Theory</i>, Academic Press, New York,1968.
Web resources	1. http://mathforum.org, 2. http://ocw.mit.edu/ocwweb/Mathematics, 3. http://www.opensource.org,

Mapping of COs with POs and PSOs:

	POs						PSOs		
	1	2	3	4	5	6	1	2	3
C01	3	1	3	2	3	3	3	2	1
C02	2	1	3	1	3	3	3	2	1
C03	3	2	3	1	3	3	3	2	1
C04	1	2	3	2	3	3	3	2	1
C05	3	1	2	3	3	3	3	2	1

Strong - 3; Medium - 2; Low - 1

Title of the Course		PROBABILITY THEORY					
Paper Number		CORE VIII					
Category	CORE	Year	II	Credits	5	Course Code	26PMACC8
		Semester	III				
Instructional Hours per Week	Lecture	Tutorial		Lab Practice		Total	
	5	1		--		6	
Pre-requisite		UG level algebra and calculus					
Objectives of the Course		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.					
Course Outcomes: Students will be able to C01: define random events, random variables, probability, Bayes' theorem, and distribution functions C02: explain expectation, moments, Chebyshev's inequality, and solve regression problems of the first and second types. C03: apply characteristic functions and probability generating functions to solve probability problems. C04: analyze discrete and continuous probability distributions and their applications in solving probability problems. C05: evaluate stochastic convergence, laws of large numbers, convergence theorems, and related probability results, and formulate solutions for advanced probability problems.							
Course Outline		Unit-I (Hours:18) Random Events and Random Variables Preliminary remarks - Random events and operations performed on them - The system of axioms of the theory of probability - Application of combinatorial formulas for computing probabilities - Conditional probability - Bayes theorem - Independent events - The concept of a random variable - The distribution function - Random variables of the discrete type and the continuous type - Functions of random variables - Multidimensional random variables - Marginal distributions - Conditional distributions - Independent random variables - Functions of multidimensional random variables. Chapter 1 (Sections 1.1 to 1.7) Chapter 2 (Sections 2.1 to 2.9)					
		Unit-II (Hours:18) Parameters of the Distribution of the Random Variables Expected values – Moments - The Chebyshev inequality - Absolute moments - Order parameters - Moments of random vectors - Regression of the first type - Regression of the second type. Chapter 3 (Sections 3.1 to 3.8)					
		Unit-III (Hours:18) Characteristic functions Properties of characteristic functions - The characteristic function and moments - Semi-invariants - The characteristic function of the sum of independent random variables - Determination of the distribution function by the characteristic function -The characteristic function of					

	multidimensional random vectors – Probability-generating functions. Chapter 4 (Sections 4.1 to 4.7) Unit-IV(Hours:18) Some Probability Distributions One-point and two-point distributions - The Bernoulli scheme. The binomial distribution - The Poisson scheme. The generalized binomial distribution - The Pólya and hypergeometric distributions - The Poisson distribution - The uniform distribution - The normal distribution - The gamma distribution - The beta distribution -The Cauchy and Laplace distributions. Chapter 5 (Section 5.1 to 5.10) Unit-V(Hours:18) Limit Theorems Preliminary remarks - Stochastic convergence – Bernoulli’s law of large numbers – The convergence of a sequence of distribution functions – The Lévy-Cramér theorem – The de Moivre-Laplace theorem – The Lindeberg-Lévy theorem - The Lapunov theorem – Poisson’s, Chebyshev’s, and Khintchin’s laws of large numbers - The 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)
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 course	Knowledge, Problem Solving, Analytical ability, Professional Competency, Professional Communication and Transferrable Skill
Recommended Text	M. Fisz, Probability Theory and Mathematical Statistics, John Wiley and Sons, New York, 1963.
Reference Books	1. V. K. Rohatgi, An Introduction to Probability Theory and Mathematical Statistics, Wiley Eastern Ltd., New Delhi, 1988(3rdPrint). 2. R.B. Ash, Real Analysis and Probability, Academic Press, New York, 1972 3. K. L. Chung, A course in Probability, Academic Press, New York, 1974. 4. R. Durrett, Probability: Theory and Examples, (2nd Edition) Duxbury Press, New York, 1996. 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	http://mathforum.org , http://ocw.mit.edu/ocwwweb/Mathematics , http://www.opensource.org , http://www.probability.net

Mapping of COs with POs and PSOs:

	POs	PSOs

	1	2	3	4	5	6	1	2	3
C01	3	1	3	1	3	3	3	2	1
C02	3	1	3	1	3	3	3	2	1
C03	3	2	3	2	3	3	3	2	1
C04	3	2	3	2	3	3	3	2	1
C05	3	2	2	1	3	3	3	2	1

Strong - 3; Medium - 2; Low - 1

Title of the Course		TOPOLOGY					
Paper Number		CORE IX					
Category	CORE	Year	II	Credits	5	Course Code	26PMACC9
		Semester	III				
Instructional Hours per week		Lecture	Tutorial		Lab Practice		Total
		5	1		-		6
Pre – requisite		Real Analysis					
Objectives of the Course		To study topological spaces, continuous functions, connectedness, compactness, countability and separation axioms.					
Course Outcomes: Students will be able to C01: learn the concepts and properties of various topological spaces, closed sets and limit points. C02: understand and apply the properties of continuous functions, product topology and examine the metrizable of various topological spaces. C03: gain knowledge and analyze the attributes of various connected spaces. C04: apply and analyze the attributes of various compact spaces. C05: classify the countability and separation axioms and to apply Urysohn Lemma to prove the Tietz extension theorem							
Course Outline	UNIT-I (Hours: 18) Topological spaces: Topological spaces – Basis for a topology – The order topology – The product topology on $X \times Y$ – The subspace topology – Closed sets and limit points. Chapter 2 (Sections 12 - 17)						
	UNIT-II (Hours: 18) Continuous functions: Continuous functions – the product topology – The metric topology. Chapter 2 (Sections 18 - 21) (Omit Section 22)						
	UNIT-III (Hours: 18) Connectedness: Connected spaces- connected subspaces of the Real line – Components and local connectedness. Chapter 3 (Sections 23 – 25)						
	UNIT- IV (Hours: 18) Compactness: Compact spaces – compact subspaces of the Real line – Limit Point Compactness – Local Compactness. Chapter 3 (Sections 26 - 29)						
	UNIT-V (Hours: 18) Countability and Separation Axiom: The Countability Axioms – The separation Axioms – Normal spaces – The Urysohn Lemma – The Urysohn metrization Theorem – The Tietz extension theorem. Chapter 4 (Sections 30 – 35)						
Extended Professional Component (is a part of Internal Component only, not to be included in the	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)						

External Examination question paper)	
Skills acquired from the course	Knowledge, Problem Solving, Analytical ability, Professional Competency, Professional Communication and Transferrable Skill
Recommended Text	James R. Munkres, <i>Topology</i> (2 nd Edition) Pearson Education Pvt. Ltd., Delhi-2002 (Third Indian Reprint)
Reference Books	1. J. Dugundji, <i>Topology</i>, Prentice Hall of India, New Delhi, 1975. 2. George F. Simmons, <i>Introduction to Topology and Modern Analysis</i>, McGraw Hill Book Co., 1963 3. J.L. Kelly, <i>General Topology</i>, Van Nostrand, Reinhold Co., New York 4. L. Steen and J. Subhash, <i>Counter Examples in Topology</i>, Holt, Rinehart and Winston, New York, 1970. 5. S. Willard, <i>General Topology</i>, Addison - Wesley, Mass., 1970
Web resources	http://mathforum.org , http://ocw.mit.edu/ocwwweb/Mathematics , http://www.opensource.org , http://en.wikipedia.org

Mapping of COs with POs and PSOs

	POs						PSOs		
	1	2	3	4	5	6	1	2	3
C01	3	1	3	2	3	3	3	2	1
C02	2	1	3	1	3	3	3	2	1
C03	3	2	3	1	3	3	3	2	1
C04	1	2	3	2	3	3	3	2	1
C05	3	1	2	3	3	3	3	2	1

Strong - 3; Medium - 2; Low - 1

Title of the Course		MACHINE LEARNING [Industry Module]					
Paper Number		CORE X					
Category	CORE	Year	II	Credits	4	Course Code	26PMACC10
		Semester	III				
Instructional Hours per week		Lecture	Tutorial		Lab Practice		Total
		5	1		-		6
Pre – requisite		Basic Knowledge in Computer Science					
Objectives of the Course		1. To explore how recent technologies influenced the learning environment. 2. To provide a comprehensive understanding of machine learning principles, practical skills in algorithm implementation and familiarity with tools.					
Course Outcomes: Students will be able to CO 1: understand the fundamentals of Machine learning, including types and algorithms and apply them to solve problems CO 2: explain the architecture and methodologies of Robotic Process Automation to implement automation solutions and develop industrial applications. CO 3: interpret cloud computing models and services to examine deployment strategies and formulate scalable computing solutions. CO 4: describe cybersecurity concepts and cyber threats to investigate information security issues and design secure computing environments. CO 5: demonstrate virtual reality technologies by integrating immersive tools to create real-world virtual applications.							
Course Outline		Unit – I (Hours: 18) Machine Learning: Introduction - Definition - Types of Machine Learning - Supervised, Unsupervised, Reinforcement Learning - Algorithms for Machine Learning – problems solved by Machine Learning – Tools for Machine Learning – Applications. Chapter 14					
		Unit - II (Hours: 18) Robotic Process Automation (RPA): Introduction to RPA –Need for automation programming constructs in RPA- Robots and Softbots – RPA architecture and process methodologies –Industries best suited for RPA. Chapter 5 (Sections 5.6)					
		Unit - III (Hours: 18) Cloud Computing: Need - Definition - Types of Cloud - Types of services – Saas. Chapter 7 (Section 7.3)					
		Unit - IV(Hours:18) Cyber Security: Cyber Crime and Information security – Classification of Cyber Crime Types. Chapter 11					
		Unit - V(Hours:18) Virtual Reality: Definition- Types of Head Mounted Displays-Tools for Reality Chapter 8 (Section 8.2)					
Extended Professional Component (is a part of Internal		Real life application related to the above topics in various fields. (To be discussed during the Tutorial hour)					

Component only, not to be included in the External Examination question paper)	
Skills acquired from the course	Knowledge, Problem Solving, Analytical ability, Professional Competency, Professional Communication and Transferrable Skill
Recommended Text	1. P. Kaliraj, T. Devi, <i>Artificial Intelligence Theory, Models and Applications</i>, 2022, ISBN 9781032008097, Boca Raton, CRC Press, Taylor & Francis Group (For Unit I) 2. P. Kaliraj and T. Devi, <i>Industry 4.0 Technologies for Education Transformation Technologies and Applications</i>, Boca Raton, CRC Press, Taylor & Francis Group, New York, 2022. (For Units II, III & V) 3. P. Kaliraj, T. Devi, <i>Securing IoT in Industry 4.0 Applications with Blockchain</i>, 2022, ISBN 9781032008103, Boca Raton, CRC Press, Taylor & Francis Group (For Unit IV)
Reference Books	1. P. Kaliraj and T. Devi, <i>Higher Education for Industry 4.0 and Transformation to Education 5.0</i>, Taylor & Francis Group, New York, 2023. 2. UiPath Inc., www.uipath.com/rpa/robotic-process-automation 3. UiPath Inc., www.uipath.com/rpa/academy 4. Uthayan Elangovan, <i>Industry 5.0 The Future of the Industrial Economy</i>, Taylor & Francis Group, New York, 2022. 5. Reiko Yamada, Aki Yamada and Deane E. Neubauer <i>Transformation of Higher Education in the Age of Society 5.0 Trends in International Higher Education</i>, Palgrave Macmillan, USA, 2023.
Web resources	https://www.javatpoint.com/applications-of-machine-learning https://flobotics.io/blog/rpa-use-cases-across-industries/ https://startupstash.com/virtual-reality-tools/ https://www.tutorialspoint.com/fundamentals_of_science_and_technology/cyber crime and cyber security.htm

Mapping of Cos with POs and PSOs

	POs						PSOs		
	1	2	3	4	5	6	1	2	3
C01	3	1	2	2	1	2	3	2	1
C02	2	3	3	2	2	3	1	2	3
C03	2	3	3	2	2	3	1	2	3
C04	2	3	2	3	2	3	2	2	3
C05	1	2	3	3	2	3	2	2	3

Strong - 3; Medium - 2; Low - 1

Title of the Course		FLUID DYNAMICS					
Paper Number		EC V (DISCIPLINE SPECIFIC)					
Category	ELECTIVE	Year	II	Credits	3	Course Code	26PMADSEC5A
		Semester	III				
Instructional Hours per week		Lecture	Tutorial		Lab Practice		Total
		3	-		-		3
Pre-requisite		Vector Analysis					
Objectives of the Course		1. To know the concepts of real fluids, velocity potential, equations of continuity, Eulers equation of motion and vortex motion with examples. 2. To gain knowledge about sources, sinks and doublets with examples. 3. To analyse the Milne - Thomson circle theorem, the Theorem of the Navier -Stokes's equation of motion of a viscous fluid. 4. To develop flexibility and creativity of the students in applying the Mathematical ideas and techniques to solve unfamiliar problems arising in everyday life					
Course Outcomes: Students will be able to CO1: understand the concepts of real and ideal fluids, velocity potential, vorticity, local and particle rates of change and the equation of continuity CO2: apply the principles and governing equations of fluid motion, including Euler's and Bernoulli's equations, to solve related problems. CO3: analyze three-dimensional flows involving sources, sinks and doublets with examples CO4: Examine two-dimensional irrotational incompressible flows using stream functions, complex potentials, image systems, and the Milne–Thomson circle theorem. CO5: formulate mathematical models of viscous fluid motion using stress analysis, viscosity and the Navier–Stokes equations to solve real-life problems.							
Course Outline		Unit I (Hours:9) Kinematics of Fluids in Motion: Real fluids and Ideal fluids - Velocity of a fluid at a point - Stream lines and path lines - Steady and Unsteady flows - The Velocity Potential - The Vorticity Vector - Local and Particle Rates of Change - The Equation of Continuity - Worked Examples. Chapter 2 (Sections 2.1 - 2.8)					
		Unit II (Hours:9) Equations of Motion of a Fluid: Pressure at a point in a fluid at rest - Pressure at a point in a moving fluid - Euler's equations of Motion - Bernoulli's equation -Worked Examples - Discussion of the case of steady motion under Conservative Body Forces - Some flows involving axial symmetry (examples 1 and 2 only). Chapters 3 (Sections 3.1, 3.2,3.4 - 3.7, 3.9)					
		Unit - III(Hours:9) Some Three-Dimensional Flows: Introduction - Sources, Sinks and Doublets-Images in rigid infinite plane - Images in solid spheres Chapter 4 (Sections 4.1 - 4.4)					

	Unit - IV(Hours:9) Some Two-Dimensional Flows: The Stream Function - The Complex Velocity Potential for Two Dimensional Irrotational, Incompressible Flow - Complex Velocity Potentials for Standard Two Dimensional Flows - Some Worked Examples - Two Dimensional Image Systems - The Milne-Thomson Circle Theorem. Chapter 5 (Sections 5.3 - 5.8)
	Unit - V(Hours:9) Viscous Fluid: Stress components in a real fluid - Relation between Cartesian Components of Stress - Translational motion of fluid element - The Coefficient of Viscosity and Laminar flow - The Navier- Stokes equation of a viscous fluid - Some solvable problems in viscous flow - Steady motion between parallel planes only. Chapter 8 (Sections 8.1 - 8.3, 8.8, 8.9 and 8.10.1)
Extended Professional Component (is a part of Internal Component only, not to be included in the External Examination question paper)	Real life application related to the above topics in various fields. (To be discussed during the Tutorial hour)
Skills acquired from the	Knowledge, Problem Solving, Analytical ability, Professional Competency, Professional Communication and Transferrable Skill
Recommended Text	Frank Chorlton, Textbook of Fluid Dynamics, CBS Publishers & Distributors, 2004.
Reference Books	1. L.M. Milne-Thomson, Theoretical Hydrodynamics, Macmillan, London, 1955. 2. G.K. Batchelor, An Introduction to Fluid Dynamics Cambridge Mathematical Library, 2000.
Web resources	http://mathforum.org , http://ocw.mit.edu/ocwweb/Mathematics , http://www.opensource.org , www.mathpages.com

Mapping with POs and PSOs

	Pos						PSOs		
	1	2	3	4	5	6	1	2	3
C01	3	3	3	3	3	3	3	3	3
C02	3	2	2	1	2	2	3	2	3
C03	3	3	3	2	3	3	3	3	3
C04	3	1	3	3	3	3	3	2	3
C05	3	2	3	3	3	3	3	3	3

Strong - 3; Medium - 2; Low - 1

Title of the Course		STOCHASTIC PROCESSES					
Paper Number		EC V (DISCIPLINE SPECIFIC)					
Category	ELECTIVE	Year	II	Credits	3	Course Code	26PMADSEC5B
		Semester	III				
Instructional Hours		Lecture	Tutorial		Lab Practice		Total
Per week		3	-		-		3
Pre-requisite		UG level probability and statistics					
Objectives of the Course		1. To study how systems evolve over time in a probabilistic manner, taking into account random inputs or disturbances. 2. To comprehend the behavior of systems or processes that exhibit random or unpredictable behavior 3. To investigate the long-term behavior and limiting properties of stochastic processes, such as convergence to a stationary distribution or steady-state behavior.					
Course Outcomes: Students will be able to C01: demonstrate proficiency in understanding and applying Chapman-Kolmogorov equations for analysing Markov chains, including the calculation of 'n' step transition probabilities C02: understand the concepts of Poisson processes and birth-death processes, and be able to apply them to real-world scenarios such as queues and storage problems C03: analyse and modeling stochastic processes characterized by continuous time and continuous state space C04: compute and interpret covariance functions, including the application of Bochner's theorem to characterize stationary processes C05: analyse renewal processes and their associated renewal functions and demonstrate proficiency in calculating and interpreting renewal functions and their properties							
Course Outline		UNIT I (Hours : 9) Stochastic Processes: An introduction (SP) – Specification of Stochastic Processes – Markov chains (MC) : Higher Transition Probabilities - Chapman - Kolmogorov equation Chapter 1 & 2 (Sections 1.5, 2.2) UNIT II (Hours : 9) Classification of States and Chains – Markov Chains with Continuous State Space – Random walk - Application to queueing process - Poisson process - Birth and Death process Chapter 2 & 3 (Sections 2.4, 2.11 & 3.1, 3.4) UNIT III(Hours : 9) Markov Processes with discrete state space (continuous time Markov chains) – Chapman Kolmogorov's equations - Wiener process – Differential equations for a Wiener Process - Kolmogorov quations - first passage time Distribution process for Wiener process. Chapter 3 & 4 (Sections 3.5 : 3.5.2, 4.2 ,4.3, 4.4 & 4.5)					

	UNIT IV(Hours:9) Stationary processes and time series: second order processes (wide sense and strict sense stationary process - Covariance function) - Moving average (MA) process - auto regressive process (AR process), - Bochner's theorem (statement), Bochner - Khinchine's representation of wide sense stationary process. Chapter 8 (Sections 8.1, 8.2.3,8.2.4,8.3.1,8.3.2)
	UNIT V(Hours:9) Renewal Processes: renewal function- renewal theorems - Elementary renewal theorem, key renewal theorems. Chapter 6(Section 6.2.1, 6.5, 6.5.1, 6.5.4)
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/TNPSC/others to be solved (To be discussed during the Tutorial hour)
Skills acquired from the Course	Knowledge, Problem Solving, Analytical ability, Professional Competency, Professional Communication and Transferrable Skill
Recommended Text	Medhi. J, (2009), Third edition, Stochastic Processes, New age International publishers
Reference Books	1. Basu.A.K. (2003) Introduction to stochastic processes, New age Publishers. 2. Ross. S.M.(1983)Stochastic Process, Wiley, New York. 3. Karlin and First course in Stochastic Process - Vol. I & II, Academic Press. Taylor. H.M. (1975)
Website and e-Learning Source	http://mathforum.org , http://ocw.mit.edu/ocwweb/Mathematics , http://www.opensource.org , www.mathpages.com

Mapping with POs and PSOs

	POs						PSOs		
	1	2	3	4	5	6	1	2	3
C01	3	3	3	3	3	3	3	3	3
C02	3	2	2	1	2	2	3	2	3
C03	3	3	3	2	3	3	3	3	3
C04	3	1	3	3	3	3	3	2	3
C05	3	2	3	3	3	3	3	3	3

Strong - 3; Medium - 2; Low - 1

Title of the Course		STATISTICS FOR LIFE AND SOCIAL SCIENCES (FOR II M.SC / M.A)					
Paper Number		EDC					
Category	EXTRA DISCIPLINARY	Year	II	Credits	2	Course Code	26PMAEDC2
		Semester r	II I				
Instructional Hours per week		Lecture	Tutorial		Lab Practice		Total
		2	1		--		3
Pre-requisite		UG level Statistics					
Objectives of the Course		The course focuses on imparting statistical techniques tailored for analyzing data in life and social sciences, emphasizing practical application and critical interpretation to enable informed decision-making in research and real-world scenarios.					
Course Outcomes: Students will be able to C01: develop proficiency in defining statistical concepts, understanding diverse data collection methods, mastering set theory, and grasping logical principles. C02: equip skills in diagrammatic presentation, frequency distribution, graphical representation of data, and calculation of measures of central tendency. C03: ensure proficiency in Probability Theory, Permutation Theorem, Combination, and Binomial Distribution. C04: understand the nature and significance of statistical inquiries. C05: understand the nature of science and introduce fundamental concepts in social statistics.							
Course Outline	UNIT - I (Hours: 9) Definitions, and Scope of Statistics -Approach to Data Collection - Introduction to Set Theory I & II -Concepts of Logic Chapter 1 (Page No. 1 -39)						
	UNIT – II (Hours: 9) Diagrammatic Presentation of Data -Frequency Distribution - Graphical Presentation of Data - Measures of Central Tendency Chapter 2 (Page No. 40 -70)						
	UNIT - III (Hours: 9) Probability Theory I&II - Permutation Theorem - Combination - Binominal Distribution Chapter 3 (Page No. 71 - 90)						
	UNIT – IV (Hours: 9) Nature and Importance of Statistical Inquiries - Basic Research Methodology I & II Chapter 4 (Page No. 91 - 126)						
	UNIT - V (Hours: 9) Nature of Science -Some Basic Concepts in Social Statistics						

	Chapter 4 (Page No. 127 -140)
Extended Professional Component	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 this course	Knowledge, Problem Solving, Analytical ability, Professional Competency, Professional Communication and Transferrable Skill
Recommended Text	Basic Statistics for Social Sciences, Dr. Henry Obasogie (Course Reviewer) – Benson Idahosa University Dr. Moses Etila Shaibu (Course Editor) – NOUN
Reference Books	1.Osuala, E.C. (1982). Introduction to Research Methodology. Awka Rd Onitsha, Nigeria: Africana-Fep Publisher Limited. 2.Okoro, E. (2002). Quantitative Techniques in Urban Analysis. Ibadan: Kraft Books Ltd. Kerlinger, Fred N. (1964). . 3. Foundations of Behavioural Research. New York: Holt, Rinehart and Winton. Whitney, F.L. (1968). 4. The Elements of Research. New York: Prentice- Hall.
Website and e-Learning Source	http://mathforum.org , http://ocw.mit.edu/ocwweb/Mathematics , http://www.opensource.org , www.mathpages.com

Mapping with POs and PSOs

	POs						PSOs		
	1	2	3	4	5	6	1	2	3
C01	3	1	3	2	3	3	3	2	1
C02	2	1	3	1	3	3	3	2	1
C03	3	2	3	1	3	3	3	2	1
C04	1	2	3	2	3	3	3	2	1
C05	3	1	2	3	3	3	3	2	1

Strong - 3; Medium - 2; Low - 1

Title of the Course		FUNCTIONAL ANALYSIS					
Paper Number		CORE XI					
Category	CORE	Year	II	Credits	5	Course Code	26PMACC11
		Semester	IV				
Instructional Hours per week		Lecture	Tutorial		Lab Practice		Total
		5	1		-		6
Pre - requisite		Elements of Real Analysis					
Objectives of the Course		To provide students with a strong foundation in functional analysis, focusing on spaces, operators and fundamental theorems. To develop student's skills and confidence in mathematical analysis and proof techniques					
Course Outcomes: Students will be able to CO 1: Understand the Banach spaces and Transformations on Banach Spaces. CO 2: Prove Hahn Banach theorem and open mapping theorem. CO 3: Describe operators and fundamental theorems. CO 4: Validate orthogonal and orthonormal sets. CO 5: Analyze and establish the regular and singular elements.							
Course Outline	Unit - I (Hours: 18) Banach Spaces: The definition and some examples - Continuous linear transformations - The Hahn-Banach theorem - The natural imbedding of N in N ** - The open mapping theorem - The conjugate of an Operator. Chapter 9: Sections 46-51						
	Unit - II (Hours: 18) Hilbert Spaces: The definition and some simple properties - Orthogonal complements - Ortho normal sets - The conjugate space H*-The adjoint of an operator - self-adjoint operators-Normal and unitary operators - Projections. Chapter 10: Sections 52-59						
	Unit - III (Hours: 18) Finite-Dimensional Spectral Theory: Matrices - Determinants and the spectrum of an operator - The spectral theorem. Chapter 11:Sections 60-62						
	Unit - IV(Hours:18) General Preliminaries on Banach Algebras: The definition and some examples - Regular and singular elements - Topological divisors of zero - The spectrum - The formula for the spectral radius - The radical and semi-simplicity. Chapter 12: Sections 64-69						
	Unit - V(Hours:18) The Structure of Commutative Banach Algebras: The Gelfand mapping - Application of the formula $r(x)=\lim\ x^n\ ^{\frac{1}{n}}$ - Involutions in Banach algebras - The Gelfand-Neumark theorem. Chapter 13:Sections 70-73						
	Extended Professional Component (is a part of Internal Component only, not to be included in the External						
		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)					

Examination question paper)	
Skills acquired from the course	Knowledge, Problem Solving, Analytical ability, Professional Competency, Professional Communication and Transferrable Skill
Recommended Text	G. F. Simmons, Introduction to Topology and Modern Analysis, McGraw Hill Education (India) Private Limited, New Delhi, 1963.
Reference Books	1. W.Rudin, Functional Analysis, McGraw Hill Education (India) Private Limited, New Delhi, 1973. 2. B.V. Limaye, Functional Analysis, New Age International, 1996. 3. C. Goffman and G. Pedrick, First course in Functional Analysis, Prentice Hall of India, New Delhi, 1987. 4. E. Kreyszig, Introductory Functional Analysis with Applications, John Wiley & Sons, New York, 1978. 5. M. Thamban Nair, Functional Analysis, A First course, Prentice Hall of India, New Delhi, 2002.
Web resources	http://www.mathforum.org/ http://ocw.mit.edu/ocwweb/Mathematics http://www.opensource.org/ http://en.wikipedia.org/

Mapping of COs with POs and PSOs:

	POs						PSOs		
	1	2	3	4	5	6	1	2	3
C01	3	1	3	2	3	3	3	2	1
C02	2	1	3	1	3	3	3	2	1
C03	3	2	3	1	3	3	3	2	1
C04	1	2	3	2	3	3	3	2	1
C05	3	1	2	3	3	3	3	2	1

Strong - 3; Medium - 2; Low - 1

Title of the Course		DIFFERENTIAL GEOMETRY					
Paper Number		CORE XII					
Category	CORE	Year	II	Credits	5	Course Code	26PMACC12
		Semester	IV				
Instructional Hours per week		Lecture	Tutorial		Lab Practice		Total
		5	1		-		6
Pre - requisite		Linear Algebra concepts and Calculus					
Objectives of the Course		1. To analyze the fundamental properties of space curves and surfaces, including curvature, torsion, and intrinsic properties, to establish a solid foundation in differential geometry. 2. To equip students with the ability to apply key theorems, such as the Gauss-Bonnet Theorem and Hilbert's Theorem, to understand and characterize various surface types, focusing on both intrinsic and extrinsic properties.					
Course Outcomes: Students will be able to							
CO 1: Understand and differentiate between intrinsic and non-intrinsic surface properties by calculating the second fundamental form and identifying lines of curvature, gaining deeper insights into differential geometry.							
CO 2: Analyze and interpret space curves by computing arc length and describing tangent, normal, and binormal vectors, as well as curvature and torsion, demonstrating a practical understanding of curve geometry.							
CO 3: Apply geodesic equations by solving canonical forms and demonstrate understanding of the Gauss-Bonnet Theorem and Gaussian curvature, enabling them to explore surfaces of constant curvature in real-world contexts.							
CO 4: Evaluate intrinsic properties of surfaces, such as metrics, direction coefficients, and families of curves, particularly focusing on surfaces of revolution and helicoids, assessing their geometric significance and applications.							
CO 5: Demonstrate an understanding of compact surfaces with constant curvature by applying Hilbert's Theorem, analyzing and identifying conjugate points on geodesics, and synthesizing advanced concepts of complete surfaces							
Course Outline	Unit - I (Hours: 18) 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- Helices. Chapter I : Sections 1 to 9.						
	Unit - II (Hours: 18) 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.						
	Unit - III (Hours: 18) Geodesics: Geodesics - Canonical geodesic equations - Normal property of geodesics- Existence Theorems - Geodesic parallels - Geodesics curvature- Gauss- Bonnet Theorem - Gaussian curvature- Surfaces of constant curvature. Chapter II: Sections 10 to 18.						
	Unit - IV(Hours:18) 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.						

	Unit - V(Hours:18) Differential Geometry of Surfaces: Compact surfaces whose points are umbilics- 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
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 course	Knowledge, Problem Solving, Analytical ability, Professional Competency, Professional Communication and Transferrable Skill
Recommended Text	T.J. Willmore, <i>An Introduction to Differential Geometry</i> , Oxford University Press, (17 th Impression) New Delhi 2002. (Indian Print)
Reference Books	1. Struik, D.T. <i>Lectures on Classical Differential Geometry</i> , Addison - Wesley, Mass. 1950. 2. Kobayashi. S. and Nomizu. K. <i>Foundations of Differential Geometry</i> , Inter science Publishers, 1963. 3. Wilhelm Klingenberg: <i>A course in Differential Geometry</i> , Graduate Texts in Mathematics, Springer-Verlag 1978. 4. J.A. Thorpe <i>Elementary topics in Differential Geometry</i> , Under-I graduate Texts in Mathematics, Springer - Verlag 1979. 5. Dr. C. S. Mittal and D. C. Agarwal, Krishna Prakasham Mandir, Meerut
Web resources	https://www.geeksforgeeks.org/real-life-applications-of-differential-geometry/ https://fiveable.me/riemannian-geometry/unit-9 https://www.caltech.edu/about/news/Geometry_of_Minimal_Surfaces

Mapping of COs with POs and PSOs:

	POs						PSOs		
	1	2	3	4	5	6	1	2	3
C01	3	2	3	2	3	3	3	2	2
C02	2	2	3	2	3	3	3	2	2
C03	3	2	3	2	3	3	3	2	2
C04	2	2	3	2	3	3	3	2	2
C05	3	2	2	3	3	3	3	2	2

Strong - 3; Medium - 2; Low - 1

Title of the Course		RESOURCE MANAGEMENT TECHNIQUES					
Paper Number		EC VI (DISCIPLINE SPECIFIC)					
Category	ELECTIVE	Year	II	Credits	3	Course Code	26PMADSEC6A
		Semester	IV				
Instructional Hours per week		Lecture	Tutorial		Lab Practice		Total
		3	1		-		4
Pre-requisite		Basics of Calculus, Probability Theory and Operations Research					
Objectives of the Course		1.To learn the methods of solving the real - world mathematical programming problems, applying minimal spanning tree, shortest route algorithms. 2.To gain knowledge about the applications of deterministic dynamic programming. 3.To analyse the formulation and solution of different inventory models and queuing systems. 4. Interpret the three categories of decision making process. 5.To familiarize the implementation of the course content in day - to - day life.					
Course Outcomes: Students will be able to CO1: learn the notions of network models, deterministic dynamic programming, inventory models, decision analysis and queuing models CO2: understand minimal spanning tree, shortest - route algorithms, forward and backward recursive approaches and solve real world problems CO3: analyse the criteria for different decision making environments, pure birth and death models and solve related problems CO4: determine the minimal spanning tree, most economical cable network, replacement policy, optimal inventory policy, solutions of cargo - loading and LP problems using dynamic programming CO5: discuss Knapsack model, queuing models and the procedure of determining optimum inventory policy in various EOQ models							
Course Outline	Unit - I (Hours:12) Network Models: Network definitions, Minimal spanning tree algorithm, Shortest - route problem: Examples of the shortest - route applications, Shortest - route algorithms. Chapter 6 (Sections: 6.1 - 6.3 (6.3.1, 6.3.2(excluding Floyd's Algorithm))						
	Unit - II(Hours:12) Deterministic Dynamic Programming: Recursive nature of computations in DP, Forward and Backward recursion, Selected DP applications: Knapsack/Flyaway Kit/Cargo - loading model, Workforce size model, Equipment replacement model. Chapter 10 (Sections: 10.1 - 10.3(10.3.1 - 10.3.3)						
	Unit - III(Hours:12) Probabilistic Inventory Models: Continuous review models: “Probabilitized” EOQ model, Probabilistic EOQ model, Single - period models: No setup model, Setup model(s - S policy). Chapter 16 (Sections: 16.1(16.1.1, 16.1.2), 16.2(16.2.1, 16.2.2)						
	Unit - IV(Hours:12) Decision Analysis: Decision making environments, Decision making under certainty, Decision making under risk: Expected value criterion, Variations						

	of the expected value criterion, Decision under uncertainty. Chapter 14 (Sections: 14.1, 14.2 (14.2.1, 14.2.2),14.3)
	Unit - V(Hours:12) Queuing Systems: Elements of a queuing model, Role of exponential distribution, Pure birth and death models (Relationship between the exponential and poisson distributions): Pure birth model, Pure death model. Chapter 17 (Sections: 17.2 - 17.4(17.4.1, 17.4.2)
Extended Professional Component (is a part of Internal Component only, not to be included in the External Examination question paper)	Real life application related to the above topics in various fields. (To be discussed during the Tutorial hour)
Skills acquired from the course	Knowledge, Problem Solving, Analytical ability, Professional Competency, Professional Communication and Transferrable Skill.
Recommended Text	Hamdy A. Taha - Operations Research, Seventh Edition, Prentice Hall of India Private limited, New Delhi.
Reference Books	1. Frederick S. Hillier, Gerald J. Lieberman, Bodhibrata Nag, Preetam Basu, Introduction to Operations Research, Ninth Edition, Tata - McGraw Hill Publications Company, New Delhi. 2. Kantiswarup, P.K.Gupta, Man Mohan, Operations Research, Tenth Edition, Sultan Chand & Sons, New Delhi.
Web resources	1. http://www.pondiuni.edu.in/storage/dde/downloads/mbaii_qt.pdf 2. https://www.netlab.tkk.fi/opetus/s383143/kalvot/E_bdpros.pdf 3. https://www.alameen.ac.in/images/QUESTIONBANK/CSE/IIYEAR/MA6453PQTLecture - Notes.pdf

Mapping of COs with POs and PSOs:

	POs						PSOs		
	1	2	3	4	5	6	1	2	3
C01	3	3	3	3	3	3	3	3	2
C02	3	3	3	3	2	2	3	3	3
C03	3	3	3	3	3	3	3	3	3
C04	3	3	3	3	3	3	3	3	3
C05	3	3	3	3	2	2	3	2	2

Strong - 3; Medium - 2; Low - 1

Title of the Course		REPRESENTATION THEORY					
Paper Number		EC VI (DISCIPLINE SPECIFIC)					
Category	ELECTIVE	Year	II	Credits	3	Course Code	26PMADSEC6B
		Semester	IV				
Instructional Hours per week		Lecture	Tutorial		Lab Practice		Total
		3	1		-		4
Pre-requisite		UG Algebra					
Objectives of the Course		1. To understand the concepts of Group representations and Group algebra. 2. To gain knowledge about Irreducible characters and Character tables.					
Course Outcomes: Students will be able to CO1: recall the basic properties of groups and learn about group representations, FG modules and reducibility and group algebras CO2: understand the concepts of FG - homomorphisms, Maschik’s theorem, Schur’s lemma and irreducible modules CO3: recognize inner product of characters and the number of irreducible characters CO4: analyse the dimensions and characters of representations of symmetric groups, dihedral groups and conjugacy classes CO5: create the character tables and orthogonality relations and gain knowledge about some elementary character table							
COURSE OUTLINE		Unit - I (Hours:15) Group representations, FG modules, FG submodules and reducibility, Group algebras Page No: 30 – 60					
		Unit - II(Hours:15) FG - homomorphisms, Maschike"s Theorem, Schur"s Lemma, Irreducible modules and the group algebra. Page No: 61 – 94					
		Unit - III(Hours:15) More on the group algebra, Conjugacy classes, Characters. Page No: 95 – 132					
		Unit - IV(Hours:15) Inner product of characters, The number of irreducible characters. Page No: 133 – 158					
		Unit - V(Hours:15) Character tables and orthogonality relations, Normal subgroups and lifted characters, Some elementary character tables. Page No: 159 – 187					
Extended Professional Component (is a part of Internal Component only, not to be included in the External		Real life application related to the above topics in various fields. (To be discussed during the Tutorial hour)					

Examination question paper)	
Skills acquired from the Course	Knowledge, Problem Solving, Analytical ability, Professional Competency, Professional Communication and Transferrable Skill.
Recommended Text	G. James and M. Liebeck, Representations and Characters of Groups, (Second edition), Cambridge University Press, London, 2001.
Reference Books	C.W. Curtis and I. Reiner, Methods of Representation Theory with applications to Finite Groups and Orders, Volume 1, Wiley Interscience, New York, 1981.
Web resources	1. https://people.math.ethz.ch/~wilthoma/docs/grep.pdf 2. http://www.m67aths.gla.ac.uk/~abartel/docs/reptheory.pdf

Mapping of COs with POs and PSOs:

	POs						PSOs		
	1	2	3	4	5	6	1	2	3
C01	2	3	3	2	2	2	2	2	2
C02	3	3	3	2	3	2	3	2	2
C03	3	3	3	2	3	2	3	2	2
C04	3	3	3	2	3	2	3	2	2
C05	3	3	3	2	3	2	3	2	2

Strong - 3; Medium - 2; Low - 1

Title of the Course		PROJECT WITH VIVA-VOCE						
Paper Number		CORE XIII						
Category	CORE	Year	II	Credits	7	Course Code	26PMAPC	
		Semester	IV					
Instructional Hours per week		Lecture	Tutorial		Lab Practice		Total	
		-	-		-		10	
Pre-requisite		UG Level Mathematics						

Title of the Course		ADVANCED COMPUTATIONAL MATHEMATICS USING PYTHON - PRACTICAL					
Paper Number		Professional Competency Skill					
Category	Skill	Year	II	Credits	2	Course Code	26PMAPCSQ
	Enhancement course	Semester	IV				
Instructional Hours per week		Lecture	Tutorial		Lab Practice		Total
		-	1		3		4
Pre-requisite		UG level Modern Algebra, Operation Research, Number theory & Artificial Intelligence					
Objectives of the Course		1. Equip students with practical skills in Python for optimization, data processing, and algebraic applications. 2. Enable students to apply Python for problem-solving in decision analysis, cryptography, and machine learning models.					
Course Outcomes: Students will be able to							
C01: Learn foundational Python libraries like Pulp, SciPy, NetworkX for solving linear and nonlinear programming problems in optimization							
C02: Understand the application of SymPy for handling algebraic expressions, modular arithmetic, and transformations in mathematical structures							
C03: Apply data processing, visualization, and machine learning techniques like linear regression, logistic regression, clustering on sample datasets using Pandas, Matplotlib, Seaborn, and scikit-learn.							
C04: Explore cryptographic algorithms like RSA and concepts such as the Chinese remainder theorem using Python programming							
C05: Develop decision-making frameworks with analytical hierarchy process, payoff matrices, and simulations to solve complex decision problems							
Course Outline		Unit - I (Hours: 12) Optimization, Modeling & Simulation: Using Python for solving LP problems with the Pulp library, Solving Network Analysis using Python with NetworkX, Solving Queuing Theory and Inventory Optimization in Python using Pulp and SciPy.optimize, creating payoff matrices and calculating optimal strategies, Simulating real world processes using SymPy.					
		Unit - II (Hours: 12) Algebra and Analysis: Basic Python exercises for Algebraic expressions, equations, and simplifications with SymPy, Coding examples of rings and fields, including modular arithmetic, Mapping and transforming structures in Python, Problems on Data analysis using Python.					
		Unit - III (Hours: 12) Machine Learning Analysis: Exploring and preprocessing a sample dataset using Pandas, Data visualization using Matplotlib and Seaborn, Implementing linear regression using scikit-learn, Implementing logistic regression, KNN, and decision trees in Python, Implementing k-means clustering on a sample dataset, Applying PCA on high-dimensional data using scikit-learn.					
		Unit - IV (Hours: 12) Number Theory and Cryptography: Problems on Chinese remainder theorem using python, Writing Python functions to compute the Euler's Totient function, Coding the RSA algorithm for key generation, encryption, and decryption in Python.					
		Unit - V (Hours: 12) ODE, PDE and Fluid Dynamics: Analyzing simple decision problems on Ordinary Differential Equations, Partial Differential Equations and Fluid dynamics using Pandas, Implementing AHP to rank decision options,					

	Generating and interpreting simulation results for decision problems.
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 course	Knowledge, Problem Solving, Analytical ability, Professional Competency, Professional Communication and Transferrable Skill
Recommended Text	1. Albert G. Holzman, Mathematical Programming for Operations Researchers and Computer Scientists, CRC Press, Boca Raton, 1981. 2. Andreas C. Muller and Sarah Guido, Introduction to Machine Learning with Python, O'Reilly Media, Inc., 1005 Gravenstein Highway North, Sebastopol, CA 95472, 2016. 3. Wes McKinney, Python for Data Analysis, O'Reilly Media, Inc., 1005 Gravenstein Highway North, Sebastopol, CA 95472, 2022.
Reference Books	1. Chris Albon, Machine Learning with Python Cookbook, O'Reilly Media, Inc., 1005 Gravenstein Highway North, Sebastopol, CA 95472, 2018. 2. Jeffrey M. W. Wong and David Fuller J., Python Programming for Operations Research 3. Yves Hilpisch, Python for finance: Analyze, O'Reilly Media, Inc., 1005 Gravenstein Highway North, Sebastopol, CA 95472, 2018 (Second Edition).
Web resources	https://benalexkeen.com/linear-programming-with-python-and-pulp/ https://realpython.com/ https://towardsdatascience.com/ https://www.geeksforgeeks.org/

Mapping of Cos with POs and PSOs

	POs						PSOs		
	1	2	3	4	5	6	1	2	3
C01	3	3	3	3	1	3	3	2	1
C02	3	3	3	3	3	3	3	2	3
C03	3	3	3	3	3	3	1	2	3
C04	3	2	2	3	3	3	2	2	3
C05	3	3	3	3	3	3	2	2	3

Strong - 3; Medium - 2; Low - 1