KAMARAJ COLLEGE

(AUTONOMOUS)

Accredited with A+ Grade by NAAC

Among Top 150 Colleges in India - NIRF Ranking 2025

இந்து நாடார் சங்கங்களால் 1966-ல் தொடங்கப்பட்ட கல்லூரி

(Affiliated to Manonmaniam Sundaranar University, Tirunelveli)

THOOTHUKUDI - 628 003.

M.Sc., Mathematics

Semester - I to IV

(for the students those who joined from the academic year 2024-2025)

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SYLLABUS

(for the students those who joined from the academic year 2024-2025)

Department Profile

Name of the Programme	M.Sc., Mathematics
Programme Code	07008
Year of Establishment	1981

Vision

- To develop student's curiosities and creativity, develop student's problems solving, contribute to
- The local community through mathematical projects,
- Nurture leadership skills and team work and inspire future leaders through research and education

Mission

- Provide students with advanced mathematical content
- Prepare students to be global representatives
- Encourage students to appreciate the beauty of mathematics
- Apply mathematical knowledge to develop society

College mail ID	kamarajcoll@gmail.com
College website	www.kamarajcollege.ac.in

Post Graduate Degree Programme

1. Introduction

Programme Outcomes, Programme Specific Outcomes and Course Outcomes

Students completing this programme will be able to present their core post- graduate discipline clearly and precisely, make abstract ideas precise by formulating them in the language of the specific discipline, describe related ideas from multiple perspectives and explain fundamental concepts. Completion of this programme will also enable the learners to join teaching profession, enhance their employability for government jobs, jobs in various other public and private enterprises.

Eligibility: Students must have passed B.Sc in Maths from a recognised university and college.

Learning outcomes- Based curriculum frame work guidelines Based regulations for under graduate programme	
Programme	**M.Sc.(Mathematics)**
Programme Code:	**07008**
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 employ ability 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.

Programme Specific Outcomes (PSOs)

PSO1: Placement: To prepare the students who will demonstrate respectful engagement with others ideas, behaviour and beliefs. Also 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 skills that will facilities start- ups and high potential organisations.

PSO3: Research and Development: Design and implement HR system and practices grounded in research that complies with employment laws, leading the organisation towards growth and development.

PSO4: Contribution to Business Words: To produce employability, 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 stakeholders for mutual benefits.

Methods of Assessment	
Recall (K1)	Simple definitions, MCQ, Recall steps, Concept definitions
Understand/ Comprehend (K2)	MCQ, True/False, Short essays, Concept explanations, Short summary or Overview
Application (K3)	Suggest idea/concept with examples, Suggest formulae, Solve problems, Observe, Explain
Analyze (K4)	Problem-solving questions, Finish a procedure in many steps, Differentiate Between various ideas, Map knowledge
Evaluate (K5)	Longer essay/ Evaluation essay, Critique or justify with pros and cons
Create (K6)	Check knowledge in specific or off beat situations, Discussion, Debating or Presentations

Methods of Evaluation		Marks	
Internal Evaluation	Continuous Internal Assessment Test	15	25
	Assignment (PPT) and Seminar	5	
	Group Discussion and Viva	5	
External Evaluation	End Semester Examination		75
Total			**100**

Total credits Post–Graduate Courses

Semester	Hours	Credits
I	30	20
II	30	23
III	30	26
IV	30	25
Total	**120**	**94**

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

Question paper Model Assessment Pattern

Continuous Internal Assessment (CIA) & End Semester Examination (ESE)

- CIA : 25
- ESE:75

Theory Course:

For theory courses there shall be two tests conducted by the faculty concerned and the average of the two can be taken as the Continuous Internal Assessment (CIA).CIA is for 30 marks max and will be converted in to 15 marks. The duration of each test shall be 1 ¼ Hrs.

Continuous Internal Assessment (Writing)	15marks
Assignment (PPT) & Seminar	5marks
Viva & Group Discussion	5marks

For theory Papers:

- Part A (10×1=10) Marks-Answer all questions (Multiple choice)
- Part B (5×5=25) Marks-Choosing either(a) or (b)
- Part C (5×8=40) Marks-Choosing either (a) or (b)

  Total =75marks

Pedagogy:

- Technology Based Learning (PPT)
- Peer Teaching (Chalk & Talk)
- Virtual Lab
- Blended Learning (Online & Offline)
- Group Learning
- Self - Study
- Games Based Learning

Course Structure for Science Stream

First Year – Semester – I

M.Sc., Mathematics

(With effect from the academic year 2024 to 2025 onwards)

Semester I	Course Code	Name of the Course	Hours /Week L/P	Credit	Duration of ESE (Hrs.)	Marks Allotted		
						CIA	ESE	Total
Core I	24PMMA11	Group Theory	6	5	3	25	75	100
Core II	24PMMA12	Real Analysis-I	6	5	3	25	75	100
Core III	24PMMA13	Ordinary Differential Equations	6	5	3	25	75	100
EC 1 (select any one)	24PEMA11 24PEMA12 24PEMA13	1. Graph Theory and Applications 2. Formal Languages and Automata Theory 3. Partial Differential Equations	6	3	3	25	75	100
EC 2 (select any one)	24PEMA14 24PEMA15 24PEMA16	1. Analytic Number Theory 2. Number Theory and Cryptography 3. Fuzzy Sets and Their Applications	6	3	3	25	75	100
		Total	**30**	**21**				

****EC – Elective Course** ****CIA – Continuous Internal Assessment**

****ESE – End Semester Examination**

Course Structure for Science Stream
First Year – Semester – II
M.Sc., Mathematics
(With effect from the academic year 2024 to 2025 onwards)

Semester II	Course Code	Title of the Course	Hours /Week L/P	Credit	Duration of ESE (Hrs.)	Marks Allotted		
						CIA	ESE	Total
Core - IV	24PMMA21	Ring Theory and Lattices	6	5	3	25	75	100
Core - V	24PMMA22	Real Analysis - II	6	5	3	25	75	100
Core - VI	24PMMA23	Probability Theory	6	5	3	25	75	100
EC - III (select any one)	24PEMA21 24PEMA22 24PEMA23	1. Research Methodology 2. Algebraic Number Theory 3. Mathematical Statistics	5	3	3	25	75	100
EC - IV (select any one)	24PEMA24 24PEMA25 24PEMA26	1. Wavelets 2. Operations Research 3. Neural Networks	5	3	3	25	75	100
SEC - I	24PSMA21	Mathematical Documentation using Latex	2	2	-	100	-	100
		Total	**30**	**23**				

**** SEC-Skill Enhancement Course** **** CIA- Continuous Internal Assessment**
**** EC –Elective Course** **** ESE- End Semester Examination**

Course Structure for Science Stream
Second Year – Semester III
M.Sc., Mathematics
(With effect from the academic year 2024 to 2025 onwards)

Semester III	Course Code	Title of the Course	Hours /Week L/P	Credit	Duration of ESE (Hrs)	Marks Allotted		
						CIA	ESE	Total
Core -VII	24PMMA31	Advanced Algebra-I	6	5	3	25	75	100
Core -VIII	24PMMA32	Complex Analysis	6	5	3	25	75	100
Core -IX	24PMMA33	Topology	6	5	3	25	75	100
Core – X Industry Module	24PMMA34	Calculus of Variations and Integral Equations	5	4	3	25	75	100
EC - VI (select any one)	24PEMA31 24PEMA32 24PEMA33	1. Mechanics 2. Mathematical Python Theory 3. Stochastic Process	4	2	3	25	75	100
SEC - II (select any one)	24PSMA31 24PSMA32 24PSMA33	1. Mathematical Foundations of Artificial Intelligence 2. R-Programming 3. Programming in C++	3	2	3	25	75	100
Training	24PTMA31	Internship / Field Visit / Industrial Visit/ Research Knowledge Updating Activity	-	2	-	40	60	100
		Total	**30**	**25**				

****EC –Elective Course**

****CIA- Continuous Internal Assessment ** ESE- End Semester Examination**

Course Structure for Science Stream
Second Year – Semester – IV
M.Sc., Mathematics
(With effect from the academic year 2024 – 2025 onwards)

Semester IV	Course Code	Title of the Course	Hours/ Week L/P	Credit	Duration of ESE (Hrs.)	Marks Allotted		
						CIA	ESE	Total
Core - XI	24PMMA41	Advanced Algebra -II	6	5	3	25	75	100
Core - XII	24PMMA42	Functional Analysis	6	5	3	25	75	100
Core - XIII	24PMMAP1	Project with Viva Voce	10	7	1.5	50	50	100
EC - IV (select any one)	24PEMA41	1. Differential Geometry	5	3	3	25	75	100
	24PEMAL1	2. Mathematical Python - Practical	5	3	3	40	60	100
	24PEMA42	3. Algebraic Topology	5	3	3	25	75	100
SEC - III (select any one)	24PSMA41	1. Introduction to Machine Learning and Applications	3	2	3	25	75	100
	24PSMA42	2. Financial Mathematics	3	2	3	25	75	100
	24PSMAL1	3. Programming in C++ (Practical)	3	2	3	40	60	100
Extension Activity	24PEA41	Pollution Awareness Literacy / Voluntary Services	-	1	1.5	50	50	100
		Total	**30**	**23**				

**** SEC-Skill Enhancement Course ** CIA- Continuous Internal Assessment**
**** EC –Elective Course ** ESE- End Semester Examination**

Extension Activity :

1. **Report Submission - 50 Marks**
2. **Viva Voce - 50 Marks**

100 Marks

Semester - I

Group Theory

Title of the Course	**Group Theory**				
Course Type	**Core - I**				
Course Code	**24PMMA11**				
Year	**I**	**Semester**	**I**	**Credits**	**5**
Instructional Hours Per week		**Lecture**	**Tutorial**	**Lab Practices**	**Total**
		5	**1**	**--**	**6**

Learning Objectives	
LO1	Basic Knowledge on normal subgroups and homomorphism.
LO2	Knowledge on Cayley's theorem and its applications.
LO3	Skill on Permutation Groups and its applications.
LO4	Knowledge about Sylow's theorems and its applications.
LO5	To introduce the concepts and to develop working knowledge on class equation, solvability of groups and finite abelian groups

Unit	**Contents**
I	A Counting Principle – Normal Subgroups and Quotient Groups - Homomorphisms (Sections: 2.5 - 2.7)
II	Automorphisms - Cayley's Theorem-Solvable Groups. (Sections**:** 2.8, 2.9. Supplementary Problems: 10-17)
III	Permutation Groups-Another Counting Principle. (Sections: 2.10, 2.11)
IV	Sylow's Theorems. (Sections**:** 2.12)
V	Direct Products – Finite Abelian Groups. (Sections: 2.13, 2.14)

Extended Professional Component (is a part of intimal Component only not to be include 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 transferable skill.
Recommended Texts	I.N. Herstein. *Topics in Algebra* (II Edition) Wiley Eastern Limited, New Delhi, 1975.
Reference Books	M. Artin, *Algebra,* Prentice Hall of India, 1991.
	P.B. Bhattacharya, S.K. Jain, and S.R. Nagpaul, *Basic Abstract Algebra* (II Edition) Cambridge University Press, 1997 (Indian Edition)
	I.S. Lutherand I.B.S. Passi, *Algebra,* Vol. I – Groups(1996); Vol. II *Rings,* Narosa Publishing House, New Delhi, 1999
	D.S. Malik, J.N.Mordeson and M.K. Sen, *Fundamental of Abstract Algebra*, McGraw Hill (International Edition), New York. 1997.
	N. Jacobson, *Basic Algebra,* Vol. I & II Hindustan Publishing Company, New Delhi.
Web Resources	1. http://mathforum.org, 2. http://ocw.mit.edu/ocwweb/Mathematics, 3. http://www.opensource.org,www.algebra.com

Course Outcomes

CO No.	On Completion of the course, students will be able to
CO1	Recall basic counting principle, characterization of normal subgroups, group homomorphism and application.
CO2	Define Solvable groups, automorphisms and Cayley's Theorem.
CO3	Explain Permutation Groups and Another Counting Principle.
CO4	Explain Sylow's theorems and apply the theorem to find number of Sylow subgroups
CO5	Define direct products, examine the properties of finite abelian groups.

Mapping With Programme Outcomes and Programme Specific Outcomes

CO / PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1	3	1	3	2	3	3	3	2
CO2	2	1	3	1	3	3	3	2
CO3	3	2	3	1	3	3	3	2
CO4	1	2	3	2	3	3	3	2
CO5	3	1	2	3	3	3	3	2

S-Strong (3) **M-Medium (2)** **L-Low (1)**

CO / PSO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	2	3	3	1
CO2	3	3	2	3	2
CO3	2	2	3	3	3
CO4	2	3	2	3	3
CO5	3	1	3	2	3

Real Analysis-I

Title of the Course	**Real Analysis-I**				
Course Type	**Core - II**				
Course Code	**24PMMA12**				
Year	**I**	**Semester**	**I**	**Credits**	**5**
Instructional Hours Per week		**Lecture**	**Tutorial**	**Lab Practices**	**Total**
		5	**1**	**--**	**6**

Learning Objectives	
LO1	Knowledge on functions of bounded variations.
LO2	Skill on Riemann – Stieltjes Integration.
LO3	Explain Necessary sufficient conditional for existence
LO4	Study on Double series and Power series.
LO5	Applications of uniform convergence in various limiting operations.

Unit	Contents
I	**Functions of bounded variation** - Introduction - Properties of monotonic functions - Functions of bounded variation - Total variation - Additive property of total variation - Total variation on [a, x] as a function of x - Functions of bounded variation expressed as the difference of two increasing functions - Continuous functions of bounded variation. (Chapter– 6 : Sections 6.1 to 6.8) **Infinite Series:** Absolute and conditional convergence - Dirichlet's test and Abel's test - Rearrangement of series - Riemann's theorem on conditionally convergent series. (Chapter 8 : Sections 8.8, 8.15, 8.17, 8.18)
II	**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- Monotonically increasing integrators, Upper and lower integrals - Additive and linearity properties of upper, lower integrals - Riemann's condition - Comparison theorems. (Chapter- 7 : Sections 7.1 to 7.6, 7.11-7.14)

III	**The Riemann - Stieltjes Integral** - Integrators of bounded variation- Sufficient conditions for the existence of Riemann-Stieltjes integrals- Necessary conditions for the existence of RS integrals- Mean value theorems -integrals as a function of the interval – Second fundamental theorem of integral calculus-Change of variable -Second Mean Value Theorem for Riemann integral – Riemann –Stieltjes integrals depending on a parameter. (Chapter- 7 : Sections 7.15 to 7.23)
IV	**Infinite Series and infinite Products** - Double sequences – Double series -Rearrangement theorem for double series – A sufficient condition for equality of iterated series - Multiplication of series – Cesaro sum ability - Infinite products. (Chapter- 8 : Sections 8.20, 8.21 to 8.26) **Power series** - Multiplication of power series - The Taylor's series generated by a function - Bernstein's theorem (Chapter 9 : Sections 9.14, 9.15, 9.19, 9.20)
V	**Sequences of Functions** – Pointwise convergence of sequences of functions - Examples of sequences of real - valued functions - Uniform convergence and continuity- Cauchy condition for uniform convergence- Uniform convergence of infinite series of functions - Riemann - Stieltjes integration – Non-uniform Convergence and Term-by-term Integration - Uniform convergence and differentiation - Sufficient condition for uniform convergence of a series - Mean convergence. (Chapter- 9: Sections 9.1 to 9.6, 9.9, 9.10, 9. 11)

Extended Professional Component (is a part of intimal Component only not to be include 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 transferable skill.

Recommended Texts	
1	Tom M.Apostol: Mathematical *Analysis*, 2nd Edition, Addison-Wesley Publishing Company Inc. New York, 1974.

Web Resources	
1. http://mathforum.org, 2. http://ocw.mit.edu/ocwweb/Mathematics, 3. http://www.opensource.org, 4. www.mathpages.com,	
Reference Books	
1	Bartle, R.G.*Real Analysis*, JohnWiley and SonsInc., 1976.
2	Rudin, W.*Principles of Mathematical Analysis*, 3rdEdition. McGraw Hill Company, New York, 1976.
3	MalikS.C. and SavitaArora, *Mathematical Analysis*, Wiley Eastern Limited, New Delhi, 1991.
4	Sanjay Aroraand Bansi Lal, *Introduction to Real Analysis*, Satya Prakashan, New Delhi, 1991.
5	Gelbaum, B.R. and J.Olmsted, *Counter Examples in Analysis*, Holden day, San Francisco, 1964.
6	A.L.Gupta and N.R.Gupta, *Principles of Real Analysis*, Pearson Education, (Indian print) 2003

Course Outcomes

CO No.	On Completion of the course, students will be able to
CO1	Analyze and evaluate functions of bounded variation and Rectifiable Curves.
CO2	Describe the concept of Riemann-Stieltjes integral and its properties.
CO3	Demonstrate the concept of the necessary and sufficient condition for existence Riemann – Stieltjes.
CO4	Formulate the concept of double series and power series
CO5	Construct various Mathematics proof of Uniform convergence in various limiting operations.

Mapping With Programme Outcomes and Programme Specific Outcomes

CO / PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1	3	1	3	2	3	3	3	2
CO2	2	1	3	1	3	3	3	2
CO3	3	2	3	1	3	3	3	2
CO4	1	2	3	2	3	3	3	2
CO5	3	1	2	3	3	3	3	2

S-Strong (3) **M-Medium (2)** **L-Low (1)**

CO / PSO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	2	3	3	1
CO2	3	3	2	3	2
CO3	2	2	3	3	3
CO4	2	3	2	3	3
CO5	3	1	3	2	3

Ordinary Differential Equations

Title of the Course	**Ordinary Differential Equations**				
Course Type	**Core - III**				
Course Code	**24PMMA13**				
Year	**I**	**Semester**	**I**	**Credits**	**5**
Instructional Hours Per week		**Lecture**	**Tutorial**	**Lab Practices**	**Total**
		5	**1**	**--**	**6**

Learning Objectives	
LO1	To develop strong background on finding solutions to linear differential equations with constant.
LO2	Skill on solving linear equation with constant coefficient.
LO3	To develop stones background on finding solutions to linear differential equations
LO4	To develop strong background on finding solutions to linear differential equations with singular points.
LO5	To study existence and uniqueness of the solutions of first order differential equations.

Unit	Contents
I	**Linear equations with constant coefficients:** Second order homogeneous equations- Initial value problems-Linear dependence and independence-Wronskian and a formula for Wronskian-Nonhomogeneous equation of order two. (Chapter 2: Sections 1 to 6)
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. (Chapter2: Sections 7 to 12)
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)
IV	**Linear equations with regular singular points:** Euler equation– Second order equations with regular singular points – Bessel Function. (Chapter 4: Sections 1 to 4 and 7, 8)
V	**Existence and uniqueness of solutions to first order equations:** Equation with variable separation – Exact equation – method of successive approximations – the Lipschitz condition– convergence of the successive approximations and the existence theorem. (Chapter 5 : Sections 1 to 6)

Extended Professional Component (is a part of intimal Component only not to be include 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 transfer able skill.

Recommended Texts	
1	E.A. Coddington, *An introduction to ordinary differential equations* (3rdPrinting) Prentice - Hall of India Ltd., New Delhi, 1987.

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

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. Delhi 2001
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
6	B.Rai, D.P. Choudary and H.I. Freedman, *A Coursein Ordinary Differential Equations,* Narosa Publishing House, New Delhi, 2002

Course Outcomes

CO No.	On Completion of the course, students will be able to
CO1	Establish the qualitative behavior of solutions of systems of differential equations.
CO2	Recognize the physical phenomena modelled by differential equations and dynamical systems.
CO3	Analyze solutions using appropriate methods and give examples.
CO4	Formulate Bessel function for regular singular points.
CO5	Understand existence and uniqueness of solutions to first order equations.

Mapping With Programme Outcomes and Programme Specific Outcomes

CO / PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1	3	1	3	2	3	3	3	2
CO2	2	1	3	1	3	3	3	2
CO3	3	2	3	1	3	3	3	2
CO4	1	2	3	2	3	3	3	2
CO5	3	1	2	3	3	3	3	2

S-Strong (3) **M-Medium (2)** **L-Low (1)**

CO / PSO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	2	3	3	1
CO2	3	3	2	3	2
CO3	2	2	3	3	3
CO4	2	3	2	3	3
CO5	3	1	3	2	3

Graph theory and Applications

Title of the Course	**Graph theory and Applications**				
Course Type	**Elective - I**				
Course Code	**24PEMA11**				
Year	**I**	**Semester**	**I**	**Credits**	**3**
Instructional Hours Per week		**Lecture**	**Tutorial**	**Lab Practices**	**Total**
		5	**1**	**--**	**6**

Learning Objectives	
LO1	To study and apply the fundamental concepts in Graph Theory
LO2	To determine connectivity and the properties of trees
LO3	To know the Matching in Graphs.
LO4	To analyze the concept of colouring
LO5	To explain the concept of vertex colourings.

Unit	Contents
I	**Basic Result:** Subgraphs–Degrees of Vertices–Paths and Connectedness – Automorphism of a simple graph – Line graphs – Operations on graphs – Graph Products. (Chapter 1: Sec 1.1 to 1.9)
II	**Connectivity:** Vertex Cuts and Edge Cuts –Connectivity and Edge Connectivity – Blocks. (Chapter 3: Sec3.1 to 3.4)
III	**Trees:** Definition, Characterization and simple properties – Centres and centroids-counting the number of Spanning Trees- Cayley's formula (Chapter 4: Sec 4.1 to 4.5)
IV	**Independent Sets and Matchings:** Vertex – Independent Sets and Vertex Coverings – Edge Independent Sets – Matchings and Factors– Matching in Bipartite Graphs– Perfect Matching and the Tutte Matrix (Chapter 5: Sec 5.1 to 5.6)

V	**Eulerian and Hamiltonian Graphs:** Eulerian Graphs- Hamiltonian Graphs-Hamilton's "Around the World" Game Graph Colorings: Vertex colorings-Applications of Graph Colorings-Critical Graphs-Brooks' Theorem. (Chapter 6: Sec 6.1 to 6.3, Chapter 7: Sec 7.1 to7.3 (up to Books's theorem).

Extended Professional Component (is a part of intimal Component only not to be include 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 transfer able skill.

Recommended Texts	
1	R. Balakrishnan and K. Ranganathan, *Text Book of Graph Theory*, Springer Publications, 2012.
Reference Books	
1	H.J. A Bondy and U.S.R. Murty. Graph Theory with Applications. North Holl and, New York, Amsterdam, Oxford, 2008.
2	West, D.B., Introduction to Graph Theory, Pearson Education, 2011.
3	Robin J. Wilson, Graph Theory, Pearson Education, Asia2002.
4	P.J. Cameron, J.H. Van Lint, Graph Theory, Coding Theory and Block Designs, London Mathematical Society Lecture Note Series (19), Cambridge University Press, Reprint in April 2013.
5	Kenneth H. Rosen, Discrete Mathematics and Its Applications, McGraw Hill, 2007

Course Outcomes

CO No.	On Completion of the course, students will be able to
CO1	Demonstrate the concept of different structures and types about graphs and explain its applications.
CO2	Determine the properties of trees and applications in network and study the concepts of connections
CO3	Acquire the knowledge about Euler Tours, Hamilton Cycles and Matchings in Graphs.
CO4	Analyze the concept of edge colouring, independent sets and cliques in Graphs
CO5	Explain the concept of vertex colourings.

Mapping With Programme Outcomes and Programme Specific Outcomes

CO / PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1	3	1	3	2	3	3	3	2
CO2	2	1	3	1	3	3	3	2
CO3	3	2	3	1	3	3	3	2
CO4	1	2	3	2	3	3	3	2
CO5	3	1	2	3	3	3	3	2

S-Strong (3) **M-Medium (2)** **L-Low (1)**

CO / PSO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	2	3	3	1
CO2	3	3	2	3	2
CO3	2	2	3	3	3
CO4	2	3	2	3	3
CO5	3	1	3	2	3

Formal Languages and Automata theory

Title of the Course	**Formal Languages and Automata theory**				
Course Type	**Elective - I**				
Course Code	**24PEMA12**				
Year	**I**	**Semester**	**I**	**Credits**	**3**
Instructional Hours Per week		**Lecture**	**Tutorial**	**Lab Practices**	**Total**
		5	**1**	**--**	**6**

Learning Objectives	
LO1	To know finite automata and finite state systems
LO2	To study about regular sets
LO3	To discuss grammar and normal forms
LO4	To analyze the pushdown automata
LO5	To explain the concept of pumping lemma
Unit	**Contents**
I	Finite automata, regular expressions and regular grammar Finite state systems – Basic definitions – Non-deterministic finite automata – Finite automata with moves – Regular expressions –Regular grammar. (Chapter 2. Sections 2.1to 2.5 Chapter 9 Section 9.1)
II	Properties of regular sets. The Pumping lemma for regular sets– Closure properties of regular sets – Decision algorithms for regular sets – The Myhill - Nerode Theorem and minimization of finite automata. (Chapter 3: Sections 3.1 to 3.4)
III	Context - free grammar Motivation and introduction–Context-free grammar –Derivation trees – Simplification of context-free grammar – Chomsky normal form – Greibach normal form. (Chapter 4 : Section 4.1 to 4.6)

IV	Pushdown automata Informal description- Definitions- Push down automata and context- free languages–Normal forms for deterministic pushdown automata. (Chapter 5 : Sections 5.1 to 5.3)
V	Properties of context-free languages The pumping lemma for CFL's–Closure properties for CFL's–Decision algorithms for CFL's. (Chapter 6 : Sections 6.1 to 6.3)

Extended Professional Component (is a part of intimal Component only not to be include 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 transfer able skill.

Recommended Texts	
1	John E.Hopcraft and Jeffrey D.Ullman, Introduction to Automata Theory, Languages and Computation, Narosa Publishing House, New Delhi, (1987).

Reference Books	
1	A.Salomaa, Formal Languages, Academic Press, New York, (1973).
2	John C. Martin, Introduction to Languages and theory of Computations (2^{nd} Edition) Tata – McGraw Hill Company Ltd., New Delhi, (1997).

CO No.	**Course Outcomes** **On Completion of the course, students will be able to**
CO1	Differentiate deterministic and non-deterministic finite automata
CO2	Acquire the knowledge of regular sets and its properties
CO3	Understand the concept of context free grammar sand normal form.
CO4	Define context free languages and push down automata.
CO5	Explain about context free languages and pumping lemma

Mapping With Programme Outcomes and Programme Specific Outcomes

CO / PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1	3	1	3	2	3	3	3	2
CO2	2	1	3	1	3	3	3	2
CO3	3	2	3	1	3	3	3	2
CO4	1	2	3	2	3	3	3	2
CO5	3	1	2	3	3	3	3	2

S-Strong (3) **M-Medium (2)** **L-Low (1)**

CO / PSO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	2	3	3	1
CO2	3	3	2	3	2
CO3	2	2	3	3	3
CO4	2	3	2	3	3
CO5	3	1	3	2	3

Mathematical Statistics

Title of the Course	**Mathematical Statistics**				
Course Code	**Elective - I**				
Course Code	**24PEMA13**				
Year	**I**	**Semester**	**I**	**Credits**	**3**
Instructional Hours Per week		**Lecture**	**Tutorial**	**Lab Practices**	**Total**
		5	**1**	**--**	**6**

Learning Objectives	
LO1	To understand random variables and expectations
LO2	To discuss binomial and poisson distribution
LO3	To know various distribution
LO4	To explain special distribution
LO5	To learn limiting distribution

Unit	**Contents**
I	The probability set function–Random Variables –Probability density function – Distribution function – Mathematical expectation–Special mathematical expectations– Chebyshev's Inequality.
II	Conditional probability –Marginal and conditional distributions – Stochastic independence Some special distributions: The Binomial distribution – The Poisson distribution
III	The Gamma and chi-square distributions –The normal distribution – The Bivariate normal distribution. Distributions of functions of random variables –Sampling theory – Transformations of variables of the discrete type– Transformations of variables of the continuous type
IV	The .t and F distributions – Distributions of order statistics – The moment generating function technique. The Distributions of χ^2 and $\frac{t^2}{F^2}$ – Expectations of functions of random variables.

V	Limiting distributions - Stochastic convergence – Limiting moment generating functions – The central limit theorem – Some theorems on limiting distributions.

Extended Professional Component (is a part of intimal Component only not to be include 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 transfer able skill.

Recommended Texts	
1	Robert V. Hogg and Allen T. Craig, *Introduction to Mathematical Statistics* (fourth edition) Chapter 1, 2 (except 1.1, 1.2, 1.3, 1.8 & 2.3), Chapter 3, 4 (except 4.5) and Chapter 5.
Web Resources	
1. https://youtu.be/lWV6tLpqJ3w 2. https://youtu.be/sr0LDJI98sY 3. https://youtu.be/eL9AmU5afR0. 4. https://youtu.be/5ltOfUUb-7U	

Reference Books	
1	M.Fisz, Probability theory and Mathematical Statistics, John Wiley & sons, New York, 1963.
2	E.J.Dudewiczn and S.N.Mishra, Modern Mathematical Statistics, John Wiley & sons, New York, 1988.
3	V.N.Rohatgi, An introduction to Probability theory and Mathematical statistics, Wiley Eastern Limited, New Delhi, 1988

Course Outcomes

CO No.	On Completion of the course, students will be able to
CO1	Discuss the sets, functions of sets, random variables and certain expectations
CO2	Discuss binomial and related distributions
CO3	Study various kinds of distributions
CO4	Discuss additional distributions and order statistics and statistical applications
CO5	Learn the convergence in distribution of a sequence of random variables

Mapping With Programme Outcomes and Programme Specific Outcomes

CO / PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1	3	1	3	2	3	3	3	2
CO2	2	1	3	1	3	3	3	2
CO3	3	2	3	1	3	3	3	2
CO4	1	2	3	2	3	3	3	2
CO5	3	1	2	3	3	3	3	2

S-Strong (3) **M-Medium (2)** **L-Low (1)**

CO / PSO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	2	3	3	1
CO2	3	3	2	3	2
CO3	2	2	3	3	3
CO4	2	3	2	3	3
CO5	3	1	3	2	3

Analytic Number Theory

Title of the Course	Analytic Number Theory				
Course Type	Elective - II				
Course Code	24PEMA14				
Year	I	Semester	I	Credits	3
Instructional Hours Per week		Lecture	Tutorial	Lab Practices	Total
		5	1	--	6

Learning Objectives	
LO1	To know the fundamental of number theory
LO2	To study the arithmetical functions
LO3	To learn di-rich let function
LO4	To analyze the concept interrelationship between various arithmetical functions
LO5	To explain che by shev's functions

Unit	Contents
I	The Fundamental Theorem of Arithmetic. (Chapter 1: Section 1.1 - 1.8 Exercise Problems: Chapter 1: 1-11)
II	Arithmetic Functions. (Chapter 2: Sections 2.1 - 2.8. Exercise problems: Chapter 2: 1- 6)
III	Multiplicative Functions and Dirichlet Multiplication. (Chapter 2: Sections 2.9 – 2.14. Exercise problems: Chapter 2: 21-23, 25, and 26)
IV	Averages of Arithmetical Functions. (Chapter 3: Sections 3.1 - 3. 9. Exercise problems: Chapter 3: 1-4)
V	Partial sums of Dirichlet Product, Chebyshev's Functions – Equivalent forms of Prime Number Theorem. (Chapter 3: Sections: 3.10, 3.11, Chapter 4: Sections 4.1– 4.4. Exercise problems : Chapter 4:3, 4, 5, 8)

Extended Professional Component (is a part of intimal Component only not to be include 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 transfer able skill.
Recommended Texts	Introduction to Analytic Number Theory – Tom M. Apostol - Springer, International Student Edition.
Web Resources	1. https://youtu.be/lWV6tLpqJ3w 2. https://youtu.be/sr0LDJI98sY 3. https://youtu.be/eL9AmU5afR0. 4. https://youtu.be/5ltOfUUb-7U.
Reference Books	1. Problems in Analytic Number Theory, M. Ram Murty, Springer(2001) 2. Steps in to Analytic Number Theory, Paul Pollack, Akash Singha Roy, Springer(2021)

Course Outcomes

CO No.	On Completion of the course, students will be able to
CO1	Study the basic concepts of elementary number theory.
CO2	Explain several arithmetical functions and construct their relationships.
CO3	Apply algebraic structure in arithmetical functions.
CO4	Demonstrate various identities satisfied by arithmetical functions.
CO5	Determine the application to $\mu(n)$ & $\Lambda(n)$ and several equivalent form of prime number theorem.

Mapping With Programme Outcomes and Programme Specific Outcomes

CO / PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1	3	1	3	2	3	3	3	2
CO2	2	1	3	1	3	3	3	2
CO3	3	2	3	1	3	3	3	2
CO4	1	2	3	2	3	3	3	2
CO5	3	1	2	3	3	3	3	2

S-Strong (3) **M-Medium (2)** **L-Low (1)**

CO / PSO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	2	3	3	1
CO2	3	3	2	3	2
CO3	2	2	3	3	3
CO4	2	3	2	3	3
CO5	3	1	3	2	3

Number Theory and Cryptography

Title of the Course	**Number Theory And Cryptography**				
Course Type	**Elective - II**				
Course Code	**24PEMA15**				
Year	**I**	**Semester**	**I**	**Credits**	**3**
Instructional Hours Per week		**Lecture**	**Tutorial**	**Lab Practices**	**Total**
		5	**1**	**--**	**6**

Learning Objectives	
LO1	To discuss the fundamental theorem of arithmetic
LO2	To understand the concept of congruences
LO3	To know arithmetic and some special functions
LO4	To explain cryptography
LO5	To explain application of cryptography

Unit	**Contents**
I	The fundamental Theorem of Arithmetic: Divisibility – Greatest common divisor- fundamental theorem of Arithmetic- Euclidean Algorithm.
II	Congruences : Basic properties of congruences - residue classes and complete residue systems- linear congruences-polynomial congruences modulo p - Lagrange's theorem and its applications- Chinese remainder theorem
III	Arithmetical functions and Dirichlet Multiplication: Mobius function- Euler totient function- Dirichlet product of Arithmetic functions - Mangoldt functions-multiplicative functions-Liouville's function-Bell series of an arithmetical function – derivatives of arithmetical functions
IV	Cryptography – some simple cryptosystems – enciphering matrices
V	Public key cryptography – idea of public key cryptography – RSA –discrete log – Knapsack cryptosystems.

Extended Professional Component (is a part of intimal Component only not to be include 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 transferable skill.

Recommended Texts	
1	Neal Koblitz., (1987). Graduate Text in Mathematics A course in Number Theory and Cryptography, New York: Springer – Verlag, Print. (Chapter 3, 4: 4.1 to 4.4).
2	Tom. M. Apostol., (1998). Introduction to Analytic Number Theory, New Delhi: Narosa Publishing house, Eighth reprint. - Print. (Chapters 1 to 2, 5.1 to 5.7).

Web Resources
1. https://youtu.be/lWV6tLpqJ3w
2. https://youtu.be/sr0LDJI98sY
3. https://youtu.be/eL9AmU5afR0.
4. https://youtu.be/5ltOfUUb-7U.

Reference Books	
1	David M Burton, (2007). Elementary Number Theory, (6th ed.), New Delhi: Tata McGraw Hill Publishing House. Print. Wade Trappe, Lawrence C Washington. (2007).
2	Introduction to Cryptography with coding theory, (2nd Ed.) New Delhi: Pearson Education. Print.

Course Outcomes

CO No.	On Completion of the course, students will be able to
CO1	Explain the concept of congruence's and prove related results
CO2	Discuss the properties of different arithmetical functions
CO3	Derive Euler's summation formula and estimate the average order of different arithmetical functions
CO4	Explain simple cryptosystems and encipher matrices
CO5	Demonstrate public key cryptography

Mapping With Programme Outcomes and Programme Specific Outcomes

CO / PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1	3	1	3	2	3	3	3	2
CO2	2	1	3	1	3	3	3	2
CO3	3	2	3	1	3	3	3	2
CO4	1	2	3	2	3	3	3	2
CO5	3	1	2	3	3	3	3	2

S-Strong (3) **M-Medium (2)** **L-Low (1)**

CO / PSO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	2	3	3	1
CO2	3	3	2	3	2
CO3	2	2	3	3	3
CO4	2	3	2	3	3
CO5	3	1	3	2	3

Fuzzy sets and Their Applications

Title of the Course	**Fuzzy sets and Their Applications**				
Course Type	**Elective - II**				
Course Code	**24PEMA16**				
Year	**I**	**Semester**	**I**	**Credits**	**3**
Instructional Hours Per week		**Lecture**	**Tutorial**	**Lab Practices**	**Total**
		5	**1**	**--**	**6**

Learning Objectives	
LO1	To study the notations of fuzzy sets
LO2	To learn the fuzzy graphs
LO3	To know the fuzzy relations
LO4	To analyze the fuzzy logic
LO5	To discuss the composition of fuzzy sets

Unit	**Contents**
I	Fundamental Notions. Chapter I : Sec.1to 8
II	Fuzzy Graphs. Chapter II: Sec.10 to18
III	Fuzzy Relations. Chapter II : Sec.19 to 29
IV	Fuzzy Logic. Chapter III: Sec.31 to 40 (omit Sec.37, 38)
V	The Laws of Fuzzy Composition. Chapter IV : Sec.43 to 49

Extended Professional Component (is a part of intimal Component only not to be include 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 transferable skill.

Recommended Texts	
1	A.Kaufman, *Introduction to the theory of Fuzzy sub sets*, Vol.I, Academic Press, New York, (1975).

Web Resources
1. https://youtu.be/lWV6tLpqJ3w 2. https://youtu.be/sr0LDJI98sY 3. https://youtu.be/eL9AmU5afR0 4. https://youtu.be/5ltOfUUb-7U

Reference Books	
1	H.J.Zimmermann, Fuzzy Set Theory andits Applications, Allied Publishers, Chennai, (1996)
2	George J.KlirandBoYuan, Fuzzy sets and Fuzzy Logic – Theory and Applications, Prentice Hall India, New Delhi, (2001).

Course Outcomes

CO No.	On Completion of the course, students will be able to
CO1	Understand the definition of Fuzzy sets and its related concepts
CO2	Define Fuzzy Graphs and explain the concepts
CO3	Explain the concepts in Fuzzy sets and its relations
CO4	Discuss about Fuzzy logic
CO5	Analyze the compositions of Fuzzy sets

Mapping With Programme Outcomes and Programme Specific Outcomes

CO / PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1	3	1	3	2	3	3	3	2
CO2	2	1	3	1	3	3	3	2
CO3	3	2	3	1	3	3	3	2
CO4	1	2	3	2	3	3	3	2
CO5	3	1	2	3	3	3	3	2

S-Strong (3) **M-Medium (2)** **L-Low (1)**

CO / PSO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	2	3	3	1
CO2	3	3	2	3	2
CO3	2	2	3	3	3
CO4	2	3	2	3	3
CO5	3	1	3	2	3

Semester - II
Ring Theory and Lattices

Title of the Course		Ring Theory and Lattices					
Course Type		Core - IV					
Year	I	Semester	II	Credits	5	Course Code	24PMMA21
Instructional Hours per week		Lecture	Tutorial		Lab Practice	Total	
		5	1		--	6	

Learning Objectives	
LO1	Introduce the concept of ring homomorphism, Quoetient Ring and integral domain.
LO2	Knowledge on Euclidean Rings.
LO3	Knowledge on Polynomial Rings and polynomial over rational field.
LO4	Study on Various radicals of a ring.
LO5	Skill on lattices and Boolean Algebra

Unit	Contents
I	Ring Homomorphism – Ideals and Quotient Rings – More Ideals and Quotient Rings – The field of Quotients of an Integral Domain (Chapter 1: Sections: 3.3 – 3.6)
II	Euclidean Rings – A Particular Euclidean Ring. (Chapter 1: Sections: 3.7 and 3.8)
III	Polynomial Rings – Polynomials over Rational Field – Polynomial Rings over Commutative Rings (Chapter 1: Sections: 3.9 – 3.11)
IV	Certain Radicals of a Ring – Jacobson Radical of a Ring – Semi simple Ring – Nil Radical (Chapter 2: Chapter 8: Definition 8.1 –Theorem 8.10)
V	Partially Ordered sets and Lattices- Distributivity and Modularity- The theorem of Jordan Holder - Boolean Algebra (Chapter 8: Sections 8.1- 8.3 & 8.5)

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 Texts:
• Topics in Algebra, I.N. Herstein, 2nd Edition, Wiley Student edition
References Books:
• A first Course in Rings and Ideals, David M. Burton, Addison - Wesley Publishing Company. • Basic Algebra I, Nathan Jacbson Yale University, W.H. Freeman and company. New York, 2nd Edition

Course outcomes	**On completion of this course, students will be able to:**
CO1	Demonstrate competence with the basic ideas of algebra including the concepts of ideals and quotient Rings.
CO2	Understand the concept of the Particular Euclidean ring.
CO3	Able to demonstrate about the Polynomial rings over Commutative rings.
CO4	Appreciate the significance Radicals
CO5	Acquired the knowledge of direct sum of rings

Mapping With Programme Outcomes and Programme Specific Outcomes

CO / PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1	3	1	3	2	3	3	3	2
CO2	2	1	3	1	3	3	3	2
CO3	3	2	3	1	3	3	3	2
CO4	1	2	3	2	3	3	3	2
CO5	3	1	2	3	3	3	3	2

S-Strong (3) **M-Medium (2)** **L-Low (1)**

CO / PSO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	2	3	3	1
CO2	3	3	2	3	2
CO3	2	2	3	3	3
CO4	2	3	2	3	3
CO5	3	1	3	2	3

Real Analysis - II

Title of the Course		Real Analysis - II					
Course Type		Core - V					
Year	I	Semester	II	Credits	5	Course Code	24PMMA22
Instructional Hours per week		Lecture	Tutorial		Lab Practice	Total	
		5	1		--	6	

Learning Objectives	
LO1	To introduce measure on the real line, Fourier Series and Integrals, calculus.
LO2	Knowledge on Lebesgue measurability and integrability.
LO3	Skill on Fourier series and Integrals.
LO4	In-depth study in multivariable
LO5	Knowledge on Implicit functions and Extremum Problems.

Unit	Contents
I	**Measure on the Real line** - Lebesgue Outer Measure - Measurable sets - Regularity - Measurable Functions - Borel and Lebesgue Measurability Chapter - 2 Sec 2.1 to 2.5 (de Barra)
II	**Integration of Functions of a Real variable** - Integration of Non- negative functions - The General Integral - Riemann and Lebesgue Integrals Chapter - 3 Sec 3.1,3.2 and 3.4 (de Barra)
III	**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 in 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 Fejer's theorem - The Weierstrass approximation theorem Chapter 11 : Sections 11.1 to 11.15 (Apostol)

IV	**Multivariable Differential Calculus** - Introduction - The Directional derivative - Directional derivative and continuity - The total derivative - The total derivative expressed in terms of partial derivatives - The matrix of linear function - The Jacobian matrix - The chain rule - Matrix form of chain rule - The mean - value theorem for differentiable functions - A sufficient condition for differentiability - A sufficient condition for equality of mixed partial derivatives - Taylor's theorem for functions of R^n to R^1 Chapter 12 : Section 12.1 to 12.14 (Apostol)
V	**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 several variables- Extremum problems with side conditions. Chapter 13 : Sections 13.1 to 13.7 (Apostol)

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 Texts:

- G. de Barra, Measure Theory and Integration, Wiley Eastern Ltd., New Delhi, 1981. (for Units I and II)
- Tom M. Apostol: Mathematical Analysis, 2nd Edition, Addison- Wesley Publishing Company Inc. New York, 1974. (for Units III, IV and V)

References Books:
• Burkill.J.C.The Lebesgue Integral, Cambridge University Press, 1951. • Munroe,M.E.Measure and Integration. Addison-Wesley, Mass.1971. • Royden,H.L. Real Analysis, Macmillan Pub. Company, New York, 1988. • Rudin, W. Principles of Mathematical Analysis, McGraw Hill Company, New York, 1979. • Malik,S.C. and Savita Arora. Mathematical Analysis, Wiley Eastern Limited. New Delhi, 1991. • Sanjay Arora and Bansi Lal, Introduction to Real Analysis, Satya Prakashan, New Delhi, 1991

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

Course outcomes	On completion of this course, students will be able to:
CO1	Understand measurable function and Lebesgue outer measure.
CO2	Explain Rieman and Lebesgue Integral.
CO3	Understand and describe the basic concepts of Fourier series and Fourier integrals with respect to the orthogonal system. Analyze and evaluate the difference between transforms of various functions.
CO4	Explain directional derivative, total derivative, matrix of linear function and sufficient condition for differentiability.
CO5	Explain implicit functions and Extremum problems with side conditions

Mapping With Programme Outcomes and Programme Specific Outcomes

CO / PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1	3	1	3	2	3	3	3	2
CO2	2	1	3	1	3	3	3	2
CO3	3	2	3	1	3	3	3	2
CO4	1	2	3	2	3	3	3	2
CO5	3	1	2	3	3	3	3	2

S-Strong (3) **M-Medium (2)** **L-Low (1)**

CO / PSO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	2	3	3	1
CO2	3	3	2	3	2
CO3	2	2	3	3	3
CO4	2	3	2	3	3
CO5	3	1	3	2	3

Probability Theory

Title of the Course		Probability Theory					
Course Type		Core - VI					
Year	I	Semester	II	Credits	5	Course Code	24PMMA23
Instructional Hours per week		Lecture	Tutorial		Lab Practice	Total	
		5	1		--	6	

Learning Objectives	
LO1	To introduce axiomatic approach to probability theory.
LO2	To study some statistical characteristics.
LO3	Skill on discrete and continuous distribution functions and their properties.
LO4	To Study the Characteristic functions.
LO5	To Know about963. Basic limit theorems.

Unit	Contents
I	**Random Events and Random Variables:** Random events – Probability axioms – Combinatorial formulae – conditional probability – Bayes Theorem – Independent events – Random Variables – Distribution Function – Joint Distribution – Marginal Distribution – Conditional Distribution – Independent random variables – Functions of random variables. Chapter 1: Sections 1.1 to 1.7 Chapter 2 : Sections 2.1 to 2.9
II	**Parameters of the Distribution:** Expectation- Moments –The Chebyshev Inequality – Absolute moments – Order parameters –Moments of random vectors – Regression of the first and second types. Chapter 3 : Sections 3.1 to 3.8
III	**Characteristic functions:** Properties of characteristic functions – Characteristic functions and moments – semi-invariants – characteristic function of the sum of the independent random variables – Determination of distribution function by the Characteristic function – Characteristic function of multidimensional random vectors – Probability generating functions. Chapter 4 : Sections 4.1 to 4.7
IV	**Some Probability distributions:** One point , two point , Binomial – Polya – Hypergeometric – Poisson (discrete) distributions – Uniform– normal gamma – Beta – Cauchy and Laplace (continuous) distributions. Chapter 5 : Section 5.1 to 5.10

V	**Limit Theorems :** Stochastic convergence – Bernoulli law of large numbers – Convergence of sequence of distribution functions – Levy-Cramer Theorems – de Moivre-Laplace Theorem – Poisson, Chebyshev, Khintchine Weak law of large numbers – Lindberg Theorem – Lapunov Theroem – Borel- Cantelli Lemma - Kolmogorov Inequality and Kolmogorov Strong Law of large numbers. Chapter 6: Sections 6.1 to 6.4, 6.6 to 6.9, 6.11 and 6.12.
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 Texts:

- M. Fisz, Probability Theory and Mathematical Statistics, John Wiley and Sons, New York, 1963.

References Books:

- R.B. Ash, Real Analysis and Probability, Academic Press, New York, 1972
- K.L. Chung, A course in Probability, Academic Press, New York, 1974.
- R. Durrett, Probability: Theory and Examples, (2nd Edition) Duxbury Press, New York, 1996.
- V.K. Rohatgi, An Introduction to Probability Theory and Mathematical Statistics, Wiley Eastern Ltd., New Delhi, 1988(3rd Print)
- S.I. Resnick, a Probability Path, Birhauser, Berlin, 1999.
- 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/ocwweb/Mathematics, http://www.opensource.org, http://www.probability.net

Course outcomes	On completion of this course, students will be able to:
CO1	To define Random Events, Random Variables, to describe Probability, to apply Bayes, to define Distribution Function, to find Joint Distribution function, to find Marginal Distribution and Conditional Distribution function, to solve functions on random variables.
CO2	To define Expectation, Moments and Chebyshev Inequality, to solve Regression of the first and second types.
CO3	To define Characteristic functions, to define distribution function, to find probability generating functions, to solve problems applying characteristic functions
CO4	To define One point, two-point, Binomial distributions, to solve problems of Hypergeometric and Poisson distributions, to define Uniform, normal, gamma, Beta distributions, to solve problems on Cauchy and Laplace distributions
CO5	To discuss Stochastic convergence, Bernoulli law of large numbers, to elaborate Convergence of sequence of distribution functions, to prove Levy-Cramer Theorems and de Moivre-Laplace Theorems, to explain Poisson, Chebyshev, Khintchine Weak law of large numbers, to explain and solve problems on Kolmogorov Inequality and Kolmogorov Strong Law of large numbers

Mapping With Programme Outcomes and Programme Specific Outcomes

CO / PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1	3	1	3	2	3	3	3	2
CO2	2	1	3	1	3	3	3	2
CO3	3	2	3	1	3	3	3	2
CO4	1	2	3	2	3	3	3	2
CO5	3	1	2	3	3	3	3	2

S-Strong (3) **M-Medium (2)** **L-Low (1)**

CO / PSO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	2	3	3	1
CO2	3	3	2	3	2
CO3	2	2	3	3	3
CO4	2	3	2	3	3
CO5	3	1	3	2	3

Research Methodology

Title of the Course		Research Methodology					
Course Type		Elective - III					
Year	I	Semester	II	Credits	3	Course Code	24PEMA21

Instructional Hours per week	Lecture	Tutorial	Lab Practice	Total
	4	1	-	5

Learning Objectives	
LO1	To know about writing style in research
LO2	To discuss the Tips and Strategies
LO3	To know about the research project
LO4	To discuss the different components of Research project
LO5	To learn the Publication and presentation of research articles and Tool kits

Unit	Contents
I	To know about writing style - Writing clearly and concisely-Level of formality - Using gender- neutral language reading other research project. Chapter 3: Section 3.1 – 3.4
II	Tips and Strategies-Planning carefully-Deciding on your writing approach-Sourcing and selecting information - Recording information/making notes. Chapter 4: Section 4.1 – 4.4.
III	Research Project: Research Project – Difference between a dissertation and a thesis - Basic requirements of research degree – Writing a proposal – Ethical considerations. Chapter 5 : Sec 5.1, 5.2, 5.3, 5.6 and 5.13
IV	Different components of a Research Project – Title page – Abstract-Acknowledgement - List of Contents – Introduction Literature Review - Methodology – Style of Presentation – Conclusions–Bibliography–Appendices. Chapter 6: Section 6.1 –6.4, 6.6, 6.7, 6.8.1, 6.9.1, 6.11 – 6.13
V	Publishing and presenting your research and Tool kit Journal Articles - A book - conference presentation- A final note - All punctuations. Chapters 7 & 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 this course	Knowledge, Problem Solving, Analytical ability, Professional Competency, Professional Communication and Transferrable Skill

Recommended Texts	Writing up your University Assignments and Research Projects – A Practical Handbook, Neil Murray and Geraldine Hughes, McGraw Hill Open University Press.
Web Resources:	http://mathforum.org, http://ocw.mit.edu/ocwweb/Mathematics, http://www.opensource.org

Course outcomes: CO	**On completion of this course, the students will be able to:**
CO1	Discuss to know about writing style
CO2	Discuss the Tips and Strategies
CO3	Known about the research project
CO4	Discuss the different components of Research project
CO5	Learn the Publication and presentation of research articles and Tool kits

Mapping With Programme Outcomes and Programme Specific Outcomes

CO / PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1	3	1	3	2	3	3	3	2
CO2	2	1	3	1	3	3	3	2
CO3	3	2	3	1	3	3	3	2
CO4	1	2	3	2	3	3	3	2
CO5	3	1	2	3	3	3	3	2

S-Strong (3) **M-Medium (2)** **L-Low (1)**

CO / PSO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	2	3	3	1
CO2	3	3	2	3	2
CO3	2	2	3	3	3
CO4	2	3	2	3	3
CO5	3	1	3	2	3

Algebraic Number Theory

Title of the Course	Algebraic Number Theory						
Course Type	Elective - III						
Year	I	Semester	II	Credits	3	Course Code	24PEMA22
Instructional Hours per week		Lecture		Tutorial	Lab Practice	Total	
		4		1	-	5	

Learning Objectives	
LO1	Demonstrate competence with the basic ideas of Diophantine and other linear equations
LO2	Solve some special equations of the type $a^2+b^2=c^2$
LO3	Able to demonstrate infinite continued functions.
LO4	Appreciate the significance of approximating irrational numbers
LO5	Acquired the knowledge of Unique factorizations.

Unit	Contents
I	Diophantine equations: Diophantine equations – The equation $ax + by = c$ – Positive solutions – Other linear equations.
II	Some special equations: The equation $a^2 + b^2 = c^2$ - The equation $a^4 + b^4 = c^2$ – The equation $a^2 + b^2 = c$.
III	Infinite continued functions: $aa^2+bb^2+cc^2 = 0$. Infinite continued functions – Irrational numbers.
IV	Quadratic Fields: Approximation to irrational numbers – Algebraic integers.
V	Unique Factorization – Units in quadratic fields.

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 Texts	An introduction to the Theory of Numbers – Ivan Nivan and Herbert S. Zukerman – II edition, Wiley Eastern Ltd. Chapter 5,6 and 9 (except 5.13, 5.14, 7.7,7.8 and 7.9)
Reference books:	Elements of Number Theory – Kumaravelu and Suseela Kumaravelu (2002), Raja Shankar Printers, Sivakasi (V edition)
Web Resources:	http://mathforum.org, http://ocw.mit.edu/ocwweb/Mathematics, http://www.opensource.org

Course outcomes: CO	**On completion of this course, the students will be able to:**
CO1	Demonstrate competence with the basic ideas of Diphantine and other linear equations
CO2	Solve some special equations of the type $a^2+b^2=c^2$
CO3	Able to demonstate infinte continued functions.
CO4	Appreciate the significance of approximating irrational numbers
CO5	Acquired the knowledge of Unique factorizations.

Mapping With Programme Outcomes and Programme Specific Outcomes

CO / PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1	3	1	3	2	3	3	3	2
CO2	2	1	3	1	3	3	3	2
CO3	3	2	3	1	3	3	3	2
CO4	1	2	3	2	3	3	3	2
CO5	3	1	2	3	3	3	3	2

S-Strong (3) **M-Medium (2)** **L-Low (1)**

CO / PSO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	2	3	3	1
CO2	3	3	2	3	2
CO3	2	2	3	3	3
CO4	2	3	2	3	3
CO5	3	1	3	2	3

Partial Differential Equations

Title of the Course		**Partial Differential Equations**					
Course Type		**Elective - III**					
Year	**I**	**Semester**	**II**	**Credits**	**3**	**Course Code**	**24PEMA23**
Instructional Hours per week		**Lecture**	**Tutorial**		**Lab Practice**	**Total**	
		4	**1**		**-**	**5**	

Learning Objectives	
LO1	To understand and classify second order equations and find general solutions
LO2	To analyse and solve wave equations in different polar coordinates
LO3	To solve Vibrating string problem, Heat conduction problem, to identify and solve Laplace and beam equations
LO4	To apply maximum and minimum principle and solve Dirichlet, Neumann problems for various boundary conditions
LO5	To apply Green's function and solve Dirichlet, Laplace problems, to apply Helmholtz operation and to solve Higher dimensional problem

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

V	Green's Function: The Delta function – Green's function – Method of Green's function – Dirichlet Problem for the Laplace and Helmholtz operators – Method of images and eigen functions – Higher dimensional problem – Neumann Problem. Chapter 10 : Section 10.1 to 10.9

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 Texts	TynMyint-U and Lokenath Debnath, Partial Differential Equations for Scientists and Engineers (Third Edition), North Holland, New York, 1987.
Reference books:	1. M.M.Smirnov, Second Order partial Differential Equations, Leningrad, 1964. 2. I.N.Sneddon, Elements of Partial Differential Equations, McGraw Hill, New Delhi, 1983. 3. R. Dennemeyer, Introduction to Partial Differential Equations and Boundary Value Problems, McGraw Hill, New York, 1968. 4. M.D.Raisinghania, Advanced Differential Equations, S.Chand & Company Ltd., New Delhi, 2001. 5. S.Sankar Rao, Partial Differential Equations, 2nd Edition, Prentice Hall of India, New Delhi. 2004
Web Resources	1. http://mathforum.org, http://ocw.mit.edu/ocwweb/Mathematics, http://www.opensource.org, www.mathpages.com

Course outcomes: CO	On completion of this course, the students will be able to:
CO1	Understand and classify second order equations and find general solutions
CO2	Analyse and solve wave equations in different polar coordinates
CO3	Solve Vibrating string problem, Heat conduction problem, to identify and solve Laplace and beam equations
CO4	Apply maximum and minimum principle and solve Dirichlet, Neumann problems for various boundary conditions
CO5	Apply Green's function and solve Dirichlet, Laplace problems, to apply Helmholtz operation and to solve Higher dimensional problem

Mapping With Programme Outcomes and Programme Specific Outcomes

CO / PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1	3	1	3	2	3	3	3	2
CO2	2	1	3	1	3	3	3	2
CO3	3	2	3	1	3	3	3	2
CO4	1	2	3	2	3	3	3	2
CO5	3	1	2	3	3	3	3	2

S-Strong (3) **M-Medium (2)** **L-Low (1)**

CO / PSO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	2	3	3	1
CO2	3	3	2	3	2
CO3	2	2	3	3	3
CO4	2	3	2	3	3
CO5	3	1	3	2	3

Wavelets

Title of the Course	Wavelets						
Course Type	Elective - III						
Year	I	Semester	II	Credits	3	Course Code	24PEMA24
Instructional Hours per week		Lecture	Tutorial		Lab Practice	Total	
		4	1		-	5	

Learning Objectives	
LO1	To determine integral wavelet transform, Fourier and inverse Fourier Transformation
LO2	To explain the concepts of Fourier and Wavelets series and their properties
LO3	To understand about the spline and interpolation formula
LO4	To analyze about the multi resolution analysis
LO5	To determine about computation of cardinal spline Wavelets

Unit	Contents
I	**An Overview :** Fourier to Wavelets – Integral Wavelets Transform and Time frequency analysis – Inversion formulas and duals – Classification of Wavelets – Multiresolution analysis – Spines and Wavelets. Fourier Analysis: Fourier and Inverse Fourier Transformation – Continuous Time Convolution – The delta function – Fourier Transformation of square integrable functions.
II	**Fourier Analysis (contd):** Fourier Series – Basic Convergence Theory – Poisson Summation Formula. Wavelet Transforms and Time Frequency Analysis: The Gabor Transforms – Short time Fourier Transforms and the uncertainty principle – The integral Wavelet Transform – Dyadic Wavelets – Inversion – Frames – Wavelet Series.
III	**Cardinal Spline Analysis :** Cardinal Spline spaces – Bsplines and their basic properties – The time scale relation and an interpolating graphical display algorithm – B-Net representations and computation of cardinal splines – Constructions of cardinal splines – constructions of spline application formulas – Construction of Spline interpolation formulas
IV	**Functions and Wavelets :** Multi-resolution analysis – Scaling functions with finite two scale relation – Direction sum Decompositions of L 2 (R) - Wavelets and their duals
V	**Cardinal Splines Wavelets:** Interpolating splines wavelets – Compactly supported spline – Wavelets – Computation of Cardinal spline Wavelets – Euler – Frebenious Polynomials (12 hours). Orthogonal Wavelets: Examples of orthogonal Wavelets – Identification of orthogonal two scale symbols – Construction of compactly supported orthogonal wavelets.

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 Texts	Content and Treatment as in Charles K. Chui, An introduction to Wavelets, Academic Press, New York, 1992.
Reference books:	1. Chui C. K. (ed) Approximation theory and Fourier Analysis, Academic Press Boston, 1991. 2. Daribechies. I, Wavelets, CBMS-NSF Series in Appl, SIAM Philadelphia, 1992. 3. Schurnaker, L. L., Spline Functions: Basic Theory, Wiley, New York, 1981. 4. Nurnberger, G, Applications to Spline Functions, Springer Verlag, New York, 1989.
Web Resources:	http://mathforum.org, http://ocw.mit.edu/ocwweb/Mathematics, http://www.opensource.org

Course outcomes: CO	**On completion of this course, the students will be able to:**
CO1	Determine integral wavelet transform, Fourier and inverse Fourier Transformation
CO2	Explain the concepts of Fourier and Wavelets series and their properties
CO3	Understand about the spline and interpolation formula
CO4	Analyze about the multi resolution analysis
CO5	Determine about computation of cardinal spline Wavelets

Mapping With Programme Outcomes and Programme Specific Outcomes

CO / PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1	3	1	3	2	3	3	3	2
CO2	2	1	3	1	3	3	3	2
CO3	3	2	3	1	3	3	3	2
CO4	1	2	3	2	3	3	3	2
CO5	3	1	2	3	3	3	3	2

S-Strong (3) **M-Medium (2)** **L-Low (1)**

CO / PSO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	2	3	3	1
CO2	3	3	2	3	2
CO3	2	2	3	3	3
CO4	2	3	2	3	3
CO5	3	1	3	2	3

Operations Research

Title of the Course	**Operations Research**						
Course Type	**Elective - III**						
Year	**I**	**Semester**	**II**	**Credits**	**3**	**Course Code**	**24PEMA25**
Instructional Hours per week		**Lecture**	**Tutorial**		**Lab Practice**	**Total**	
		3	**1**		**-**	**4**	

Learning Objectives	
LO1	To able to build and solve Transportation and Assignment problems.
LO2	To learn the constructions of network and optimal scheduling using CPM and PERT.
LO3	To solve linear integer programming models.
LO4	To understand the need of inventory management.
LO5	To understand basic characteristic features of a queuing system.

Unit	Contents
I	Transportation Models and its Variants: Definition of the Transportation Model – Non-Traditional Transportation Model– Transportation Algorithm – The Assignment Model. Chapter 5: Sections 5.1, 5.2, 5.3- 5.3.1,5.3.2,5.4-5.4.1.
II	Network Analysis: Network Definitions – Minimal Spanning Tree Algorithm – Shortest Route Problem – Maximum Flow Model – CPM –PERT. Chapter 6: Sections 6.2, 6.3- 6.3.1,6.3.2, 6.4-6.41,6.4.2, 6.6-6.6.1,6.6.2. Exercise problems.
III	Integer Linear Programming: Illustrative Examples–Integer Programming Algorithms. Chapter 9: Sections 9.1, 9.2.1, 9.2.3 Exercise problems.
IV	Deterministic Inventory Models –General Inventory model– Static Economic order Quantity models- Probabilistic Inventory Models - Continuous Review – Probabilistic EOQ Models - Single Period Models. Chapter 11 – Sections 11.1, 11.2-11.2.1 Chapter 16 –Sections 16.1, 16.2-16.2.1, 16.2.2 , Exercise problems.
V	Queuing Theory: Basic Elements of Queuing Model – Role of Poisson and Exponential Distributions – Pure Birth and Death Models –Specialised Poisson Queues - (M/G/1): GD/∞/∞) - Pollaczek - Khintechine Formula. Chapter 17: Sections 17.2, 17.3, 17.4, 17.6, 17.7. Exercise 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 this course	Knowledge, Problem Solving, Analytical ability, Professional Competency, Professional Communication and Transferrable Skill
Recommended Texts	Operations Research (Sixth Edition), Hamdy A. Taha, Prentice Hall of India Private Limited, New Delhi.
Reference books:	Operations Research, H.K Pathak, Dr. Pradeep K. Joshi and C.Sharma,Shree Shiksha Sahitya Prakashan Publication, Reprint 2022-23. Operations Research: Principles and Applications, Second Edition, G. Srinivasan, Easrern Economy Edition, PHI
Web Resources:	http://mathforum.org, http://ocw.mit.edu/ocwweb/Mathematics, http://www.opensource.org

Course outcomes: CO	**On completion of this course, the students will be able to:**
CO1	Be able to build and solve Transportation and Assignment problems using appropriate method
CO2	Learn the constructions of network and optimal scheduling using CPM and PERT
CO3	Ability to construct linear integer programming models and solve linear integer programming models using branch and bound method
CO4	Understand the need of inventory management.
CO5	To understand basic characteristic features of a queuing system and acquire skills in analyzing queuing models

Mapping With Programme Outcomes and Programme Specific Outcomes

CO / PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1	3	1	3	2	3	3	3	2
CO2	2	1	3	1	3	3	3	2
CO3	3	2	3	1	3	3	3	2
CO4	1	2	3	2	3	3	3	2
CO5	3	1	2	3	3	3	3	2

S-Strong (3) **M-Medium (2)** **L-Low (1)**

CO / PSO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	2	3	3	1
CO2	3	3	2	3	2
CO3	2	2	3	3	3
CO4	2	3	2	3	3
CO5	3	1	3	2	3

Neural Networks

Title of the Course	Neural Networks						
Course Type	Elective - III						
Year	I	Semester	II	Credits	3	Course Code	24PEMA26
Instructional Hours per week		Lecture	Tutorial		Lab Practice	Total	
		3	1		-	4	

Learning Objectives	
LO1	To analyze different neuron network models
LO2	To understand the common learning algorithms
LO3	To analyze back propagation algorithms with examples.
LO4	To implement the common learning algorithms.
LO5	To evaluate quadratic functions.

Unit	Contents
I	Neuron Model and Network Architectures: Mathematical Neural Model-Network Architectures Perceptron-Hamming Network-Hopfield Network-Learning Rules.
II	Perceptron Architectures: Perceptron Architectures and Learning Rules with proof of convergence-Supervised Hebbian Learning-Linear Associator.
III	Supervised Hebbian Learning: The Hebb Rule-Pseudo inverse rule-Variation of Hebbian Learning-Back Propagation Multilayer Perceptrons.
IV	Back Propagation: Back Propagation algorithm convergence and Generalization-Performances surfaces and optimum points- Taylor series.
V	Performance surface and performance optimizations: Directional derivatives-Minima-Necessary conditions for optimality Quadratic functions-Performance optimizations- Steepest Descent Newton's method-Conjugate Gradient.

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 Texts	Martin T. Hagan, Howard B/Demuth and Mark Beale, Neural Network Design, Vikas Publishing House, New Delhi, 2002.
Reference books:	1. James A. Freeman, David M.Skapura, Neural Networks Algorithms, Applications and Programming Techniques, Pearson Education, 2003. 2. Robert J. Schalk off, Artificial Neural Network, McGraw-Hill International Edition, 1997.
Web Resources:	1. https://nptel.ac.in/courses/117/105/117105084/ 2. https://nptel.ac.in/courses/106/106/106106184/

Course outcomes: CO	**On completion of this course, the students will be able to:**
CO1	Understand and analyze different neuron network models
CO2	Understand the basic ideas behind most common learning algorithms for multilayer perceptions, radial basis function networks.
CO3	Describe Hebb rule and analyze back propagation algorithms with examples.
CO4	Study convergence and generalization and implement common learning algorithms.
CO5	Study directional derivatives and necessary conditions for optimality and to evaluate quadratic functions.

Mapping With Programme Outcomes and Programme Specific Outcomes

CO / PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1	3	1	3	2	3	3	3	2
CO2	2	1	3	1	3	3	3	2
CO3	3	2	3	1	3	3	3	2
CO4	1	2	3	2	3	3	3	2
CO5	3	1	2	3	3	3	3	2

S-Strong (3) **M-Medium (2)** **L-Low (1)**

CO / PSO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	2	3	3	1
CO2	3	3	2	3	2
CO3	2	2	3	3	3
CO4	2	3	2	3	3
CO5	3	1	3	2	3

Mathematical Documentation Using LaTex

Title of the Course	**Mathematical Documentation Using LaTex**						
Course Type	**Skill Enhancement Course - I**						
Year	**I**	**Semester**	**II**	**Credits**	**2**	**Course Code**	**24PSMA21**
Instructional Hours per week		**Lecture**	**Tutorial**		**Lab Practice**	**Total**	
		1	**-**		**1**	**2**	

Learning Objectives

LO1	To learn the latest techniques in Latex
LO2	To comparing other mathematical software
LO3	To write mathematical equations and to draw graphs using Latex
LO4	To fix footnotes and header
LO5	To create tables and type formulae in Mathematics

Unit	Contents
I	Introduction - Basics of a Latex file- Text, Symbols and Commands: Command names and arguments – Environments– Declarations – Lengths – Special characters
II	Document Layout and Organization: Document class – Page style – Parts of the document – Table of contents
III	Displayed Text: Changing font style – Centering and indenting – Lists – Generalized lists Theorem like-declarations
IV	Text in Boxes: Boxes - Footnotes and marginal notes. Tables: Tabular stops – Tables
V	Mathematical Formulas: Mathematical Environment – Main elements of math mode – Mathematical symbols - Additional Elements.

Recommended Texts	Guide to Latex, Helmut Kopka and Patrick W.Daly, Fourth Edition, Addison – Wesley, Pearson Education, 2004.
Reference books:	1. E. Krishnan, LaTeX TUTORIALS — A Primer, Indian TEX Users Group, 2003 2. H. Kopka and P.W. Daly, A Guide to LaTeX, Addison - Wesley, 2003. 3. Martin J. Erickson and Donald Bindner, A Student's Guide to the Study, Practice, and Tools of Modern Mathematics, CRC Press, Boca Raton, FL, 2011

Course outcomes: CO	**On completion of this course, the students will be able to:**
CO1	Learn the latest techniques in Latex for the preparation of printable documents
CO2	Avoid difficulty while typing a project or thesis comparing other mathematical software
CO3	Write mathematical equations and to draw graphs using Latex
CO4	Fix footnotes and header
CO5	Create tables and type formulae in Mathematics

Mapping With Programme Outcomes and Programme Specific Outcomes

CO / PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1	3	1	3	2	3	3	3	2
CO2	2	1	3	1	3	3	3	2
CO3	3	2	3	1	3	3	3	2
CO4	1	2	3	2	3	3	3	2
CO5	3	1	2	3	3	3	3	2

S-Strong (3) **M-Medium (2)** **L-Low (1)**

CO / PSO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	2	3	3	1
CO2	3	3	2	3	2
CO3	2	2	3	3	3
CO4	2	3	2	3	3
CO5	3	1	3	2	3

Semester - III

Advanced Algebra – I

Title of the Course	Advanced Algebra - I						
Course Type	Core - VII						
Course Code	24PMMA31						
Year	II	Semester	III	Credits	5		
Instructional Hours per week	Lecture	Tutorial	Lab Practice	Total			
	5	1	-	6			

Learning Objectives	
LO1	To explain dual space, modules and linear Transformation
LO2	To describe the concept of Triangular Matrices
LO3	To demonstrate the concept of Nilpotent and Jordan form of Matrices
LO4	To define Rational Canonical form of a Matrix, Trace and Transpose and Determinants
LO5	To explain Hermitian, Unitary and Normal Transformations

Unit	Contents
I	**Vector Spaces:** Dual Space- Modules- The Algebra of Linear Transformation. Sections: 4.3 and 6.1
II	Characteristic Roots- Matrices- Triangular Form Sections: 6.2- 6.4
III	Nilpotent Form- Jordan Form- Canonical Form Sections: 6.5 - 6.6
IV	Rational Canonical Form-Trace and Transpose – Determinants Sections: 6.7 – 6.9
V	**Transformation**: Hermitian, unitary and normal transformations, Real Quadratic Forms. Section: 6.10, 6.11

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 Texts	Topics in Algebra, I.N. Herstein, 2nd Edition, Wiley Student edition
Reference books:	• A course in Abstract algebra (Third edition) - Vijay. K.Khanna, S.K. Bhambri – Vikas Publishing House – New Delhi. • Fields and Rings- Kalplesky, Irving (second edition)- University of Chicago- Chicago- 1972

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

Course outcomes CO	**On completion of this course, the students will be able to:**
CO1	Explain dual space, modules and linear Transformation
CO2	Describe the concept of Triangular Matrices
CO3	Demonstrate the concept of Nilpotent and Jordan form of Matrices
CO4	Define Rational Canonical form of Matrix, Trace and Transpose and Determinants
CO5	Explain Hermitian, Unitary and Normal Transformations

Mapping with Programme Outcomes and Programme Specific Outcomes

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1	3	3	2	3	3	2	3	3
CO2	2	3	3	3	2	3	3	2
CO3	3	3	3	2	3	3	3	2
CO4	3	3	3	3	3	3	3	3
CO5	3	2	3	3	2	2	3	3

S-Strong (3) **M-Medium (2)** **L-Low (1)**

CO/ PSO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	2	3	3	3
CO2	3	3	2	3	3
CO3	2	3	3	3	3
CO4	3	3	3	2	3
CO5	3	3	3	3	2

Complex Analysis

Title of the Course	**Complex Analysis**					
Course Type	**Core - VIII**					
Course Code	**24PMMA32**					
Year	**II**	**Semester**	**III**	**Credits**	**5**	
Instructional Hours per week		**Lecture**	**Tutorial**		**Lab Practice**	**Total**
		5	**1**		**-**	**6**

Learning Objectives	
LO1	To explain analytic functions and power Series
LO2	To explain higher derivatives and removable singularities
LO3	To demonstrate the concept of the general form of Cauchy's theorem
LO4	To describe the harmonic functions
LO5	To Develop Taylor and Laurent series

Unit	Contents
I	**Analytic functions**: Analytic functions- Polynomials- Rational functions- Power Series Chapter 2: Section 2.1.2-2.1.4, 2.2.4 Problems: Chapter 2: 2.1.2 (1,4,5,7), 2.2.4(2-6)
II	**Cauchy's Integral Formula:** The Index of a point with respect to a closed curve – The Integral formula – Higher derivatives. Local Properties of analytic Functions: Removable Singularities- Taylor's Theorem – Zeros and poles – The local Mapping – The Maximum Principle. Chapter 4: Section 2: 4.2.1 to 4.2.3, Chapter 4: Section 3 : 4.3.1 to 4. 3.4
III	**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 - Multiply connected regions - Residue theorem - The argument principle. Chapter 4 : Section 4 : 4.4.1 to 4.4.7 (except 4.4.6), Chapter 4: Section 5: 4.5.1 and 4.5.2
IV	**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: 4.5.3, Chapter 4: Sections 6: 4.6.1 to 4.6.

V	**Harmonic Functions and Power Series Expansions:** Schwarz theorem - The Reflection principle - Weierstrass theorem – Taylor's Series – Laurent series. Chapter 4 : Sections 6: 4.6.4 and 4.6.5, Chapter 5 : Sections 1: 5.1.1 to 5.1.3

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 Texts	Lars V.Ahlfors, *Complex Analysis*, (3rd edition) McGraw Hill Co., New York, 1979
Reference books:	1. H.A. Presfly, *Introduction to Complex Analysis*, Clarendon Press, Oxford, 1990. 2. J.B. Conway, *Functions of one complex variables* Springer - Verlag, International Student Edition, Narosa Publishing Co.1978 3. E. Hille, *Analytic function Theory* (2 vols.), Gon & Co, 1959. 4. M.Heins, *Complex function Theory*, Academic Press, New York, 1968.
Web Resources	http://mathform.org, http://ocw.mit.edu/ocwweb/Mathematics http://www.opensourse.org

Course outcomes: CO	On completion of this course, the students will be able to:
CO1	Explain analytic functions and power Series.
CO2	Explain index of a point, integral formula, higher derivatives and removable singularities
CO3	Demonstrate the general form of Cauchy's theorem
CO4	Describe the concept of definite integral and harmonic functions
CO5	Develop Taylor and Laurent series

Mapping with Programme Outcomes and Programme Specific Outcomes

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1	3	3	2	3	3	2	3	3
CO2	2	3	3	3	2	3	3	2
CO3	3	3	3	2	3	3	3	2
CO4	3	3	3	3	3	3	3	3
CO5	3	2	3	3	2	2	3	3

S-Strong (3) **M-Medium (2)** **L-Low (1)**

CO/ PSO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	2	3	3	3
CO2	3	3	2	3	3
CO3	2	3	3	3	3
CO4	3	3	3	2	3
CO5	3	3	3	3	2

Topology

Title of the Course	**Topology**						
Course Type	**Core - IX**						
Course Code	**24PMMA33**						
Year	**II**	**Semester**	**III**	**Credits**	**5**		
Instructional Hours per week		**Lecture**		**Tutorial**	**Lab Practice**	**Total**	
		5		**1**	**-**	**6**	
Learning Objectives							
LO1	To define and illustrate the concept of topological spaces						
LO2	To understand the product topology and metric topology						
LO3	To understand Connected spaces						
LO4	To understand Limit Point, Compactness and Local Compactness						
LO5	To develop characterize connectedness and compactness						

Unit	Contents
I	**Topological spaces:** Topological spaces – Basis for a topology – The order topology – The product topology on X x Y – The subspace topology – Closed sets and limit points. Chapter 2 : Sections 12 to 17
II	**Continuous functions:** Continuous functions – the product topology – The metric topology. Chapter 2 : Sections 18 to 21
III	**Connectedness:** Connected spaces- Components and Local Connectedness Chapter 3: Sections 23 & 25.
IV	**Compactness:** Compact spaces – Limit Point Compactness – Local Compactness. Chapter 3: Sections 26 to 29 (except 27).
V	**Countability and Separation Axiom**: The Countability Axioms – The separation Axioms – Normal spaces – The Urysohn Lemma – The Urysohn Metrization Theorem. Chapter 4: Sections 30 to 34.

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 Texts	James R. Munkres, *Topology* (2nd Edition) Pearson Education Pvt. Ltd., New Delhi-2002 (Third Indian Reprint).
Reference books:	1. James R. Munkres, *Topology* (2nd Edition) Pearson Education Pvt. Ltd., New Delhi 2002 (Third Indian Reprint) 2. H.K Pathak and J.P Chauhan, *Topology*, Shree Shiksha Sahitya Prakashan Publisher, Reprint 2023-2024. 3. J. Dugundji , *Topology* , Prentice Hall of India, New Delhi, 1975. 4. George F.Simmons, *Introduction to Topology and Modern Analysis*, McGraw Hill Book Co., 1963 5. J.L. Kelly, *General Topology*, Van Nostrand, Reinhold Co., New york 6. L.Steen and J.Subhash, Counter Examples in Topology, Holt, Rinehart and Winston, New York, 1970. 7. S.Willard, *General Topology*, Addison - Wesley, Mass., 1970
Web Resources	1. http://mathforum.org, http://ocw.mit.edu/ocwweb/Mathematics, http://www.opensource.org , 2. http://en.wikipedia.org

Course outcomes: CO	On completion of this course, the students will be able to:
CO1	Define and illustrate the concept of topological spaces and the basic definitions of open sets, neighbourhood, interior, exterior, closure and their axioms for defining topological space.
CO2	Understand continuous functions, the product topology and metric topology.
CO3	Understand Connected spaces, Components and Local Connectedness
CO4	Understand Compact spaces, Limit Point Compactness and Local Compactness.
CO5	Develop qualitative tools to characterize connectedness and compactness

Mapping with Programme Outcomes and Programme Specific Outcomes

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1	3	3	2	3	3	2	3	3
CO2	2	3	3	3	2	3	3	2
CO3	3	3	3	2	3	3	3	2
CO4	3	3	3	3	3	3	3	3
CO5	3	2	3	3	2	2	3	3

S-Strong (3) **M-Medium (2)** **L-Low (1)**

CO/ PSO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	2	3	3	3
CO2	3	3	2	3	3
CO3	2	3	3	3	3
CO4	3	3	3	2	3
CO5	3	3	3	3	2

Calculus of Variations and Integral Equations

Title of the Course	**Calculus of Variations and Integral Equations**				
Course Type	**Core - X**				
Course Code	**24PMMA34**				
Year	**II**	**Semester**	**III**	**Credits**	**4**

Instructional Hours per week	**Lecture**	**Tutorial**	**Lab Practice**	**Total**
	4	**1**	**-**	**5**

Learning Objectives	
LO1	To understand the Calculus of Variations and Applications
LO2	To understand the Constraints and Lagrange's Multipliers
LO3	To learn Integral Equations
LO4	To explain the causes and effects of Linear Equations
LO5	To explain the Hilbert Schmidt theory

Unit	**Contents**
I	Calculus of Variations and Applications: Maxima and Minima – The simplest case –Illustrative examples-The variational notation-the more general case.
II	Constraints and Lagrange's Multipliers – Variable endpoints - Sturm Liouville problems-Hamilton's principles - Lagrange equations
III	Integral Equations – Introduction –Relation between differential and integral equations – The Green's function - Alternative definition of Green's function.
IV	Linear Equations in cause and effect - The influence function – Fredholm equations with separable kernels – Illustrative Examples.
V	Hilbert Schmidt theory – Iterative methods for solving equations of second kind-Fredholm theory

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 Texts	Methods of Applied Mathematics, Francis B. Hildebrand, sections 2.1to 2.11, 3.1 to 3.9 and 3.11.
Web Resources	http://mathforum.org, http://ocw.mit.edu/ocwweb/Mathematics, http://www.opensource.org , http://en.wikipedia.org

Course outcomes: CO	**On completion of this course, the students will be able to:**
CO1	Understand the Calculus of Variations and Applications
CO2	Understand the Constraints and Lagrange's Multipliers
CO3	Integral Equations
CO4	Explain the causes and effects of Linear Equations
CO5	Explain the Hilbert Schmidt theory

Mapping with Programme Outcomes and Programme Specific Outcomes

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1	3	3	2	3	3	2	3	3
CO2	2	3	3	3	2	3	3	2
CO3	3	3	3	2	3	3	3	2
CO4	3	3	3	3	3	3	3	3
CO5	3	2	3	3	2	2	3	3

S-Strong (3) **M-Medium (2)** **L-Low (1)**

CO/ PSO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	2	3	3	3
CO2	3	3	2	3	3
CO3	2	3	3	3	3
CO4	3	3	3	2	3
CO5	3	3	3	3	2

Mechanics

Title of the Course	Mechanics						
Course Type	Elective - V						
Course Code	24PEMA31						
Year	II	Semester	III	Credits	2		
Instructional Hours per week	Lecture	Tutorial	Lab Practice	Total			
	3	1	-	4			

Learning Objectives	
LO1	To demonstrate the knowledge of II principles in mechanics
LO2	To interpret classical dynamics
LO3	To apply the variation principle for real physical situations
LO4	To study applications in mechanical and electromagnetic fields
LO5	To describe the Kinetic energy and Moment of inertia of a particle

Unit	Contents
I	Mechanical Systems : The Mechanical system- Generalised coordinates – Constraints - Virtual work - Energy and Momentum Chapter 1 : Sections 1.1 to 1.5
II	Lagrange's Equations: Derivation of Lagrange's equations- Examples- Integrals of motion. Chapter 2 : Sections 2.1 to 2.3
III	Hamilton's Equations: Hamilton's Principle -Hamilton's Equation - Other variational principle. Chapter 4 : Sections 4.1 to 4.3
IV	Hamilton-Jacobi Theory : Hamilton Principle function – Hamilton-Jacobi Equation – Separability Chapter 5 : Sections 5.1 to 5.3
V	Canonical Transformation: Differential forms and generating functions – Special Transformations– Lagrange and Poisson brackets. Chapter 6 : Sections 6.1, 6.2 and 6.3

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 Texts	D. Greenwood, *Classical Dynamics*, Prentice Hall of India, New Delhi, 1985.
Reference books:	1. H. Goldstein, *Classical Mechanics,* (2nd 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.Griffth, *Principles of Mechanics* (3rdEdition) McGraw Hill Book Co., New York, 1970.
Web Resources	http://mathforum.org, http://ocw.mit.edu/ocwweb/Mathematics, http://www.opensource.org, www.physicsforum.com

Course outcomes: CO	**On completion of this course, the students will be able to:**
CO1	Demonstrate the knowledge of II principles in mechanics.
CO2	Interpret and consider complex problems of classical dynamics in a systematic way.
CO3	Apply the variation principle for real physical situations
CO4	Explore different applications of these concepts in the mechanical and electromagnetic fields.
CO5	Describe and apply the concept of Angular momentum, Kinetic energy and Moment of inertia of a particle

Mapping with Programme Outcomes and Programme Specific Outcomes

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1	3	3	2	3	3	2	3	3
CO2	2	3	3	3	2	3	3	2
CO3	3	3	3	2	3	3	3	2
CO4	3	3	3	3	3	3	3	3
CO5	3	2	3	3	2	2	3	3

S-Strong (3) **M-Medium (2)** **L-Low (1)**

CO/ PSO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	2	3	3	3
CO2	3	3	2	3	3
CO3	2	3	3	3	3
CO4	3	3	3	2	3
CO5	3	3	3	3	2

Mathematical Python – Theory

Title of the Course	Mathematical Python – Theory				
Course Type	Elective - V				
Course Code	24PEMA32				
Year	II	Semester	III	Credits	2

Instructional Hours per week	Lecture	Tutorial	Lab Practice	Total
	3	1	-	4

Learning Objectives	
LO1	To demonstrate the solving Techniques
LO2	To solve Algorithm problems
LO3	To know basic python
LO4	To understand python functions
LO5	To learn mathematical problems in python

Unit	Contents
I	**Problem Solving Techniques:** Problem solving Techniques – Algorithm, flowchart, pseudo code, programming; Algorithms: properties, quality (time, space); building blocks of algorithms - statements, state, control flow, functions, notation (pseudo code, flow chart, programming language)
II	**Algorithmic Problem Solving:** Algorithmic problem solving, simple strategies for developing algorithms (iteration, recursion), pseudo code for some Mathematical Problems – greatest of two numbers, print n natural numbers, greatest common divisor, Fibonacci sequence up to n terms. Practical applications of algorithms.
III	**Introduction To Python**: Introduction to Python, Python interpreter, Modes of Python Interpreter, Values and Data Types, Variables, Keywords, Identifiers, Statements and Expressions, Input and Output, Comments, Docstring, Lines and Indentation, Quotation, Tuple Assignment, Operators and Types of Operators, Operator Precedence.

IV	**Python Functions:** Functions, Types of function, Function definition (Sub program), Flow of Execution, Function Prototypes, Parameters and Arguments; Modules; Conditionals: Boolean values and operators, conditional (if), alternative (if-else), chained conditional (if-else-if); Iteration: state, while, for, break, continue, pass; Fruitful functions: return values, parameters, local and global scope, function composition, recursion.
V	**String, Lists, Tuples In Python**: Strings: string slices, immutability, string functions and methods, string module; Lists as arrays. Lists: list operations, list slices, list methods, list loop, mutability, aliasing, cloning lists, list parameters; Tuples: tuple assignment, tuple as return value.

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 Texts	Allen B. Dowley, *Think Python: How to Think Like a Computer Scientist*, 2nd Edition.
Reference books:	1. Wes McKinney, *Python for Data Analysis: Data Wrangling with Pandas, NumPy, and Ipython*, O'Reilly, 2nd Edition, 2018. 2. Jake VanderPlas, *Python Data Science Hand Book: Essential Toolsfor working with Data*, O'Reilly, 2017. 3. Wesley J. Chun, *II Python Programming*, Prentice Hall, 2006. 4. N.Safina Devi and C.Devamanoharan, *Algorithmic Problem Solving and Python Beginner's Guide*, Francidev Publications, 2023

Web Resources	• http://www.programmer-books.com/introducing-data-science-pdf/ • http://www.CS.uky.edu/~keen/115/haltermanpythonbook.pdf • http://math.ecnu.edu.cn/~lfzhou/seminar/IJoel Geusl Datascience from Scratch First Princ.pdf

Course outcomes: CO	On completion of this course, the students will be able to:
CO1	Demonstrate solving Techniques
CO2	Solving Algorithm problems
CO3	Know basic python
CO4	Understanding python functions
CO5	Learn mathematical problems in python

Mapping with Programme Outcomes and Programme Specific Outcomes

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1	3	3	2	3	3	2	3	3
CO2	2	3	3	3	2	3	3	2
CO3	3	3	3	2	3	3	3	2
CO4	3	3	3	3	3	3	3	3
CO5	3	2	3	3	2	2	3	3

S-Strong (3) **M-Medium (2)** **L-Low (1)**

CO/ PSO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	2	3	3	3
CO2	3	3	2	3	3
CO3	2	3	3	3	3
CO4	3	3	3	2	3
CO5	3	3	3	3	2

Stochastic Process

Title of the Course	**Stochastic Process**							
Course Type	**Elective - VI**							
Course Code	**24PEMA33**							
Year	**II**	**Semester**	**III**	**Credits**	**2**			
Instructional Hours per week		**Lecture**		**Tutorial**		**Lab Practice**		**Total**
		3		**1**		**-**		**4**
Learning Objectives								
LO1	To define Markov chain and Transition probability matrix							
LO2	To understand the concepts of queuing models							
LO3	To explain about the pure birth, death processes and Poisson process.							
LO4	To acquire the knowledge of some special Renewal processes							
LO5	To describe the joint probabilities for Brownian motion							

Unit	Contents
I	**Markov Chains:** Classification of general stochastic processes – markov chain – Examples – Transition probability matrix – Classification of states – Recurrence Chapter 1: Section 3 only and Chapter 2: sections 1 to 5.
II	**Limit theorems of Markov chains :** Discrete renewal equation and its proof – Absorption probabilities – criteria for recurrence – Queuing models Chapter 3 : Sections 1 to 7
III	**Continuous time Markov Chains :** Poisson process – Pure Birth process – Birth and Death process - Birth and Death process with absorbing states Chapter 1 : Section 2 (Poisson process) Chapter 4 : Sections 1, 2 and 4 to 7
IV	**Renewal processes :** Definition and related concepts – Some special renewal processes Chapter 5 : sections 1 – 3
V	**Brownian Motion :** Definition – Joint probabilities for Brownian Motion – Continuity of paths and the maximum variables – Variations and extensions Chapter 1 : Section 2 (Brownian Motion) Chapter 7 : sections 1 to 4 and 7A only

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 Texts	S.Karlin and H.M. Taylor, *A first course in stochastic processes* (2nd edition) Academic Press, New York, 1975
Reference books:	1. E. Cinler, *Introduction to stochastic processes*, Prentice Hall Inc, New Delhi, 1975 2. D.R.Cox and H.D.Miller, *Theory of stochastic processes* (3rd Edition) Chapman and hall, London, 1983 3. D.Kannan, *An introduction to stochastic processes*, North-Holland, New York,1979 4. S.M. Ross, *Stochastic processes*, John Wiley and Sons, New York, 1983 *5.* H.W.Taylor and S.Karlin, *An introduction to stochastic modelling* 6. (3rd Edition), Academic Press, New York, 1998
Web Resources	http://mathforum.org, http://ocw.mit.edu/ocwweb/Mathematics, http://www.opensource.org, www.physicsforum.com

Course outcomes: CO	**On completion of this course, the students will be able to:**
CO1	Define Markov chain and Transition probability matrix.
CO2	Understand the concepts of queuing models and limit theorems on Markov chains.
CO3	Explain about the pure birth, death processes and Poisson process.
CO4	Acquire the knowledge of some special Renewal processes.
CO5	Describe the joint probabilities for Brownian motion

Mapping with Programme Outcomes and Programme Specific Outcomes

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1	3	3	2	3	3	2	3	3
CO2	2	3	3	3	2	3	3	2
CO3	3	3	3	2	3	3	3	2
CO4	3	3	3	3	3	3	3	3
CO5	3	2	3	3	2	2	3	3

S-Strong (3) **M-Medium (2)** **L-Low (1)**

CO/ PSO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	2	3	3	3
CO2	3	3	2	3	3
CO3	2	3	3	3	3
CO4	3	3	3	2	3
CO5	3	3	3	3	2

Mathematical Foundations of Artificial Intelligence

Title of the Course	**Mathematical Foundations of Artificial Intelligence**					
Course Type	**Skill Enhancement Course – II**					
Course Code	**24PSMA31**					
Year	**II**	**Semester**	**III**	**Credits**	**2**	
Instructional Hours per week	**Lecture**		**Tutorial**	**Lab Practice**	**Total**	
	3		**-**	**-**	**3**	
Learning Objectives						
LO1	To discuss the Artificial Intelligence including topics and applications					
LO2	To explain the significance of intelligent agents					
LO3	To explain the significance of knowledge.					
LO4	To explain the bases structures and algorithms.					
LO5	To illustrate how artificial intelligence works in gaming applications					

Unit	Contents
I	Topics of Artificial Intelligence, Timelines of Artificial Intelligence, Branches of Artificial Intelligence, Applications of Artificial Intelligence.
II	Intelligent agents: structure and types of agents- Environment- Autonomous Agents
III	Problem Solving: Production Systems–State Space Representation– Example problems.
IV	Heuristic Search Techniques: Generate and Test-Hill Climbing-Simulated Annealing-Search Techniques
V	Knowledge Representation: Knowledge Management- Types of Knowledge- Knowledge Representation

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 Texts	1. Vinod Chandra S.S, Anand Hareendran .S- "Artificial Intelligence: Principles and Applications", Prentice Hall of India, New Delhi, 2020 2. Stuart Russell and Peter Norvig –"Artificial Intelligence: A Modern Approach", 3rd Edition Prentice Hall of India, New Delhi, 2009
Reference books:	Judith Hurwitz and Daniel Kirsch, Machine Learning For Dummies, IBM Limited Edition, Wiley, 2018.
Web Resources	http://mathforum.org, http://ocw.mit.edu/ocwweb/Mathematics, http://www.opensource.org, www.physicsforum.com

Course outcomes: CO	**On completion of this course, the students will be able to:**
CO1	The discuss Artificial Intelligence including topics, branches, and applications
CO2	Explain the significance of intelligent agents in the Artificial Intelligence.
CO3	Explain the significance of knowledge.
CO4	Explain the bases structures and algorithms.
CO5	Illustrate how artificial intelligence works in gaming applications

Mapping with Programme Outcomes and Programme Specific Outcomes

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1	3	3	2	3	3	2	3	3
CO2	2	3	3	3	2	3	3	2
CO3	3	3	3	2	3	3	3	2
CO4	3	3	3	3	3	3	3	3
CO5	3	2	3	3	2	2	3	3

S-Strong (3) **M-Medium (2)** **L-Low (1)**

CO/ PSO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	2	3	3	3
CO2	3	3	2	3	3
CO3	2	3	3	3	3
CO4	3	3	3	2	3
CO5	3	3	3	3	2

R-Programming

Title of the Course	**R-Programming**						
Course Type	**Skill Enhancement Course – II**						
Course Code	**24PSMA32**						
Year	**II**	**Semester**	**III**	**Credits**	**2**		
Instructional Hours per week		**Lecture**		**Tutorial**	**Lab Practice**	**Total**	
		3		**-**	**-**	**3**	
Learning Objectives							
LO1	To understand the fundamentals of R.						
LO2	To illustrate the loading, retrieval techniques of data.						
LO3	To understand how data is analyzed using simple functions						
LO4	To use flow control statements in simple programs.						
LO5	To explain Histograms, plots and ggplot2 visualize data.						

Unit	Contents
I	Introduction to R programming - Installing R and R Studio - R Studio over view working in the console.
II	Arithmetic operators -logical operators – functions- Data structures in R - creating variables - numeric, character and logical data – vectors .
III	Data frames– factors - sorting numeric, character, and factor vectors -Control statements in R – loop statements
IV	R packages - installing and loading packages - setting up your working directory - working with missing data-
V	Statistical graphs - Scatter Plots - Box Plots- Histograms – Bar plots – pie chart - ggplot2 package to visualize data

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 Texts	Sandip Rakshit, R Programming for Beginners, McGraw Hill Education (India), 2017.
Web Resources	http://mathforum.org, http://ocw.mit.edu/ocwweb/Mathematics, http://www.opensource.org, www.physicsforum.com

Course outcomes: CO	**On completion of this course, the students will be able to:**
CO1	Understand the fundamentals of R.
CO2	Illustrate the loading, retrieval techniques of data.
CO3	Understand how data is analyzed using simple functions
CO4	Use flow control statements in simple programs.
CO5	Explain Histograms, plots and ggplot 2 visualise data.

Mapping with Programme Outcomes and Programme Specific Outcomes

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1	3	3	2	3	3	2	3	3
CO2	2	3	3	3	2	3	3	2
CO3	3	3	3	2	3	3	3	2
CO4	3	3	3	3	3	3	3	3
CO5	3	2	3	3	2	2	3	3

S-Strong (3) **M-Medium (2)** **L-Low (1)**

CO/ PSO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	2	3	3	3
CO2	3	3	2	3	3
CO3	2	3	3	3	3
CO4	3	3	3	2	3
CO5	3	3	3	3	2

Programming in C++

Title of the Course	Programming in C++					
Course Type	Skill Enhancement Course – II					
Course Code	24PSMA33					
Year	II	Semester	III	Credits	2	
Instructional Hours per week		Lecture	Tutorial		Lab Practice	Total
		3			-	3

Learning Objectives	
LO1	To understand the structure of C++ program
LO2	Explain Control Structures- Functions in C++.
LO3	Explain all functions classes and Objects.
LO4	Explain the Nesting of member functions
LO5	Explain Constructors and Destructors

Unit	Contents
I	Structure of C++ program – Tokens – Keywords –Identifies and constants- all data types – Constants – all variables – All operators- Manipulator. Chapter 2 : Sec : 2.6 Chapter 3 : Sec : 3.1 – 3.18
II	All Expressions – Conversion – Operator overloading – Operator Precedence – Control Structures- Functions in C++ - Introduction – Main Function – Function Prototyping- Return by reference Chapter 3, Sec: 3.19 -3.24 Chapter 4, Sec : 4.1 – 4.5
III	Inline Functions – arguments – Function overloading – all functions classes and Objects. Chapter 4 , Sec: 4.6 - 4.11 Chapter 5, Sec: 5.1 – 5.5
IV	Nesting of member functions – Private member function – Arrays with in a class and Objects – Friendly function – Returning Objects – Pointers to members – Local Classes. Chapter 5, Sec 5.7 – 5.19
V	Constructors and Destructors – Operator over loading and Type conversions. Chapter 6 & 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 this course	Knowledge, Problem Solving, Analytical ability, Professional Competency, Professional Communication and Transferrable Skill

Recommended Texts	E. Balagurusamy, Object Oriented Programming with C++, 4th Edition, The McGraw- Hill Company, New Delhi, 2008.
Reference books:	V. Ravichandran, Programming with C++, Second Edition Tata McGraw-Hill, New Delhi, 2006.
Web Resources	http://mathforum.org, http://ocw.mit.edu/ocwweb/Mathematics, http://www.opensource.org, www.physicsforum.com

Course outcomes: CO	**On completion of this course, the students will be able to:**
CO1	Understand the **s**tructure of C++ program
CO2	Explain Control Structures- Functions in C++.
CO3	Explain all functions classes and Objects.
CO4	Explain the Nesting of member functions
CO5	Explain Constructors and Destructors

Mapping with Programme Outcomes and Programme Specific Outcomes

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1	3	3	2	3	3	2	3	3
CO2	2	3	3	3	2	3	3	2
CO3	3	3	3	2	3	3	3	2
CO4	3	3	3	3	3	3	3	3
CO5	3	2	3	3	2	2	3	3

S-Strong (3) **M-Medium (2)** **L-Low (1)**

CO/ PSO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	2	3	3	3
CO2	3	3	2	3	3
CO3	2	3	3	3	3
CO4	3	3	3	2	3
CO5	3	3	3	3	2

Internship / Field Visit / Industrial Visit/ Research Knowledge Updating Activity

Title of the Course	**Internship / Field Visit / Industrial Visit/ Research Knowledge Updating Activity**					
Course Type	**Training**					
Course Code	**24PTMA31**					
Year	**II**	**Semester**	**III**	**Credits**	**2**	
Instructional Hours per week		**Lecture**	**Tutorial**		**Lab Practice**	**Total**
		-	**-**		**-**	**-**

Learning Objectives	
CO1	To enhance student to work as team work.
CO2	To equipped the student with the skill and desire to solve societal problems
CO3	To develop the work ethic.
CO4	To improve communication skill and responsibilities among students
CO5	To explore, experience and apply the academic knowledge in ground

Course Outcomes	On completion of this course, students will / can;
CO1	Enhance the professional competency to conduct field work.
CO2	Gain practical knowledge related to their studies.
CO3	Help the student to understand the subject theories and methodology better.
CO4	Gain particle skill and knowledge.
CO5	Increase the employment prospect of the student

Mapping with Programme Outcomes and Programme Specific Outcomes

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1	3	3	2	3	3	2	3	3
CO2	2	3	3	3	2	3	3	2
CO3	3	3	3	2	3	3	3	2
CO4	3	3	3	3	3	3	3	3
CO5	3	2	3	3	2	2	3	3

S-Strong (3) **M-Medium (2)** **L-Low (1)**

CO/ PSO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	2	3	3	3
CO2	3	3	2	3	3
CO3	2	3	3	3	3
CO4	3	3	3	2	3
CO5	3	3	3	3	2

Semester - IV
Advanced Algebra – II

Title of the Course	**Advanced Algebra**						
Course Type	**Core - XI**						
Year	**II**	**Semester**	**IV**	**Credits**	**5**	**Course Code**	**24PMMA41**
Instructional Hours per week		**Lecture**	**Tutorial**		**Lab Practice**	**Total**	
		5	**1**		**-**	**6**	

Learning Objectives	
LO1	To learn extension fields and Algebraic extensions.
LO2	To explain the nature of roots of Polynomials.
LO3	To Compose clear and accurate proofs using the concepts of Galois Theory.
LO4	To bring out insight into Finite fields.
LO5	To understanding the concepts of Frobenius , Integral Quaternions and the Four - Square theorem.

Unit	**Contents**
I	Extension fields. Chapter 5: Section 5.1
II	Roots of Polynomials. - More about roots. Chapter 5: Sections 5.3 and 5.5
III	Elements of Galois theory. Chapter 5 : Section 5.6
IV	Finite fields - Wedderburn's theorem on finite division rings. Chapter 7: Sections 7.1 and 7.2 (Theorem 7.2.1 only)
V	A theorem of Frobenius - Integral Quaternions and the Four-Square theorem. Chapter 7 : Sections 7.3 and 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 this Course	Knowledge, Problem Solving, Analytical ability, Professional Competency, Professional Communication and Transferrable Skill

Recommended Texts	• I.N. Herstein. Topics in Algebra (II Edition) Wiley Eastern Limited, New Delhi, 1975.
Reference books:	• M.Artin, Algebra, Prentice Hall of India, 1991. • P.B.Bhattacharya, S.K.Jain, and S.R.Nagpaul, Basic Abstract Algebra • (II Edition) Cambridge University Press, 1997 (Indian Edition) • I.S.Luther and I.B.S.Passi, Algebra, Vol. I –Groups(1996); Vol. II • Rings,Narosa Publishing House , New Delhi, 1999 • D.S.Malik, J.N. Mordeson and M.K.Sen, Fundamental of AbstractAlgebra, McGraw Hill (International Edition), New York. 1997. • N.Jacobson, Basic Algebra, Vol. I & II Hindustan Publishing Company, New Delhi.
Web Resources	• http://mathforuo,http://ocw.mit.edu/ocwweb/Matheatics, • http://www.opensource.org, www.algebra.com

Course Outcomes	On completion of this course, the students will be able to:
CO1	Prove theorems by applying algebraic ways of thinking like extension fields and Algebraic extensions
CO2	Explain the nature of roots of Polynomials
CO3	Compose clear and accurate proofs using the concepts of
CO4	Bring out insight into Finite fields
CO5	Demonstrate knowledge and understanding of fundamental concepts including a theorem of Frobenius , Integral Quaternions and the Four - Square theorem Galois Theory

Mapping with Programme Outcomes and Programme Specific Outcomes

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1	3	3	2	3	3	2	3	2
CO2	2	3	3	3	2	3	3	3
CO3	3	2	3	2	3	2	3	3
CO4	3	3	2	3	3	3	3	3
CO5	3	2	3	3	2	3	3	2

S-Strong (3) **M-Medium (2)** **L-Low (1)**

CO/ PSO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	3	3	3
CO2	3	3	3	3	3
CO3	3	3	3	3	3
CO4	3	3	3	3	3
CO5	3	3	3	3	3

Functional Analysis

Title of the Course		Functional Analysis					
Course Type		Core - XII					
Year	II	Semester	IV	Credits	5	Course Code	24PMMA42
Instructional Hours per week		Lecture	Tutorial		Lab Practice	Total	
		5	1		-	6	

Learning Objectives	
LO1	To understand the Banach spaces and Transformations on Banach Spaces
LO2	To prove open mapping theorem
LO3	To describe operators and fundamental theorems
LO4	To validate spectral theorem
LO5	To analyze and establish the regular and singular elements

Unit	Contents
I	Banach Spaces**:** The definition and some examples – Continuous linear transformations – The Hahn-Banach theorem – The natural imbedding of N in N^{**}. Chapter 9: Sections 46 - 49
II	The open mapping theorem – The conjugate of an operator. The properties– Orthogonal complements– Orthonormal sets Chapter 9: Sections 50 and 51 Chapter 10 : Sections 52 - 54
III	The conjugate space H* - The adjoint of an operator – self - adjoint operators - Normal and unitary operators – projections. Chapter 10: Section 55 - 59
IV	Finite dimensional Spectral Theory**:** Determinants and the spectrum of an operator –The spectral theorem. Chapter 11: Sections 61, 62
V	General Preliminaries on Banach Algebras**:** The definition and some examples – Regular and singular elements – Topological divisors of zero – The spectrum. Chapter 12: Sections 64 - 67

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 Texts	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, NewDelhi,1987. 4. E. Kreyszig, Introductory Functional Analysis with Applications,John Wiley & Sons, New York, 1978. 5. Thamban Nair, Functional Analysis, A First course, Prentice Hall of India, New Delhi, 2002.
Web Resources	http://mathforum.org, http://ocw.mit.edu/ocwweb/Mathematics, http://www.opensource.org, http://en.wikiepedia.org

Course Outcomes	**On completion of this course, the students will be able to:**
CO1	Understand the Banach spaces and Transformations on Banach Spaces
CO2	Prove open mapping theorem
CO3	Describe operators and fundamental theorems
CO4	Validate spectral theorem
CO5	Analyze and establish the regular and singular elements

Mapping with Programme Outcomes and Programme Specific Outcomes

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1	3	3	2	3	3	2	3	2
CO2	2	3	3	3	2	3	3	3
CO3	3	2	3	2	3	2	3	3
CO4	3	3	2	3	3	3	3	3
CO5	3	2	3	3	2	3	3	2

S-Strong (3) **M-Medium (2)** **L-Low (1)**

CO/ PSO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	3	3	3
CO2	3	3	3	3	3
CO3	3	3	3	3	3
CO4	3	3	3	3	3
CO5	3	3	3	3	3

Project with Viva Voce

Title of the Course		Project with Viva Voce					
Course Type		Core - XIII					
Year	II	Semester	IV	Credits	7	Course Code	24PMMAP1
Instructional Hours per week		Lecture	Tutorial		Lab Practice	Total	
		-	-		-	10	

Learning Objectives	
LO1	To assess the student dissertation for the award of degree, jointly by supervisor and one external examiner affiliated to Manonmaniam Sundaranar University.
LO2	To develop confident and empowers student for future career.
LO3	To better prepare students for solving real-world problems and issues while teaching them, encouraging giving additional information related to their topic.
LO4	To developed student interpersonal skills.
LO5	To encourages students to develop a balanced, diverse approach to solving real- societal problems, both on their own and in a team
Course Outcomes	
Course Outcomes	On completion of this course, students will can be to
CO1	Gives the student a skill such as problem solving, and helps to develop additional skills integral to their Future, such as critical thinking and time management.
CO2	Enhance their knowledge through practicals and experience.
CO3	Be developed interpersonal skills and decision-making skills.
CO4	Give a platform to demonstrate his/her abilities.
CO5	Be able to identify the strength and weakness, which will help them to enhance and improve their ability.

Mapping with Programme Outcomes and Programme Specific Outcomes

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1	3	3	2	3	3	2	3	2
CO2	2	3	3	3	2	3	3	3
CO3	3	2	3	2	3	2	3	3
CO4	3	3	2	3	3	3	3	3
CO5	3	2	3	3	2	3	3	2

S-Strong (3) **M-Medium (2)** **L-Low (1)**

CO/ PSO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	3	3	3
CO2	3	3	3	3	3
CO3	3	3	3	3	3
CO4	3	3	3	3	3
CO5	3	3	3	3	3

Differential Geometry

Title of the Course	**Differential Geometry**						
Course Type	**Elective- VI**						
Year	**II**	**Semester**	**IV**	**Credits**	**3**	**Course Code**	**24PEMA41**
Instructional Hours per week		**Lecture**	**Tutorial**		**Lab Practice**	**Total**	
		4	**1**		**-**	**5**	
Learning Objectives							
LO1	To explain fundamental form of a surface and Geodesics						
LO2	To evaluate these concepts with related examples						
LO3	To compose problems on geodesics						
LO4	To recognize applicability of developable						
LO5	To construct and analyze the problems on curvature and minimal surfaces						

Unit	Contents
I	**Space curves:** Definition of a space curve – Arc length – tangent – normal and binormal – curvature and torsion – contact between curves and surfaces- tangent surface- involutes and evolutes – Intrinsic equations – Fundamental Existence Theorem for space curves- Helices. Chapter 1: Sections 1 to 9.
II	**Intrinsic properties of a surface:** Definition of a surface – curves on a surface – Surface of revolution – Helicoids – Metric – Direction coefficients – families of curves – Isometric correspondence – Intrinsic properties. Chapter 2: Sections 1 to 9.
III	**Geodesics:** Geodesics – Canonical geodesic equations – Normal property of geodesics – Existence Theorems – Geodesic parallels – Geodesics curvature- Gauss – Bonnet Theorem – Gaussian curvature – surface of constant curvature. Chapter 2: Sections 10 to 18
IV	**Non Intrinsic properties of a surface:** The second fundamental form – Principal curvature – Lines of curvature – Developable – Developable associated with space curves and with curves on surface - Minimal surfaces – Ruled surfaces. Chapter 3: Sections 1 to 8.

V	**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 4: 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 this Course	Knowledge, Problem Solving, Analytical ability, Professional Competency, Professional Communication and Transferrable Skill
Recommended Texts	T.J. Willmore, An Introduction to Differential Geometry, Oxford University Press, (17th Impression) New Delhi 2002. (Indian Print)
Reference books:	1. Struik, D.T. Lectures on Classical Differential Geometry, Addison –Wesley, Mass. 1950. 2. Kobayashi. S. and Nomizu. K. Foundations of Differential Geometry, Inter science Publishers, 1963. 3. Wilhelm Klingenberg: A Course in Differential Geometry, Graduate in Mathematics, Springer-Verlag 1978. 4. J.A. Thorpe Elementary topics in Differential Geometry, Under- graduate Texts in Mathematics, Springer - Verlag 1979.
Web Resources	1. http://mathforum.org, http://ocw.mit.edu/ocwweb/Mathematics, 2. http://www.opensource.org, www.physicsforum.com

Course Outcomes	On completion of this course, the students will be able to:
CO1	Explain space curves, Curves between surfaces, metrics on a surface, fundamental form of a surface and Geodesics
CO2	Evaluate these concepts with related examples
CO3	Compose problems on geodesics
CO4	Recognize applicability of developable
CO5	Construct and analyze the problems on curvature and minimal surfaces

Mapping with Programme Outcomes and Programme Specific Outcomes

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1	3	3	2	3	3	2	3	2
CO2	2	3	3	3	2	3	3	3
CO3	3	2	3	2	3	2	3	3
CO4	3	3	2	3	3	3	3	3
CO5	3	2	3	3	2	3	3	2

S-Strong (3) **M-Medium (2)** **L-Low (1)**

CO/ PSO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	3	3	3
CO2	3	3	3	3	3
CO3	3	3	3	3	3
CO4	3	3	3	3	3
CO5	3	3	3	3	3

Mathematical Python – Practical

Title of the Course		**Mathematical Python - Practical**					
Course Type		**Elective - VI**					
Year	**II**	**Semester**	**IV**	**Credits**	**3**	**Course Code**	**24PEMAL1**
Instructional Hours per week		**Lecture**	**Tutorial**		**Lab Practice**	**Total**	
		3	**-**		**2**	**5**	

Learning Objectives	
LO1	To write programs using advanced concepts of Python.
LO2	To write, Test and Debug Python Programs.
LO3	To implement Conditionals and Loops for Python Programs.
LO4	To use functions and represent Compound data using Lists, Tuples and Dictionaries.
LO5	To read, write and manipulate data from & to files in Python.

List of Practicals in Mathematical Python:

1. Find minimum/maximum in a list / guess an integer in given range
2. Distance between two points
3. Find GCD
4. Sum an array of numbers
5. Linear search
6. Binary search.
7. Find the numbers which are divisible by n in a given range
8. Print first n Fibonacci numbers
9. Selection sort
10. Insertion sort
11. Merge sort
12. Count word frequencies
13. Generate adjacency matrix of any graph on n vertices
14. Find degree of vertices from given adjacency matrix of the graph
15. Find odd number in given array/ Replace odd numbers with given integer in the given array
16. Compute multiplication of two 3x3 matrices
17. Compute mean and standard deviation of given array
18. Create a Bar plot/Pie chart for comparing three features.

Recommended Text	Allen B.Dowley,Think Python: How to Think Like a Computer Scientist, 2nd Edition.
Reference Books	Wes McKinney, Python for Data Analysis: Data Wrangling with Pandas, NumPy, and Ipython, O'Reilly, 2nd Edition, 2018. Jake VanderPlas, Python Data Science Hand Book: Essential Tools for working with Data, O'Reilly, 2017. Wesley J. Chun, Core Python Programming, Prentice Hall, 2006. N.Safina Devi and C.Devamanoharan, Algorithmic Problem Solving and Python- A Beginner's Guide, Francidev Publications, 2023.

Course Outcomes	**On completion of this course, the students will be able to**
CO1	Write programs using advanced concepts of Python
CO2	Write, Test and Debug Python Programs
CO3	Implement Conditionals and Loops for Python Programs
CO4	Use functions and represent Compound data using Lists, Tuples and Dictionaries
CO5	Read, write and manipulate data from & to files in Python

Mapping with Programme Outcomes and Programme Specific Outcomes

CO/PO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**
CO1	3	3	2	3	3	2	3	2
CO2	2	3	3	3	2	3	3	3
CO3	3	2	3	2	3	2	3	3
CO4	3	3	2	3	3	3	3	3
CO5	3	2	3	3	2	3	3	2

S-Strong (3) **M-Medium (2)** **L-Low (1)**

CO/ PSO	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**
CO1	3	3	3	3	3
CO2	3	3	3	3	3
CO3	3	3	3	3	3
CO4	3	3	3	3	3
CO5	3	3	3	3	3

Algebraic Topology

Title of the Course	**Algebraic Topology**						
Course Type	**Elective –VI**						
Year	**II**	**Semester**	**IV**	**Credits**	**3**	**Course Code**	**24PEMA42**
Instructional Hours per week		**Lecture**	**Tutorial**		**Lab Practice**	**Total**	
		4	**1**		**-**	**5**	

Learning Objectives	
LO1	To know the concepts homotopy, homology and co-homology
LO2	To prove topological results by using algebraic methods
LO3	To use the theory to solve elementary topological problems
LO4	To compute algebra-topological invariants in specific examples
LO5	To discuss the concepts covering spaces of a graph

Unit	Contents
I	Homotopy of paths, fundamental group of a topological space – homotopy of maps of topological spaces – contractible and simply connected spaces. Chapter 9: Sec: 51, 52.
II	The Fundamental group of the circle, Path lifting lemma – Retractions and fixed points – Brouwer's fixed – point theorem for the disc – The fundamental Theorem of Algebra. Chapter 9. Sec: 54 - 56
III	Covering spaces, Equivalence of covering spaces – The general lifting lemma – The universal covering space. Chapter 9 : Sec: 53, Chapter 13: Sec: 79, 80
IV	Separation theorems in the plane – Null homotopy lemma – The Jordan separation theorem – A general separation theorem – Homotopy Extension lemma – Borsuk lemma – Invariance of domain. Chapter 10: Sec: 61, 62
V	Applications to Group theory: Covering spaces of a graph – The fundamental group of a graph. Chapter 14: Sec 83, 84.

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 Texts	James R. Munkres, Topology, Prentice Hall of India, New Delhi, 2002 (2nd Edition).
Reference books	1. M.K.Agoston, Algebraic topology- A First Course, Marcel Dekker, 1962 2. Satya Deo, Algebraic Topology, Hindustan Book Agency, New Delhi, 2003. 3. M.Greenberg and Harper, Algebraic Topology-A First course, Benjamin/Cummings, 1981. 4. C.F. Maunder, Algebraic topology, Van Nastrand, New York, 1970
Web Resource	http://mathforum.org, http://ocw.mit.edu/ocwweb/Mathematics, http://www.opensource.org, www.physicsforum.com

Course Outcomes	**On completion of this course, the students will be able to:**
CO1	Give an account of the concepts homotopy, homology and co-homology, their basic properties and relationships
CO2	Prove topological results by using algebraic methods
CO3	Use the theory to solve elementary topological problems
CO4	Compute algebra-topological invariants in specific examples
CO5	Explain the fundamental concepts of algebraic topology and their role in modern mathematics and applied contexts

Mapping with Programme Outcomes and Programme Specific Outcomes

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1	3	3	2	3	3	2	3	2
CO2	2	3	3	3	2	3	3	3
CO3	3	2	3	2	3	2	3	3
CO4	3	3	2	3	3	3	3	3
CO5	3	2	3	3	2	3	3	2

S-Strong (3) **M-Medium (2)** **L-Low (1)**

CO/ PSO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	3	3	3
CO2	3	3	3	3	3
CO3	3	3	3	3	3
CO4	3	3	3	3	3
CO5	3	3	3	3	3

Introduction to Machine Learning and Applications

Title of the Course		**Introduction to Machine Learning and Applications**					
Course Type		**Skill Enhancement Course - III**					
Year	**II**	**Semester**	**IV**	**Credits**	**2**	**Course Code**	**24PSMA41**
Instructional Hours per week		**Lecture**	**Tutorial**		**Lab Practice**	**Total**	
		3	**-**		**-**	**3**	

Learning Objectives	
LO1	To explain applications of Machine learning
LO2	To explain the Power of Machine Learning
LO3	To discuss the applications of Machine Learning
LO4	To explain different supervised machine learning algorithms
LO5	To explain the neural networks and applications of machine learning.

Unit	**Contents**
I	Understanding Machine Learning – What Is Machine Learning?
II	Defining Big Data – Big Data in Context with Machine Learning – Leveraging the Power of Machine Learning
III	Descriptive analytics – Predictive analytics – The Roles of Statistics and Data Mining with Machine Learning
IV	Approaches to Machine Learning – Supervised learning – Unsupervised learning – Reinforcement learning
V	Neural Networks – Applying machine Learning – Understanding machine Learning Techniques

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 Texts	1. Judith Hurwitz and Daniel Kirsch, Machine Learning For Dummies, IBM Limited Edition, Wiley, 2018. . Ethem Alpaydın "Introduction to Machine Learning Second Edition", The MIT Press Cambridge, Massachusetts, London, England

Course Outcomes	**On completion of this course, the students will be able to:**
CO1	Explain the basic concepts and applications of Machine learning
CO2	Explain the big data and Leveraging the Power of Machine Learning
CO3	Discuss the applications of Machine Learning
CO4	Compare and contrast different supervised machine learning algorithms
CO5	Explain the neural networks and applications of machine learning.

Mapping with Programme Outcomes and Programme Specific Outcomes

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1	3	3	2	3	3	2	3	2
CO2	2	3	3	3	2	3	3	3
CO3	3	2	3	2	3	2	3	3
CO4	3	3	2	3	3	3	3	3
CO5	3	2	3	3	2	3	3	2

S-Strong (3) **M-Medium (2)** **L-Low (1)**

CO/ PSO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	3	3	3
CO2	3	3	3	3	3
CO3	3	3	3	3	3
CO4	3	3	3	3	3
CO5	3	3	3	3	3

Financial Mathematics

Title of the Course	**Financial Mathematics**						
Course Type	**Skill Enhancement Course - III**						
Year	**II**	**Semester**	**IV**	**Credits**	**2**	**Course Code**	**24PSMA42**
Instructional Hours per week		**Lecture**	**Tutorial**		**Lab Practice**	**Total**	
		3	**-**		**-**	**3**	

Learning Objectives	
LO1	To understanding probability theory
LO2	To analyze the Geometric Brownian Motion
LO3	To knowledge of Interest Rate and making fair present value
LO4	To examine pricing contracts by understanding and usingArbitrage
LO5	To understanding Arbitrage theorem with various examples

Unit	Contents
I	Probability and Normal Random Variables.
II	Brownian Motion and Geometric Brownian Motion.
III	Interest Rate and Present Value Analysis.
IV	Pricing Contracts via Arbitrage.
V	The Arbitrage Theorem.

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 Texts	Sheldon M. Ross, An Introduction to Mathematical Finance: Options and Other Topics, Second Edition, Cambridge University Press, First published 2002.
Reference books:	Karatzas and S.E.Shreve, Methods of Mathematical Finance, Springer, 1998.

Course Outcomes	**On completion of this course, the students will be able to:**
CO1	Understanding probability theory
CO2	Analyze the Geometric Brownian Motion
CO3	Knowledge of Interest Rate and making fair present value analysis
CO4	Examine pricing contracts by understanding and using Arbitrage
CO5	Understanding Arbitrage theorem with various examples

Mapping with Programme Outcomes and Programme Specific Outcomes

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1	3	3	2	3	3	2	3	2
CO2	2	3	3	3	2	3	3	3
CO3	3	2	3	2	3	2	3	3
CO4	3	3	2	3	3	3	3	3
CO5	3	2	3	3	2	3	3	2

S-Strong (3) **M-Medium (2)** **L-Low (1)**

CO/ PSO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	3	3	3
CO2	3	3	3	3	3
CO3	3	3	3	3	3
CO4	3	3	3	3	3
CO5	3	3	3	3	3

Programming in C- Practicals

Title of the Course		**Programming in C - Practicals**					
Course Type		**Skill Enhancement Course - III**					
Year	**II**	**Semester**	**IV**	**Credits**	**2**	**Course Code**	**24PSMAL1**

List of Practical's:

1. Programs to evaluate sin x, cos x, e^{-x} to 0.0001% accuracy.
2. Program to calculate the variance and standard deviation of a set of numbers.
3. Program to find Product of matrices, inverse of a matrix using functions. Macro that obtains largest of three numbers.
4. Define a class of students and prepare a statement containing name, total marks of Ranks (using functions).
5. Program to check whether a number/ string is a palindrome without using the corresponding standard function.
6. Write a program to conversion between polar and rectangle co-ordinates
7. Define a class string and exhibit the use of string manipulations.
8. Write a program to finding area of 2 different shapes
9. Create a class FLOAT that contains one float data. Overload all the four arithmetic.
10. Write a C++ program implement a class 'Complex' of complex numbers. The class could be include member functions to add and subtract two complex numbers.
11. Write a C ++ program to implement a class for complex numbers with add and multiply as member functions. Overload ++ operator to increment a complex number.
12. Write a program in C++ to demonstrate friend function.

Extension Activity /Pollution Awareness/Literacy/ Voluntary Services

Title of the Course		**Extension Activity /Pollution Awareness/Literacy/ Voluntary Services**					
Course Type		**Extension Activity**					
Year	**II**	**Semester**	**IV**	**Credits**	**1**	**Course Code**	**24PEA41**
Instructional Hours per week		**Lecture**	**Tutorial**		**Lab Practice**	**Total**	
		-	**-**		**-**	**-**	

Learning Objectives	
LO1	Extension activities concentrates on putting across in an understandable manner new ideas and improved technologies of practical utility to the rural, tribal and urban privileged and underprivileged people.
LO2	Enables students to use the newly acquired knowledge and skills to improve their general standard of living.
LO3	It is a social science that attempts to adopt various strategies of change in the behaviour patterns of people through technological and scientific innovations for the improvement of their standard of living.
LO4	The idea behind the extension work is the coming together for the task of social up liftmen.
LO5	Students typically develop leadership and teamwork skills and become more attuned to working amongst populations of varying ethnicity or socio economic status.

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	1. E.Balagurusamy, Object Oriented Programming with C++, 4th Edition, The McGraw- Hill Company, New Delhi, 2008.
Reference Book	1. V.Ravichandran, Programming with C++, Second Edition Tata McGraw- Hill, New Delhi, 2006.

Course Outcomes	On completion of this course, the students will be able to:
CO1	Is a learning-teaching methods connect meaningful community service to academic curricula
CO2	Service-learning blends community service goals and formal and informal (standard/academic and experiential/non-standard) educational goals in a manner that benefits participants and recipients.
CO3	Extension activities and learning is a set of techniques and tools that can strengthen community relationships and connections.
CO4	Extension contributes to national development programmers.
CO5	It enhances leadership and team work qualities among the students

Mapping with Programme Outcomes and Programme Specific Outcomes

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1	3	3	2	3	3	2	3	2
CO2	2	3	3	3	2	3	3	3
CO3	3	2	3	2	3	2	3	3
CO4	3	3	2	3	3	3	3	3
CO5	3	2	3	3	2	3	3	2

S-Strong (3) **M-Medium (2)** **L-Low (1)**

CO/ PSO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	3	3	3
CO2	3	3	3	3	3
CO3	3	3	3	3	3
CO4	3	3	3	3	3
CO5	3	3	3	3	3

Blue Print – End Semester Examinations Semester - I to IV

Class: P.G. **Time: 3 Hours** **Max. Marks: 75**

Section A **(10 x 1 = 10)**

Answer all questions. Choose the correct answer.

(With four options)

	Unit I	Unit II	Unit III	Unit IV	Unit V
Question Nos.	1 & 2	3 & 4	5 & 6	7 & 8	9 & 10

Section B **(5 x 5 = 25)**

Answer all questions choosing either (a) or (b).

Answer should not exceed 250 words

	Unit I	Unit II	Unit III	Unit IV	Unit V
Question Nos.	11 (a) & 11 (b)	12 (a) & 12 (b)	13 (a) & 13 (b)	14 (a) & 14 (b)	15 (a) & 15 (b)

Section C **(5 x 8 = 40)**

Answer all questions choosing either (a) or (b).

Should exceed 500 words

	Unit I	Unit II	Unit III	Unit IV	Unit V
Question Nos.	16 (a) & 16 (b)	17 (a) & 17 (b)	18 (a) & 18 (b)	19 (a) & 19 (b)	20 (a) & 20 (b)