



**MARUDHAR KESARI JAIN COLLEGE FOR WOMEN
(AUTONOMOUS)**

Vaniyambadi – 635 751

PG & Research Department of Mathematics

for

Postgraduate Programme

Master of Science in Mathematics

Regulations 2024-2025

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1. Preamble

The Department endeavors to be a center of excellence nurturing joyful curiosity in learning, enthusiastic creativity in research, and passion for building a respectful, free, transparent and dynamic pedagogic community.

To provide an education that transforms students from curriculum to the needs of society. Offer broad and balanced academic programs that are mutually reinforcing and emphasize high quality and creative instruction to the students. We aim to develop well-rounded and thoughtful students prepared to cope with a changing post-modern and globalized world. To provide high quality education, respectful and inclusive environment that builds a foundation for life-long learning.

The Department of Mathematics established in the year 1994 with UG course and it offers PG since 2000. The Department offers research program M.Phil from 2012 and Ph.D from 2022. The objective of the Department is to enhance student knowledge towards global perspective and skill oriented. The Department is well known for its teaching and learning process of quality education. The department organizes International Conferences, Seminars, and Hands-on training, Workshops, Competitions, Guest lecturers to inculcate the skill of students to face contemporary growth in Mathematics. Memorandum of Understanding with reputed Institutions. Apart from curriculum the department offers Aptitude test, Bridge Course Value Added Courses and NET/SET/CSIR Coaching for the students.

PROGRAMME OUTCOMES (PO)

Programme	M.Sc., Mathematics
Programme Code	PS09
Duration	2 years[PG]
Programme Outcomes	<p>PO1: Problem Solving Skill : Apply knowledge of Management theories and Human Resource practices to solve business problems through research in Global context.</p> <p>PO2: Decision Making Skill : Foster analytical and critical thinking abilities for data-based decision-making.</p> <p>PO3: Ethical Value : Ability to incorporate quality, ethical and legal value-based perspectives to all organizational activities.</p> <p>PO4: Communication Skill : Ability to develop communication, managerial and interpersonal skills.</p> <p>PO5: Individual and Team Leadership Skill : Capability to lead themselves and the team to achieve organizational goals.</p> <p>PO6: Employ ability Skill : Inculcate contemporary business practices to enhance employability skills in the competitive environment.</p> <p>PO7: Entrepreneurial Skill : Equip with skills and competencies to become an entrepreneur.</p> <p>PO8: Moral and ethical awareness / reasoning : Ability to embrace moral / ethical values in conducting one's life</p>
Programme Specific Outcomes:	<p>PSO1: Placement To prepare the students who will demonstrate respectful engagement with others' ideas, behaviors, beliefs and apply diverse frames of reference to decisions and actions.</p> <p>PSO2-Entrepreneur To create effective entrepreneurs by enhancing their critical thinking, problem solving, decision making and leadership skill that will facilitate startups and high potential organizations.</p> <p>PSO3–Research and Development Design and implement HR systems and practices grounded in research that comply with employment laws, leading the organization towards growth and development.</p>

Eligibility for Admission:

Candidate for admission to the first year of M.Sc Mathematics Department of Mathematics shall be required to have passed the UG with Mathematics

Methods of Evaluation and Assessment

Methods of Evaluation		
Internal Evaluation		25 Marks
External Evaluation	End Semester Examination	75 Marks
	Total	100 Marks
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	

Semester-I						
Code	Course Title	Hours Distribution				C
		L	T	P	S	
24PMAC11	CC-1 Algebraic Structure	2	1	2	0	4
24PMAC12	CC-2 Real Analysis I	3	1	2	0	4
24PMAC13	CC-3 Ordinary Differential Equations	3	1	1	0	3
24PMAE11/ 24PMAE12	EC-1 Graph Theory and Applications / Number Theory and Cryptography	3	1	1	0	3
24PMAE13/ 24PMAE14	EC-2 Discrete Mathematics / Fuzzy Sets and their Applications	3	1	1	0	3
24PMAA11	AECC -1 Mathematical Documentation Using LATEX	1	0	1	0	2
24PCHR11	VE-1 Human Rights	1	1	0	0	2
Total					30	21

Semester- II						
Code	Course Title	Hours Distribution				C
		L	T	P	S	
24PMAC21	CC-4 Advanced Algebra	3	1	1	0	4
24PMAC22	CC-5 Real Analysis II	3	1	1	0	4
24PMAC23	CC-6 Partial Differential Equations	3	1	1	0	3
24PMAC24	CC-7 Difference Equations	3	1	1	0	3
24PMAE21/ 24PMAE22	EC-3 Tensor Analysis and Relativity Theory / Mathematical Statistics	2	1	1	0	3
24PMAE23/ 24PMAE24	EC-4 Machine Learning / Neural Networks	2	1	1	0	3
24PMAS21	SEC -1(NME) Numerical Methods	1	1	0	0	2
Total					30	22

Semester-III						
24PMAC31	CC-8 Complex Analysis	3	1	1	1	5
24PMAC32	CC-9 Probability Theory	3	1	1	1	4
24PMAC33	CC-10 Topology	3	1	0	1	4
24PMAC34	CC-11 Mechanics	3	1	1	1	4
24PMAE31 / 24PMAE32	EC-5 Fluid Dynamics/ Algebraic Number Theory	2	0	1	1	3
24PMAS31	SEC-2 Research Tools and Techniques	2	0	0	1	2
24PMAIN31	Internship	0	0	0	0	2
Total					30	24

Semester-IV						
24PMAC41	CC-12 Functional Analysis	3	1	1	1	5
24PMAC42	CC-13 Differential Geometry	3	1	1	1	5
24PMAC43	CC-14 Project	0	0	5	1	5
24PMAE41/ 24PMAE42	EC-6 Resource Management Techniques / Financial Mathematics	2	1	1	1	4
24PMAP41	PEC-1 Stochastic Process	2	0	0	1	2
24PMAL41	SLC-1 Mathematical Modelling	2	0	1	1	2
Total					30	23
Total Credits						90+2*

Students must complete at least one online course (MOOC) from plat forms like SWAYAM, NPTEL, or Nanmudalvan with in the fifth semester. Additionally, engaging in a specified Self-learning Course is mandatory To qualify for the degree, and successful participation will be acknowledged with an extra credit of 2*.

CC	Core Course	14
EC	Elective Paper	6
SEC	Skill Enhancement Course	2
AEC	Ability Enhancement Compulsory Courses	1
VE	Value Educations	1
	Internship	1
PEC	Professional Enhancement Course	1
SLC	Self-Learning Course	1

1st YEAR: FIRST SEMESTER

Course Code	Course Name	Category	L	T	P	S	Credits	Hours	Marks		
									CIA	External	Total
24PMAC11	Algebraic Structure	Core Course 1	2	1	2	0	4	5	25	75	100
Learning Objectives											
LO1	To Know the concepts on class equations										
LO2	To Acquire Knowledge on Solvable Groups										
LO3	To Gain the knowledge on Transformations										
LO4	To Understanding the concept of Jordan Forms										
LO5	To develop strong background on Trace and Transpose.										
Unit	Content										Hours
1	Counting Principle- Class equation for finite groups and its applications- Sylow's theorems										15
2	Solvable groups- Direct products- Finite abelian groups-Modules										15
3	Linear Transformations: Canonical forms–Triangular form- Nilpotent Transformations										15
4	Jordan form- rational canonical form										15
5	Trace and transpose- Hermitian, unitary, normal transformations, real Quadratic form										15

CO	Course Outcomes
CO1	To Recall basic counting principle, define class equations to solve problems, explain Sylow's theorems and apply the theorem to find number of Sylow subgroups
CO2	To Define Solvable groups, define direct products, examine the properties of finite abelian groups, define modules
CO3	To Define similar Transformations, define invariant subspace, explore the properties of triangular matrix, to find the index of nilpotence to decompose a space in to invariant Subspaces
CO4	To Define Jordan, canonical form, Jordan blocks, define rational canonical form, define company on matrix of polynomial, find the elementary devices of transformation, apply the concepts to find characteristic polynomial of linear transformation
CO5	To Define trace, define transpose of a matrix, explain the properties of trace and transpose, to find trace, to find transpose of matrix, to prove Jacobson lemma using the triangular form

Textbooks:	
1	I.N. Herstein Topics in Algebra (II Edition) Wiley Eastern Limited, NewDelhi,1975
2	Algebra-Michal Artin-PHI Learning Pvt.Ltd,2009
3	University Algebra-2 nd Edition-N.S. Gopalakrishnan, University of Poona, pune
4	Modern Algebra- S.Arumugum, A.T. Asaac, SCI Tech Publications Pvt Ltd
5	Modern Algebra-V-IIK.J Narayanan, T.K. Manicavachagam Pillai
Reference Books:	
1	M. Artin, Algebra ,Prentice Hall of India,2006
2	I.S.LutherandI. B.S.Passi, Algebra, Vol. I–Groups(1996)
3	I.S.LutherandI. B.S.Passi, Algebra,Vol.I Groups (1996); Vol.II Rings, Narosa Publishing House, New Delhi,1999
4	D.S.Malik, J.N. Mordeson and M.K.Sen, Fundamental of Abstract Algebra, McGraw Hill (International Edition),NewYork.1997
5	N. Jacobson, Basic Algebra, Vol.I & II W.H. Freeman (1980); also published by Hindustan Publishing Company, New Delhi.
Web resources:	
1	http://mathforum.org , http://ocw.mit.edu/ocwwweb/Mathematics , http://www.opensource.org , www.algebra.com

Mapping with Programme Outcomes and Programme Specific Outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3
CO1	3	3	3	2	3	3	3	2	3	2	2
CO2	2	3	3	3	3	3	2	2	3	2	3
CO3	3	3	3	2	3	3	3	2	3	2	2
CO4	2	3	3	2	3	3	2	2	3	2	2
CO5	3	3	2	3	3	3	3	2	3	2	3
Total	13	15	14	12	15	15	13	10	15	10	12
Average	2.6	3	2.8	2.4	3	3	2.6	2	3	2	2.4

3 – Strong, 2- Medium, 1- Low

1st YEAR: FIRST SEMESTER

Course Code	Course Name	Category	L	T	P	S	Credits	Hours	Marks		
									CIA	External	Total
24PMAC12	Real Analysis I	Core Course 2	3	1	2	0	4	6	25	75	100
Learning Objectives											
LO1	To work comfortably with functions of Bounded Variation										
LO2	To develop the concept of Riemann-Stieltjes Integral										
LO3	To update the Knowledge on Sufficient and Necessary Conditions for Riemann-Stieltjes Integral										
LO4	To Construct the various properties of Infinite Series										
LO5	To formulate distinct limiting operations										
Unit	Content										Hours
1	<p>Unit-I :Functions of bounded variation Introduction-Properties of monotonic functions -Functions of bounded variation - Total variation - Additive property of total variation - Total variation on $[a, x]$ as a function of x - Functions of bounded variation expressed as the difference of two increasing functions- Continuous functions of bounded variation. Infinite Series: Absolute and conditional convergence- Dirichlet's test and Abel's test-Rearrangement of series-Riemann's theorem on conditionally Convergent series.</p>										18
2	<p>Unit-II: The Riemann-Stieltjes Integral Introduction - Notation - The definition of the Riemann - Stieltjes integral Linear Properties - Integration by parts- Change of variable in a Riemann -Stieltjes integral-Reduction to a Riemann Integral–Euler's summation formula - Monotonically increasing integrators, Upper and lower integrals - Additive and linearity properties of upper, lower integrals-Riemann's condition-Comparison theorems.</p>										18
3	<p>Unit-III:The Riemann-Stieltjes Integral Integrators of bounded variation-Sufficient conditions for the existence of Riemann-Stieltjes integrals-Necessary conditions for the existence of R Sintegrals- Mean value theorems -integrals as a function of the interval – Second fundamental theorem of integral calculus-Change of variable Second Mean Value Theorem for Riemann integral-Riemann Stieltjes integrals depending on a parameter- Differentiation under integral sign-Lebesgue criteria on for existence of Riemann integrals.</p>										18
4	<p>Unit-IV: Infinite Series and infinite Products Double sequences - Double series - Rearrangement theorem for double series – A sufficient condition for equality of iterated series - Multiplication of series – Cesarosumm ability-Infinite products. Power series - Multiplication of power series - The Taylor's series generated by a function- Bernstein's theorem-Abel's limit theorem-Tauber's theorem</p>										18

5	Unit-V:Sequences of Functions Point wise 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.	18
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CO	Course Outcomes
CO1	To Analyze and evaluate functions of bounded variation and Rectifiable Curves.
CO2	To Describe the concept of Riemann-Stieltjes integral and its properties.
CO3	To Demonstrate the concept of step function, upper function, Lebesgue function and their Integrals
CO4	To Construct various mathematical proofs using the properties of Lebesgue integrals and Establish the Lebesgue not one convergence theorem.
CO5	To Formulate the concept and properties of inner products, norms and measurable functions.
Textbooks:	
1	Tom M.Apostol: Mathematical Analysis,2ndEdition,Addison-WesleyPublishing Company Inc. NewYork, 1974.
2	Elements of Real Analysis- Shanti Narayan, Dr.M.D.Raisinghanian,S.Chand
3	IntroductiontoRealAnalysis,FourthEdition,RobertG.Bartle,DpnaldR.Sherbert
4	Real Analysis (Real analysis and Theory of Convergence),Vimal Saraswat,AnilKumar Menaria, Gajendrapal Singh Rathore)
5	Real Analysis with Theory and Application ,Manoj Gunjal Raja Raman , Rohit Muranjan ChandanK. Roy
Reference Books:	
1	Rudin,W. Principles of Mathematical Analysis,3rdEdition.Mc Graw HillCompany,New York,1976.
2	Malik,S.C. and Savita Arora. Mathematical Anslysis, Wiley Eastern Limited. NewDelhi, 1991.
3	Sanjay Arora and Bansilal, Introduction to Real Analysis, Satya Prakashan, New Delhi, 1999
4	Gelbaum, B.R.andJ.Olmsted,Counter Examples in Analysis, Holdenday, San Francisco, 1964.
5	A.L.Gupta and N.R.Gupta, Principles of Real Analysis, Pearson Education, (Indian print) 2003.
Web resources:	
1	http://ocw.mit.edu/ocwwweb/Mathematics
2	http://www.opensource.org/
3	http://www.mathpages.com/

Mapping with Programme Outcomes and Programme Specific Outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3
CO1	3	3	2	3	3	3	2	3	2	3	2
CO2	2	3	3	3	3	2	2	3	2	3	3
CO3	3	3	2	3	3	3	2	3	2	3	2
CO4	2	3	2	3	3	2	2	3	2	3	2
CO5	3	2	3	3	3	3	2	3	2	2	3
Total	13	14	12	15	15	13	10	15	10	14	12
Average	2.6	2.8	2.4	3	3	2.6	2	3	2	2.8	2.4

3 – Strong, 2- Medium, 1- Low

1st YEAR: FIRST SEMESTER

Course Code	Course Name	Category	L	T	P	S	Credits	Hours	Marks		
									CIA	External	Total
24PMAC13	Ordinary Differential Equations	Core Course 3	3	1	1	0	3	5	25	75	100
Learning Objectives											
LO1	To develop strong background on finding solutions to linear differential equations										
LO2	To recognize the concept of Wronskian										
LO3	To understand the Problems solving techniques in Legendre Polynomial										
LO4	To formulate the Euler Equation with Second order										
LO5	To Learn Various the oreticalideason successive approximations										
Unit	Content										Hours
1	Linear equations with constant coefficients Second order homogeneous equations-Initial value problems-Linear dependence and independence-Wronskian and a formula for Wronskian- Non- homogeneous equation of order two										15
2	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.										15
3	Linear equation with variable coefficients Initial value problems-Existence and uniqueness theorems-Solutions to solve anon-homogeneous equation –Wronskian and linear dependence– Reduction of the order of a homogeneous equation–homogeneous equation with analytic coefficients-The Legendre equation.										15
4	Linear equation with regular singular points Euler equation – Second order equations with regular singular points – Exceptional cases–Bessel Function										15
5	Existence and uniqueness of solutions to first order equations: Equation with variable separated – Exact equation – method of successive approximations–the Lipschitz condition–convergence of the successive approximations and the existence theorem.										15

CO	Course Outcomes
CO1	To Establish the qualitative behavior of solutions of systems of differential equations
CO2	To Develop analytical skills necessary for understanding and manipulating differential Equations
CO3	To Analyse solutions using appropriate methods for linear equation with variable coefficient

CO4	To Analyse solutions using appropriate methods and give examples
CO5	To Learn techniques for solving inear ODEs with Bessel's Function
Textbooks:	
1	E.A.Coddington, An introduction to ordinary differential equations(3rd Printing) Prentice-Hall of India Ltd., New Delhi,1987.
2	A Textbook on Ordinary Differential Equation Springer–Shair Ahmad, Antonio Ambrosetti
3	Ordinary Differential Equation: Basics and Beyond- Darid G.Schacffer
4	Ordinary Differential Equation With Application–Sze–Bihsu–World Scientific
5	Solved Problems in Ordinary Differential Equation and its application–Garne Joshuallan
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 Mc Graw Hill, New Delhi,1974.
3	N.N. Lebedev, Special functions and their applications, Prentice Hall of India, New Delhi, 1965
4	An Introduction to Ordinary Differential Equation–Springer–Ravi P.Agarwal
5	Textbook of Ordinary Differential Equation-C.R.Monotal–Easter Economy Edition
Web resources:	
1	http://mathforum.org , http://ocw.mit.edu/ocwwweb/Mathematics , http://www.opensource.org , www.mathpages.com

Mapping with Programme Outcomes and Programme Specific Outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3
CO1	3	3	2	3	3	3	2	3	2	3	2
CO2	2	2	3	3	3	2	2	3	2	3	3
CO3	3	3	2	3	3	3	2	3	2	3	2
CO4	3	2	2	3	3	2	2	3	2	3	2
CO5	3	3	3	3	3	3	2	3	2	2	3
Total	14	13	12	15	15	13	10	15	10	14	12
Average	2.8	2.6	2.4	3	3	2.6	2	3	2	2.8	2.4

3 – Strong, 2- Medium, 1- Low

1st YEAR: FIRST SEMESTER

Course Code	Course Name	Category	L	T	P	S	Credits	Hours	Marks		
									CIA	External	Total
24PMAE11	Graph theory and Application	Elective Course 1	3	1	1	0	3	5	25	75	100

Learning Objectives

LO1	To study and develop the concept of graphs
LO2	To demonstrate the ideas on Euler graph and Hamilton graph
LO3	To understand the definitions of Matchings and Edge colourings
LO4	To apply the knowledge of Ramsey's Theorem
LO5	To Explicate the applications of Planarity and colourability

Unit	Content	Hours
1	Graphs, Subgraphs and Trees Graphs and simple graphs - Graph Isomorphism - The Incidence and Adjacency Matrices- Subgraphs - Vertex Degrees - Paths and Connection - Cycles - Trees - Cut Edges and Bonds - Cut Vertices.	15
2	Connectivity, Euler Tours and Hamilton Cycles Connectivity - Blocks - Euler tours – Hamilton	15
3	Matchings, Edge Colourings Matchings - Matchings and Coverings in Bipartite Graphs – Edge Chromatic Number	15
4	Independent Sets and Cliques, Vertex Colourings Independent sets - Ramsey's Theorem – Chromatic Number - Brooks' Theorem - Chromatic Polynomials	15
5	Planar Graphs Plane and planar Graphs - Dual graphs - Euler's Formula - The Five-Colour Theorem	15

CO	Course Outcomes
CO1	Grasp features and properties of various types of graphs.
CO2	Demonstrate capacity of illustration for mathematical reasoning through analyzing, providing and explaining concepts of Eulerian circuits and Hamiltonicity in graphs.
CO3	Understand the definitions and properties of matching and independent sets.
CO4	Apply the concepts of graphs to model them in real life situations.
CO5	Explicate the applications of planarity and colorability.

Textbooks:

1	J.A.Bondy and U.S.R. Murthy, Graph Theory and Applications, Macmillan, London, 1976
2	R.J.Wilson and J.J.Watkins, Graphs : An Introductory Approach, John Wiley and Sons, New York, 1989.

3	R.J. Wilson, Introduction to Graph Theory, Pearson Education, 4th Edition, 2004, Indian Print.
4	S.A.Choudum, A First Course in Graph Theory, MacMillan India Ltd. 1987
5	Graph Theory. By R. Balakrishnan, K. Ranganathan
Reference Books:	
1	Invitation to Graph Theory, S.Arumugam. S.Ramachandran, SCITECH Publications (INDIA) PVT.LTD
2	Graph Theory, J.A Bondy
3	J.Clark and D.A.Holton , A First look at Graph Theory, Allied Publishers, New Delhi, 1995.
4	R.Gould. Graph Theory, Benjamin/Cummings, Menlo Park, 1989
5	A.Gibbons, Algorithmic Graph Theory, Cambridge University Press, Cambridge, 1989.
Web resources:	
1	https://nptel.ac.in/courses/111106050/

Mapping with Programme Outcomes and Programme Specific Outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3
CO1	3	3	2	2	2	3	2	2	2	2	2
CO2	3	3	2	2	2	3	2	2	2	2	2
CO3	3	3	2	2	3	3	2	2	2	2	3
CO4	3	3	3	3	3	3	3	3	3	3	3
CO5	3	3	3	2	3	3	3	2	3	2	3
Total	15	15	12	11	13	15	12	11	12	11	13
Average	3	3	2.4	2.2	2.6	3	2.4	2.2	2.4	2.2	2.6

3 – Strong, 2- Medium, 1- Low

1st YEAR: FIRST SEMESTER

Course Code	Course Name	Category	L	T	P	S	Credits	Hours	Marks		
									CIA	External	Total
24UMAF11	Discrete Mathematics	Elective Course 2	3	1	1	0	3	5	25	75	100

Learning Objectives

LO1	To Introduce the algebraic structures of lattices and Boolean algebra. Construct the switching circuits with applications
LO2	To educate the finite fields and its mathematics properties
LO3	To Inculcate the polynomials over finite fields, Irreducibility and Factorization of polynomials
LO4	To Indoctrinate the coding theory with the linear and cyclic codes
LO5	To acquire the knowledge of coding theory

Unit	Content	Hours
1	Lattices Properties and Examples of Lattices – Distributive Lattices – Boolean Algebras – Boolean Polynomials	15
2	Applications of Lattices Switching Circuits – Applications of Switching Circuits	15
3	Finite Fields Finite Fields.	15
4	Polynomials Factorization of Polynomials over Finite Fields	15
5	Coding Theory Linear Codes – Cyclic Codes	15

CO	Course Outcomes
CO1	To Know the algebraic structures of lattices and Boolean algebra, and sketch the minimization of Boolean polynomials.
CO2	To Model the switching circuits with applications
CO3	To Understand the finite fields and its mathematics properties.
CO4	To Acquire the notions of the polynomials over finite fields, Irreducibility and factorization of polynomials
CO5	To Apply the coding theory with the linear and cyclic codes in cryptography

Textbooks:

1	Rudolf Lidl and Gunter Pilz, Applied Abstract Algebra, 2 nd Indian Reprint, Springer Verlag, New York, 2006
2	N.Chandrasekaran and M.Umaparvathi, Discrete mathematics, PHI Learning Private Limited, New Delhi, 2010.
3	Rudolf Lidl and Gunter Pilz, Applied Abstract Algebra, 2 nd Indian Reprint, Springer Verlag, New York, 2006.

4	J.L.Gersting, Mathematical Structures for Computer Science, 3 rd Edn., Computer Science Press, New York.
5	S.Wiitala, Discrete Mathematics - A Unified Approach, Mc Graw Hill Book Co
Reference Books:	
1	A.Gill, Applied Algebra for Computer Science, Prentice Hall Inc., New Jersey.
2	J.L.Gersting, Mathematical Structures for Computer Science, 3 rd Edn., Computer Science Press, NewYork.
3	S.Wiitala, Discrete Mathematics - A Unified Approach, Mc Graw Hill Book Co
Web resources:	
1	http://www.discrete-math-hub.com/resources-and-help.html
2	https://onlinecourses.nptel.ac.in/noc22_cs123/preview
3	https://onlinecourses.nptel.ac.in/noc22_cs85/preview

Mapping with Programme Outcomes and Programme Specific Outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3
CO1	3	3	2	2	2	3	2	3	3	2	3
CO2	3	3	2	2	3	3	3	3	3	3	3
CO3	3	3	2	2	2	3	2	3	3	2	3
CO4	3	3	2	2	3	3	3	3	3	3	3
CO5	3	3	2	2	3	3	3	3	3	3	3
Total	15	15	10	10	13	15	13	15	15	13	15
Average	3	3	2	2	2.6	3	2.6	3	3	2.6	3

3 – Strong, 2- Medium, 1- Low

1st YEAR: FIRST SEMESTER

Course Code	Course Name	Category	L	T	P	S	Credits	Hours	Marks		
									CIA	External	Total
24UMAC21	Mathematical Documentation Using Latex	Allied Elective core course 1	1	0	1	0	2	2	25	75	100
Learning Objectives											
LO1	Inculcate the computer knowledge										
LO2	Introduce the LaTeX software										
LO3	Train in the Preparation of Project and dissertations using LaTeX.										
LO4	Educate the Latex coding										
LO5	Understand the concepts of Cross References, Footnotes, Margin pars and Endnotes.										
Unit	Content										Hours
1	Unit–I: The Basics of LaTeX What is LaTeX-Simple Typesetting: Spaces, Quotes, Dashes, Special Symbols - Fonts: Type Style - Type Size										6
2	Unit–II: The Document Document Class: Font Size, Paper Size, Page Formats – Page Style – Page Numbering – Formatting Lengths – Parts of a Documents – Bibliography (Basics)										6
3	Unit–III: The Tables Displayed Text: Making Lists – Rows & Columns: Tables only										6
4	Unit– IV: Type setting Mathematics The Basics: Superscripts & Subscripts, Roots, Mathematical Symbols – Custom Commands – More on Mathematics: Single Equations, Group of Equations, Numbered Equations										6
5	Unit–V: Mathematics Miscellany Mathematics Miscellany: Matrices, Dots, Delimiters, Affixing Symbols over or under – Typing Simple Theorems										6

CO	Course Outcomes
CO1	After studying this course the students will be able to create and typeset a LaTeX document
CO2	After studying this course the students will be able to create and typeset mathematical document
CO3	After studying this course the students will be able to learn about pictures and graphics in LaTeX
CO4	After studying this course the students will be able to automatic generation of a table of contents, bibliographies and indexes

CO5	After studying this course the students will be able to use tabular and array environments within LaTeX.
Textbooks:	
1	A Primer, Latex Tutorials, Indian TEX users group, Trivandrum, India.
2	A guide to Latex and Electronic publishing, fourth edition, Helmut Kopka, Patrick W. Daly, 2004
3	Latex Tutorial Jeff Clark, Revised February 26,2002
4	Latex in 24 hours- Apractical guide for Scientific Writing, Dilip Datta.
5	George Gratzer, More Math Into LATEX, 4th Edition, Springer Science (2007).
Reference Books:	
1	Peter Flynn, A beginner's introduction to typesetting with
2	LATEX, Silmaril Consultants, Textual Therapy Division, 2003
3	Frank Mittelbach, Michel Goossens, The LaTeX Companion, Second Edition, Addison-Wesley, 2004
4	Firuza Karmali (Aibara) – A short introduction to LaTeX.
5	George Gratzer- Practical Latex, Springer Science
Web resources:	
1	https://www.latex-tutorial.com/tutorials/
2	https://www.latex-tutorial.com/
3	http://www.tug.org.in/tutorials.html

Mapping with Programme Outcomes and Programme Specific Outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3
CO1	3	3	3	2	3	3	3	2	3	2	2
CO2	2	3	3	3	3	3	2	2	3	2	3
CO3	3	3	3	2	3	3	3	2	3	2	2
CO4	2	3	3	2	3	3	2	2	3	2	2
CO5	3	3	2	3	3	3	3	2	3	2	3
Total	13	15	14	12	15	15	13	10	15	10	12
Average	2.6	3	2.8	2.4	3	3	2.6	2	3	2	2.4

3 – Strong, 2- Medium, 1- Low

1st YEAR: SECOND SEMESTER

Course Code	Course Name	Category	L	T	P	S	Credits	Hours	Marks		
									CIA	External	Total
24UMAC21	Advanced Algebra	Core course 4	3	1	0	1	4	5	25	75	100
Learning Objectives											
LO1	To Know the concepts on Extension Fields										
LO2	To Acquire Knowledge on Roots of Polynomials										
LO3	To Gain the knowledge on Elements of Galois theory										
LO4	To Understand the concept of finite division rings										
LO5	To Develop the concepts on Solvability by radicals										
Unit	Content										Hours
1	Extension fields–Transcendence of e. Chapter 5: Sections 5.1 and 5.2										15
2	Roots of Polynomials. –More about roots. Chapter 5 : Sections 5.3 and 5.5										15
3	Elements of Galois theory. Chapter 5: Section 5.6										15
4	Finite fields- Wedderburn’s theorem on finite division rings. Chapter 7: Sections 7.1 and 7.2 (Theorem 7.2.1 only)										15
5	Solvability by radicals - A theorem of Frobenius - Integral Quaternions and the Four-Square theorem. Chapter 5: Section 5.7 (Exclude Lemma 5.7.1, Lemma 5.7.2 and Theorem 5.7.1) Chapter 7: Sections 7.3 and 7.4										15

CO	Course Outcomes
CO1	Learn the fundamental concepts of Extension fields
CO2	Develop the concepts of splitting field for a given roots of polynomial.
CO3	Gain the knowledge and write proofs using the concepts of Galois Theory.
CO4	Understand the concept of finite division rings.

CO5	Demonstrate and Understand the use of solvability by radicals
Textbooks:	
1	I.N.Herstein, Topics in Algebra (II Edition) Wiley Eastern Limited, NewDelhi,1999.
Reference Books:	
1	M.Artin, Algebra, Prentice Hall of India, 1991.
2	P.B.Bhattacharya, S.K.Jain, and S.R.Nagpaul, Basic Abstract Algebra (II Edition) Cambridge University Press,1997. (Indian Edition)
3	I.S.Luther and I.B.S.Passi,Algebra,Vol. I–Groups(1996);Vol.II Rings, Narosa Publishing House,NewDelhi,1999
4	D.S.Malik, J.N.Mordeson and M.K.Sen, Fundamental of Abstract Algebra, McGraw Hill (International Edition), NewYork.1997
5	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.algebra.com/

Mapping with Programme Outcomes and Programme Specific Outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3
CO1	3	2	3	3	3	3	3	3	3	2	2
CO2	2	2	3	3	3	3	2	3	3	2	2
CO3	3	3	3	2	3	3	3	3	3	2	3
CO4	2	2	3	3	3	3	2	3	3	2	2
CO5	3	3	3	3	3	3	3	3	3	2	3
Total	13	12	15	14	15	15	13	15	15	10	12
Average	2.6	2.4	3	2.8	3	3	2.6	3	3	2	2.4

3 – Strong, 2- Medium, 1- Low

1st YEAR: SECOND SEMESTER

Course Code	Course Name	Category	L	T	P	S	Credits	Hours	Marks		
									CIA	External	Total
24PMAC22	Real Analysis II	Core course 5	3	1	0	1	4	5	25	75	100
Learning Objectives											
LO1	To work on Measurable functions										
LO2	To develop the concept of integration on Riemann										
LO3	To update the basic concepts on Fourier Series and Fourier Integrals										
LO4	To know about Matrix functions										
LO5	To analyze Implicit functions										
Unit	Content										Hours
1	Measure on the Real line - Lebesgue Outer Measure - Measurable sets - Regularity - Measurable Functions - Borel and Lebesgue Measurability Chapter -2 Sections 2.1 to 2.5										15
2	Integration of Functions of a Real variable - Integration of Non-negative functions- The General Integral- Riemann and Lebesgue Integrals Chapter-3 Sections 3.1, 3.2 and 3.4										15
3	Fourier Series and Fourier Integrals - Introduction - Orthogonal system of functions- The theorem on best approximation-The Fourier series of a function relative to an orthonormal system-Properties of Fourier Coefficients- The Riesz-Fischer Theorem - The convergence and representation problems for trigonometric series - The Riemann - Lebesgue Lemma - The Dirichlet Integrals - An integral representation for the partial sums of Fourier series - Riemann's localization theorem - Sufficient conditions for convergence of a Fourier series at a particular point–Cesaro sumability of Fourier series. Chapter 11: Sections 11.1 to 11.13										15
4	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 - Taylor's theorem for functions of R^n to R^1 Chapter12: Sections 12.1 to 12.11 and 12.14										15
5	Implicit Functions and Extremum Problems: Functions with non-zero Jacobian determinants–The inverse function theorem-The Implicit function theorem- Extrema of real valued functions of severable variables- Extremum problems with side conditions. Chapter13: Sections 13.1to 13.7										15

CO	Course Outcomes
CO1	Know about measurable functions
CO2	Analyze the integration functions on Riemann
CO3	Understand and describe the basic concepts of Fourier series and Fourier integrals with respect to orthogonal system.
CO4	Formulate and evaluate Differentiable functions and matrix in linear form
CO5	Know about implicit functions and extremum real valued functions
Textbooks:	
1	G. De Barra, Measure Theory and Integration, Wiley Eastern Ltd., New Delhi, 1981.(for Units 1 and 2)
2	Tom M.Apostol : Mathematical Analysis, 2nd Edition, Narosa Publishing House, 1977. (for Units 3, 4 and 5)
Reference Books:	
1	Burkill,J.C. The Lebesgue Integral, Cambridge University Press,1951.
2	Munroe, M.E, Measure and Integration.Addison-Wesley,Mass.1971.
3	Roydon,H.L .Real Analysis, Macmillan Pub. Company, NewYork,1988.
4	Rudin,W. Principles of Mathematical Analysis, Mc Graw Hill Company, NewYork,1979
5	Malik,S.C. and Savita Arora. Mathematical Analysis, Wiley Eastern Limited.NewDelhi,1991.
Web resources:	
1	http://mathforum.org//
2	http://ocw.mit.edu/ocwweb/Mathematics//
3	www.opensource.org//

Mapping with Programme Outcomes and Programme Specific Outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3
CO1	3	3	2	3	3	3	2	3	2	3	2
CO2	2	3	3	3	3	2	2	3	2	3	3
CO3	3	3	2	3	3	3	2	3	2	3	2
CO4	2	3	2	3	3	2	2	3	2	3	2
CO5	3	2	3	3	3	3	2	3	2	2	3
Total	13	14	12	15	15	13	10	15	10	14	12
Average	2.6	2.8	2.4	3	3	2.6	2	3	2	2.8	2.4

3 – Strong, 2- Medium, 1- Low

1st YEAR: SECOND SEMESTER

Course Code	Course Name	Category	L	T	P	S	Credits	Hours	Marks		
									CIA	External	Total
24PMAC23	Partial Differential Equation	Core course 6	2	1	1	1	3	5	25	75	100
Learning Objectives											
LO1	Understand the theory and methods of First order Partial Differential Equations (PDEs)										
LO2	Get Knowledge to solve Second order PDE										
LO3	Understand the concepts of elliptic differential equations										
LO4	Enrich the knowledge about parabolic differential equations										
LO5	Develop Knowledge about the hyperbolic differential equations										
Unit	Content										Hours
1	Partial Differential Equations of First Order Formation and solutions of first order PDE – Integral surfaces –Orthogonal surfaces – First order non-linear equations – characteristics– compatible systems of first order equations– Charpit’s Method. Chapter 0: Sections 0.4 – 0.6, 0.8 – 0.11 (Exclude 0.11.1)										15
2	Fundamental Concepts Introduction–classification of second order PDE –canonical forms Adjoint operators. Chapter1:Sections1.1-1.4										15
3	Elliptic Differential Equations Derivation of Laplace and Poisson equations – Boundary value problem – Separation of variables – Dirichlet’s and Newmann problems for a rectangle – Solution of Laplace equation in spherical coordinates. Chapter 2: Sections 2.1-2.2,2.5 -2.7, 2.12										15
4	Parabolic Differential Equations Formation and elementary solution of diffusion equation with boundary conditions– Dirac Delta function – Separation of variable method - Solution of diffusion equation in spherical coordinates. Chapter 3: Sections 3.1, 3.3 - 3.5,3.7										15
5	Hyperbolic Differential Equations Occurrence of the Wave equation - Derivation and Solution of 1-D wave equation by canonical reduction– Initial Value Problem; D’Alembert solution – IVP and BVP for 2-D wave equation – Periodic solution for 1-D wave equation in spherical coordinates systems –Uniqueness of the solution for 1-D wave equation– Duhamel’s principle. Chapter 4: Sections 4.1 to 4.4,4.7,4.9,4.11- 4.12										15

CO	Course Outcomes
CO1	Analyze the methods for first order PDE
CO2	Understand the fundamentals of second order PDE
CO3	Develop knowledge on the elliptical differential equations
CO4	Implement the knowledge to solve the parabolic differential equations
CO5	Model and solve the hyperbolic differential equations
Textbooks:	
1	K.Sankara Rao, Introduction to Partial differential equations (Third edition), Prentice Hal of India Ltd., New Delhi, 2016.
Reference Books:	
1	R. Denemeyer, Introduction to Partial differential equations and boundary value problems, Mc Graw Hill, New York, 1968
2	Paul Duchateau Dacid W. Zachmann, Partial Differential Equations, Tata McGraw-Hill Publishing Company Limited, New Delhi
3	M.D.Raisinghania, Advanced differential equations, S. Chand & Company Ltd. New Delhi, 2001.
4	R.C. Mc Owen, Partial differential equations, 2 nd edition, Pearson education, New Delhi, 2005
5	A.K.Nandakumaran, P.S.Datti, Partial Differential Equations Classical Theory with a Modern Touch, Cambridge University Press.
Web resources:	
1	https://nptel.ac.in/courses/111103021/
2	onlinecourses.nptel.ac.in>noc21_ma18//
3	onlinecourses.nptel.ac.in>noc22_ma28
4	onlinecourses.nptel.ac.in>noc21_ma33

Mapping with Programme Outcomes and Programme Specific Outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3
CO1	3	3	3	2	3	3	3	2	3	2	2
CO2	2	3	3	3	3	3	2	2	3	2	3
CO3	3	3	3	2	3	3	3	2	3	2	2
CO4	2	3	3	2	3	3	2	2	3	2	2
CO5	3	3	2	3	3	3	3	2	3	2	3
Total	13	15	14	12	15	15	13	10	15	10	12
Average	2.6	3	2.8	2.4	3	3	2.6	2	3	2	2.4

3 – Strong, 2- Medium, 1- Low

1st YEAR: SECOND SEMESTER

Course Code	Course Name	Category	L	T	P	S	Credits	Hours	Marks		
									CIA	External	Total
24PMAC24	Difference Equation	Core course 7	2	1	1	1	3	5	25	75	100
Learning Objectives											
LO1	To provide basic knowledge about the discretization process, the discrete version of Difference equations										
LO2	To understand the Linear Periodic systems.										
LO3	To develop the student's ability to solve difference equations using Z-transforms										
LO4	To obtain knowledge on Oscillation Theory										
LO5	To articulate asymptotic behavior of solutions of difference equations.										
Unit	Content										Hours
1	Linear Difference Equations of Higher Order: Difference calculus-General Theory of Linear Difference Equations- Linear Homogeneous Equations with Constant coefficients–Non-homogeneous Equations: Method of Undetermined Coefficients, the method of variation of constants-Limiting behavior of Solutions. Chapter 2: Sections 2.1 to 2.5										15
2	System of Linear Difference Equations: Autonomous Systems- The Basic Theory-The Jordan form–Linear periodic systems. Chapter3: Sections 3.1 to 3.4										15
3	The Z-Transform Method : Definitions and examples, Properties of Z-transform-The Inverse Z-transform and Solutions, Difference Equations: Power series method, partial fraction method, the inverse integral method-Volterra difference equation of convolution type Chapter 5: Sections 5.1 to 5.3										15
4	Oscillation Theory: Three-term difference Equations–Self-Adjoint-Second Order Equations-Nonlinear Difference Equations. Chapter 7 : Sections 7.1 to 7.3										15
5	Asymptotic Behavior of Difference Equation: Tools of Approximation - Poincare's Theorem - Asymptotically Diagonal Systems – High-Order Difference Equations - Second Order Difference Equations. Chapter 8 : Sections 8.1 to 8.5										15

CO	Course Outcomes
CO1	Solve problems on Linear Difference Equations of Higher order.
CO2	Understand the system of Linear Periodic systems.
CO3	Apply Z-transform techniques in Difference equations.
CO4	Describe on Oscillation Theory.
CO5	Work on Asymptotic Behavior of Difference Equation.

Textbooks:

1	Saber N. Elaydi, An Introduction to Difference Equations, Third Edition, Springer Verlag, New York, 2005 (First Indian Reprint 2008).
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Reference Books:

1	Ronald E. Mickens, Difference Equations Theory, Applications and Advanced Topics, Third Edition, CRC Press, New York, 2015
2	R.P. Agarwal, Difference Equations and Inequalities, Marcel Dekker, 1999.
3	S. Goldberg, Introduction to Difference Equations, Dover Publications, 1986
4	V.Lakshmikantham and Trigiante, Theory of Difference Equations Numerical Methods and Applications, Second Edition, Academic Press, New York, 1988.
5	Walter G.Kelly, Allan C.Peterson, Difference Equations, An Introduction with Applications, Academic Press, New York, 2001 (First Indian Reprint 2006).

Web resources:

1	http://people.math.aau.dk/~matarne/11-mat/notes2011a.pdf//
2	http://pj.freefaculty.org/guides/stat/Math/Difference//
3	http://Equations/DifferenceEquations- guide.pdf//

Mapping with Programme Outcomes and Programme Specific Outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3
CO1	3	2	3	2	2	2	2	3	3	2	3
CO2	2	3	2	3	3	2	3	2	2	3	2
CO3	3	3	2	3	3	3	2	3	3	2	2
CO4	2	2	3	3	3	2	3	2	2	3	2
CO5	3	2	3	3	2	2	2	3	2	2	3
Total	13	12	13	14	13	11	12	13	12	12	12
Average	2.6	2.4	2.6	2.8	2.6	2.2	2.4	2.6	2.4	2.4	2.4

3 – Strong, 2- Medium, 1- Low

1st YEAR: SECOND SEMESTER

Course Code	Course Name	Category	L	T	P	S	Credits	Hours	Marks		
									CIA	External	Total
24PMAE21	Tensor Analysis and Relativity Theory	Elective course 3	2	1	0	1	3	4	25	75	100
Learning Objectives											
LO1	To learn the system of different orders in Tensor Algebra.										
LO2	To provide the Knowledge of Tensor Calculus										
LO3	To Understand the concept of Covariant of differentiation and intrinsic differentiation.										
LO4	To gain the knowledge about the theory of relativity.										
LO5	To Analyze the concept of relativistic Doppler effect										
Unit	Content										Hours
1	Tensor Algebra Systems of Different orders-Summation Convention-Kronecker Symbols - Examples-Transformation of coordinates in S_n -Invariants-Covariant and Contravariant vectors - Tensors of Second Order - Mixed Tensors of Type (p,q) – Zero Tensor- Tensor Field Algebra of Tensors-Equality of Tensors-Symmetric and Skew – symmetric tensors - Outer multiplication, Contraction and Inner Multiplication Chapter I : I.1to I.3 and I.7 Chapter II : II.1-II.13										12
2	Tensor Calculus Riemannian Space-Christoffel Symbols and their properties Chapter III : III.1 and III.2										12
3	Tensor Calculus (Contd.) Covariant Differentiation of Tensors-Riemann-Christoffel Curvature Tensor- Intrinsic Differentiation. Chapter III : III.3 - III.5										12
4	Introduction to Relativity Introduction-Maxwell’s equation-the Ether theory-the principle of relativity-relativistic kinematics–Events and simultaneity– examples Chapter 7:7.1-7.2										12
5	Introduction to Relativity(Contd.) Time dilation – longitudinal contradiction-the invariant interval-proper time and proper distance–the world line-example. Addition of velocities- example–the relativistic Doppler effect-example. Chapter 7:7.2										12

CO	Course Outcomes
CO1	Learn the system of different orders in Tensor Algebra
CO2	Gain the knowledge of Tensor Calculus
CO3	To Understand the concept of Covariant of differentiation and intrinsic differentiation.
CO4	Describe the concept of theory of relativity
CO5	Know about relativistic Doppler effect and its applications
Textbooks:	
1	U.C.De, Absos Ali Shaikh and Joydeep Sengupta, Tensor Calculus, Narosa Publishing House, New Delhi,2004.(For Units 1,2 and 3)
2	Donald T.Greenwood, Classical Dynamics, Dover Publication Inc, NewDelhi,1985.(For Units 4 and 5)
Reference Books:	
1	J.L.Synge and A.Schild, Tensor Calculus, Toronto, 1949.
2	A.S.Eddington. The Mathematical Theory of Relativity, Cambridge University Press, 1930.
3	P.G. Bergman, An Introduction to Theory of Relativity,NewYork,1942
4	C.E.Weatherburn, Riemannian Geometry and the Tensor Calculus, Cambridge, 1938.
5	Goldstein, Classical Mechanics(Addition Wesley)
Web resources:	
1	http://mathforum.org//
2	http://ocw.mit.edu/ocwwweb/Mathematics//
3	http://www.opensource.org//
4	http://www.mathpages.com//

Mapping with Programme Outcomes and Programme Specific Outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3
CO1	3	2	3	3	2	3	3	3	3	2	2
CO2	3	3	3	3	3	3	3	3	3	3	3
CO3	2	2	3	2	2	2	2	2	3	2	2
CO4	2	3	2	3	3	3	3	3	2	3	3
CO5	3	2	3	3	2	2	3	2	3	2	2
Total	13	12	14	14	12	13	14	13	14	12	12
Average	2.6	2.4	2.8	2.8	2.4	2.6	2.8	2.6	2.8	2.4	2.4

3 – Strong, 2- Medium, 1- Low

II YEAR: THIRD SEMESTER

Course Code	Course Name	Category	L	T	P	S	Credits	Hours	Marks		
									CIA	External	Total
24PMAC31	Complex Analysis	Core Course-8	3	1	1	1	5	6	25	75	100
Learning Objectives											
LO1	To analyze and evaluate local properties of analytical functions and definite										
LO2	To demonstrate the concept of the general form of Cauchy's theorem.										
LO3	To describe the concept of definite integral and harmonic functions.										
LO4	To develop Taylor and Laurent series										
LO5	To learn the infinite products, canonical products and Jensen's formula.										
Unit	Content										Hours
1	Cauchy's Integral Formula The Index of a point with respect to a closed curve – The Integral formula – Higher derivatives. Local Properties of analytical Functions: Removable Singularities-Taylor's Theorem – Zeros and poles – The local Mapping – The Maximum Principle. Chapter 4 : Section 2 : 2.1 to 2.3 Chapter 4 : Section 3 : 3.1 to 3.4										18
2	The General form of Cauchy's Theorem Chains and cycles- Simple Connectivity - Homology - The General statement of Cauchy's Theorem - Proof of Cauchy's theorem - Locally exact differentials- Multiply connected regions - Residue theorem – The argument principle. Chapter 4 : Section 4 : 4.1 to 4.7 Chapter 4 : Section 5: 5.1 and 5.2										18
3	Evaluation of Definite Integrals and Harmonic Functions Evaluation of definite integrals - Definition of Harmonic function and basic properties - Mean value property - Poisson formula. Chapter 4 : Section 5 : 5.3 Chapter 4 : Sections 6 : 6.1 to 6.3										18
4	Harmonic Functions and Power Series Expansions Schwarz theorem - The reflection principle – Weierstras's theorem –Taylor's Series – Laurent series. Chapter 4 : Sections 6:6.4 and 6.5 Chapter 5 : Sections 1:1.1 to 1.3										18
5	Partial Fractions and Entire Functions Partial fractions -Infinite products – Canonical products – Gamma Function- Jensen's formula – Hadamard's Theorem. Chapter 5 : Sections 2: 2.1 to 2.4 Chapter 5 : Sections 3:3.1 and 3.2										18
Total										90	
Theory 80% Problem- 20%											

CO	Course Outcomes
	The Students will be able to
CO1	Analyze and evaluate local properties of analytical functions and definite integrals
CO2	Work out on general form of Cauchy's theorem and multiply connected regions
CO3	Evaluate definite integral and harmonic functions.
CO4	Apply Taylor and Laurent series.
CO5	Examine the infinite products, canonical products and Jensen's formula.
Textbooks:	
1	Lars V. Ahlfors, <i>Complex Analysis</i> , (3rd edition) McGraw Hill Co., New York, 1979
Reference Books:	
1	H.A. Presfly, <i>Introduction to complex Analysis</i> , Clarendon Press, oxford, 1990
2	J.B. Conway, <i>Functions of one complex variables</i> Springer - Verlag, International student Edition, Narosa Publishing Co.1978
3	E.Hille, <i>Analytic function Theory</i> (2 vols.), Gonm and Co, 1959.
4	M.Heins, <i>Complex function Theory</i> , Academic Press, New York, 1968.
5	James Ward Brown, R.V. Churchil, <i>Complex Variables and Applications</i> , McGraw Hill Education Private Limited,8th Edition, 2014
Web resources:	
1	http://mathforum.org
2	http://www.opensource.org
3	http://en.wikipedia.org

Mapping with Programme Outcomes and Programme Specific Outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3
CO1	3	2	3	2	3	3	2	3	3	2	2
CO2	2	2	3	2	3	3	2	2	3	2	3
CO3	3	2	3	2	3	3	3	3	3	2	2
CO4	2	2	3	2	3	3	2	2	3	2	3
CO5	3	2	2	3	3	3	2	3	3	2	2
Total	13	10	14	11	15	15	11	13	15	10	12
Average	2.6	2	2.8	2.5	3	3	2.5	2.6	3	2	2.4

3 – Strong, 2- Medium, 1- Low

II YEAR: THIRD SEMESTER

Course Code	Course Name	Category	L	T	P	S	Credits	Hours	Marks		
									CIA	External	Total
24PMAC32	Probability Theory	Core Course-9	3	1	1	1	4	6	25	75	100
Learning Objectives											
LO1	To understand Random Events, Random Variables, to describe Probability, to apply Baye's to define Distribution Function, to find Joint Distribution function, Marginal Distribution and Conditional Distribution function.										
LO2	To define Expectation, Moments and Chebyshev's Inequality, to solve Regression of the first and second types.										
LO3	To learn Characteristic functions, distribution function, to find probability generating functions										
LO4	To describe One point, two-point Binomial distributions, to solve problems of Hyper geometric and Poisson distributions, to define Uniform, normal, gamma, Beta distributions.										
LO5	To discuss Stochastic convergence, Bernaulli's 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's, Khintchine Weak law of large numbers, to explain and solve problems on Kolmogorov Inequality and Kolmogorov Strong Law of large numbers.										
Unit	Content										Hours
1	Random Events and Random Variables Random events –Probability axioms – Combinatorial formulae – conditional probability –Baye's 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										18
2	Parameters of the Distribution Expectation- Moments –The Chebyshev's Inequality – Absolute moments – Order parameters –Moments of random vectors – Regression of the first and second types. Chapter 3 : Sections 3.1 to 3.8										18
3	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										18
4	Some Probability distributions One point and two point distribution ,Binomial – Polya – Hypergeometric – Poisson (discrete) distributions –Uniform – normal- gamma – Beta – Cauchy and Laplace (continuous) distributions. Chapter 5 : Section 5.1 to 5.10										18

5	Limit Theorems Stochastic convergence – Bernaulli’s law of large numbers – Convergence of sequence of distribution functions –Levy-Cramer Theorems – De Moivre-Laplace Theorem – Poisson, Chebyshev’s, Khintchine Weak law of large numbers – Lindberg Theorem – Lapunov Theroem – Borel-Cantelli Lemma – Kolmogorov Inequality and Kolmogorov Strong Law of large numbers. Chapter 6: Sections 6.1 to 6.4, 6.6 to 6.9, 6.11 and 6.12. (Omit Sections 6.5, 6.10)	18
Total		90
Theory 80% Problem 20%		

Course Outcomes	
CO	The Students will be able to
CO1	Apply Random Events, Random Variables and distribution functions.
CO2	Work on Expectation, Moments and Chebyshev’s Inequality and Regression types.
CO3	Determine Characteristic functions, distribution function and probability generating functions
CO4	Solve problems on Binomial distributions, Hypergeometric and Poisson distributions.
CO5	Evaluate Stochastic convergence, Bernaulli law of large numbers, Kolmogorov Inequality and Kolmogorov Strong Law of large numbers.
Textbooks:	
1	M.Fisz, <i>Probability Theory and Mathematical Statistics</i> , John Wiley and Sons, New York,1963.
Reference Books:	
1	R.B. Ash, <i>Real Analysis and Probability</i> , Academic Press, New York, 1972
2	K.L. Chung, <i>A course in Probability</i> , Academic Press, New York, 1974
3	R.Durrett, <i>Probability: Theory and Examples</i> , (2nd Edition) Duxbury Press, New York, 1996.
4	V.K. Rohatgi, <i>An Introduction to Probability Theory and Mathematical Statistics</i> , WileyEastern Ltd., New Delhi, 1988(3rd Print).
5	S.I. Resnick, <i>A Probability Path</i> , Birhauser, Berlin, 1999.
Web resources:	
1	http://mathforum.org//
2	www.opensource.org//

Mapping with Programme Outcomes and Programme Specific Outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3
CO1	3	2	3	2	3	3	2	3	3	2	2
CO2	2	2	3	2	3	3	2	2	3	2	3
CO3	3	2	3	2	3	3	3	3	3	2	2
CO4	2	2	3	2	3	3	2	2	3	2	3
CO5	3	2	2	3	3	3	2	3	3	2	2
Total	13	10	14	11	15	15	11	13	15	10	12
Average	2.6	2	2.8	2.5	3	3	2.5	2.6	3	2	2.4

3 – Strong, 2- Medium, 1- Low

II YEAR: THIRD SEMESTER

Course Code	Course Name	Category	L	T	P	S	Credits	Hours	Marks		
									CIA	External	Total
24PMAC33	Topology	Core Course-10	3	1	0	1	4	5	25	75	100
Learning Objectives											
LO1	To define and illustrate the concept of topological spaces, open sets, neighbourhood, interior, exterior, closure and their axioms.										
LO2	To understand continuity, compactness, connectedness, homeomorphism and topological properties.										
LO3	To analyze and apply the topological concepts in Functional Analysis										
LO4	To determine a point in a topological space is either a limit point or not for a given subset of a topological space.										
LO5	To develop qualitative tools to characterize connectedness, compactness, second countable, Hausdorff and develop tools to identify when two are equivalent (homeomorphic).										
Unit	Content										Hours
1	Topological spaces Topological spaces – Basis for a topology – The order topology – The product topology on $X \times Y$ – The subspace topology – Closed sets and limit points. Chapter 2 : Sections 12 to 17										15
2	Continuous functions Continuous functions – The product topology – The metric topology. Chapter 2 : Sections 18 to 21										15
3	Connectedness Connected spaces- connected subspaces of the Real line – Components and local connectedness. Chapter 3: Sections 23 to 25.										15
4	Compactness Compact spaces – compact subspaces of the Real line – Limit Point Compactness – Local Compactness. Chapter 3: Sections 26 to 29.										15
5	Countability and Separation Axiom: The Countability Axioms – The separation Axioms – Normal spaces – The Urysohn Lemma – The Urysohn Metrization Theorem – The Tietze extension theorem. Chapter 4 : Sections 30 to 35.										15
	Total										75
Theory 100%											

CO	Course Outcomes
	The Students will be able to
CO1	Study the concept of topological spaces, open sets, neighbourhood, interior, exterior, closure and their axioms.
CO2	Understand continuity, compactness, connectedness, homeomorphism and topological properties
CO3	Apply the topological concepts in Functional Analysis
CO4	Evaluate whether a point in a topological space is either a limit point or not for a given subset of a topological space
CO5	Review qualitative tools to characterize connectedness, compactness, second countable, Hausdorff.
Textbooks:	
1	James R. Munkres, <i>Topology</i> (2nd Edition) Pearson Education Private. Ltd., Delhi-2010 (Third Indian Reprint)
Reference Books:	
1	J.Dugundji, <i>Topology</i> , Prentice Hall of India, New Delhi, 1975.
2	George F.Simmons, <i>Introduction to Topology and Modern Analysis</i> , McGraw Hill Book Co., 1963
3	J.L. Kelly, <i>General Topology</i> , Van Nostrand, Reinhold Co., New York.
4	L.Steen and J.Subhash, <i>Counter Examples in Topology</i> , Holt, Rinehart and Winston, New York,1970.
5	S.Willard, <i>General Topology</i> , Addison - Wesley, Mass., 1970
Web resources:	
1	http://mathforum.org
2	http://www.opensource.org
3	http://en.wikipedia.org

Mapping with Programme Outcomes and Programme Specific Outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3
CO1	3	2	3	2	3	3	3	2	3	2	2
CO2	2	2	3	2	3	3	3	2	3	2	3
CO3	3	2	3	2	3	3	3	2	3	2	2
CO4	2	2	3	2	3	3	3	2	3	2	3
CO5	3	2	3	3	3	3	3	2	3	2	2
Total	13	10	15	11	15	15	15	10	15	10	12
Average	2.6	2	3	2.2	3	3	3	2	3	2	2.4

3 – Strong, 2- Medium, 1- Low

II YEAR: THIRD SEMESTER

Course Code	Course Name	Category	L	T	P	S	Credits	Hours	Marks		
									CIA	External	Total
24PMAC34	Mechanics	Core Course-11	3	1	1	1	4	6	25	75	100
Learning Objectives											
LO1	To understand mechanical systems under generalized coordinate systems										
LO2	To apply mechanics techniques in virtual work-Lagrange Equations										
LO3	To develop students ability to deal with Energy and momentum										
LO4	To learn the concept of Hamilton -Jacobi Theory.										
LO5	To discuss the Canonical Transformation.										
Unit	Content										Hours
1	Mechanical Systems The Mechanical system-Generalized coordinates- Constraints-Virtual work– Energy and Momentum. Chapter1: Sections 1.1 to 1.5										18
2	Lagrange's Equations Derivation of Lagrange's equations- Examples - Integrals of motion. Chapter 2: Sections 2.1 to 2.3										18
3	Hamilton's Equations Hamilton's Principle - Hamilton's Equation - Other variational principles. Chapter4: Sections 4.1 to 4.3										18
4	Hamilton-Jacobi Theory Hamilton's Principle function-Hamilton-Jacobi Equation-Separability. Chapter5: Sections 5.1 to 5.3										18
5	Canonical Transformation Differential forms and generating functions - Lagrange and Poisson brackets. Chapter 6: Sections 6.1 , 6.3 (Omit 6.2)										18
	Total										90
Theory 80% Problem 20%											

CO	Course Outcomes
	The Students will be able to
CO1	Understand mechanical systems under generalized coordinate systems
CO2	Apply mechanical techniques in virtual work by Lagrange
CO3	Evaluate energy and momentum in Hamilton's Equations
CO4	Understand Hamilton-Jacobi theory
CO5	Work on Canonical Transformation.
Textbooks:	
1	D.T. Greenwood, <i>Classical Dynamics</i> , Prentice Hall of India, New Delhi, 1985.
Reference Books:	
1	H.Goldstein, <i>Classical Mechanics</i> ,(2nd Edition) Narosa Publishing House, New Delhi,1950.
2	N.C.Raneand P.S.C.Joag, <i>Classical Mechanics</i> , Tata McGraw Hill, 1991.
3	J.L.Synge and B.A. Griffith, <i>Principles of Mechanics</i> (3rd Edition) McGraw Hill Book Co.,New York, 1970.
4	French and Ebison, <i>Introduction to Classical Mechanics</i> , Kluwer Academic Publishers
5	George Hrabovsky, <i>Classical Mechanics</i> , Penguin Books
Web resources:	
1	https://ocw.mit.edu/courses/physics/8-09-classical-mechanics-iii-fall-2014/

Mapping with Programme Outcomes and Programme Specific Outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3
CO1	3	2	3	2	2	2	2	3	3	3	3
CO2	2	3	2	3	3	2	3	2	2	3	2
CO3	3	3	2	3	2	2	2	3	3	3	2
CO4	2	2	2	2	3	2	2	3	2	2	3
CO5	3	3	2	3	2	2	3	2	2	3	2
Total	13	13	11	13	12	10	12	13	12	14	12
Average	2.6	2.6	2.2	2.6	2.4	2	2.4	2.6	2.4	2.8	2

3 – Strong, 2- Medium, 1- Low

II YEAR: THIRD SEMESTER

Course Code	Course Name	Category	L	T	P	S	Credits	Hours	Marks		
									CIA	External	Total
24PMAE31	Fluid Dynamics	Elective Course-V	2	0	1	1	3	4	25	75	100
Learning Objectives											
LO1	To understand the concepts of kinematics of fluids in motions										
LO2	To find the pressure at a point in a moving fluid										
LO3	To discuss Stokes stream function.										
LO4	To analyze complex velocity potential for two dimensional flows										
LO5	To derive the Navier – Stokes equations of motion of a Viscous fluid										
Unit	Content										Hours
1	Kinematics of Fluids in Motion Real fluids and ideal fluids – Velocity of a fluid at a point, Stream lines, path lines, steady and unsteady flows –The Velocity potential –The vorticity vector – Local and particle rates of changes –Equations of continuity – Worked examples. Chapter 2: Sections 2.1 to 2.8										12
2	Equations of Motion of a Fluid Pressure at a point in a fluid at rest – Pressure at a point in a moving fluid – Conditions at a boundary of two inviscid immiscible fluids – Euler's equation of motion –Discussion of the case of steady motion under conservative body forces. Chapter 3: Sections 3.1 to 3.4 and 3.7										12
3	Some Three Dimensional Flows Introduction – Sources, sinks and doublets – Images in a rigid infinite plane –Axis symmetric flows – Stokes stream function. Chapter 4: Sections 4.1- 4.3, 4.5										12
4	Some Two Dimensional Flows The stream function – The complex potential for two dimensional, irrotational incompressible flow –Complex velocity potentials for standard two dimensional flows – Some worked examples – Two dimensional image systems –The Milne Thompson circle Theorem. Chapter 5: Sections 5.3 to 5.8										12
5	Viscous Flows Stress components in a real fluid – Relations between Cartesian components of stress – Translational motion of fluid element –The co-efficient of viscosity and Laminar flow – The Navier –Stokes equations of motion of a Viscous fluid. Chapter 8: Sections 8.1 to 8.3, 8.8 and 8.9										12
	Total										60
Theory- 60%, Problem-40%											

Course Outcomes	
CO	The Students will be able to
CO1	Understand the concepts of kinematics of fluids in motions.
CO2	Evaluate the pressure at a point in a moving fluid
CO3	Work on Stokes stream function intrinsic
CO4	Analyze complex velocity potential for two dimensional flows
CO5	Solve the Navier – Stokes equations of motion of a Viscous fluid
Textbooks:	
1	F.Chorlton, <i>Text Book of Fluid Dynamics</i> , CBS Publications. Delhi, 1985
Reference Books:	
1	R.W.Fox and A.T.McDonald. <i>Introduction to Fluid Mechanics</i> , Wiley, 1985.
2	E.Krause, <i>Fluid Mechanics with Problems and Solutions</i> , Springer, 2005.
3	B.S.Massey, J.W.Smith and A.J.W.Smith, <i>Mechanics of Fluids</i> , Taylor and Francis, New York, 2005 .
4	P.Orlandi, <i>Fluid Flow Phenomena</i> , Kluwer, New Yor, 2002.
5	T.Petrila, <i>Basics of Fluid Mechanics and Introduction to Computational Fluid Dynamics</i> , Springer,Berlin, 2004.
Web resources:	
1	http://web.mit.edu/1.63/www/lecnote.html

Mapping with Programme Outcomes and Programme Specific Outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3
CO1	3	3	3	2	3	2	3	2	3	3	3
CO2	3	3	2	2	2	2	2	3	2	2	3
CO3	3	3	3	2	3	2	3	2	3	3	3
CO4	3	3	3	3	3	3	3	3	3	2	3
CO5	3	3	3	3	3	3	2	3	2	3	2
Total	15	15	14	12	14	12	13	13	13	13	14
Average	3	3	2.8	2.4	2.8	2.4	2.6	2.6	2.6	2.6	2.8

3 – Strong, 2- Medium, 1- Low

II YEAR: THIRD SEMESTER

Course Code	Course Name	Category	L	T	P	S	Credits	Hours	Marks		
									CIA	External	Total
24PMAE32	Algebraic Number Theory	Elective Course-V	2	0	1	1	3	4	25	75	100
Learning Objectives											
LO1	To learn about rings, fields and factorization of polynomials.										
LO2	To know about norms and traces over ring of integers										
LO3	To understand factorization to irreducible polynomials.										
LO4	To study on Euclidean Quadratic fields										
LO5	To analysis concepts of ideals.										
Unit	Content										Hours
1	Algebraic Background Rings and Fields- Factorization of Polynomials - Field Extensions - Symmetric Polynomials - Modules - Free Abelian Groups. Chapter 1: Sec. 1.1 to 1.6										12
2	Algebraic Numbers Algebraic numbers - Conjugates and Discriminants - Algebraic Integers - Integral Bases - Norms and Traces - Rings of Integers. Chapters 2: Sec. 2.1 to 2.6										12
3	Quadratic and Cyclotomic Fields Quadratics and cyclotomatic fields : Factorization into irreducibles: Trivial factorization - Factroization into irreducibles - Examples of nonunique factorization into irreducibles. Chapter 3: Sec. 3.1 and 3.2 ; Chapter 4: Sec. 4.2 to 4.4										12
4	Prime Factroization - Euclidean Domains - Euclidean Quadratic fields - Consequences of unique factorization - The Ramanujan –Nagell Theorem. Chapter 4: Sec. 4.5 to 4.9										12
5	Ideals Prime Factorization of Ideals - The norms of an Ideal - Non-unique Factorization in Cyclotomic Fields.. Chapter 5 : Sec. 5.2 to 5.4										12
	Total										60
Theory-90% Problem-10%											

CO	Course Outcomes The Students will be able to
CO1	Study about rings, fields and factorization of polynomials.
CO2	Recall on norms and traces over ring of integers.
CO3	Solve factorization to irreducible polynomials.
CO4	Understand Euclidean Quadratic fields
CO5	Work on concepts of ideals.
Textbooks:	
1	Steward and D.Tall. <i>Algebraic Number Theory and Fermat's Last Theorem</i> (3rd Edition) A.K.Peters Ltd., Natrick, Mass. 2002..
Reference Books:	
1	Z.I.Bosevic and I.R.Safarevic, <i>Number Theory</i> , Academic Press, New York, 1966
2	J.W.S.Cassels and A.Frohlich, <i>Algebraic Number Theory</i> , Academic Press, New York, 1967
3	R J.W.S.Cassels and A.Frohlich, <i>Algebraic Number Theory</i> , Academic Press, New York, 1967
4	P.Samuel, <i>Algebraic Theory of Numbers</i> , Houghton Mifflin Company, Boston, 1970.
5	A.Weil. <i>Basic Number Theory</i> , Springer, New York, 1967.
Web resources:	
1	http://mathforum.org//
2	http://www.opensource.org//
3	www.mathpages.com//

Mapping with Programme Outcomes and Programme Specific Outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3
CO1	3	3	3	3	3	3	3	3	3	3	3
CO2	3	2	2	3	2	3	3	2	3	2	3
CO3	3	3	3	2	3	3	2	2	3	3	3
CO4	3	2	3	3	3	3	3	3	3	2	3
CO5	3	2	3	3	3	3	3	3	3	3	3
Total	15	12	14	14	14	15	14	13	15	13	15
Average	3	2.4	2.8	2.8	2.8	3	2.8	2.6	3	2.6	5

3 – Strong, 2- Medium, 1- Low

II YEAR: THIRD SEMESTER

Course Code	Course Name	Category	L	T	P	S	Credits	Hours	Marks		
									CIA	External	Total
24PMAS31	Research Tools And Techniques	SEC-II	2	0	1	1	2	3	25	75	100
Learning Objectives											
LO1	To demonstrate the knowledge of Research methodology and research problem										
LO2	To create the knowledge on Research Design										
LO3	To learn the concept of measurement and scaling										
LO4	To analyze the data.										
LO5	To formulate the hypothesis and to learn the concept of critical value										
Unit	Content										Hours
1	Research Methodology- Meaning-Objectives- Types- Methods. Research Problem-Definition-Techniques. Chapter 1: Section:1.1 to 1.8 Chapter 2: Section:2.1 to 2.4										9
2	Research Design-Meaning,-Features- Concepts- types- principles- Different Research Design- Principles and experimental design Chapter 3: Section:3.1 to 3.7										9
3	Measurement and Scaling-Qualitative and quantitative data- Classification, Techniques, Scaling-Classification. Chapter 5: Section:5.1 to 5.7										9
4	Data Collection-Introduction-Experiments and survey -Primary and Secondary data Chapter 6: Section:6.1 to 6.4										9
5	Testing of Hypothesis-Basic concepts-Critical region and critical value – Procedure. Chapter 10: Section:10.1 to 10.6										9
	Total										45
Theory-100%											
CO	Course Outcomes										
	The Students will be able to										
CO1	Understand the knowledge of Research methodology and research problem.										
CO2	Frame the Research Designs.										
CO3	Work on measurement and scaling.										
CO4	Able to collect and classify the data										
CO5	Formulate the hypothesis and learnt the concept of critical value.										
Textbooks:											
1	C.R.Kothari, Gaurav Garg, <i>Research Methodology Methods and Techniques</i> , New AgeInternational Publishers, 2019.										

Reference Books:	
1	Dr. Prabhat Pandey Dr. Meenu Mishra Pandey , <i>Research Methodology: Tools and Techniques</i> , Bridge Center, 2015
2	Ackoff, Russell L. <i>The Design of Social Research</i> , University of Chicago Press: Chicago, 1961
3	Allen, T. Harrell, <i>New Methods in Social Research</i> , Praeger Publication: New York, 197
4	Baker, R.P. and Howell, A.C. <i>The Preparation of Reports</i> , Ronald Press: New York, 1958.
5	Barzun, Jacques and Graff. F. <i>The Modern Researcher</i> , Harcourt, Brace Publication: New York, 1990
Web resources:	
1	http://mathforum.org//
2	http://www.opensource.org//
3	www.mathpages.com//

Mapping with Programme Outcomes and Programme Specific Outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3
CO1	3	2	2	3	2	3	3	3	3	2	3
CO2	2	3	2	3	3	3	3	3	3	3	3
CO3	2	3	3	3	3	2	3	2	2	3	3
CO4	3	2	3	3	2	3	3	2	2	3	3
CO5	2	2	3	3	3	3	2	2	3	2	2
Total	12	12	13	15	13	14	14	12	13	13	14
Average	2.4	2.4	2.6	3	2.6	2.8	2.8	2.4	2.6	2.6	2.8

3 – Strong, 2- Medium, 1- Low

II YEAR: THIRD SEMESTER

Course Code	Course Name	Category	L	T	P	S	Credits	Hours	Marks		
									CIA	External	Total
24PMAIN31	Internship		0	0	0	0	2	25	25	75	100
Learning Objectives											
LO1	Engage in a professional working environment to gain hands-on experience and understand the practical applications of theoretical knowledge.										
LO2	Analyze various aspects of developing computer-based solutions while fostering teamwork and collaboration.										
LO3	Demonstrate proficiency in problem-solving, soft skills, and other essential abilities required for professional growth and development.										
LO4	Develop additional competencies and specialized skills relevant to a chosen occupation or profession.										
LO5	Enhance interpersonal, social, and communication skills to promote effective workplace interaction.										
REGULATIONS											
1	Every student must complete an internship program in a relevant firm, industry, or organization during the course of study to gain practical exposure.										
2	After completing the second semester, the student should identify and analyze a suitable project to be undertaken during the third semester.										
3	During the internship, students are expected to actively participate in assigned tasks and document the work performed throughout the training period.										
4	A detailed internship report must be prepared and submitted by the student in the format prescribed by the institution.										
5	The report submission will take place at the end of the third semester, followed by presentation and viva voce evaluation during the semester examination.										
6	The evaluation of the internship/project work will be for 100 marks, comprising 50 internal (25 for report and 25 for viva) and 50 externals (25 for report and 25 for viva), assessed jointly by internal and external examiners. The external examiner shall be appointed from affiliated colleges or, if necessary, from within the college.										
7	Students must secure at least 50% of the total marks to pass. Those who fail to meet this requirement must improve their performance and resubmit their report in the next available attempt. The final report must include all prescribed sections and be submitted to the Controller of Examinations within the specified date.										

CO	COURSE OUTCOMES
CO1	Identify specific areas of interest and enhance relevant skills and competencies
CO2	Cultivate greater self-awareness while fostering respect and appreciation for others.
CO3	Develop professional work habits and attitudes essential for success in the workplace.
CO4	Recognize the significance of effective communication, interpersonal skills, and teamwork.
CO5	Promote proactive preparation to transition internship experiences and creativity into full-time employment immediately upon graduation.

Internal Marks Awarded for the Internship – 25 Marks

Component	Marks
Internship Review I (During the Beginning of The Semester)	5 Marks
Internship Review II (During the End of The Semester)	15 Marks
Progress of The Internship by the Student Participated	5 Marks

External Marks Awarded for the Internship – 75 Marks

Component	Marks
Evaluation of the Internship Report	25 Marks
Presentation	25 Marks
Viva Voce Examination	25 Marks

II YEAR: FOURTH SEMESTER

Course Code	Course Name	Category	L	T	P	S	Credits	Hours	Marks		
									CIA	External	Total
24PMAC41	Functional Analysis	Core	3	1	1	1	5	6	25	75	100
Learning Objectives											
LO1	To study Banach spaces and continuous linear transformations.										
LO2	To understand the concepts of Open mapping theorem and properties of Orthogonal complements.										
LO3	To learn conjugate space H^* , adjoint, self-adjoint, normal and Unitary operators.										
LO4	To understand the preliminaries of Banach Algebra.										
LO5	To study on commutative Banach Algebras.										
Unit	Content									Hours	
1	Banach Spaces: Definition and some examples – Continuous linear transformations – The Hahn-Banach theorem- The natural imbedding of N in N^{**} . Chapter9: Sections 46-49									18	
2	Banach Spaces and Hilbert Spaces: The open mapping theorem – The conjugate of an Operator-The definition and some simple properties–Orthogonal complements–Orthonormal sets. Chapter9: Sections 50-51 Chapter10: Sections 52-54									18	
3	Hilbert Spaces: The conjugate space H^* -The adjoint of an operator–self- adjoint operators-Normal and unitary operators – Projections. Chapter10: Sections 55-59									18	
4	General Preliminaries on Banach Algebras: The definition and some examples – Regular and singular elements – Topological divisors of zero – The spectrum – The formula for the spectral radius– The radical and semi- simplicity. Chapter12: Sections 64-69									18	
5	The Structure of Commutative Banach Algebras: The Gelfand mapping – Applications of the formula $r(x) = \lim \ x^n\ ^{1/n}$ – Involutions in Banach algebras-The Gelfand-Neumark theorem. Chapter13: Sections 70-73									18	
Total									90		
Theory 80% problem 20%											

CO	Course Outcomes
	The students will be able to
CO1	Understand Banach spaces and Transformations on Banach Spaces.
CO2	Apply conjugate operator and Open mapping theorem.
CO3	Work on the Hilbert spaces.
CO4	Classify on Banach algebra and spectral radius.
CO5	Construct the concept of Gelfand- Neumark theorem and its applications.
Text books	
1	G.F. Simmons, Introduction to Topology and Modern Analysis, McGraw Hill Education (India) Private Limited, New Delhi, 1963.
Reference Books	
1	W. Rudin, Functional Analysis, McGraw Hill Education (India) Private Limited, New Delhi, 1973.
2	B.V. Limaye, Functional Analysis, New Age International, 1996.
3	C. Goffman and G. Pedrick, First course in Functional Analysis, Prentice Hall of India, New Delhi, 1987.
4	E. Kreyszig, Introductory Functional Analysis with Applications, John Wiley and Sons, New York, 1978.
5	M. Thamban Nair, Functional Analysis, A First course, Prentice Hall of India, New Delhi, 2002.
Website and e-Learning Source	
1	http://mathforum.org ,
2	http://www.opensource.org/
3	http://en.wikiopedia.org

Mapping with Programme Outcomes and Programme Specific Outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3
CO1	3	2	3	2	3	3	3	2	3	2	2
CO2	2	2	3	2	3	3	3	2	2	3	3
CO3	3	2	3	2	3	3	3	2	3	3	3
CO4	2	2	3	2	3	3	3	2	3	2	3
CO5	3	2	2	3	3	3	3	2	3	2	3
Total	13	10	14	11	15	15	15	10	14	12	14
Average	2.6	2	2.8	2.2	3	3	3	2	2.8	2.4	2.8

3 – Strong, 2- Medium, 1- Low

II YEAR: FOURTH SEMESTER

Course Code	Course Name	Category	L	T	P	S	Credits	Hours	Marks		
									CIA	External	Total
24PMAC42	Differential Geometry	Core	3	1	1	1	5	6	25	75	100
Learning Objectives											
LO1	To study on space curves, characterizations and Fundamental Existence theorem.										
LO2	To learn intrinsic properties and metrics of surface.										
LO3	To analysis Geodesics and Geodesic curvature problems.										
LO4	To study non- intrinsic properties of a surface and applicability.										
LO5	To gain knowledge on differential geometry of surface and Hilbert's lemma.										
Unit	Content										Hours
1	Space curves: Definition of a space curve – Arc length – tangent – normal and binormal – curvature and torsion of a curve given as the intersection of two surfaces – contact between curves and surfaces- tangent surface- involutes and evolutes- Intrinsic equations – Fundamental Existence Theorem for space curves- Helices. Chapter I: Sections 1 - 9.										18
2	Intrinsic properties of a surface: Definition of a surface – curves on a surface – Surface of revolution – Helicoids – Metric- Direction coefficients – families of curves- Isometric correspondence- Intrinsic properties. Chapter II: Sections 1 - 9.										18
3	Geodesics: Geodesics – Canonical geodesic equations – Normal property of geodesics- Existence Theorems – Geodesic parallels – Geodesics curvature- Gauss- Bonnet Theorem – Gaussian curvature- surface of constant curvature. Chapter II: Sections 10 - 18.										18
4	Local Non-intrinsic properties of a surface: The second fundamental form- Principal curvatures – Lines of curvature – Developable - Developable associated with space curves and with curves on surface - Minimal surfaces – Ruled surfaces. Chapter III: Sections 1 - 8.										18
5	Local Non-intrinsic properties of a surface: Fundamental equations of surface theory-Fundamental existence theorem for surfaces. Differential Geometry of Surfaces in the Large: Introduction-Compact surfaces whose points are umbilic- Hilbert's lemma– Compact surfaces of constant Gaussian or mean curvature – Complete surfaces. Chapter III: Sections 9 - 11 Chapter IV: Sections 1 – 5										18
	Total										90
	Theory 80% problem 20%										

CO	Course Outcomes
	The students will be able to
CO1	Understand the concepts of a space curves and to compute curvature, torsion.
CO2	Classify the curves on surface and its intrinsic properties.
CO3	Compute problems on Geodesics.
CO4	Work on developable and non-intrinsic properties of a surface.
CO5	Express Hilbert's lemma and the fundamental existence theorem for surface theory.
Text books:	
1	T.J. Willmore, An Introduction to Differential Geometry, Oxford University Press, (17th Impression) New Delhi 2002. (Indian Print)
Reference Books:	
1	D. Somasundaram, Differential Geometry A First Course, Alpha Science International Limited, 2005
2	Kobayashi. S. and Nomizu. K., Foundations of Differential Geometry, Inter science Publishers, 1963.
3	Wilhelm Klingenberg: A course in Differential Geometry, Graduate Texts in Mathematics, Springer-Verlag, 1978.
4	J.A. Thorpe, Elementary topics in Differential Geometry, Undergraduate Texts in Mathematics, Springer - Verlag, 1979.
5	D.T. Struik, Lectures on Classical Differential Geometry, Addison – Wesley, Mass, 1950.
Website and e-Learning Source	
1	http://mathforum.org
2	http://www.opensource.org , www.physicsforum.com

Mapping with Programme Outcomes and Programme Specific Outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3
CO1	3	2	3	2	3	3	3	2	2	2	3
CO2	2	2	3	2	3	3	3	2	3	3	2
CO3	3	2	3	2	3	3	3	2	3	2	2
CO4	2	2	3	2	3	3	3	2	3	2	3
CO5	3	2	2	3	3	3	3	2	3	2	3
Total	13	10	14	11	15	15	15	10	11	11	13
Average	2.6	2	2.8	2.2	3	3	3	2	2.2	2.2	2.6

3 – Strong, 2- Medium, 1- Low

II YEAR: FOURTH SEMESTER

Course Code	Course Name	Category	L	T	P	S	Credits	Hours	Marks		
									CIA	External	Total
24PMAC43	Project	Core	0	0	5	1	5	6	25	75	100
Learning Objectives											
LO1	Engage in a real-time project environment to apply theoretical knowledge for practical problem-solving.										
LO2	Analyze different stages of project development and implementation while demonstrating effective project and collaboration.										
LO3	Demonstrate technical proficiency, analytical skills, and professional ethics in executing the assigned project work.										
LO4	Develop research project and innovative approaches relevant to the chosen project domain.										
LO5	Strengthen communication, documentation, and presentation skills required for professional project execution.										
REGULATIONS											
1	Every student must undertake an individual project work in a relevant domain, preferably aligned with their area of specialization, during the course of study to gain practical and analytical exposure.										
2	After completing the third semester, the student should identify, propose, and obtain approval for a suitable project topic to be executed during the fourth semester.										
3	During the project period, students are expected to actively participate in all stages of the project, including analysis, design, implementation, and documentation.										
4	A comprehensive project report must be prepared and submitted by the student in the prescribed institutional format. Students have to submit the copies of the thesis in the book form (size: 21.0 cm ×13.5 cm). Dissertation text should be typed in double line spacing and Times New Roman font size 12 and number of pages should be restricted to be maximum of 100 pages.										
5	The project report submission will take place at the end of the fourth semester, followed by a presentation and viva voce evaluation during the semester examination.										
6	The evaluation of the project work will be for 100 marks, comprising 25 internal, 50 project evaluation and 25 for viva-voice, assessed jointly by internal and external examiners. The external examiner shall be appointed from affiliated colleges of Parent University, University Departments, or any other affiliated colleges.										
7	Students must secure at least 50% of the total marks to pass. Those who are absent/fail to meet this requirement must improve their performance and resubmit the project report in the next available attempt. The final report must include all prescribed sections and be submitted to the Controller of Examinations within the specified date.										

CO	COURSE OUTCOMES
CO1	Identify and define a real-world problem, applying relevant concepts and methodologies to develop an effective project solution.
CO2	Cultivate independent thinking, critical analysis and collaborative skills throughout the project.
CO3	Demonstrate professional ethics, responsibility and effective project management abilities.
CO4	Communicate research and technical findings through well-structured documentation and presentations.
CO5	Enhance readiness for professional employment or further research by applying innovative and creative approaches to project development.

II YEAR: FOURTH SEMESTER

Course Code	Course Name	Category	L	T	P	S	Credits	Hours	Marks		
									CIA	External	Total
24PMAE41	Resource Management Techniques	Elective	2	1	1	1	4	5	25	75	100
Learning Objectives											
LO1	To solve integer linear Programming problems.										
LO2	To learn Decision making under different types and Decision Making with Utilities.										
LO3	To understand CPM and PERT techniques in scheduling problems.										
LO4	To classify various types of replacement problems and maintenance techniques.										
LO5	To use differential calculus-based methods to obtain the optimal solutions.										
Unit	Content										Hours
1	Integer linear Programming Cutting plane algorithm – Gomory’s all and mixed integer cutting plane method. Chapter: 7 Sections 7.1-7.5										15
2	Decision Theory Steps in Decision theory Approach-Types of Decision-Making Environments-Decision making Under Uncertainty-Decision Making under Risk-Decision Tree Analysis. Chapter:11 Sections 11.1-11.5,11.7										15
3	Object Scheduling Network diagram representation – Critical path method – PERT-Project Time-Cost Trade off. Chapter:13 Sections 13.1-13.7										15
4	Replacement and Maintenance Models Mechanism of items-Replacement of items Deteriorates with time-Replacement of items that fail completely- Other Replacement Problems. Chapter: 17 Sections 17.1-17.5										15
5	Classical Optimization Theory Unconstrained Optimization-Constrained Optimization – Equality constraints — Lagrangian method – Kuhn– Tucker Necessary and Sufficient conditions. Chapter: 23 Sections 23.1-23.4										15
Total										75	
Theory 40% Problem 60%											

Course Outcomes	
CO	The students will be able to
CO1	Formulate and analyze optimization problems.
CO2	Make efficient decisions and applying various decision-making criteria.
CO3	Effectively manage construction, project and to calculate CPM.
CO4	Solve replacement problems and maintenance models.
CO5	Classify optimization problems and work on Kuhn– Tucker problems.
Textbooks:	
1	J.K. Sharma, Operations Research Theory and Applications (6 th Edition), Trinity Press, Laxmi Publications Pvt. Ltd., New Delhi, Reprint 2017.
Reference Books:	
1	R. Panneerselvam, Operations Research, Prentice Hall of India, New Delhi, 2008.
2	Anderson, Quantitative Methods for Business ‘, 8th Edition, Thomson Learning, 2002.
3	Winston, Operations Research, Thomson Learning, 2003.
4	Vohra, Quantitative Techniques in Management, Tata Mc Graw Hill, 2002.
5	Anand Sarma, Operations Research, Himalaya Publishing House, 2003.
Website and e-Learning Source	
1	http://mathforum.org//
2	http://ocw.mit.edu/ocwweb/Mathematics//
3	www.mathpages.com//
4	http://www.opensource.org//

Mapping with Programme Outcomes and Programme Specific Outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3
CO1	3	3	3	3	3	3	3	3	3	3	3
CO2	3	2	2	2	2	2	2	2	3	2	2
CO3	3	3	3	2	3	3	3	3	3	3	3
CO4	3	2	3	3	3	2	3	3	2	2	2
CO5	3	2	3	3	3	3	3	3	3	3	3
Total	15	12	14	13	14	13	14	14	14	13	13
Average	3	2.4	2.8	2.6	2.8	2.6	2.8	2.8	2.8	2.6	2.6

3 – Strong, 2- Medium, 1- Low

II YEAR: FOURTH SEMESTER

Course Code	Course Name	Category	L	T	P	S	Credits	Hours	Marks		
									CIA	External	Total
24PMAE42	Financial Mathematics	Elective	2	1	1	1	4	5	25	75	100
Learning Objectives											
LO1	To understand models and Neutral Probability Measure.										
LO2	To learn stochastic and deterministic models.										
LO3	To study Brownian Motion.										
LO4	To understand the Stochastic Calculus.										
LO5	To classify the Block-Scholes Model.										
Unit	Content										Hours
1	Single Period Models: Definitions from Finance - Pricing a forward - One-step Binary Model - a ternary Model - Characterization of no arbitrage - Risk-Neutral Probability Measure.										15
2	Binomial Trees and Discrete Parameter Martingales: Multi-period Binary model - American Options - Discrete parameter martingales and Markov processes - Martingale Theorems - Binomial Representation Theorem –Overture to Continuous models.										15
3	Brownian Motion: Definition of the process - Levy's Construction of Brownian Motion - The Reflection Principle and Scaling - Martingales in Continuous time.										15
4	Stochastic Calculus: Non-differentiability of Stock prices - Stochastic Integration - Ito's formula - Integration by parts and Stochastic Fubini Theorem – Girsanov Theorem - Brownian Martingale Representation Theorem – Geometric Brownian Motion - The Feynman - Kac Representation.										15
5	Block-Scholes Model: Basic Block-Scholes Model - Block-Scholes price and hedge for European Options - Foreign Exchange - Dividends - Bonds– Market price of risk.										15
	Total										75
	Theory 80% problem 20%										

CO	Course Outcomes
	The students will be able to
CO1	Use discrete and continuous processes in financial modeling.
CO2	Gain knowledge in the relationship between stochastic and deterministic models.
CO3	Understand the roles of Put and Call options in risk reduction.
CO4	Understand hedging strategies to reduce risk.
CO5	Understand the role of the Black-Scholes partial differential equation and its boundary and final conditions in option pricing.
Text books:	
1	Alison Etheridge, A Course in Financial Calculus, Cambridge University Press, Cambridge, 2002.
Reference Books:	
1	Martin Boxtor and Andrew Rennie, Financial Calculus: An Introduction to Derivatives Pricing, Cambridge University Press, Cambridge, 1996.
2	Chapman and Hall, Introduction to Stochastic Calculus Applied to Finance, 1996.
3	Marek Musiela and Marek Rutkowski, Martingale Methods in Financial Modeling, Springer Verlag, New York, 1988.
4	Robert J. Elliott and P. Ekkehard Kopp, Mathematics of Financial Markets, Springer Verlag, New York, 2001 (3rd Printing)
Website and e-Learning Source	
1	https://archive.org/details/financialmathema032436mbp

Mapping with Programme Outcomes and Programme Specific Outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3
CO1	3	2	3	2	3	3	3	2	2	2	3
CO2	2	2	3	2	3	3	3	2	3	3	2
CO3	3	2	3	2	3	3	3	2	3	2	2
CO4	2	2	3	2	3	3	3	2	3	2	3
CO5	3	2	2	3	3	3	3	2	3	2	3
Total	13	10	14	11	15	15	15	10	11	11	13
Average	2.6	2	2.8	2.2	3	3	3	2	2.2	2.2	2.6

3 – Strong, 2- Medium, 1- Low

II YEAR: FOURTH SEMESTER

Course Code	Course Name	Category	L	T	P	S	Credits	Hours	Marks		
									CIA	External	Total
24PMAP41	Stochastic Processes	PEC	2	0	0	1	2	3	25	75	100
Learning Objectives											
LO1	To understand the fundamentals of stochastic processes, classify Markov chains and their states.										
LO2	To analyze the stability, structure of Markov chains using graph theory and statistical inference.										
LO3	To know the model real-world systems using Poisson processes and their generalizations.										
LO4	To apply birth-death processes and continuous-time Markov models to dynamic systems.										
LO5	To solve Kolmogorov equations and first passage time problems by using Brownian motion, Wiener processes.										
Unit	Content									Hours	
1	Stochastic Processes Stochastic processes – Specification of Stochastic processes. Markov Chains: Definitions and Examples – Higher transition probabilities – Generalization of independent Bernoulli trials - Classification of States and Chains. Chapter1 :1.5; Chapter2 :2.1- 2.4									9	
2	Markov Chains Stability of Markov system – Graph theoretic approach –Markov chain with denumerable number of states-Markov Chains with Continuous State Space Chapter2:2.6 -2.8 and 2.11.									9	
3	Markov Processes with Discrete State Space Poisson process: Poisson process and Related distributions - Generalizations of Poisson process. Chapter3 :3.1 - 3.3									9	
4	Markov Processes with Discrete State Space (Cont.....) Birth and death process – Markov processes with discrete state space (Continuous time Markov chain) - Erlang Process. Chapter3 :3.4-3.5 and 3.7									9	
5	Markov Processes with Continuous State Space Introduction-Brownian motion – Wiener process – Differential equations for Wiener Process – Kolmogorov equations – First passage time distribution for Wiener process. Chapter4 :4.1 - 4.5									9	
Total									45		
Theory 60% problem 40%											

Course Outcomes	
CO	The students will be able to
CO1	Know the classification of stochastic processes.
CO2	Know Markov chains and the stability condition.
CO3	Understand Poisson process and its properties.
CO4	Discuss on Poisson process and birth and death process.
CO5	Understand Brownian process and Weiner process.
Textbooks:	
1	J. Medhi, Stochastic Processes (5 th Edition), New Academic Science Limited, New Delhi, 2022.
Reference Books:	
1	S. Karlin, A first course in Stochastic Processes, (2 nd Edition), Academic Press, 1958.
2	U.N. Bhat, Elements of Applied Stochastic Processes, John Wiley Sons, 1972.
3	E. Cinlar, Introduction to Stochastic Processes, PHI, 1975.
4	S.K. Srinivasan and A. Vijayakumar, Stochastic Processes, Narosa Publishing House, 2003.
Website and e-Learning Source	
1	http://mathforum.org .
2	http://ocw.mit.edu/ocwweb/Mathematics ,
3	www.mathpages.com .

Mapping with Programme Outcomes and Programme Specific Outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3
CO1	3	3	3	3	3	3	3	3	3	3	3
CO2	3	2	2	2	2	2	3	2	3	2	3
CO3	3	3	3	2	3	3	3	3	3	3	3
CO4	3	2	3	3	3	3	3	2	3	2	3
CO5	3	2	3	3	3	3	3	3	3	3	3
Total	15	12	14	13	14	14	15	13	15	13	15
Average	3	2.4	2.8	2.6	2.8	2.8	3	2.6	3	2.6	3

3 – Strong, 2- Medium, 1- Low

II YEAR: FOURTH SEMESTER

Course Code	Course Name	Category	L	T	P	S	Credits	Hours	Marks		
									CIA	External	Total
24PMAL41	Mathematical Modelling	SLC	2	0	1	1	2	4	25	75	100
Learning Objectives											
LO1	To understand the fundamentals and significance of mathematical modelling in real-world situations.										
LO2	To classify different types of mathematical models, identify their key characteristics and applications.										
LO3	To develop and analyze differential equations including linear, non-linear and compartmental types.										
LO4	To construct and interpret system models such as prey–predator, competition, and epidemic models using ordinary differential equations.										
LO5	To explore the use of graph theory in mathematical modelling such as directed and signed graphs, to represent network-based systems.										
Unit	Content									Hours	
1	Mathematical Modelling Simple situations requiring mathematical modelling -Classification of Mathematical Models - Characteristics of mathematical models. Chapter1 :1.1, 1.3 -1.4.									12	
2	Mathematical Modelling through ordinary differential equations of first order: Linear Growth and Decay Models. Non-Linear growth and decay models, Compartment models. Chapter2: 2.2 - 2.4.									12	
3	Mathematical Modelling through system of Ordinary differential equations of first order: Mathematical Modelling in population dynamics- Mathematical Modelling of epidemics through systems of ordinary differential equations of first order. Chapter3 :3.1 - 3.2.									12	
4	Mathematical Modelling through difference equations: The need for Mathematical modelling through difference equations: some simple models -Basic theory of linear difference equations with constant coefficients -Mathematical modelling through difference equations in economics and finance. Chapter 5: 5.1 - 5.3.									12	
5	Mathematical modelling through Graphs Situations that can be modelled through graphs - Mathematical models in terms of directed graphs - Mathematical models in terms of signed graphs Chapter 7: 7.1 -7.3									12	
Total									60		
Theory 70% problem 30%											

Course outcomes	
CO	The students will be able to
CO1	Explain simple situations requiring mathematical modelling and determine the characteristics and classifications of such models.
CO2	Develop models using differential equations to represent linear and non-linear growth and decay processes, including compartmental systems.
CO3	Construct and analyze models using systems of first-order ordinary differential equations, including prey–predator, competition, and epidemic models.
CO4	Explain and apply the concept of difference equations in developing discrete-time mathematical models for various real-world scenarios.
CO5	Apply graph theory concepts to construct and analyze mathematical models using directed and signed graphs.
Text books:	
1	J N Kapur, Mathematical Modelling, New Age International, Publishers (2009).
Reference Books:	
1	D. N. Burghes, Modelling with Difference Equations, Ellis Harwood and John Wiley.
2	D. J. G. James and J. J. Macdonald, Case studies in Mathematical Modelling, Stanly Thames, Cheltenham.
3	M. Cross and A. O. Moscardini, The art of Mathematical Modelling, Ellis Harwood and John Wiley.
4	C. Dyson, Elvery, Principles of Mathematical Modelling, Academic Press, NewYork.
Website and e-Learning Source	
1	http://www.mathfoundation.com
2	https://nptel.ac.in

Mapping with Programme Outcomes and Programme Specific Outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3
CO1	2	3	3	3	2	2	3	3	2	3	2
CO2	2	3	3	3	2	2	3	2	2	3	2
CO3	2	3	3	3	2	2	3	3	2	3	2
CO4	3	2	3	2	2	2	3	2	2	3	2
CO5	2	3	2	3	2	2	3	3	2	3	2
Total	11	14	14	14	10	10	15	13	10	15	10
Average	2.2	2.8	2.8	2.8	2	2	3	2.6	2	3	2

3 – Strong, 2- Medium, 1- Low