MARUDHAR KESARI JAIN COLLEGE FOR WOMEN (AUTONOMOUS)

Vaniyambadi – 635 751

PG & Research Department of Mathematics

for

Postgraduate Programme

Master of Science in Mathematics

From the Academic Year 2024-25

CONTENT

LEARNING OUTCOMES BASED CURRICULUM FRAMEWORK FOR POSTGRADUATE EDUCATION

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

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-1Algebraic 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
					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
					30	**22**

L-Lecture T-Tutorial P-Practical S-Seminar C-Credit

Students must complete at least one online course (MOOC) from platforms like SWAYAM, NPTEL, or Naan mudhalvan within the forth 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*.

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-2nd 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/ocwweb/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	**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.	18
2	**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.	18
3	**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.	18
4	**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	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

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 Levimo 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.Raisinghania,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/ocwweb/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	ATextbookonOrdinaryDifferentialEquationSpringer–ShairAhmad,AntonioAmbrosetti
3	Ordinary Differential Equation: Basics and Beyound- DaridG.Schacffer
4	Ordinary Differential Equation With Application–Sze–Bihsu–WorldScientific
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, NewDelhi,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–RaviP.Agarwal
5	Textbook of Ordinary Differential Equation-C.R.Monotal–Easter Economy Edition
Web resources:	
1	http://mathforum.org,http://ocw.mit.edu/ocwweb/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, 2nd Indian Reprint, Springer Verlag, NewYork, 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, 2nd Indian Reprint, Springer Verlag, New York, 2006.

4	J.L.Gersting, Mathematical Structures for Computer Science, 3rd 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, 3rdEdn., 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 5.1and 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 (Theorem7.2.1only)**	15
5	Solvability by radicals - A theorem of Frobenius - Integral Quaternions and the Four-Square theorem. **Chapter 5: Section 5.7 (Exclude Lemma5.7.1, 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 o 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. Dennemeyer, Introduction to Partial differential equations and boundary value problems, Mc Graw Hill, NewYork, 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, 2nd 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).
Reference Books:	
1	Ronald E. Mickens, Difference Equations Theory, Applications and Advanced Topics, Third Edition,CRC Press,NewYork,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, NewYork, 1988.
5	Walter G.Kelly, Allan C.Peterson, Difference Equations, An Introduction with Applications, Academic Press, NewYork, 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 Sn-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/ocwweb/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