Thiruvalluvar University, Vellore

(A State University)

Tamil Nadu- 632115, India.

Department of Mathematics

M.Sc MATHEMATICS

Percentage of Revised Syllabus during the Academic Year 2018-2019

S.No	Course code	Course Name	Percentage Revised
1	MDMA 12	REAL ANALYSIS – I	100%
2	MDMA 15B	SPECIAL FUNCTIONS	100%
3	MDMA 15E	DISCRETE MATHEMATICS	100%
4	MDMA 22	REAL ANALYSIS – II	100%
5	MDMA 34	APPLIED PROBABILITY AND STATISTICS	100%
6	MDMA 41	APPLIED NUMERICAL ANALYSIS	100%
7	MDMA 43	ANALYTIC NUMBER THEORY	100%
8	MDMA 45A	MATLAB & LaTeX	100%

Head Department of Mathematics

THIRUVALLUVAR UNIVERSITY, VELLORE – 115
UNIVERSITY DEPARTMENT (CBCS) from 2018 – 2019 (Batch)

M.SC MATHEMATICS

MDMA 11 : ALGEBRA-I

Objectives: To enable the students to acquire the basic knowledge in group theory and ring theory.

Course Outcome: At the end of the Course, the Students will able to	
CO1	Identify whether the given abstract structure is group or not.
CO2	Apply the concepts of homomorphism and isomorphism forcomparing the algebraic features of mathematical systems in groups and rings.
CO3	Define an automorphism of a group,Direct,semi direct Products and abelian groupssymmetric group, ring and some special classes of rings like commutative ring, fields.
CO4	Analyze Principal ideal domains,Polynomial rings – Definitions and basic properties.
CO5	Discussed about Euclidean domains, principal ideal domains and unique factorization

***Employability: Laying strong foundation on the mathematical concepts train the students to choose the career in Mathematics Research and Education*.**

UNIT-I: Introduction to Groups

Dihedral groups – Homomorphisms and Isomorphisms - Group actions – Subgroups -Definition and Examples – Centralizers and Normalizer, Stabilizers and Kernels - Cyclic groupsand Cyclic subgroups of a group – Subgroups generated by subsets of a group.

Chapter 1: 1.2, 1.6 & 1.7 and Chapter 2: 2.1 - 2.4.

UNIT-II: Quotient Groups and Homomorphisms

Definitions and Examples – More on cosets and Lagrange's Theorem – The isomorphismtheorems - Composition series and the Holder program – Transpositions and the Alternatinggroup.

Chapter 3: (Full).

UNIT-III: Group Actions

Group actions and permutation representations – Groups acting on themselves by leftmultiplication - Cayley's theorem – Groups acting on themselves by conjugation – The classequation – Automorphisms – The Sylow theorems – The simplicity of An – Direct and semidirect Products and abelian groups - Direct Products – The fundamental theorem of finitelygenerated abelian groups.

Chapter 4 & Chapter 5: 5.1 - 5.2

UNIT-IV: **Introduction to Rings**

Basic definitions and examples – Examples - Polynomial rings - Matrix rings and group rings - Ring Homomorphisms and quotient rings – Properties of Ideals - Rings of fractions – The Chinese remainder theorem.

Chapter 7: (Full)

UNIT-V:**Euclidean domains, principal ideal domains and unique factorization**

Domains

Principal ideal domains – Unique factorization domains – Polynomial rings – Definitionsand basic properties – Polynomial rings over fields - Polynomial rings that are uniquefactorization domains – Irreducibility criteria – Polynomial ring over fields.

Chapter 8 & Chapter 9: (Full)

Recommended Text

1. David S. Dummit and Richard M. Foote, Abstract Algebra (Second Edition), Wiley, 2003.

Reference Books

1. Serge Lang, Algebra, Springer, 2002.
2. I.N. Herstein. Topics in Algebra (II Edition) Wiley Eastern Limited, New Delhi, 1975.
3. M. Artin, Algebra, Prentice Hall of India, 1991.
4. N. Jacobson, Basic Algebra, Vol. I & II, published by Hindustan Publishing Company, New Delhi, 1980.
5. W.H. Freeman, published by Hindustan Publishing Company, New Delhi, 1980.
6. I.S. Luther and I.B.S. Passi, Algebra, Vol. I - Groups (1996); Vol. II *Rings*, Narosa Publishing House, New Delhi, 1999.
7. Joseph A. Gallian, Contemporary Abstract Algebra, Brooks/Cole Pub Co.,2012.

MDMA 12 : REAL ANALYSIS – I

Objectives: Develop the ability to reflect on problems that are quite significant in the field of real analysis. Develop the ability to reflect on problems that are quite significant in the field of real analysis. Ability to consider problems that could be solved by implementing concepts from different areas in mathematics. Ability to identify, formulate, and solve problems. Understanding of professional and ethical responsibilitiesS2-Communicate ideas effectively in graphical, oral, and written media

CO1: students will be able to apply limiting properties to describe and prove continuity and differentiability conditions for real and complex functions.

CO2: Have a good understanding of **derivative** securities. Acquire knowledge of how forward contracts, futures contracts, swaps and options work, how they are used and how they are priced. Develop a reasoned argument in handling problemsabout functions, especially those that are of bounded variation

CO3:Be able to describe and explain the fundamental features of a range of key financial **derivative** instruments.

CO4: Learn the theory of Riemann-Stieltjes integrals, to be aquainted with the ideas of the total variation and to be able to deal with functions of bounded variation.

CO5:Knowledge of the implementation of theories in problem solving of Riemann-Stieltjes integrals . create ability to understand the different math concepts and be able to implement them in our everyday problems.

Skilldevelopment: Laying strong foundation on the mathematical concepts train the students to choose the career in Mathematics Research and Education.

Unit 1: Limits and Continuity: Connectedness, Components of a metric space, Arc wise connectedness, Uniform continuity, Uniform continuity and compact sets, Fixed-point theorem for contractions, Discontinuities of real - valued functions, Monotonic functions.
Chapter 4: 4.16 - 4.23 (18 Hours)
Unit 2: Derivatives: Introduction, Definition of derivative, Derivatives and continuity, Algebra of derivatives, The chain rule, One sided derivatives and infinite derivatives, Functions with nonzero derivative, Zero derivatives and local extrema, Rolle's theorem, The Mean Value Theorem for derivatives, Intermediate –value theorem for derivatives, Taylor's formula with remainder.
Chapter 5: 5.1 - 5.12 (18 Hours)
Unit 3: Functions of Bounded Variations and Rectifiable Curves: Introduction, Properties of monotonic functions, Functions of bounded variation, Total variation, Additive property of total variation, Total variation on [a, x] as a function x, Functions of bounded variation expressed as the difference of increasing functions, Continuous functions of bounded variation.
Chapter 6: 6.1 – 6.8 (18 Hours)
Unit 4: 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, Step functions as integrators, Reduction of a Riemann-Stieltjes integral to a
finite sum, Euler's summation formula, Monotonically increasing integrators. Upper and lower integrals, Additive and linearity properties of upper and lower integrals, Riemann's condition.
Chapter 7: 7.1 - 7.13 (18 Hours)
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Unit 5: Riemann – Stieltjes Integral (Continuation) Comparison theorems, Integrators of bounded variation, Sufficient conditions for existence of Riemann-Stieltjes integrals, Necessary conditions for existence of Riemann-Stieltjes integrals, Mean Value Theorem for conditions for Riemann-Stieltjes integrals, The integral as a function of the interval, Second fundamental theorem of integral calculus, Change of variable in a Riemann integral, Second Mean-Value Theorem for Riemann integrals, Riemann-Stieltjes integrals depending on a parameter, Differentiation under the integral sign, Interchanging the order of integration.
Chapter 7: 7.14 - 7.25 **(18 Hours)**
Text Book:
➢ Tom M. Apostal, "**Mathematical Analysis**", Addison - Wesley Publishing Company, 1974.
References: 1. Walter Rudin, "**Principles of Mathematical Analysis**", Mc Graw Hill Inc, 1964. 2. Anthony W. Knapp, "**Basic Real Analysis"**, Birkhauser, 2005. 3. Wilder, R. L., "**The Foundations of**

Mathematics", second Edition, John Wiley & Sons, New York, 1965.
4. Kenneth A. Ross, "**Elementary Analysis: Theory of Calculus"**, Second edition Springer, 2013.

MDMA 13 :Ordinary Differential Equations

Objectives:
• The main purpose of the course is to introduce students to the theory and methods of ordinary differential equations. • Students should be able to implement the methods taught in the course to work associated problems, including proving results of suitable accessibility.

Course Outcome: On successful completion of the course, the students will be able to	
CO1	Enhancing students to explore some of the basic theory of linear ODEs, gain ability to recognize certain basic types of higher-order linear ODEs for which exact solutions may be obtained, and to apply the corresponding methods of solution.
CO2	Able to solve non-homogeneous linear equations with constant coefficients using the methods of undetermined coefficients and variation of parameters and application problems modelled by linear differential equations
CO3	Recognize ODEs and system of ODEs concepts that are encountered in the real world, understand and be able to communicate the underlying mathematics involved in order to solve the problems using multiple approaches.
CO4	Students are introduced to modern concepts and methodologies in ordinary differential equations, with particular emphasis on the methods that can be used to solve very large-scale problems.
CO5	Introduction of Elementary Critical Points - System of Equations with constant coefficients and - Linear Equation with Constant Coefficients.

Employability:Recognize ODEs and system of ODEs concepts that are encountered in the eal world, understand and be able to communicate the underlying mathematics involved in order to solve the problems using multiple approaches.

UNIT-I: Linear Differential Equations of Higher Order
Introduction - Higher Order Equations - A Modeling Problem - Linear Independence - Equations with Constant Coefficients - Equations with Variable Coefficients – Wronskian - Variation of Parameters - Some Standard Methods - Method of Laplace Transforms.
Chapter 2: 2.1 - 2.10

UNIT-II: Systems of Linear Differential Equations

Introduction - Systems of First Order Equations - Model for arms Competition between two Nations - Existence and Uniqueness Theorem - Fundamental Matrix - Non-homogeneous Linear Systems - Linear Systems with Constant Coefficients - Linear Systems with Periodic Coefficients.

Chapter 4: 4.1 - 4.8

UNIT-III: Existence and Uniqueness of Solutions

Introduction – Preliminaries - Successive Approximations - Picard's Theorem - Some Examples - Continuation and Dependence on Initial Conditions – Fixed point methods.

Chapter 5: 5.1 - 5.6

UNIT-IV: Boundary Value Problems Rings

Introduction - Strum-Liouville Problem - Green's Function - Application of Boundary Value Problems (BVP) - Picard's Theorem.
Chapter 7: 7.1 – 7.5

UNIT-V: Stability of Linear and Nonlinear Systems
Introduction - Elementary Critical Points - System of Equations with Constant Coefficients - Linear Equation with Constant Coefficients - Lyapunov Stability.
Chapter: 9: 9.1 - 9.5

Recommended Text
S.G. Deo, V. Lakshmikantham and V. Raghavendra, "Ordinary Differential Equations", Second Edition, Tata Mc Graw-Hill publishing company Ltd, New Delhi, 2004.

Reference Books
1. Earl. A. Coddington, "An Introduction to Ordinary Differential Equations", Prentice Hall of India, New Delhi.
2. G.F. Simmons, S.G. Krantz, "Differential Equations: Theory, Technique and Practice" Tata Mc - Graw Hill Book Company, New Delhi, India, 2007.

MDMA 14 : Mechanics

Objectives:

- To Provide the classical mechanics approach to solve a mechanical problem.
- To study mechanical systems under generalized coordinate system, virtual work, energy and momentum.

Course Outcomes: After completing this course, the student will be able to

CO1 - Understand D'Alembert's Principle and simple application of Lagrangian formulation.
CO2 - Analyze the Derivation of Lagrange equation from Hamiltons's Principle and modified Hamilton's principle.

CO3 - Dintinguish the Concept of Hamilton equation of motion and Principle of least action.

CO4 - Obtain canonical equations using different combinations of generating functions and subsequently developing Hamilton Jacobi Method to solve equations of motion.
CO5 - Study the application of theory of canonical transformations to dynamical theory.

Employability: Defining different sets of generalized coordinates for a given mechanical system and the use of canonical transformations. The use of analytical treatments in checking the numerical models

Unit - I: Introductory Concepts
The Mechanical system - Generalized coordinates - Holonomic and non- holonomic systems - constraints – Virtual work – D’ Alembert’s principle – Energy and Momentum.
Chapter 1: 1.1 – 1.5 (18 Hours)
Unit - II: Lagrange’s Equations
Derivation of Lagrange’s equations – Examples – integrals of motion - cyclic or ignorable coordinates.
Chapter 2: 2.1 – 2.3 (18 Hours)
Unit - III: Hamilton’s Equations
Hamilton’s principle - Hamilton’s equations - other variational principle - Principle of Least action.
Chapter 4: 4.1 – 4.3 (18 Hours)
Unit - IV: Hamilton – Jacobi Theory
Hamilton principle function - Hamilton–Jacobi equation - Separability.
Chapter 5: 5.1 – 5.3 (18 Hours)
Unit - V: Canonical Transformation
Differential forms and generating functions – Special Transformations – Lagrange and Poisson brackets.
Chapter 6: 6.1 – 6.3 **(18 Hours)**
Text Book:
- D. Greenwood, Classical Dynamics, Prentice Hall of India, New Delhi, 1985.

References:
1. H. Goldstein, Classical Mechanics (Second Edition), Narosa Publishing House, India, New Delhi.
2. N.C.Rane and P.S.C. Joag, Classical Mechanics, McGraw Hill, 1991.
3. J.L. Synge and B.A. Griffth, Principles of Mechanics (3rd Edition), McGraw Hill Book Co. New York, 1970.

MDMA 15B :SPECIAL FUNCTIONS

OBJECTIVES	• The aim of the course is to discuss Special functions and multiple Fourier series, Boundary Value Problems**.** • Understand the Partial Differential Equations and Laplace Transformations**.**
Course Outcome: At the completion of the Course, the Students will able to	
CO1	Students solved Special functions and multiple Fourier Series, Legendre polynomials.
CO2	Solved Boundary Value Problems, Fourier series – solutions in Cartesian co-ordinates.
CO3	Students derived wave and heat equation on two dimensional Partial Differential Equations in both rectangular and circular plates.
CO4	Solved wave equation, diffusion equation, Poisson equation and Laplace equation by the method of separation of variables.
CO5	Having the knowledge about what is Laplace transforms and its simple properties.

Employability: Problem solving skill utilize the so obtained knowledge to build and enhance important work in sciences and engineering, business, manifacturing and communication.

Unit I: Special functions and multiple Fourier Series:

Orthogonal functions – Bessel functions and Legendre polynomials – Generalized Fourier series expansions of an arbitrary function in terms of orthogonal functions – Bessel functions of order zero and Legendre polynomials – Fourier series expansions of functions of two and three variables.

Unit II: Boundary Value Problems:

Solutions of one dimensional wave equation – One dimensional heat equation (without derivation) – Fourier series – solutions in Cartesian co-ordinates.

Unit III: Partial Differential Equations:

Two dimensional wave equations in rectangular – Cartesian and cylindrical polar coordinate systems — Two dimensional heat flow in transient state both in rectangular and circular plates.

Unit IV: Partial Differential Equations:

Solutions of wave equation – diffusion equation – Poisson equation and Laplace equation by the method of separation of variables – Transverse vibration of rectangular and circular membranes – Potentials due to charged circular rings – circular plates and spheres.

Unit V: Laplace Transformations:

Laplace transforms – simple properties – inverse Laplace Transformation – Convolution theorem – application to solution of ordinary differential equations.

Recommended Text:

1. J.N.Sharma and R.K.Gupta (1998) Special Functions, Krishna Prakashan Mandir, Meerut.23

References :

1. F.B.Hildebrand. (1977) Advanced Calculus for Applications. Prentice Hall. New Jersey.

2. Advanced Engineering & Sciences M.K.Venkataraman, The National Publishing Co.

3. Applied Mathematics for Engineers and Physicists, Luis A Pipes and Hartill, McGraw Hill.

4. Engineering Mathematics Series, Veerarajan. T, Tata Mcgraw Hill Publicatin

5. Advanced Engineering Mathematics, Erwin Kreyszing, fifth edition, Wiley Eastern pubishers, 1985.

6. Mathematics For Biological Sciences, Arya. J.C. and R.W Kardber , Prentice Hall International Edn(1979).

MDMA 15E : DISCRETE MATHEMATICS

Course Objectives: To develop logical thinking and its application to computer science (to emphasize the importance of proving statements correctly and de-emphasize the hand-waving approach towards correctness of an argument). The subject enhances one's ability to reason and ability to present a coherent and mathematically accurate argument. About 40% of the course time will be spent on logic and proofs and remaining 60% of the course time will be devoted to functions, relations, etc.

CO1: Simplify and evaluate basic logic statements including compound statements, implications, inverses, converses, and contrapositives using truth tables and the properties of logic.

CO2: Express a logic sentence in terms of predicates, quantifiers, and logical connectives•\

CO3: Apply the operations of sets and use Venn diagrams to solve applied problems; solve problems using the principle of inclusion-exclusion.

CO4: Determine the domain and range of a discrete or non-discrete function, graph functions, identify one-to-one functions, perform the composition of functions, find and/or graph the inverse of a function, and apply the properties of functions to application problems.

CO5: Determine if a graph is a binary tree, N-ary tree, or not a tree; use the properties of trees to classify trees, identify ancestors, descendants, parents, children, and siblings; determine the level of a node, the height of a tree or subtree and apply counting theorems to the edges and vertices of a tree.

Employability: To understanding the concepts and significance of lattices and boolean algebra which are widely used in computer science and engineering.

Unit I:
The Foundations: Logic, Sets and Functions: Logic – Propositional - Equivalences – Predicates and Quantifiers - Sets – Set Operations – Functions – Sequences and Summations – The Growth of Functions.
Chapter 1: 1.1 – 1.9 (18 Hours)
Unit II:
The Fundamentals: Algorithms, the Integers, and Matrices Algorithms - Complexity of Algorithms - Integers and Algorithms - Applications of Number Theory - Matrices.
Chapter 2: 2.1 – 2.5 (18 Hours)
Unit III:
Mathematical Reasoning: Methods of Proof - Mathematical Induction – Recursive Definitions – Recursive Algorithms -Program Correctness.
Chapter 3: 3.1 – 3.5 (18 Hours)
Unit IV:
Relations: Relations and Their Properties – *n*-array Relations and Their Applications – Representing Relations – Closures of Relations – Equivalence Relations – Partial Orderings.
Chapter 6: 6.1 – 6.6 (18 Hours)
Unit V:
Trees: Introduction of Trees – Applications of Tress – Tree Traversal – Trees and Sorting – Spanning Tress – Minimum Spanning Trees.
Chapter 8: 8.1 – 8.6 (18 Hours)
Text Book:
Kenneth H. Rosen, Discrete Mathematics and Its Applications, McGraw – Hill Publications, 1999.

Reference Books:

28 1. S. Lipschutz, M. Lipson, "**Discrete Mathematics**", Tata McGraw-Hill Publishing Company, New Delhi, 2006. 2. J. Truss, "**Discrete Mathematics for Computer Scientists**", Pearson Education Limited, England, 1999. 3. J. P. Trembley and R. Manohar, **"Discrete Mathematical Structures with Applications to Computer Sciences**", Tata McGraw Hill, Singapore, 1987.

MDMA 21 : ALGEBRA –II

Objectives	✓ To facilitate the basic concepts of Vector Spaces andMatrix of a linear transformation. ✓ To enable students to learn Rational Canonical Form and Jordan Canonical Form in detail. ✓ To introduce the concept of Finite Fields
Course Outcome: At the end of the Course, the Students will able to	
CO1	Define the Matrix of a linear transformation and Dual vector spaces.
CO2	Comparison betweenRational Canonical Form and Jordan Canonical Form, Field extensions and Algebraic Extensions.
CO3	Define Splitting fields, Algebraic closures and Cyclotomic polynomials.
CO4	Analyze the fundamental theorem of Galois theory.
CO5	Related definitions and fundamental theorem of Galois theory and Finite Fields.

Employability: Laying strong foundation on the mathematical concepts train the students to choose the career in Mathematics Research and Education.

UNIT-I: Vector Spaces

Definitions and basic theory – The Matrix of a linear transformation – Dual vector spaces – Determinants.

Chapter 11: 11.1 - 11.4

UNIT-II: Module over Principal Ideal Domain

Basic definitions and examples – The Basic Theory –The Rational Canonical Form –The Jordan Canonical Form.

Chapter 10: 10.1 & Chapter 12: 12.1 - 12.3

UNIT-III:Field theory

Basic Theory of field extensions – Algebraic Extensions.

Chapter 13: 13.1 - 13.2

UNIT-IV: Field Theory (Cont…)

Splitting fields and Algebraic closures – Separable and inseparable extensions – Cyclotomic polynomials and extensions.

Chapter 13: 13.4 - 13.6

UNIT-V: Galois Theory

Basic definitions – The fundamental theorem of Galois theory – Finite Fields.

Chapter 14: 14.1 - 14.3

Recommended Text

1. David S. Dummit and Richard M. Foote, Abstract Algebra (Second Edition), Wiley,2003.

Reference Books

1. Serge Lang, Algebra, Springer, 2002.
2. I.N. Herstein. Topics in Algebra (II Edition) Wiley Eastern Limited, New Delhi, 1975.
3. M.Artin, Algebra, Prentice Hall of India, 1991.
4. N.Jacobson, Basic Algebra, Vol. I & II W.H.Freeman; also published by Hindustan Publishing Company, New Delhi, 1980.
5. I.S.Luther and I.B.S.Passi, Algebra, Vol. I - Groups (1996); Vol. II *Rings*, Narosa Publishing House, New Delhi, 1999.
6. Joseph A. Gallian, Contemporary Abstract Algebra, Brooks / Cole Pub Co., 2.

MDMA 22 : REAL ANALYSIS - II

Objectives	✓ To introduce the concepts Double sequences, Double series and Multiplication of series ✓ To enable the students to know about Uniform convergence and Riemann-Stieltje’s integration.
Course Outcome: At the end of the Course, the Students will able to	
CO1	Define Double sequences, Double series and Multiplication of series.
CO2	Distinguish Point-wise convergence of sequences of functionand Uniform convergence of infinite series of functions.
CO3	Analyze Non-uniformly convergent sequences that can be integrated term by term,Sufficient conditions for uniform convergence of a series.
CO4	An application tocomplex-valued functions.
CO5	Apply Functions with non-zero Jacobian determinant.

Employability: Laying strong foundation on the mathematical concepts train the students to choose the career in Mathematics Research and Education.

UNIT-I: Infinite series and Infinite products

Double sequences - Double series - Rearrangement theorem for double series – A sufficientcondition for equality of iterated series - Multiplication of series – Cesaro summability – Infinite products.

Chapter 8: 8.20 – 8.26

UNIT-II: Sequence of Functions

Point-wise convergence of sequences of functions - Examples of sequences of real valued functions - Definition of uniform convergence - Uniform convergence and continuity – The Cauchy condition for uniform convergence - Uniform convergence of infinite series of functions.

Chapter 9: 9.1 – 9.6

UNIT-III: Sequence of Functions [Contd...]

Uniform convergence and Riemann-Stieltje's integration – Non-uniformly convergent sequences that can be integrated term by term - Uniform convergence and differentiation – Sufficient conditions for uniform convergence of a series - Uniform convergence and double sequences - Mean convergence.

Chapter 9: 9.8 – 9.13

UNIT-IV: Multi-Variable Differential Calculus

Introduction - The differential derivative - Directional derivatives and continuity – The totalderivative - The total derivative expressed in terms of partial derivatives - An application tocomplex-valued functions - The matrix of a linear function - The Jacobian matrix - The chain rule.

Chapter 12: 12.1 – 12.9

UNIT-V: Implicit functions and Extremum problems
Introduction - Functions with non-zero Jacobian determinant - The inverse function theorem - The implicit function theorem.

Chapter 13: 13.1 – 13.4

Recommended Text

Tom M. Apostal, "**Mathematical Analysis**", Addison - Wesley Publishing Company, 1974

Reference Books

1. Walter Rudin, "**Principles of Mathematical Analysis**", McGraw Hill Inc, 1964.
2. Anthony W. Knapp, "**Basic Real Analysis"**, Birkhauser, 2005.
3. Dieudome, J., "**Foundations of Modern Analysis"**, Academic press, Inc, Newyork, 1960.

MDMA 23 : PARTIAL DIFFERENTIAL EQUATIONS

OBJECTIVES	✓ Learn the elementary concepts and basic ideas involved in partial differential equations. ✓ Develop the mathematical skills to solve problems involving partial differential equations rather than general theory. ✓ Understand the partial differential equations as models of various physical processes such as mechanical vibrations, transport phenomena including diffusion, heat transfer and electrostatics.
Course Outcome: On successful completion of the course, the students will be able to	

CO1	Extract information from partial differential equations to interpret the reality.
CO2	Know the various types of methods and their limitations to solve the partial differential equations.
CO3	Identify the physical situations and real world problems to formulate mathematical models using partial differential equations.
CO4	Apply the acquired knowledge to select the most appropriate method to solve the particular partial differential equations.
CO5	To understand Formation and solution of one-dimensional & two dimensional wave equation - canonical reduction – IVP and BVP.

Employability: *Apply the acquired knowledge to select the most appropriate method to solve the particular partial differential equations.*

UNIT-I: PARTIAL DIFFERENTIAL EQUATIONS OF FIRST ORDER
Formation and solution of PDE- Integral surfaces - Cauchy Problem order equation - Orthogonal surfaces - First order non-linear - Characteristics - Compatible system – Charpit's method.
Chapter 0: 0.4 to 0.11 (omit 0.1, 0.2, 0.3 and 0.11.1)
UNIT-II: FUNDAMENTALS
Introduction - Classification of Second order PDE - Canonical forms – Adjoint operators - Riemann's method.
Chapter 1: 1.1 to 1.5
UNIT-III: ELLIPTIC DIFFERENTIAL EQUATIONS
Derivation of Laplace and Poisson equation - BVP - Separation of Variables - Dirichlet's Problem and Newmann Problem for a rectangle - Solution of Laplace equation in Cylindrical and spherical coordinates - Examples.
Chapter 2: 2.1, 2.2, 2.5 to 2.7, 2.10 to 2.13(omit 2.3, 2.4, 2.8 and 2.9)
UNIT-IV: PARABOLIC DIFFERENTIAL EQUATIONS
Formation and solution of Diffusion equation – Dirac - Delta function - Separation of variables method - Solution of Diffusion Equation in Cylindrical and spherical coordinates - Examples.
Chapter 3: 3.1 to 3.7 and 3.9. (omit 3.8)

UNIT - V: HYPERBOLIC DIFFERENTIAL EQUATIONS
Formation and solution of one-dimensional wave equation - canonical reduction – IVP - D'Alembert's solution - IVP and BVP for two-dimensional wave equation - Periodic solution of one-dimensional wave equation in cylindrical and spherical coordinate systems - Uniqueness of the solution for the wave equation - Duhamel's Principle - Examples.
Chapter 4: 4.1 to 4.12 (omit 4.5, 4.6 & 4.10)
Recommended Text

K. Sankar Rao, *Introduction to Partial Differential Equations*, 2nd Edition, Prentice Hall of India, New Delhi. 2005

Reference Books
1. R.C.McOwen, Partial Differential Equations, 2nd Edn. Pearson Eduction, New Delhi, 2005.

2. I.N.Sneddon, Elements of Partial Differential Equations, McGraw Hill, New Delhi, 1983.

3. R. Dennemeyer, Introduction to Partial Differential Equations and Boundary Value Problems, McGraw Hill, New York, 1968.

4. M.D. Raisinghania, Advanced Differential Equations, S.Chand & Company Ltd., New Delhi, 2001.

MDMA 24 : Topology

Course Objectives:

To provide knowledge on point set topology, topological space, Quotient spaces, product spaces and metric spaces sequences, continuity of functions connectedness and compactness, homotopy and covering spaces.

Course Outcomes: Upon successful completion of the course, students will be able to:

CO1 : Define and illustrate the concept of topological spaces and continuous functions.
CO2 : Prove a selection of theorems concerning topological space, continuous functions, product topologies, and quotient topologies.
CO3 : Define and illustrate the concept of product of topologies.
CO4 : Define and illustrate the concepts of the separation axioms.
CO5 : Define connectedness and compactness, and prove a selection of related theorems, and describe different examples distinguishing general, geometric, and algebraic topology.Press, 2000.

***Employability**: Laying strong foundation on the mathematical concepts train the students to choose the career in Mathematics Research and Education.*

Unit I: Topological Spaces
Topological Spaces - xamples Basis for a topology – Sub-basis closed sets –interior – closure - boundary – Limitpoints Hausdorff spaces Subspace topology – The product topology on X - Projections.
Chapter 2: Section: 12 - 17 **(18 Hours)**
Unit II: Continuous Functions
Continuous functions Examples Homeomorphisms topological property pasting lemma – Box topology - Comparison of the product topology and the box topology – the metric topology – Sequence Lemma – Uniform Limit theorem.
Chapter 2: Section: 18 - 21 **(18 Hours)**
Unit III: Connected Spaces
Connected Spaces– connected subspace of the real line – Linear continuum –Intermediate Theorem – components and Local connectedness – Totally disconnected spaces.
Chapter 3: Section: 23 - 25 **(18 Hours)**
Unit IV: Compact Spaces
Compact Spaces - Compact subspace of the real line – The Lebesque number lemma – Uniform continuity theorem – Limit point compactness – Local compactness – one point compactification.
Chapter 3: Section: 26 - 29 **(18 Hours)**
Unit V: Countability and Separation Axioms
First countable and second countable spaces – separation axioms – regular and completely regular spaces– ormal and completely Normal spaces – Urysohn's lemma – Urysohn's metrization theorem – Tietze Extension theorem.
Chapter 4: Section: 30 - 35 **(18 Hours)**
Text Book:
 James R. Munkres, "Topology", 2nd Edition, Prentice Hall of India Pvt.Ltd., (Third Indian Reprint).
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MDMA 25D : CRYPTOGRAPHY AND DATA SECURITY

Objective: To provide conceptual understanding of network security issues, challenges and mechanisms. To develop basic skills of secure network architecture and explain the theory behind the security of different cryptographic algorithms.To describe common network vulnerabilities and attacks, defense mechanisms against network attacks, and cryptographic protection mechanisms.To explore the requirements of real-time communication security and issues related to the security of web services.

CO1: learn to classify the symmetric encryption techniques

CO2 : learn Illustrate various Public key cryptographic techniques

CO3 : Evaluate the authentication and hash algorithms.

CO4 : learn to implement authentication applications.

CO5: Summarize the intrusion detection and its solutions to overcome the attacks. Basic concepts of system level security.

Enterpreneurship: *Gaining knowledge of cryptography including the field's terminology and methods, as well as modern trends in applying cryptography to data security.*

Unit I: Some Topics in Elementary Number Theory Time estimates for doing arithmetic – Divisibility and the Euclidean algorithm – Congruences.
Chapter 1: Sections 1,2 and 3 **(18 Hours)**
Unit II: Finite Fields and Quadratic Residues Some applications to factoring – Quadratic residues and reciprocity.
Chapter 1: Section 4 and C**hapter 2:** Section 2 **(18 Hours)**
Unit III: Cryptography Some simple Cryptosystems – Enciphering matrices.
Chapter 3 (18 Hours)
Unit IV: Public Key The idea of public key cryptography – RSA – Discrete log – Knapsack – Zero-Knowledge protocols and oblivious transfer.
Chapter 4 Section 1 – 4. **(18 Hours)**
Unit V: Primality and Factoring Pseudo primes – The rho method – Fermat factorization and factor bases – The continued fraction method – The quadratic sieve method.
Chapter 5 (18 Hours)
Text Book:
➢ Neal Koblitz, "A Course in Number Theory and Cryptography"- Second Edition, Springer Publishers.

References: 1. A.Menezes, P. van Oorschot and S. Vanstone, "Handbook of Applied Cryptography", CRC press, 1996. 2. Douglas R. Stinson "Cryptography theory and practice" Second Edition, Chapman and Hall / CRC. 3. Tom. M. Apostol**, "Introduction to Analytic Number Theory**", Springer, New Delhi, 1993.

MDMA 31 : FUNCTIONAL ANALYSIS

Objectives:

- This course introduces functional analysis and operator theoretic concepts. This area combines ideas from linear algebra and analysis in order to handle infinite-dimensional vector spaces and linear mappings thereof.
- This course provides an introduction to the basic concepts which are crucial in the modern study of partial differential equations, Fourier analysis, quantum mechanics, applied probability and many other fields.

Course Outcome: On successful completion of the course, the students will be able to	
CO1	Appreciate how ideas from different areas of mathematics combine to produce new tools that are more powerful than would otherwise be possible.
CO2	Understand how functional analysis underpins modern analysis.
CO3	Develop their mathematical intuition and problem-solving capabilities, especially in predicting the space in which the solution of a partial differential equation belongs to.
CO4	Learn advanced analysis in terms of Sobolev spaces, Besov spaces, Orlicz spaces and other distributional spaces.
CO5	Definition and examples of Banach Algebras – To understand the Regular and simple elements, radical and semi-simplicity

Enterpreneurship: *Gaining knowledge of cryptography including the field's terminology and methods, as well as modern trends in applying cryptography to data security.*

UNIT-I BANACH SPACES

Banach spaces – Definition and examples – Continuous Linear Transformations – Hahn Banach Theorem.

Chapter 9: Sections 46 to 48

UNIT-II BANACH SPACES AND HILBERT SPACES

The natural embedding of N in N** - Open mapping theorem – Conjugate of an operator –Hilbert space – Definition and properties.

Chapter 9: Sections 49 to 51; Chapter 10: Sections 52.

UNIT-III HILBERT SPACE

Orthogonal complements – Orthonormal sets – Conjugate space H* - Adjoint of an operator.

Chapter 10: Sections 53 to 56.

UNIT-IV OPERATIONS ON HILBERT SPACES

Self – adjoint operator – Normal and Unitary Operators – Projections.

Chapter 12: Sections 57 to 59.

UNIT-V BANACH ALGEBRAS

Banach Algebras – Definition and examples – Regular and simgle elements – Topological divisors of zero – spectrum – the formula for the spectral radius – the radical and semi-simplicity.

Chapter 12: Sections 64 to 69.

Recommended Text

G.F.Simmons, Introduction to topology and Modern Analysis, McGraw Hill International Book Company, New York, 1963.

Reference Books

1. W. Rudin Functional Analysis, Tata McGraw-Hill Publishing Company, New Delhi, 1973.
2. H.C. Goffman and G. Fedrick, First Course in Functional Analysis, Prentice Hall of India,New Delhi, 1987.
3. Bela Bollobas, Linear Analysis an introductory course, Cambridge Mathematical Text books, Cambridge University Press, 1990.
4. D. Somasundaram, Functional Analysis, S. Viswanathan Pvt. Ltd., Chennai, 1994.
5. G. Bachman & L.Narici, Functional Analysis Academic Press, New York, 1966.
6. E. Kreyszig Introductory Functional Analysis with Applications, John wiley & Sons, New York.,1978.

MDMA 32 : COMPLEX ANALYSIS

Objectives:

- To lay the foundation for this subject, to develop clear thinking and analyzing capacity for further study.
- Cauchy's Theorem guaranteeing that certain integrals along closed paths are zero. This striking result leads to useful techniques for evaluating real integrals based on the 'calculus of residues'.
- Important results are the Mean Value Theorem, leading to the representation of some functions as power series (the Taylor series), and the Fundamental Theorem of Calculus which establishes the relationship between differentiation and integration.

Course Outcome: On successful completion of the course, the students will be able to	
CO1	Analyze limits and continuity for complex functions as well as consequences of continuity.
CO2	Apply the concept and consequences of analyticity and the Cauchy-Riemann equations and of results on harmonic and entire functions including the fundamental theorem of algebra.
CO3	Evaluate integrals along a path in the complex plane and understand the statement of Cauchy's Theorem
CO4	Represent functions as Taylor, power and Laurent series, classify singularities and poles, find residues and evaluate complex integrals using the residue theorem.
CO5	Discuss Harmonic Functions, basic properties – and deriving the theorems Schwarz's a Weierstrass's, Taylor's series and Laurent series

Employability: *Laying strong foundation on the mathematical concepts train the students to choose the career in Mathematics Research and Education.*

UNIT-I: Complex Functions

Spherical representation of complex numbers - Analytic functions - Limits and continuity - Analytic Functions - Polynomials - Rational functions – Elementary Theory of Power series - Sequences - Series - Uniform Convergence - Power series - Abel's limit functions - Exponential and Trigonometric functions - Periodicity – The Logarithm.

Chapter 1: 1.2 & 1.4 and **Chapter 2:** 2.1 – 2.3

UNIT-II: Analytical functions as mappings

Conformality - Arcs and closed curves - Analytic functions in Regions – Conformal mapping - Length and area - Linear transformations - Linear group - Cross ratio -symmetry - Oriented Circles - Families of circles - Elementary conformal mappings - Use of level curves - Survey of Elementary mappings - Elementary Riemann surfaces.

Chapter 3: 3.2 – 3.4
UNIT-III: Complex Integration
Fundamental Theorems - Line Integrals – Rectifiable Arcs- Line Integrals as ArcsCauchy's Theorem for a rectangle and in a disk- Cauchy's Integral Formula – Index of point with respect to a closed curve – The Integral formula – Higher order derivatives – Local properties of analytic functions – Taylor's Theorem – Zeros and
Poles–Local mapping – Maximum Principle.
Chapter 4: 4.1 – 4.3

UNIT-IV: Complex Integration (Contd…)
The General form of Cauchy's Theorem - Chains and Cycles – Simple connectivity –Homology – General statement of Cauchy's theorem – Proof of Cauchy's theorem –Locally exact differentials - Multiply connected regions – Calculus of residues –Residue Theorem – Argument Principle – Evaluation of definite Integrals.
Chapter 4: 4.4 – 4.5
UNIT-V: Harmonic functions and Power Series expansions
Harmonic Functions – Definition and basic properties – Mean-value Property –Poisson's formula – Schwarz's Theorem – Reflection Principle – Weierstrass's theorem – Taylor's series- Laurent series.
Chapter 4: 4.6 and **Chapter 5:** 5.1

Recommended Text
"Complex Analysis" by L.V. Ahlfors, Third Edition, McGraw Hill, New York, 1979.

Reference Books
1. J.B. Conway, Functions of One Complex Variable, Narosa Publication House, New Delhi, 1980.
2. S. Ponnusamy, Foundations of Complex Analysis, Narosa Publication House, New Delhi 2004.
3. S. Lang, Complex Analysis, Addison - Wesley Mass, 1977.

MDMA 33 : FLUID DYNAMICS

OBJECTIVES	The aim of the course is to discuss kinematics of fluids in motion, Equations of motion of a fluid, three dimensional flows, two dimensional flows and viscous flows.
Course Outcome: At the completion of the Course, the Students will able to	
CO1	Students know what are Real fluids and ideal fluids, flows and solved problems regarding this.
CO2	Solved some problems and derivations about equation of motion of fluid and learn some naming theorems.
CO3	Students got some knowledge about some three dimensional and two dimensional flows.
CO4	To understand the geometrical knowledge of two dimensional flows – use of cylindrical polar coordinates and complex velocity potential for standard

	two dimensional flows – the Milne-Thomson circle theorem with examples.
CO5	Analyze the Stress components and relation between Cartesian components of stress, translation motion of a fluid element – the rate of strain quadric. Navier –Stokes equations of motion of a viscous fluid.

Enterpreneurship: *Analyze fluid flow problems with the application of the momentum and energy equations. Understand modelling approximations in finding exact solutions. Apply basic principles of multi-variable calculus, differential equations and complex variables to fluid dynamic problems*

Unit I: Kinematics of fluids in motion:

Real fluids and ideal fluids - velocity of a fluid at a point - stream lines and path lines - steady and unsteady flows - the velocity potential - the vorticity vector - local and particle rates of change - the equation of continuity - worked examples.

Chapter 2 : 2.1 – 2.8 (18 Hours)

Unit II: Equation of motion of fluid:

Pressure at a point in 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 - Bernoulli's equation – worked examples.

Chapter 3 : 3.1 – 3.6 (18 Hours)

Unit III: Some three dimensional flows:

Introduction – sources – sinks and doublets – Axis symmetric flow – Stokes stream function.

Chapter 4 : 4.1– 4.2 & 4.5 (18 Hours)

Unit IV: Some two dimensional flows:

Meaning of two dimensional flows – use of cylindrical polar coordinates – the stream function – the potential for two dimensional – irrotational – incompressible flows – complex velocity potential for standard two dimensional flows – the Milne-Thomson circle theorem with examples.

Chapter 5 : 5.1 – 5.5 & 5.8 (18 Hours)

Unit V : Viscous Flows : Stress components in real fluids – relation between Cartesian components of stress – translation motion of a fluid element – the rate of strain quadric and principle stresses – Some further properties of the rate of strain quadric stress analysis in fluid motion – relation between stress and rate of strain – the co-efficient of viscosity and laminar flow – the Navier –Stokes equations of motion of a viscous fluid.
Chapter 8 : 8.1 – 8.9 (18 Hours)

Text Book:

1. F. Chorlton, Text book of Fluid Dynamics, CBS Publication, New Delhi, 1985.
2. M.K.Venkataraman, Advanced Engineering & Sciences, The National Publishing Co.

References:

1. G.K.Batchelor, An Introduction of Fluid Mechanics, Foundation Books, New Delhi,1993.

2. A.R.Paterson, A First Course in Fluid Dynamics, Cambridge University Press, New York, 1987.

3. R.K.Rathy, An Introduction to Fluid Dynamics, IBH Publishing Company, New Delhi,1976.

4. R.Von Mises, O.Friedrichs, Fluid Dynamics, Springer International Student Edition,Narosa Publishing House, New Delhi.

5. S.W.Yuan, Foundation of Fluid Mechanics, Prentice Hall Private Ltd, New Delhi, 1976.

MDMA 34 : APPLIED PROBABILITY AND STATISTICS

Objectives:

- ✓ To enable the students to acquire the knowledge of statistics
- ✓ To make the students understand various characteristics of discrete and continuous statistical distributions with mathematical techniques

Course Outcome : At the end of the Course, the Students will able to	
CO1	Describe the concepts of Random variables and Distribution Function with examples.
CO2	Evaluate Binomial, Poisson distributions, Regression and Correlationdistributions.
CO3	Analyze student's t-test, F-test and Chi-square test.
CO4	Analyze Randomized Block Design (RBD) and Latin Square Design (LSD).
CO5	Basic concept-Reliabilities of series.

***Skilldevelopment**: The ability to use probabilistic reasoning and the foundations of probability theory to describe probabilistic engineering experiments in terms of sample spaces, event algebras, classical probability and statistics*

UNIT-I: Random Variables

Random variables - the concept of a random variable - distribution and density functions - random variables of the discrete and continuous type - joint distribution and joint density functions - marginal distribution - conditional distribution - co-variance – correlation - mathematical expectation - Moment generating function - characteristic function.

Chapter 2: Chapter 1 & 2 (1.1 – 1.7, 2.1 – 2.9): M. Fisz, Probability theory and Mathematical Statistic, John Willey and sons, Newyork, 1963.

UNIT-II: Some Probability Distributions

Binomial and Poisson distributions - Normal distribution - Gamma and Exponential distribution - Weibull distribution - Regression and Correlation - Partial and Multiple Correlation – Multiple regression.

Chapter – 4 (4.1 - 4.7): M. Fisz, Probability theory and Mathematical Statistic, John Willey and sons, Newyork, 1963.

UNIT-III: Testing of Hypothesis
Estimation and procedure of testing of hypothesis - Large sample tests - Small sample tests - student's t-test - F-test - Chi-square test - Testing of mean, variance and proportions - independence of attributes and goodness of fit.

Chapter 4 & Chapter 5 of M. Fisz, Probability theory and Mathematical Statistic, John Willey and sons, Newyork, 1963.

UNIT-IV: Design of Experiments
Analysis of variance - One way and two way classifications - completely Random Design (CRD) - Randomized Block Design (RBD) - Latin Square Design (LSD).

Chapter 10: Kishore S. Trivedi, Probability & Statistics with Reliability, queuing and computer Science applications, Prentice Hall of India, Pvt. Ltd., New Delhi (2009).

UNIT-V: Reliability
Basic concept-Reliabilities of series and parallel systems-System Reliability-Hazard function Reliability and Availability-Maintainability.

Chapter 15 & 16 (15.1 - 15.2, 16.1 - 16.5) Kishore S. Trivedi, Probability & Statistics with Reliability, queuing and computer Science applications, Prentice Hall of India, Pvt. Ltd., New Delhi (2009).

Recommended Text

1. R.E.Walpole, R.H.Mayers, S.L.Mayers and K.Ye, Probability and Statistics for engineers and scientists, 7th Edition, Pearson Education (2003).
2. Kishore S. Trivedi, Probability & Statistics with Reliability, queuing and computer Science applications, Prentice Hall of India, Pvt. Ltd., New Delhi (2009).

Reference Books

1. J.L.Devore, Probability and Statistics, 5th Edition, Thomson (2000).
2. R.A.Johnson, Miller & Freund's Probability and Statistics for Engineers, Seventh edition, Pearson Education, New Delhi (2008).
3. Gupta S.C. and Kapoor V.K., Fundamentals of Mathematical Statistics, Sultan Chand & Sons, 11th Edition, 2003.

MDMA 35E : STABILITY THEORY

Objective : The ability to understand the characteristics of various types of nonlinearities present inphysical systems.2.The ability to carry out the stability analysis of non-linear control systems.

Tolearn the methods for analyzing the behavior of nonlinear control systems and the designing of control systems

CO1 .The ability to carry out the analysis and design of digital control systems.

CO2 The ability to design compensators for digital control system to achieve desiredspecifications. Ability to perform the stability analysis nonlinear systems by Lyapunovmethoddevelop design skills in optimal control problems

CO3.The ability to represent digital control systems using state space models. Ability to derive discrete-time mathematical models in both time domain (difference equations, state equations) and z-domain

CO4.The ability to analyze the effect sampling on stability, controllability and observability. Ability to predict and analyze transient and steady-state responses and stability and sensitivity of both open-loop and closed-loop linear, time-invariant, discrete-time control systems

CO5.The ability to design digital controllers for industrial applications. Ability to acquire knowledge of state space andstate feedback in modern control systems, pole placement, design of state observers and output feedback controller.

Skilldevelopment: *Understanding and learning how control theory underpins modern technologies and provides an insight in mathematical analysis*.

Unit I: Observability: Linear Systems – Observability Grammian – Constant coefficient systems – Reconstruction kernel – Nonlinear Systems.
Chapter 2 (18 Hours)
Unit II: Controllability: Linear systems – Controllability Grammian – Adjoint systems – Constant coefficient systems – Steering function – Nonlinear systems.
Chapter 3: Sections 3.1-3.3 (18 Hours)
Unit III: Stability: Stability – Uniform stability – Asymptotic stability of linear systems - Linear time varying systems – Perturbed linear systems – Nonlinear systems.
Chapter 4 (18 Hours)
Unit IV: Stabilizability: Stabilization via linear feedback control – Bass method – Controllable subspace – Stabilization with restricted feedback.
Chapter 5 (18 Hours)
Unit V: Optimal Control: Linear time varying systems with quadratic performance criteria – Matrix Riccati equation – Linear time invariant systems – Nonlinear Systems.
Chapter 6 (18 Hours)
K.Balachandran and **J.P.Dauer**, *Elements of Control Theory*, Narosa, New Delhi, 1999.

Books for Supplementary Reading and Reference: 1. R.Conti, *Linear Differential Equations and Control,* Academic Press, London, 1976. 2. R.F.Curtain and A.J.Pritchard, *Functional Analysis and Modern Applied Mathematics,* Academic Press, New York, 1977. 3. J.Klamka, *Controllability of Dynamical Systems*, Kluwer Academic Publisher, Dordrecht, 1991. 4. J.Klamka, *Controllability of Dynamical Systems*, Kluwer Academic Publisher, Dordrecht, 1991

MDMA 41 : APPLIED NUMERICAL ANALYSIS

Objectives:
✓ To know and apply different numerical techniques to solve algebraic and differential equations.
✓ To know methods of finding approximate values for definite integrals.

Course Outcome: At the end of the Course, the Students will able to	
CO1	Apply finite difference to evaluate polynomial using interpolation for equal andunequal intervals
CO2	Solve simultaneous linear equations by using Gauss elimination method, matrix inversion method, Gauss-Jordan Method, Gauss – Seidal method
CO3	Compute derivative of a function at the point in the given interval by using Newton's and Gauss forward and backward differences formulae.
CO4	Utilize General Quadrature formula, Trapezoidal rule, Simpson's rule, Weddle's Rule in integration and find the numerical solution of the first order ordinary differential equations
CO5	Analyzing the Difference Quotients - classification of PDE - Schmidt explicit formula – Crank-Nicolson method - Hyperbolic equations - Solution of two dimensional heat equations

Enterpreneurship: *Solve algebraic and transcendental equations using appropriate numerical methods and approximate a function using appropriate numerical methods.*

UNIT-I: Algebra and Transcendental System of Equations

General iterative method - Bisection method - Secant method – Newton - Raphson method- solution of system of equations - Gaussian elimination method - Gauss Jordan method – LU decomposition method - Rate of convergence Gauss - Seidel method - Eigen value of a Matrix - Power method - Jacobi method.

Text Book 1: Chapter 2: 2.3 - 2.4 & 2.10 - 2.11

UNIT-II: Interpolation

Interpolation with equal intervals - Newton's forward and backward formula – Central difference interpolation formula - Gauss forward and backward formula - Sterling's formula - Bessel's formula - Interpolation with unequal intervals - Lagrange's interpolation and inverse interpolation formula - Newton's divided difference formula - Interpolation with cubic spline.

Text Book 1: Chapter 3: 3.2 - 3.4 & 3.7 and Chapter 4: 4.1

UNIT-III: Numerical Differentiation and Integration

Numerical differentiation - Formulae for derivatives - Maxima and minima of a tabulated function - Numerical Integration - Trapezoidal rule - Simpson's and rules - Romberg's method - Applications.

Text Book 1: Chapter 5: 5.2, 5.4 & 5.6 - 5.7

UNIT-IV: Ordinary Differential Equations

First order equations - System of equations and higher order equations - Taylor series method - Euler method - Modified and Improved Euler's method - Runge kutta methods - Fourth order Runge kutta method - Multi step methods: Adams - Bash forth and Milne's methods - Linear two point Boundary value problems: The shooting method.

Text Book 1: Chapter 6: 6.2 - 6.4 & 6.6 - 6.7.

UNIT-V: Partial Differential Equations

Difference Quotients - classification of partial differential equations - Elliptic equation Laplace equation by Liebmann's iteration process - Poisson's equations - Parabolic equations – Schmidt explicit formula – Crank-Nicolson method - Hyperbolic equations - Solution of two dimensionalheat equations.

Text Book 2: Chapter 12:12.1 - 12.7, 12.8.2 & 12.9

Recommended Text

1. M.K.Jain, S.R.K.Iyengar and R.K.Jain, Numerical methods for Scientific and Engineering, New Age International Ltd., 5th Edition (2010).
2. B.S.Grewal, J.S.Grewal, Numerical methods in Engineering and Science, Khanna Publishers, New Delhi, 1999.

Reference Books

1. S.S.Sastry, Introductory methods of Numerical Analysis, Prentice Hall of India Pvt.Ltd., New Delhi (2003).
2. M.K.Venkatraman, Numerical methods in Science and technology, National Publishers Company, 1992.
3. P.Kandasamy, K.Thilagavathy and K.Gunavathy, Numerical methods, S.Chandand Company, New Delhi, 2003.

MDMA 42 : CALCULUS OF VARIATIONS AND INTEGRAL EQUATIONS

OBJECTIVES	• The aim of the course is to introduce to the students the concept of calculus of variation and its applications. • Introduce various types of integral equations and how to solve these equations.
Course Outcome: At the completion of the Course, the Students will able to	
CO1	Students know the concept and properties of variational problems with fixed and moving boundaries, functions of dependent and independent variables and also solve some applications problems in mechanics.
CO2	Able to solve differential equations and integral equation problems. Find the solution of eigen value, eigen functions.
CO3	Implementation of various methods to solve Fredholm Intergral equation.
CO4	Students gain acquire knowledge about Hilbert – Schmidt Theory
CO5	Deriving the complex Hilbert space – Orthogonal system of function and Solutions of Fredholm of Integral equation of first kind

Enterpreneurship: *Problem solving skill utilize the so obtained knowledge to build and enhance important work in sciences and engineering, business, manifacturing and communication.*

Unit I: Variational problems with fixed boundaries:

The concept of variation and its properties – Euler's equation – Variational problems for Functions – Functional dependent on higher order derivatives – Functions of several independent variables – Some applications to problems of Mechanics.

Unit II: Variational problems with moving boundaries:

Movable boundary for a functional dependent on two functions – one –sided variations- Reflection and Refraction of extremals – Diffraction of light rays.

Unit III: Integral Equation:

Introduction – Tyoes of Kernals- Eign value and Egien functions – connection with differential equations – Solution of an integral equation – Initial value problems – Boundary value problems.

Unit IV: Solution of Fredholm Intergral equation:

Second kind with separable kernel – Orthogonality and reality eigen function – Fredholm Integral equation with separable kernel – Solution of Fredholm Integral Equation by successive substitution – successive approximation – Volterra integral equation – Solution by successive substitution.

Unit V: Hilbert – Schmidt Theory :

Complex Hilbert space – Orthogonal system of function – Gram –Schmitorthognalization process – Hilbert – Schmidt theorems – Solutions of Fredholm of Integral equation of first kind.

Text Book:

1. A.S. Gupta, Calculus of Variations with Application, Prentice Hall of India,New Delhi, 2005.

2. Sudir k. Pundir and Rimple Pundir, Integral Equations and Boundary Value Problems, Pragati Prakasam, Meerut, 2005.

MDMA 43 : ANALYTIC NUMBER THEORY

Objective:
Find quotients and remainders from integer division. Apply Euclid's algorithm and backwards substitution, understand the definitions of congruences, residue classes and least residues. Add and subtract integers, modulo n, multiply integers and calculate powers, modulo n . Determine multiplicative inverses, modulo n and use to solve linear congruences.

CO1: learn to apply mathematical concepts and principles to perform numerical and symboliccomputations.use technology appropriately to investigate and solve mathematical and statisti-cal problems.

CO2: lean write clear and precise proofs.iv. communicate effectively in both written and oral form. Understand the concept of a congruence and use various results related to con-gruences including the Chinese Remainder Theorem.

CO3: Demonstrate the ability to read and learn mathematics and/or statistics inde-pendently. Identify certain number theoretic functions and their properties

CO4: To dentify and apply various properties of and relating to the integers includingthe Well-Ordering Principle, primes, unique factorization, the division algorithm,and greatest common divisors.

CO5: Solve certain types of Diophantine equations. Identify how number theory is related to and used in cryptography.

Skilldevelopment: *Laying strong foundation on the mathematical concepts train the students to choose the career in Mathematics Research and Education.*

Unit I: Divisibility theory in the integers The Division Algorithm – The Greatest Common Divisor – The Euclidean Algorithm – The Diophantine equation , Primes and their distribution: The Fundamental theorem of Arithmetic.
Chapter 2: 2.1 – 2.4 and Chapter 3: 3.1 (18 Hours)
Unit II: The Theory of Convergences Karl Friedrich Gauss – Basic Properties of Congruence – Specia Divisibility Tests – Linear congruences. Fermat's Theorem: Pierre de Fermat – Fermat's Factorization Method – The
Little theorem and Wilson's theorem.
Chapter 4: 4.1 – 4.4 and Chapter 5: 5.1 – 5.4 (18 Hours)
Unit III: Number Theoretic Functions The functions and – The Mobius inversion formula – The Greatest Integer Function. Euler's
generalization of Fermat's theorem: Leonhard Euler – Euler's Phi-function – Euler's theorem

Chapter 6: 6.1 – 6.3 and Chapter 7: 7.1 – 7.3. (18 Hours)
Unit IV: Primitive Roots and Indices The Order of an integer Modulo – Primitive Roots for Primes – Composite Numbers having Primitive Roots – The Theory of Indices.
Chapter 8: 8.1 – 8.4 (18 Hours)
Unit V: The Quadratic Reciprocity law
Euler's Criterion – The Legendre Symbol and its properties – Quadratic Reciprocity – Quadratic Congruence with Composite Moduli.
Chapter 9: 9.1 – 9.4 **(18 Hours)**
Text book:
David M. Burton, Elementary Number Theory, 6th edition, McGraw Hill, 2006.
Reference Books:
Tom. M. Apostal, **"Introduction to Analytic Number Theory"**, Springer, New Delhi, 1993.
Thomas Koshy, **"Elementary Number Theory"**, Elesvier, California, 2005.

N. Robbins, **"Beginning Number Theory"**, 2nd Edition, Narosa Publishing, New Delhi, 2007.

Gareth A. Jones and J. Mary Jones, **"Elementary Number Theory",** Springer Verlag, Indian Reprint, 2005.

MDMA 44 : GRAPH THEORY

Objectives: To enable the students to learn the fundamental concepts of Graphtheory

Course Outcome: At the end of the Course, the Students will able to	
CO1	Recognize the characteristics of graph
CO2	Convert the graph into matrix form and explain operations on graphs
CO3	Analyze special graphs like Eulerian graphs and Hamiltonian graphs with examples
CO4	Describe planar graphs and identify the chromatic number of the graph.
CO5	Discuss the different types of graphs and five color theorem and, four color conjecture - Non Hamiltonian planar graphs.

Employability: *Be able to formulate and prove central theorems about trees, matching, connectivity, colouring and planar graphs. discuss the concept of graph, tree, Euler graph, cut set and Combinatorics.*

UNIT-I:Graphs and Sub-Graphs

Graphs and simple graphs - Graph isomorphism - Incidence and adjacency matrices – Subgraphs-Vertex degrees - Path and Connection cycles – Applications: The shortest path problem– Trees: Trees - Cut edges and bonds - Cut vertices - Cayley's formula.

Chapter 1 (Except 1.9) and Chapter 2 (Except 2.5)

UNIT-II Connectivity

Connectivity – Blocks - Euler tours and Hamilton cycles: Euler tours – Hamilton cycles –Applications: The Chinese postman problem.

Chapter 3 (Except 3.3) and Chapter 4 (Except 4.4)

UNIT-III: **Matchings**

Matchings - Matching and coverings in bipartite graphs - Perfect matchings –. Edge colorings:Edge chromatic number - Vizing's theorem - Applications: The timetabling problem.

Chapter 5: (Except 5.5) and Chapter 6

UNIT-IV:Independent sets and Cliques

Independent sets - Ramsey's theorem - Turan's theorem - Vertex colorings: Chromatic number - Brook's theorem – Hajo's conjecture - Chromatic polynomials - Girth and chromatic number.

Chapter 7: (Except 7.4 - 7.5) and Chapter 8 (Except 8.6)

UNIT-V:**Planar Graphs**

Plane and planar graphs - Dual graphs - Euler's formula - Bridges - Kuratowski's Theorem(statement only) – The Five color theorem and The Four color conjecture - Non Hamiltonianplanar graphs.

Chapter 9 (Except 9.8)

Recommended Text

1. J.A.Bondy and U.S.R. Murthy, Graph Theory and Applications, Macmillan, London,1976.

Reference Books

1. R.J. Wilson, Introduction to Graph Theory, Pearson Education, 4th Edition, 2004, IndianPrint.
2. J.Clark and D.A.Holton, A First look at Graph Theory, Allied Publishers, New Delhi,1995.
3. R.J. Wilson, Introduction to Graph Theory, Pearson Education, 4th Edition, 2004, IndianPrint.
4. Gary Chartrand, Introduction to Graph Theory, Tata McGraw-Hill Education, 2006.
5. A.Gibbons, Algorithmic Graph Theory, Cambridge University Press, Cambridge, 1989.
6. Douglas B.West, Introduction to Graph Theory, Pearson, 2000.

MDMA 45A : MATLAB & LaTeX

Objectives:

- This course provides basic fundamentals on MATLAB, primarily for numerical computing. To learn the characteristics of script files, functions and function files. To enhance the programming skills with the help of MATLAB and its features which allow learning and applying specialized technologies.
- Format words, lines, and paragraphs, design pages, create lists, tables, references, and figures in LATEX. Creating a table of contents and lists of figures and tables; as well as how to cite books,• create bibliographies, and generate an index.

Course Outcome: At the end of the Course, the Students will able to

CO1	It lays foundation for doing matrix manipulations, plotting of functions and data, implementation of algorithms, and creation of user interfaces.
CO2	It helps in integrating computation, visualization and programming in an easy to use¬ environment where problems and solutions are expressed in familiar mathematical notations. This software is a more flexible programming tool for users in order to create large and complex application programs
CO3	It consists of set of tools that facilitates for developing, managing, debugging and profiling M files, and MATLAB's applications.
CO4	Use LaTeX and various templates acquired from the course to compose Mathematical documents, presentations, and reports.

Enterpreneurship: *It helps in integrating computation, visualization and programming in an easy to use environment where problems and solutions are expressed in familiar mathematical notations.*

UNIT-I

Introduction - Basics of MATLAB, Input – Output, File types – Platform dependence – General commands.

Chapter 1

UNIT-II

Interactive Computation: Matrices and Vectors – Matrix and Array operations – Creating and Using In line functions – Using Built-in Functions and On-line Help – Saving and loading data – Plotting simple graphs.

Chapter 3

UNIT-III

Applications – Linear Algebra - Solving a linear system – Finding Eigen values and Eigen vectors–Matrix Factorizations.

Chapter 5: 5.1, 5.2

UNIT-IV

Applications – Data Analysis and Statistics – Numerical Integration – ordinary differential equations – Nonlinear Algebraic Equations.

Chapter 5: 5.3 to 5.6

UNIT-V

Chapters in Text book 2

Recommended Text

1. RUDRA PRATAP, Getting Started with MATLAB-A Quick Introduction for Scientists and Engineers, Oxford University Press, 2010.

2. John Warbrick, Essential Latex++, 1994

Reference Books

1. William John Palm, Introduction to Matlab 7 for Engineers, McGraw-Hill Professional, 2005.

2. Dolores M. Etter, David C. Kuncicky, Introduction to MATLAB 7, Prentice Hall, 2004.