Savitribai Phule Pune University, Pune

(Formerly University of Pune)

Two Year Degree Program in Mathematics

(Faculty of Science & Technology)

Revised Syllabi for

M.Sc. - Mathematics

Part-I

(For Colleges Affiliated to Savitribai Phule Pune University, Pune)

Choice Based Credit System Syllabus

To be implemented from the Academic Year 2019-2020

Title of the Course: M.Sc./M.A. (Mathematics)

Preamble :

Savitribai Phule Pune University has decided to change the syllabi of various faculties from June,2019. Taking into consideration the rapid changes in science and technology and new approaches in different areas of mathematics and related subjects, Board of studies in Mathematics after a thorough discussion with the teachers of Mathematics from different colleges affiliated to University of Pune has prepared the syllabus of M.Sc./M. A. Semester - I and Semester- II (w.e.f. 2019-20) Mathematics course under the Choice Based Credit System (CBCS).
The model curriculum as developed by U. G. C. is used as a guideline for the present syllabus.

Aims and Objectives of the new curriculum :

i) To maintain updated curriculum.
ii) To take care of fast development in the knowledge of mathematics.
iii) To enhance the quality and standards of Mathematics Education.
iv) To provide a broad common frame work, for exchange, mobility and free dialogue across the Indian Mathematical and associated community.
v) To create and aptitude for Mathematics in those students who show a promise for higher studies and creative work in Mathematics.
vi) To create confidence in others, for equipping themselves with that part of Mathematics which is needed for various branches of Sciences or Humanities in which they have aptitude for higher studies and original work.

Sr. No.	Courses		% of Assessment		Total Marks	Credit
	Semester-I	Semester-II	I A	U E		
1	MTUT111: Linear Algebra	MTUT 121: Complex Analysis	30	70	100	4
2	MTUT112: Real Analysis	MTUT 122: General Topology	30	70	100	4
3	MTUT113. Group Theory	MTUT 123: Ring Theory	30	70	100	4
4	MTUT114. Advance Calculus	MTUT 124: Advance Numerical Analysis	30	70	100	4
5	MTUT115: Ordinary Differential Equations	MTUT 125: Partial Differential Equations	30	70	100	4

The study tour is important to learn, network and collaborate with academics, students and industry professionals in Science and Technology, Engineering and Mathematics recruiters . It is also important to know and understand different cultures, easily adapt to new environments, skillfully negotiate business deals. **Therefore department of Mathematics should arrange a student's study tour in each academic year .**

Equivalence of previous syllabus with new syllabus:

Semester I and Semester II Old Courses Equivalent New Courses

Old Courses	New Courses
MT 501: Real Analysis	MTUT112: Real Analysis
MT 502: Advanced Calculus	MTUT114: Advanced Calculus
MT 503: Group Theory	MTUT113: Group Theory
MT 504: Numerical Analysis	MTUT124: Advanced Numerical Analysis
MT 505: Ordinary Differential Equations	MTUT115: Ordinary Differential Equations
MT 601: Complex Analysis	MTUT121: Complex Analysis
MT 602:General Topology	MTUT122: General Topology
MT 603: Rings and Modules	MTUT123: Rings and Modules
MT 604: Linear Algebra	MTUT111: Linear Algebra
MT 605:Partial Differential Equations	MTUT125: Partial Differential Equations

Details of Syllabus:

Semester I

MTUT-111: LINEAR ALGEBRA

Unit I. Vector Spaces. **[06 Hours]**

1.1 Vector Spaces,
1.2 Subspaces and linear dependence,
1.3 The concepts of basis and dimension
1.4 Some general theorems about finitely generated vector spaces..

Unit II. Linear Transformation and Matrices. **[06 Hours]**

2.1 Linear Transformations
2.2 Addition and multiplication of matrices.
2.3 Linear Transformations and matrices.

Unit III. Vector Spaces with an Inner product. **[10 Hours]**

3.1 The concept of symmetry
3.2 Inner Product.

Unit IV. The Theory of a single Linear Transformation. **[10 Hours]**

4.1 Basic Concepts
4.2 Invariant Subspaces
4.3 The Triangular form theorem
4.4 The rational and Jorden canonical forms.

Unit V. Dual Vector Spaces and Multilinear Algebra. **[14 Hours]**

5.1 Quotient spaces and dual vector spaces
5.2 Bilinear forms and duality
5.3 Direct sums and tensor products
5.3 A proof of the elementary divisor theorem.

Unit VI. Orthogonal and Unitary Transformations **[14Hours]**

6.1 The structure of orthogonal transformations
6.2 The principal axis theorem
6.3 Unitary transformation and the spectral theorem.

Recommended Book:

Charles W. Curtis: Linear Algebra An Introductory Approach, Springer.
Chapter 2: Sect- 3, 4, 5, 7. Chapter 3: Sect-11 (except Theorem 11.7, Definition

11.8, Theorem 11.7′, Definition 11.10, Theorem 11.11, Theorem 11.12), 13.
Chapter 4: Section 15. Chapter 7: Sections 22, 23, 24, 25. Chapter 8: Sections 26, 27, 28, 29.
Chapter 9: Sections 30, 31,32

Reference Books:

1) Vivek Sahai, Vikas Bist, Linear Algebra, Narosa Publication.
2) K. Hoffman, Ray Kunze, Linear Algebra, Prentice Hall of India Private Ltd.
3) P. B. Bhattacharya, S. R. Nagpaul, S. K. Jain, First Course in Linear Algebra, 2 nd Edition, New Age International Publishers.
4) S. Kumaresan, Linear Algebra A Geometric Approach, PHI Learning Private Ltd

MTUT-112 : REAL ANALYSIS

Unit-I. Lebesgue Measure: [20 Hours]

1.1 Lebesgue Outer Measure
1.2 σ- algebra of Lebesgue Measurable Sets
1.3 Outer and Inner Approximation of Lebesgue Measurable Sets
1.4 Countable Additivity
1.5 Contiuity
1.6 Borel-Cantelli Lemma
1.7 Non-measurable Set, Cantor Set, Cantor-Lebesgue Function.

Unit-II. Lebesgue Measurable Functions: [18 Hours]

2.1 Definition and algebra of Lebesgue Measurable Functions
2.2 Sequential Point wise Limits and Approximations by Simple Functions
2.3 Littlewood's Three Principles
2.4 Egoroff's Theorem
2.5 Lusin's Theorem.

Unit-III. Differentiation and Integration: [22 Hours]

3.1 Continuity of Monotone Functions
3.2 Lebesgue's Differentiation Theorem
3.3 Functions of Bounded Variation
3.4 Jordan's Theorem, Absolutely Continuous Functions
3.5 Integration of Derivatives
3.6 Differentiation of Indefnite Integral
3.7 Fundamental Theorem of Calculus.

Recommended Book:

Real Analysis-Fourth Edition, Authors: H. L. Royden, P. M. Fitzpatrick.
Sections: Chapter 2 - sections 2.1 to 2.7, Chapter 3 - sections 3.1 to 3.3, Chapter 6 - sections 6.1 to 6.5.

Reference Books:

1. Real Analysis: Authors: Elias M. Stein, Rami Shakarchi.
2. Basic Real Analysis: Author: Anthony W. Knapp.
3. Beginning Functional Analysis: Authors: Karen Saxe (Springer International Edition)

MTUT- 113: GROUP THEORY

UNIT-I: Groups, Subgroups and Cyclic Groups [12 HOURS]

1.1 Definition and Examples of Groups; Properties of Groups; Order of a finite

group; Order of an element in group; Subgroups; Subgroup Tests.

1.2 Cyclic Groups; Properties of Cyclic Groups; Classification of Subgroups of Cyclic Groups.

UNIT-II: Permutation Groups- Isomorphism [12 HOURS]

2.1 Permutations Groups; Definition and notation; Cycles; Properties of Permutations; Even and odd permutations; Alternating Group of degree n.

2.2 Isomorphism of Group; Properties of Isomorphisms; Cayley's Theorem; Automorphisms.

UNIT-III: Cosets, Lagrange's Theorem, External Direct Product [12 HOURS]

3.1 Cosets; Lagrange's Theorem and consequences; Stabilizer and orbit; Orbit stabilizer theorem.

3.2 External Direct Products; Properties of External Direct Products; Group of units modulo n as an external direct product.

UNIT-IV: Normal Subgroups, Homomorphisms [12 HOURS]

4.1 Normal Subgroups; Factor Groups; Application of Factor Groups; Internal Direct Products.

4.2 Group Homomorphisms; Definition and examples; Properties of Homomorphisms; First Isomorphism Theorem.

UNIT-V: Sylow Theorems [8 HOURS]

5.1 Fundamental Theorem of Finite Abelian Groups; Isomorphism Classes of Abelian Groups; Proof of the Fundamental Theorem.

5.2 Conjugacy Classes; Class Equation; The Sylow Theorems; Applications of Sylow's Theorems.

UNIT-VI: Group Actions [4 HOURS]

6.1 Group Actions; Definition and examples; Permutation representation associated to a given action; Faithful action; Kernel; Left regular action.

Recommended Books:

1) **Joseph Gallian, Contemporary Abstract Algebra**, 9 th Edition, Cengage Learning India Pvt. Ltd. ISBN-10 9353502527
   Chapters 2, 3, 4, 5 (except last article: A check Digit Scheme based on D5). Chapters 6, 7 (except: Rotations of a cube and Soccer Ball and subsequent Article). Chapter 8 (except: Applications). Chapters 9, 10, 11, 24.
2) **David S. Dummit, Richard M. Foote**, Abstract Algebra, 2 nd Edition, John Wiley and Sons (Indian Edition)
   In chapter 1 only Article 1.7.

Reference Books:

1) I. S. Luthar, I. B. S. Passi, Algebra (Vol 1), Groups; Narosa Publication House.
2) I. N. Herstein, Topics in Algebra, Wiley Eastern Ltd.
3) M. Artin, Algebra, Prentice Hall.
4) N. S. Gopalkrishnan, University Algebra, Wiley Eastern Ltd.
5) J. B. Fraleigh, A First Course in Abstract Algebra, 7 th Edition, Pearson Edition Ltd.

MTUT 114: ADVANCED CALCULUS

UNIT-I: Differential Calculus of Scalar and Vector Fields [20 Hours]

1.1 Functions from R^n to R^m . Scalar and vector fields; Limits and continuity.

1.2 The derivative of a scalar field with respect to a vector; Directional derivatives and partial derivatives; Partial derivatives of higher order; Inverse function theorem and Implicit Function theorem . (without proof)

1.3 Directional derivatives and continuity; The total derivatives; The gradient of a scalar field; A sufficient condition for differentiability.

1.4 A chain rule for derivatives of scalar fields; Applications to geometry. Level sets.Tangent planes; Derivatives of vector fields; Differentiability implies continuity; The chain rule for derivatives of vector fields; Matrix form of the chain rule.

UNIT-II: Line Integrals [10 Hours]

2.1 Paths and line integrals; Other notations for line integrals; Basic properties of line integrals.

2.2 The concept of work as a line integral; Line integrals with respect to arc length; Further applications of line integrals.

2.3 Open connected sets. Independence of the path; The first and second fundamental theorem of calculus for line integrals; Necessary and sufficient conditions for a vector field to be a gradient; Necessary conditions for a vector field to be a gradient.

UNIT-III: Multiple Integrals [15 Hours]

3.1 Partitions of rectangles. Step functions; The double integral of a step function; The definition of the double integral of a function defined and bounded on a rectangle ; Upper and lower double integrals; Evaluation of double integral by repeated one- dimensional integration; Geometric interpretation of the double integral as a volume; Worked examples.

3.2 Integrability of continuous functions; Integrability of bounded functions with discontinuities ; Double integrals extended over more general regions; Applications to area and volume; Worked examples.

3.3 Green's theorem in the plane; Some applications of Green's theorem; A necessary and sufficient condition for a two dimensional vector field to be a gradient.

3.4 Change of variables in a double integral; Special cases of the transformation formula with proof; General case of the transformation formula with proof; Extensions to higher dimensions; Change of variables in an n-fold integral; Worked examples.

UNIT-IV: Surface Integrals [15 Hours]

4.1 Parametric representation of a surface; The fundamental vector product; The fundamental vector product as a normal to the surface; Area of a parametric surface.

4.2 Surface integrals; Change of parametric representation ; Other notations for surface integrals

4.3 The theorem of Stokes; Curl and divergence of a vector field; Properties of curl and divergence; the divergence theorem (Gauss' theorem) and applications of divergence theorem.

Recommended Book:

1) **Tom M. Apostol**, Calculus Volume II (Second Edition) Indian Reprint 2016 (John Wiley & Sons, Inc) ISBN:978-81-265-1520-2.
   Unit 1: Chapt 8 : 8.1 to 8.22. ;Unit 2: Chapt 10 : 10.1 to 10.11, 10.14 to 10.16.
   Unit 3: Chapt 11 : 11.1 to 11.15; 11.19 to 11.22, 11.26 to 11.34.;
   Unit 4: Chapt 12: 12.1 to 12.15, 12.19 and 12.21.
2) For " Inverse Function Theorem" and "Implicit Function Theorem", use Tom M. Apostol, Mathematical Analysis 2nd Edition Narosa Publication 20th Reprint 2002.

ISBN 978-81-85015-66-8. Unit-I: Chapter 13: Sections 13.3 and 13.4.

Reference Books:

1) Gerald B. Folland, Advanced Calculus , Pearson Edn 2012. 2) A Devinatz, Advanced Calculus (Holt , Reinhart & Winston) 1968.

MTUT 115: ORDINARY DIFFERENTIAL EQUATIONS

Unit I: Linear equations of the first order [04 hours]

1.1 Linear equations of the first order
1.2 The equation y'+ay=0
1.3 The equation y'+ay=b(x)
1.4 The general linear equations of first order

Unit II: Linear equations with constant coefficients [14 hours]

2.1 Second order homogeneous equations
2.2 Initial value problems for second order equations
2.3 Linear dependence and independence
2.4 Formula for the Wronskian
2.5 Non homogeneous equations of order two
2.6 Homogeneous equations of order n
2.7 Non homogeneous equations of order n
2.8 Algebra of constant coefficients equations

Unit III: Linear equations with variable coefficients [14 hours]

3.1 Initial value problems for the homogeneous equation
3.2 Solutions of the homogeneous equation
3.3 Wronskian and linear independence
3.4 Reduction of order of the homogeneous equation
3.5 Non homogeneous equations with analytic coefficients
3.6 Homogeneous equations
3.7 Legendre equation

Unit IV: Linear Equations with regular singular points [14 hours]

4.1 Euler equation
4.2 Second order equation with regular singular points
4.3 Exceptional cases
4.4 Bessel's equation
4.5 Regular singular point at infinity

Unit V: Existence and uniqueness of solutions to first order equations [14 hours]

5.1 Equations with variables separated
5.2 Exact equations
5.3 Method of successive approximations
5.4 Lipschitz condition
5.5 Approximation to, and uniqueness of, solutions

Recommended Book:

E. A. Coddington, An Introduction to Ordinary Differential Equations (Prentice-Hall).

Chapter- 1.4 -1.7; 2.1-2.12; 3.1-3.8; 4.1- 4 .4, 4.6- 4.8; 5.1 -5.8.

Reference Books :

G. F. Simmons and S. G. Krantz, Dfferential Equatins (Tata McGraw-Hill).

SEMESTER-II

MTUT 121: COMPLEX ANALYSIS

Unit I: Basic Properties of Complex Numbers: **[04 hours]**

1.1 Arithmetic of Complex Numbers

1.2 The Fundamental Theorem of Algebra

Unit II Complex Differentiability and Conformality: **[10 hours]**

2.1 Definition and Basic Properties

2.2 Polynomials and Rational Functions

2.3 Analytical Functions: Power Series

2.4 Cauchy- Riemann Equations

2.5 Review of Calculus of Two Real Variables

Unit III: Contour Integration: **[14 hours]**

3.1 Definition and Basic Properties

3.2 Existence of Primitives

3.3 Cauchy-Goursat Theorem

3.4 Cauchy's Theorem via Green's Theorem

3.5 Cauchy's Integral Formulae

3.6 Analyticity of Complex Differentiable Functions

3.7 A Global Implication: Liouville

3.8 Mean Value and Maximum Modulus

Unit IV: Zeros and Poles: **[14 hours]**

4.1 Zeros of Holomorphic Functions

4.2 Open Mapping Theorem

4.3 Singularities

4.4 Laurent Series

4.5 Residues

Unit V: Application to Evaluation of Definite Real Integrals: **[12 hours]**

5.1 Trigonometric Integrals

5.2 Improper Integrals

5.3 Jordan's Inequality

Unit VI: Local And Global Properties: **[06 hours]**

6.1 Schwarz's Lemma

6.2 Local mapping

Recommended Book:

1. **Anant R. Shastri, Basic Complex Analysis of One Variable**, Macmillan Publishers India, 2010 .
   Ch. 1: 1.1 , 1.8.1 , Ch. 2: 2.1,2.2, 2.3(only 2.3.1); Ch. 3: 3.1, 3.2,
   Ch. 4: 4.1 to 4.5, 4.7,4.8 , Ch. 5: 5.1 to 5.5, Ch. 6: 6.1 to 6.3; Ch. 7: 7.1, 7.2

Reference Books:

1. J. W. Brown and R.V. Churchill, Complex Variables and Applications, Indian Edition. (Eighth Edition)
2. John. B. Conway, Functions of One Complex Variable, Springer International Student Edition. (Second Edition)
3. S. Ponnusamy, Foundation of Complex Analysis, Narosa Publications. (Second Edition)
4. L.V. Alfors, Complex Analysis, McGraw Hill, 1979.

MTUT- 122 : GENERAL TOPOLOGY

Unit 1. Prerequisites **[10 hours]**

1.1 : Cartesian Products
1.2 : Finite Sets
1.3 : Countable and Uncountable Sets
1.4 : Infinite Sets and Axiom of Choice
1.5 : Well Ordered Sets

Unit 2. Topological Spaces and Continuous Functions **[20 hours]**

2.1 : Topological Spaces
2.2 : Basis for a Topology
2.3 : Order Topology
2.4 : Product Topology on X× Y
2.5 : Subspace Topology
2.6 : Closed Sets and Limit Points
2.7 : Continuous Functions
2.8 : The Product Topology, Metric Topology
2.9 : Quotient Topology

Unit 3. Connected and Compact Spaces **[15 hours]**

3.1 : Connected spaces
3.2 : Connected Subspaces of Real Line
3.3 : Components and Local Connectedness
3.4 : Compact spaces
3.5 : Compact Subspaces of the Real Line
3.6 : Limit point compactness
3.7 : Local Compactness

Unit 4. Countablity and Separation Axioms **[15 hours]**

4.1 : The Countability Axioms
4.2 : The Separation axioms and Normal Spaces
4.3 : Urysohn Lemma (State Only)
4.4 : The Urysohn Metrization Theorem (State Only)
4.5 : Tietze Extension Theorem
4.6 : Tychonoff's Theorem.

Text Book:

J. R. Munkres, Topology: A First Course, (Prentice Hall, Second Edition), 2000.
Chapter 1 : Sec. 5 to 7, Sec. 9 to 10. ;Chapter 2: Sec.12 to 22.
Chapter 3 : Sec. 23 to 29. ; Chapter 4 : Sec. 30 to 35 ; Chapter 5 : Sec. 37.

Reference Books:

1**.** K J¨anich. Topology. Springer, 1984.
2. M A Armstrong. Basic Topology. Springer, 1983.
3. O Viro, O Ivanov, V Kharlamov, and N Netsvetaev. Elementary Topology: Problem Textbook, AMS Publication, 2008.
4. K. D. Joshi, Introduction to General Topology, John Wiley & Sons .

MTUT123: RING THEORY

Unit I : Rings **[16 hours]**

1.1 Basic Terminologies
1.2 Rings of Continuous functions

1.3 Matrix Rings, Polynomial Rings, Power Series Rings, Laurent Rings, Boolean Rings, Some Special Rings,

1.4 Direct Products

1.5 Several Variables

1.6 Opposite Rings

1.7 Characteristic of a Ring.

Unit II : Ideals **[12 hours]**

2.1 Definitions

2.2 Maximal Ideals

2.3 Generators

2.4 Basic Properties of Ideals

2.5 Algebra of Ideals

2.6 Quotient Rings

2.7 Ideals in Quotient Rings

2.8 Local Rings.

Unit III : Homomorphisms of Rings **[10 hours]**

3.1 Definitions and Basic Properties

3.2 Fundamental theorems

3.3 Endomorphism Rings

3.3 Field of Fractions, Prime fields.

Unit IV : Factorisation Domains **[12 hours]**

4.1 Division in Domains

4.2 Euclidean Domains

4.3 Principal Ideal Domains

4.4 Factorisation Domains

4.5 Unique Factorisation Domains

4.6 Eisenstein's Crieterion.

Unit V : Modules **[10 hours]**

5.1Definitions and Examples

5.2 Direct Sums

5.3 Free Modules

5.4 Quotient Modules

5.5 Homomorphism

5.6 Simple Modules

5.7 Modules over PID.

Recommended Book:

C. Musili, Rings and Modules, 2nd Revised Edition, Narosa Publishing House. (Chapters 1, 2, 3, 4, 5)

Reference Books :

1. Dummit and Foote, Abstract Algebra, second edition (Wiley India).
2. Luther and Passi, Algebra II, Narosa Publishing House.
3. Jain and Bhattacharya, Basic Abstract Algebra, 2nd Edition, Cambridge University Press.
4. Joseph Gallian, Contemporary Algebra, 7th Edition, Narosa Publishing House.

MTUT 124: ADVANCED NUMERICAL ANALYSIS

UNIT-I: Root Finding Methods [10 HOURS]

1.1 Convergence; Floating Point Number Systems; Floating Point Arithmetic.

1.2 Fixed Point Interaction Schemes; Newton's Method; Secant Method; Accelerating Convergence.

UNIT-II: System of Equations [14 HOURS]

2.1 Gaussian Elimination; Pivoting Strategies.

2.2 Error Estimates and Condition Number; LU decomposition; Direct Factorization.

2.3 Iterative Techniques for Linear Systems: Basic Concepts and Methods.

2.4 Nonlinear Systems of Equations.

UNIT-III: Eigenvalues and Eigenvectors [10 HOURS]

3.1 The Power Method.

3.2 The Inverse Power Method.

3.3 Reduction to Symmetric Tridiagonal Form.

3.4 Eigenvalues of Symmetric Tridiagonal Matrices.

UNIT-IV: Differentiation and Integration [14 HOURS]

4.1 Numerical Differentiation, Part II.

4.2 Numerical Integration – The Basics and Newton-Cotes Quadrature; Composite Newton-Cotes Quadrature.

UNIT-V: Initial Value Problems of Ordinary Differential Equations [12 HOURS]

5.1 Euler's Method; Higher-Order One-Step Methods: Taylor Methods.

5.2 Runge-Kutta Methods.

5.3 Multistep Methods.

5.4 Convergence and Stability Analysis.

RECOMMEDNDED BOOK:

1) **Brian Bradie**, A Friendly Introduction to Numerical Analysis, Pearson Prentice Hall 2007, ISBN 978-81-317-0942-9.
   Sections: 1.2 – 1.4, 2.3 – 2.6, 3.1, 3.2, 3.4 -3.6, 3.8, 3.10, 4.1, 4.2, 4.4, 4.5, 6.2, 6.4, 6.5, 7.2-7.6
2) **John H. Mathews, Kurtis D. Fink**, Numerical Methods Using Matlab, 4th Edition, Pearson Education (Singapore) Pte. Ltd., Indian Branch, Delhi 2005. (SciLab commands similar to MatLab commands can be used for problems)

REFERENCE BOOKS:

1) **K .E. Atkinson**, An Introduction to Numerical Analysis, Second Edition, John Wiley & Sons.
2) **J. L. Buchaman, P. R. Turner**, Numerical Methods and Analysis, McGraw Hill, 1992 cop.
3) **M.K. Jain, S.R.K. Iyengar, R.K. Jain**, Numerical Methods for Scientific &

MTUT 125: PARTIAL DIFFERENTIAL EQUATIONS

1. INTRODUCTION TO PARTIAL DIFFERENTIAL EQUATIONS OF FIRST ORDER [12 Hours]

1.1 Genesis of first order P.D.E.

1.2 Compatible systems

1.3 Charpit's method

1.4 Jacobi's method

1.5 Non Linear first order P.D.E

2. FUNDAMENTAL CONCEPTS [16 Hours]

2.1 First order partial differential equations

2.2 Classification of Second Order PDE

2.3 Canonical Forms, Canonical Form for Hyperbolic Equation , Canonical Form for Parabolic Equation , Canonical Form for Elliptic Equation

2.4 Linear Partial Differential Equations with Constant Coefficients, General Method for Finding CF of Reducible Non-homogeneous Linear PDE ,General Method to Find CF of Irreducible Non-homogeneous Linear PDE

3. ELLIPTIC AND PARABOLIC DIFFERENTIAL EQUATIONS [20 Hours]

3.1 Occurrence of the Laplace and Poisson Equations , Derivation of Laplace Equation , Derivation of Poisson Equation

3.2 Boundary Value Problems (BVPs)

3.3 Green's first and second identities

3.4 Dirichlet Problem for a Rectangle

3.5 Occurrence of the Diffusion Equation

3.6 Boundary Conditions

3.7 Elementary Solutions of the Diffusion Equation

3.8 Dirac Delta Function

3.9 Separation of Variables Method (with examples)

4. **HYPERBOLIC DIFFERENTIAL EQUATIONS [12 Hours]**

4.1 Occurrence of the Wave Equation

4.2 Derivation of One-dimensional Wave Equation

4.3 Solution of One-dimensional Wave Equation by Canonical Reduction

4.4 Vibrating string- Variable separable solution(examples)

Recommended Books

1. An Elementary Course in Partial Differential Equations, T Amarnath ,Narosa Publication (Chapter 1)
2. Intoduction to Partial Differential Equations, K.Sankara Rao (Third Edition) PHI Learning Private Limited

Reference Books

1. Elements of Partial Differential Equations, Ian Sneddon, Dover Publication
2. An Introduction to Partial Differential Equations, Yehud Pinchor & Jaco Rubinstein, Cambridge University Press