UNIVERSITY OF MADRAS

SYLLABUS

M.Sc. Mathematics

(for the academic year 2021-2022)

S.No	Faculty Name	Qualification
1	Mrs.K.Malligeswari	M.Sc., M.Phil
2	Mrs.J.Prabha	M.Sc., M.Phil, B.Ed, SLST '90
3	Mrs.P.P.Sharmishta	M.Sc., M.Phil, SET
4	Mrs.N.K.Vinodhini	M.Sc., M.Phil, SET
5	Mrs.K.Sheela	M.Sc., M.Phil, SET
6	Mrs.R.Mahalakshmi	M.Sc., M.Phil
7	Mrs.C.D.Kalpana	M.Sc., M.Phil
8	Mrs.R.Mary Mercy Priya	M.Sc., M.Phil
9	Dr. M.Arunma	M.Sc., M.Phil, PGDAOR, Ph.D, SET
10	Dr .S.Geetha	M.Sc., M.Phil, Ph.D, SET
11	Mrs.S.Gayathri	M.Sc., M.Phil, PGDCA, SET
12	Dr .V.Sathyavathy	M.Sc., M.Phil, M.Ed, Ph.D, SET
13	Mrs.B.Kavitha	M.Sc., M.Phil, B.Ed, SET

M.Sc. DEGREE COURSE IN MATHEMATICS

SEMESTER –I

ALGEBRA-I (MFF1A)

COURSE OBJECTIVES

1. To provide deep knowledge about various algebraic structures.
2. To develop a strong foundation in linear algebra that provide a basic for advanced studies.
3. Understand Sylows theorem and its applications.
4. To Study of Linear Transformations, Algebra of Polynomials, Invariant space and their properties.
5. Give particular attention to canonical forms of linear transformations, diagonalizations of linear transformations, matrices and determinants.

SYLLABUS

UNIT-I

Group actions on a set, Sylow theorems - Applications of Sylow theorems.
Chapter 3: Section 3.6
Chapter 4: Sections 4.2 and 4.3 from J.B. Farleigh

UNIT II

Direct products - Finite abelian groups- Modules.
Chapter 2: Sections 2.13 and 2.14
Chapter 4: Section 4.5 from I.N. Herstein

UNIT III

Linear Transformations: Canonical forms –Triangular form - Nilpotent transformations.

Chapter 6: Sections 6.4 , 6.5 from I.N. Herstein

UNIT IV

Jordan form - rational canonical form
Chaper 6: Sections 6.6 and 6.7 from I.N. Herstein

UNIT V

Trace and transpose - Hermitian, unitary, normal transformations, real quadratic form.

Chapter 6 : Sections 6.8, 6.10 and 6.11 (Omit 6.9) from I.N. Herstein

COURSE OUTCOMES

Student will be able to

1. Understand the basic concepts of matrices of Linear Transformation and its applications.
2. Recognize the concepts of Invariant subspaces and induced transformation.
3. Understand the basic concept of determinants and its properties.
4. Analyze canonical Form, Jordan Form and Rational canonical Form.
5. They gain knowledge about larger group like direct product.

REFERENCE BOOKS

1. J.B. Fraleigh, A first course in Abstract Algebra, 5th edition.
2. I.N. Herstein. Topics in Algebra (II Edition) Wiley, 2002.
3. M.Artin, Algebra, Prentice Hall of India, 1991.
4. P.B.Bhattacharya, S.K.Jain, and S.R.Nagpaul, Basic Abstract Algebra (II Edition) Cambridge University Press, 1997. (Indian Edition)
5. I.S.Luther and I.B.S.Passi, Algebra, Vol. I –Groups(1996); Vol. II Rings (1999), Narosa Publishing House , New Delhi
6. D.S.Dummit and R.M.Foote, Abstract Algebra, 2nd edition, Wiley, 2002.
7. N.Jacobson, Basic Algebra, Vol. I & II W.H.Freeman (1980); also published by Hindustan Publishing Company, New Delhi.

MAPPING-COURSE OBJECTIVES WITH PROGRAMME OUTCOME

CO/PO	PO1	PO2	PO3	PO4	PO5
CO1	M	L	L	L	S
CO2	S	S	M	L	S
CO3	M	L	S	M	S
CO4	M	L	S	S	S
CO5	L	M	M	S	S

Key: S-Strong, M-Medium/Moderate, L-Low

REAL ANALYSIS – I (MFF1B)

COURSE OBJECTIVES

1. To provide a deeper and rigorous understanding of functions of bounded variation.
2. To understand the concepts of absolute and conditional convergence of infinite series.
3. To provide deep insight into the concept of Riemann-Stieltjes integral.
4. To understand the concepts of double sequences and rearrangement of series.
5. To study the convergence of sequences of functions.

SYLLABUS

Unit 1

Functions of bounded variation - Introduction - Properties of monotonic functions - Functions of bounded variation - Total variation - Additive property of total variation - Total variation on [a, x] as a function of x - Functions of bounded variation expressed as the difference of two increasing functions - Continuous functions of bounded variation.

Chapter – 6 : Sections 6.1 to 6.8

Infinite Series : Absolute and conditional convergence - Dirichlet's test and Abel's test - Rearrangement of series - Riemann's theorem on conditionally convergent series.

Chapter 8 : Sections 8.8, 8.15, 8.17, 8.18

Unit 2

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 and lower integrals - Riemann's condition - Comparison theorems.

Chapter - 7 : Sections 7.1 to 7.14

Unit 3

The Riemann-Stieltjes Integral - Integrators of bounded variation-Sufficient conditions for the existence of Riemann-Stieltjes integrals-Necessary conditions for the existence of Riemann-Stieltjes integrals- Mean value theorems for Riemann - Stieltjes integrals - The integrals 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 integral-Riemann-Stieltjes integrals depending on a parameter-Differentiation under the integral sign-Lebesgue criteriaon for the existence of Riemann integrals.

Chapter - 7 : 7.15 to 7.26

Unit 4

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 - Cesarosummability - Infinite products.

Chapter - 8 Sec, 8.20, 8.21 to 8.26

Power series - Multiplication of power series - The Taylor's series generated by a function - Bernstein's theorem - Abel's limit theorem - Tauber's theorem

Chapter 9: Sections 9.14 9.15, 9.19, 9.20, 9.22, 9.23

Unit 5

Sequences of Functions - Pointwise 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 - Uniform convergence and Riemann - Stieltjes integration – Non-uniform Convergence and Term-by-term Integration - Uniform convergence and differentiation - Sufficient condition for uniform convergence of a series - Mean convergence.

Chapter -9 Sec 9.1 to 9.6, 9.8,9.9, 9.10,9.11, 9.13

COURSE OUTCOMES

Students will be able to

1. Acquaint with the details of the functions of bounded variation and Total variation and to verify convergence of series using Dirichlet's and Abel's tests.'
2. Apply the concepts of step functions, Euler's summation formula, Integration by parts etc.
3. Apply the concepts of mean value theorems in making estimate for the integral and fundamental theorems of integral calculus to integrate a derivative.
4. Determine the convergence of double sequences and double series and to find the disk of convergence of power series.
5. Understand the effect of uniform convergence on the limit function with respect to continuity, differentiability and integrability.

REFERENCE BOOKS

1. Tom M.Apostol :*Mathematical Analysis*, 2nd Edition, Narosa,1989.
2. Bartle, R.G. *Real Analysis*, John Wiley and Sons Inc., 1976.
3. Rudin,W. *Principles of Mathematical Analysis*, 3rd Edition. McGraw Hill Company, New York, 1976.
4. Malik,S.C. and Savita Arora. *Mathematical Anslysis*, Wiley Eastern Limited.New Delhi, 1991. 1.
5. Sanjay Arora and Bansi Lal, *Introduction to Real Analysis*, Satya Prakashan, New Delhi, 1991.
6. Gelbaum, B.R. and J. Olmsted, *Counter Examples in Analysis*, Holden day, San Francisco, 1964.
7. A.L.Gupta and N.R.Gupta, *Principles of Real Analysis*, Pearson Education, (Indian print) 2003.

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MAPPING-COURSE OBJECTIVES WITH PROGRAMME OUTCOME

CO/PO	PO1	PO2	PO3	PO4	PO5
CO1	S	M	S	M	S
CO2	S	M	S	M	S
CO3	S	M	S	S	S
CO4	S	S	M	S	S
CO5	S	M	M	S	S

Key: S-Strong, M-Medium/Moderate, L-Low

ORDINARY DIFFERENTIAL EQUATIONS (MFF1C)

COURSE OBJECTIVES:

1.To study solutions of linear differential equations with constant and variable coefficients.
2.To understand and able to apply various theoretical ideas that underlined in existence and uniqueness theorems.
3.To provide knowledge in Linear dependence and independence, Wronskian etc.,
4.To find power series solutions of special type of differential equations.
5.To study boundary value problems.

SYLLABUS

UNIT I

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.
Chapter 2: Sections 1 to 6

UNIT II

Linear equations with constant coefficients
Homogeneous and non-homogeneous equation of order n –Initial value problems-Annihilator method to solve non-homogeneous equation.

Chapter 2 : Sections 7 to 11.

UNIT-III

Linear equation with variable coefficients
Initial value problems -Existence and uniqueness theorems – Solutions to solve a non-homogeneous equation – Wronskian and linear dependence – reduction of the order of a homogeneous equation – homogeneous equation with analytic coefficients-The Legendre equation.

Chapter : 3 Sections 1 to 8 (Omit section 9)

UNIT -IV

Linear equation with regular singular points
Second order equations with regular singular points –Exceptional cases – Bessel equation
Chapter 4 : Sections 3, 4 and 6 to 8 (omit sections 5 and 9)

UNIT-V

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
Chapter 5 : Sections 1 to 6 (Omit Sections 7 to 9)

COURSE OUTCOMES

Students will be able to
1. Recall the types of linear homogeneous equations of second order equations.
2. Analyse non homogeneous ODE using the method of underlined coefficients.
3. Understand and apply the theorems on IVP to ODE and comprehend the EULERS equation and Bessel's equations, and Regular singular points.
4. to analyse solutions using appropriate methods and give examples.
5.formulate Green's function for BVP

REFERENCE BOOKS

1. E.A.Coddington, A introduction to ordinary differential equations (3rd Printing) Prentice-Hall of India Ltd.,New Delhi, 1987.
2. Williams E. Boyce and Richard C. Di Prima, Elementary differential equations and boundary value problems,John Wiley and sons, New York, 1967.
3. George F Simmons, Differential equations with applications and historical notes, Tata McGraw Hill, New Delhi, 1974.
4. N.N. Lebedev, Special functions and their applications, Prentice Hall of India, New Delhi, 1965.
5. W.T.Reid. Ordinary Differential Equations, John Wiley and Sons, New York, 1971
6. M.D.Raisinghania,Advanced Differential Equations, S.Chand& Company Ltd. New Delhi 2001
7. B.Rai, D.P.Choudhury and H.I. Freedman, A Course in Ordinary Differential Equations, Narosa Publishing House, New Delhi, 2002.

MAPPING-COURSE OBJECTIVES WITH PROGRAMME OUTCOME

CO/PO	PO1	PO2	PO3	PO4	PO5
CO1	S	S	M	S	M
CO2	M	M	M	M	S
CO3	M	M	M	M	M
CO4	M	S	M	M	M
CO5	S	M	M	M	M

Key: S-Strong, M-Medium/Moderate, L-Low

GRAPH THEORY (MFF1D)

COURSE OBJECTIVES

1. To give in depth knowledge about types of graphs, vertex and edge connectivity.
2. Analyze the concepts of connectivity, Euler and Hamilton cycles.
3. To understand matchings and colourings.
4. To provide knowledge on independent sets , cliques and colourability .
5. To understand planarity and a few applications of graph theory.

SYLLABUS

Unit 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 ana Bonds – Cut Vertices.
Chapter 1 (Section 1.1 – 1.7)
Chapter 2 (Section 2.1 – 2.3)

Unit 2

Connectivity, Euler tours and Hamilton Cycles : Connectivity – Blocks – Euler tours – Hamilton Cycles.
Chapter 3 (Section 3.1 – 3.2)
Chapter 4 (Section 4.1 – 4.2)

Unit 3

Matchings, Edge Colourings : Matchings – Matchings and Coverings in Bipartite Graphs – Edge Chromatic Number – Vizing's Theorem.
Chapter 5 (Section 5.1 – 5.2)
Chapter 6 (Section 6.1 – 6.2)

Unit 4

Independent sets and Cliques, Vertex Colourings : Independent sets – Ramsey's Theorem – Chromatic Number – Brooks' Theorem – Chromatic Polynomials.
Chapter 7 (Section 7.1 – 7.2)
Chapter 8 (Section 8.1 – 8.2, 8.4)

Unit 5

Planar graphs : Plane and planar Graphs – Dual graphs – Euler's Formula – The Five- Colour Theorem and the Four-Colour Conjecture.
Chapter 9 (Section 9.1 – 9.3, 9.6)

COURSE OUTCOMES

Students will be able to

1. Identify the properties of different graphs and their applications.
2. Demonstrate knowledge of basic concepts of graph theory.
3. Apply the concepts of graph theory in research activities.
4. Identify the applications of planarity and colourability.
5. Apply the concepts of connectivity, Euler and Hamilton cycles in the real life situations.

REFERENCE BOOKS

1. J.A.Bondy and U.S.R. Murthy ,Graph Theory and Applications , Macmillan, London, 1976.
2. J.Clark and D.A.Holton ,A First look at Graph Theory, Allied Publishers, New Delhi , 1995.
3. R. Gould. Graph Theory, Benjamin/Cummings, Menlo Park, 1989.
4. A.Gibbons, Algorithmic Graph Theory, Cambridge University Press, Cambridge, 1989.

5. R.J.Wilson and J.J.Watkins, Graphs : An Introductory Approach, John Wiley and Sons, New York, 1989.
6. R.J. Wilson, Introduction to Graph Theory, Pearson Education, 4th Edition, 2004, Indian Print.
7. S.A.Choudum, A First Course in Graph Theory, MacMillan India Ltd. 1987.

MAPPING-COURSE OBJECTIVES WITH PROGRAMME OUTCOME

CO/PO	PO1	PO2	PO3	PO4	PO5
CO1	S	S	M	S	S
CO2	S	S	S	S	M
CO3	S	S	S	S	M
CO4	M	M	M	S	M
CO5	S	S	S	M	S

Key: S-Strong, M-Medium/Moderate, L-Low

DISCRETE MATHEMATICS (MFFAB)

COURSE OBJECTIVES

1. To provide students with an overview of Lattices
2. To provide students with applications of Lattices
2.To Demonstrate knowledge of basic concepts of Boolean Algebra.
4. To study about Irreducible polynomials and factorization of polynomials.
3.To Introduce the concept of Coding Theory.

SYLLABUS

UNIT-I

Lattices:
Properties of Lattices: Lattice definitions – Modular and distributive lattice; Boolean algebras: Basic properties – Boolean polynomials, Ideals; Minimal forms of Boolean polynomials.
Chapter 1: § 1 A and B § 2A and B. § 3.

UNIT-II
Applications of Lattices:
Switching Circuits: Basic Definitions - Applications
Chapter 2: § 1 A and B

UNIT-III

Finite Fields

Chapter 3: § 2

UNIT-IV
Polynomials :
Irreducible Polynomials over Finite fields – Factorization of Polynomials
Chapter 3: § 3 and §4.

UNIT-V
Coding Theory :
Linear Codes and Cyclic Codes.
Chapter 4 § 1 and 2

COURSE OUTCOMES

1. Will learn an overview of Lattices
2. Acquire knowledge about applications of Lattices
2. Apply recursive functions and solve recurrence relations. .
4. Understand Irreducible polynomials and factorization of polynomials.
3. Recognize the concept of Coding Theory.

REFERENCE BOOKS

1. "Rudolf Lidl and Gunter Pilz, Applied Abstract Algebra, Springer-Verlag, New York, 1984.
2. A. Gill, Applied Algebra for Computer Science, Prentice Hall Inc., New Jersey.
3. J.L. Gersting, Mathematical Structures for Computer Science(3rdEdn.), Computer Science Press, New York.
4. S. Wiitala, Discrete Mathematics- A Unified Approach, McGraw Hill Book Co.

MAPPING-COURSE OBJECTIVES WITH PROGRAMME OUTCOME

CO/PO	PO1	PO2	PO3	PO4	PO5
CO1	S	M	S	S	M
CO2	S	S	S	S	S
CO3	S	S	M	S	M
CO4	S	S	S	S	S
CO5	S	S	S	S	S

Key: S-Strong, M-Medium/Moderate, L-Low

SEMESTER –II

ALGEBRA-II (MFF2A)

COURSE OBJECTIVES

1. Understand the concept of extension fields and roots of polynomials
2. Analyze the elements of Galois theory and Galois Groups over the rationals
3. Understand the basic concepts of solvability by radicals and finite fields.
4. Introduce the concept of solvability of polynomial equations by radicals.
5. Study the Cayley digraphs of groups.

SYLLABUS

UNIT-I

Extension fields – Transcendence of e.
Chapter 5: Section 5.1 and 5.2

UNIT II

Roots of Polynomials. - More about roots
Chapter 5: Sections 5.3 and 5.5

UNIT III

Elements of Galois theory.
Chapter 5: Section 5.6

UNIT IV

Finite fields - Wedderburn's theorem on finite division rings.
Chapter 7: Sections 7.1 and 7.2 (Theorem 7.2.1 only)

UNIT V

Solvability by radicals – Galois groups over the Rationals -– A theorem of Frobenius.

Chapter 5: Sections 5.7 and 5.8
Chapter 7: Sections 7.3

COURSE OUTCOMES

Student will be able to

1. Provide deep knowledge about splitting fields, separable extension.
2. Relation between the concept of field extensions and Galois Theory.
3. Formulate some special roots of polynomials.
4. Construct Galois group for several classical situations.
5. Understand some important result about normal and separable extensions.

REFERENCE BOOKS

1. I.N. Herstein. Topics in Algebra (II Edition) Wiley, 2002.
2. M.Artin, Algebra, Prentice Hall of India, 1991.

3. P.B.Bhattacharya, S.K.Jain, and S.R.Nagpaul, Basic Abstract Algebra (II Edition) Cambridge University Press, 1997. (Indian Edition)

4. I.S.Luther and I.B.S.Passi, Algebra, Vol. I –Groups(1996); Vol. II Rings, (1999)Narosa Publishing House , New Delhi.

5. D.S.Dummit and R.M.Foote, Abstract Algebra, 2nd edition, Wiley, 2002.

6. N.Jacobson, Basic Algebra, Vol. I & II Hindustan Publishing Company, New Delhi.

MAPPING-COURSE OBJECTIVES WITH PROGRAMME OUTCOME

CO/PO	PO1	PO2	PO3	PO4	PO5
CO1	S	M	M	S	S
CO2	M	S	M	M	S
CO3	S	S	S	M	S
CO4	M	M	S	M	S
CO5	S	M	M	L	S

Key: S-Strong, M-Medium/Moderate, L-Low

REAL ANALYSIS – II (MFF2B)

COURSE OBJECTIVES

1. To provide a deeper and rigorous understanding of measure on the real line.
2. To understand the concepts of integration of functions of a real variable.
3. To understand the concept of Fourier series and Fourier integrals.
4. To provide deep insight into the concepts of multi variable differential calculus.
5. To understand the concepts of implicit functions and extreme problems.

SYLLABUS

Unit 1

Measure on the Real line - Lebesgue Outer Measure - Measurable sets - Regularity - Measurable Functions - Borel and Lebesgue Measurability.
Chapter - 2 Sec 2.1 to 2.5 of de Barra

Unit 2

Integration of Functions of a Real variable - Integration of Non- negative functions - The General Integral - Riemann and Lebesgue Integrals.
Chapter - 3 Sec 3.1,3.2 and 3.4 of de Barra

Unit 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 Thorem - The convergence and representation problems in 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 summability of Fourier series- Consequences of Fejer's theorem - The Weierstrass approximation theorem.
Chapter 11 : Sections 11.1 to 11.15 of Apostol.

Unit 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 - A sufficient condition for differentiability - A sufficient condition for equality of mixed partial derivatives - Taylor's theorem for functions of R^n to R^1.
Chapter 12 : Section 12.1 to 12.14 of Apostol

Unit 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.
Chapter 13 : Sections 13.1 to 13.7 of Apostol.

COURSE OUTCOMES

Students will be able to

1. Understand basic properties of measurable functions.
2. Analyse measurable sets and Lebesgue measure.
3. Solve the problems based on convergence of Fourier series.
4. Apply the concepts of multivariable differential calculus in various fields.
5. Understand the mathematical proofs in real analysis like inverse function theorem and the implicit function theorem.

REFERENCE BOOKS

1. G. de Barra, Measure Theory and Integration, New Age International, 2003 (for Units I and II)
2. Tom M.Apostol :Mathematical Analysis, 2nd Edition, Narosa,1989.
3. Burkill,J.C. The Lebesgue Integral, Cambridge University Press, 1951.
4. Munroe,M.E. Measure and Integration. Addison-Wesley, Mass.1971.
5. Royden,H.L.Real Analysis, Macmillan Pub. Company, New York, 1988.
6. Rudin, W. Principles of Mathematical Analysis, McGraw Hill Company, New York,1979.
7. Malik,S.C. and Savita Arora. Mathematical Analysis, Wiley Eastern Limited. New Delhi, 1991.

MAPPING-COURSE OBJECTIVES WITH PROGRAMME OUTCOME

CO/PO	PO1	PO2	PO3	PO4	PO5
CO1	S	S	M	M	S
CO2	S	S	M	M	S
CO3	M	S	S	S	S
CO4	S	M	S	S	S
CO5	S	S	M	M	S

Key: S-Strong, M-Medium/Moderate, L-Low

PARTIAL DIFFERENTIAL EQUATIONS (MFF2C)

COURSE OBJECTIVES

1. To Introduce different methods to solve partial differential equations.
2. To Acquire knowledge in classification of PDE and the methods to solve.
3. To Enables the students to find the solutions of PDE in practical application like Engineering, physics etc.,
4. To impart knowledge of PDE for modelling the general structure of solutions.
5. To solve boundary value problems and point out its significance.

SYLLABUS

UNIT-I

Partial Differential Equations of First Order: Formation and solution of PDE- Integral surfaces – Cauchy Problem order eqn Orthogonal surfaces – First order non-linear – Characteristics – Compatible system – Charpit method. Fundamentals: Classification and canonical forms of PDE.
Chapter 0: 0.4 to 0.11 (omit 0 .1,0.2,0.3 and 0.11.1)
Chapter 1: 1.1 to 1.5

UNIT-II

Elliptic Differential Equations: Derivation of Laplace and Poisson equation – BVP – Separation of Variables – Dirichlet's Problem and Newmann Problem for a rectangle – Interior and Exterior Dirichlets's problems for a circle – Interior Newmann problem for a circle – Solution of Laplace equation in Cylindrical – Examples.
Chapter 2: 2.1, 2. 2 ,2.5 to 2.11&2.13 (omit 2.3 and 2.4&2.12 and Examples)

UNIT-III

Parabolic Differential Equations: Formation and solution of Diffusion equation – Dirac-Delta function – Separation of variables method – Solution of Diffusion Equation in Cylindrical .
Chapter 3: 3.1 to 3.6 and 3.9 (omit 3.7,3.8 & 3.10)

UNIT-IV

Hyperbolic Differential equations: Formation and solution of one-dimensional wave equation – canocical reduction – IVP- d'Alembert's solution – Vibrating string – Forced Vibration – IVP and BVP for two-dimensional wave equation – Periodic solution of one-dimensional wave equation in cylindrical and spherical coordinate systems – vibration of circular membrane – Uniqueness of the solution for the wave equation

Chapter 4: 4.1 to 4.8,4.10&4.11(omit 4.9,4.12&4.13)

UNIT-V

Green's Function: Green's function for laplace Equation – methods of Images – Eigen function Method – Green's function for the wave and Diffusion equations.

Laplace Transform method: Solution of Diffusion and Wave equation by Laplace Transform.

Chapter 5: 5.1 to 5.6 Chapter 6: 6.13.1 and 6.13.2 only (omit (6.14)

COURSE OUTCOMES

Students will be able to

1. Understand and remember the physical situations with real world problems to construct mathematical models using PDE.
2. Analyse the type of PDE and different methods to solve.
3. Evaluate Laplace equation and analyse its application
4. Investigate and solve boundary value problems and point out its significance.
5. Be critically competent in solving linear PDEs using classical solution method.

REFERENCE BOOKS

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

2. R.C.McOwen, Partial Differential Equations, 2ndEdn. 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.

MAPPING-COURSE OBJECTIVES WITH PROGRAMME OUTCOME

CO/PO	PO1	PO2	PO3	PO4	PO5
CO1	S	S	M	S	S
CO2	S	S	M	S	S
CO3	S	S	S	S	M
CO4	S	S	M	S	S
CO5	S	S	M	M	M

Key: S-Strong, M-Medium/Moderate, L-Low

PROBABILITY (MFF2D)

COURSE OBJECTIVES

1. To develop the mathematical probability and their applications
2. To examine the relationship between explanatory and response variables.
3. To interpret the properties of distributions in probability theory.
4. To acquire knowledge about characteristics and properties of theoretical distributions.
5. To Study un biasedness and consistency of limit theorems.

SYLLABUS

UNIT-I

Random Events and Random Variables: Random events – Probability axioms – Combinatorial formulae – conditional probability – Bayes Theorem – Independent events – Random Variables – Distribution Function – Joint Distribution – Marginal Distribution – Conditional Distribution – Independent random variables – Functions of random variables.

Chapter 1: Sections 1.1 to 1.7

Chapter 2 : Sections 2.1 to 2.9

UNIT-II

Parameters of the Distribution

Expectation- Moments – The Chebyshev Inequality – Absolute moments – Order parameters – Moments of random vectors – Regression of the first and second types.

Chapter 3 : Sections 3.1 to 3.8

UNIT-III

Characteristic functions : Properties of characteristic functions – Characteristic functions and moments – semi-invariants – characteristic function of the sum of the independent random variables – Determination of distribution function by the Characteristic function – Characteristic function of multidimensional random vectors – Probability generating functions.

Chapter 4 : Sections 4.1 to 4.7

UNIT-IV

Some Probability distributions: One point , two point , Binomial – Polya – Hypergeometric – Poisson (discrete) distributions – Uniform – normal gamma – Beta – Cauchy and Laplace (continuous) distributions.

Chapter 5 : Section 5.1 to 5.10 (Omit Section 5.11)

UNIT-V

Limit Theorems : Stochastic convergence – Bernaulli law of large numbers – Convergence of sequence of distribution functions – Levy Cramer Theorems – de Moivre-Laplace Theorem – Poisson, Chebyshev, Khintchine Weak law of large numbers – Lindberg Theorem – LapunovTheroem – Borel-Cantelli Lemma - Kolmogorov Inequality and Kolmogorov Strong Law of large numbers.

Chapter 6 : Sections 6.1 to 6.4, 6.6 to 6.9 , 6.11 and 6.12. (Omit Sections 6.5, 6.10,6.13 to 6.15)

COURSE OUTCOMES

Students will be able to

1. Study multivariate distributions and the independence of random variables.
2. Predicting the effect of an independent variable on the dependent variable.
3. Apply the concepts and methods to find the characteristic functions of the distributions.
4. Evaluating the characteristics of different discrete and continuous distributions.
5. Understand the convergence of distributions and central limit theorem

REFERENCE BOOKS

1. M. Fisz, Probability Theory and Mathematical Statistics, John Wiley and Sons, New York, 1963.
2. R.B. Ash, Real Analysis and Probability, Academic Press, New York, 1972
3. K.L.Chung, A course in Probability, Academic Press, New York, 1974.
4. R.Durrett, Probability : Theory and Examples, (2nd Edition) Duxbury Press, New York, 1996.
5. V.K.RohatgiAn Introduction to Probability Theory and Mathematical Statistics, Wiley Eastern Ltd., New Delhi, 1988(3rd Print).
6. S.I.Resnick, A Probability Path, Birhauser, Berlin,1999.
7. B.R.Bhat , Modern Probability Theory (3rd Edition), New Age International (P)Ltd, New Delhi, 1999

MAPPING-COURSE OBJECTIVES WITH PROGRAMME OUTCOME

CO/PO	PO1	PO2	PO3	PO4	PO5
CO1	S	S	S	M	S
CO2	S	S	M	M	S
CO3	S	S	M	S	S
CO4	M	S	S	M	M
CO5	S	S	M	M	S

Key: S-Strong, M-Medium/Moderate, L-Low

MATHEMATICAL PROGRAMMING (MFFAD)

COURSE OBJECTIVES

1. To make the students understand solving LPP using various methods.
2. To understand the concept of Nonlinear Programming Problems.
3. Solving LPP through Dynamic Programming.
4. To solve Classical Optimization Method
5. To understand the concept of Goal Programming problem.

SYLLABUS

Unit 1

Integer Linear Programming : Types of Integer Linear Programming Problems – Concept of Cutting Plane – Gomory's All Integer Cutting Plane Method – Gomory's Mixed Integer Cutting Plane Method Branch and Bound Method.
Chapter 7 .

Unit 2

Dynamic Programming : Characteristics of Dynamic Programming Problem - Developing Optimal Decision Policy- Dynamic Programming under Certainty – DP approach to solve LPP

Chapter 22

Unit 3

Classical Optimization Method : Unconstrained Optimization – Constrained Multi-variable Optimization with Equality Constraints – Constrained Multi-variable Optimization with inequality Constraints.

Non-linear Programming Methods : Examples of NLPP – General NLPP – Graphical Solution – Quadratic Programming – Wolfe's modified simplex method

Chapter 23, Chapter 24: Sections 24.1 to 24.4 (Omit Beale's method)

Unit 4

Linear Programming Problem – Simple problems.

Parametric Linear Programming : Variation in the coefficients cj, Variations in the Right hand side, bi

Chapter 4 : Section 4.1 to 4.3, Chapter 29

Unit 5

Goal Programming : Difference between LP and GP approach – Concept of Goal Programming – Goal Programming Model formulation – Graphical solution method of Goal Programming.

Chapter 8 : Section 8.1 to 8.5

COURSE OUTCOMES

Students will be able to

1. Explain various techniques to solve real life problems expressed in terms of LPP.
2. Able to solve Dynamic Programming Problem using LPP.
3. Apply the fundamental concept of Integer Programming Problems.
4. Understand the Classical Optimization Method with Unconstrained Optimization and Constrained Multi- variable Optimization with Equality Constraints.
5. Learn about the differences between Linear Programming Problem and Goal Programming Problem.

REFERENCE BOOKS

1. J.K.Sharma, Operations Research,(fourth edition) Macmillan, New Delhi, 2009.
2. Hamdy A. Taha, Operations Research, (Seventh edition) Prentice – Hall of India Private Limited, New Delhi, 1997
3. F.S. Hiller &J.Lieberman Introduction to Operations Research (7th edition) Tata – McGraw Hill Company , New Delhi, 2001.
4. Beightler. C, D.phillips, B. Wilde, Foundations of Optimization (2nd edition) Prentice Hall Pvt Ltd., New York, 1979
5. S.S. Rao – Optimization Theory and Applications, Wiley Eastern, New Delhi. 1990..

MAPPING-COURSE OBJECTIVES WITH PROGRAMME OUTCOME

CO/PO	PO1	PO2	PO3	PO4	PO5
CO1	S	S	M	S	S
CO2	M	M	S	S	S
CO3	S	M	M	S	S
CO4	M	M	S	S	S
CO5	S	S	S	M	M

Key: S-Strong, M-Medium/Moderate, L-Low

PROGRAMMING IN C^{++} (MFFBB)

COURSE OBJECTIVES

1. To give the students an awareness of the object-oriented programming.
2. To enable the students to write the C++ programs using classes, functions, and interfaces.
3. To make applications using C++ programs.
4. To develop class and objects in C++ programs.
5. To become familiar with operator overloading and type conversion in C++

SYLLABUS

UNIT – I : Tokens, Expressions and Control Structures
Chapter 3 : Sections 3.1 – 3.25

UNIT – II : Functions in C^{++}
Chapter 4 : Sections 4.1 to 4.12

UNIT – III : Classes and Objects
Chapter 5 : Sections 5.1 to 5.19

UNIT – IV : Constructors and Destructors
Chapter 6 : Sections 6.1 – 6.11

UNIT – V: Operator overloading and Type Conversions
Chapter 7 : Sections 7.1 to 7.9

COURSE OUTCOMES

Students will be able to

1. Write, compile, and execute C++ programs.
2. Create Classes, objects, arrays of objects, constructors, and Destructors.
3. Analyse over loading operators and inheritance.
4. Deliberate files, pointers, and templates. Create, design, and develop quality programs in C++.
5. Learn how to use C++ templates, files, and advanced features.

REFERENCE BOOKS

1. E. Balaguruswamy, Object Oriented Programming with C^{++}, Tata McGraw Hill, New Delhi, 1999
2. D.Ravichandran, Programming with C^{++}, Tata McGraw Hill, New Delhi, 1996

MAPPING-COURSE OBJECTIVES WITH PROGRAMME OUTCOME

CO/PO	PO1	PO2	PO3	PO4	PO5
CO1	S	S	S	S	M
CO2	S	M	S	S	M
CO3	S	M	M	S	M
CO4	S	S	S	S	M
CO5	S	S	S	S	S

Key: S-Strong, M-Medium/Moderate, L-Low

SEMESTER III

COMPLEX ANALYSIS I (MFF3A)

COURSE OBJECTIVES

1. To Evaluate integrals, singularities and determine the values of integrals using residues.
2. To Apply and understand about limits and to know how they are used in series and problems.
3. To Analyze functions of complex variables in terms of continuity and analyticity.
4. To understand Power series expansion of various functions.
5. To have widespread knowledge of partial fractions and entire functions.

SYLLABUS

Unit I

Cauchy's Integral Formula: The Index of a point with respect to a closed curve – The Integral formula – Higher derivatives.

Local Properties of analytical Functions : Removable Singularities-Taylors's Theorem – Zeros and poles – The local Mapping – The Maximum Principle.

Chapter 4 : Section 2 : 2.1 to 2.3, Section 3 : 3.1 to 3.4

Unit II

The general form of Cauchy's Theorem : Chains and cycles Simple Connectivity - Homology - The General statement of Cauchy's Theorem - Proof of Cauchy's theorem - Locally exact differentials Multilply connected regions - Residue theorem - The argument principle.
Chapter 4 : Section 4 : 4.1 to 4.7, Section 5: 5.1 and 5.2

UNIT-III
Evaluation of Definite Integrals and Harmonic Functions: Evaluation of definite integrals - Definition of Harmonic functions and basic properties - Mean value property - Poisson formula.
Chapter 4 : Section 5 : 5.3, Section 6 : 6.1 to 6.3

Unit IV
Harmonic Functions and Power Series Expansions: Schwarz theorem - The reflection principle - Weierstrass theorem – Taylor Series – Laurent series.
Chapter 4 : Sections 6.4 and 6.5
Chapter 5 : Sections 1.1 to 1.3

UNIT-V
Partial Fractions and Entire Functions: Partial fractions – Infinite products – Canonical products – Gamma Function- Jensen's formula
Chapter 5 : Sections 2.1 to 2.4, Sections 3.1

COURSE OUTCOMES

1. Define and recognise the basic properties of complex numbers.
2. Will be equipped to find series expansions of functions.
3. Able to evaluate definite integrals.
4. Apply CR equations and harmonic functions to solve problems.
5. Understand the concepts of complex functions and its related theorems.

REFERENCE BOOKS

1. Lars V. Ahlfors, Complex Analysis, (3rd edition) McGraw Hill Co., New York, 1979
2. H.A. Priestly, Introduction to Complex Analysis, Clarendon Press,Oxford, 2003
3. J.B.Conway, Functions of one complex variable Springer International Edition, 2003
4. T.WGamelin, Complex Analysis, Springer International Edition, 2004.
5. D.Sarason, Notes on complex function Theory, Hindustan Book Agency, 1998.

MAPPING-COURSE OBJECTIVES WITH PROGRAMME OUTCOME

CO/PO	PO1	PO2	PO3	PO4	PO5
CO1	S	S	S	S	S
CO2	S	M	S	M	S
CO3	S	S	M	S	S
CO4	S	M	S	M	S
CO5	S	M	M	S	S

Key: S-Strong, M-Medium/Moderate, L-Low

TOPOLOGY (MFF3B)

COURSE OBJECTIVES

1.To Demonstrate knowledge and understanding the basic concepts of topological spaces.
2. To understand the concepts of continuous functions, connectedness and compactness.
3. To introduce the concepts of countability and separation axioms.
4. To introduce the concepts of product topology and Tychonoff theorem.
5. To understand the concepts of Homotopy of paths and Fundamental group.

SYLLABUS

Unit I

Topological spaces, Basis for a topology, Product topology on X x Y, Subspace topology, Closed sets and Limit points, Continuous functions.
Chapter 2 - Sections 12, 13, 15, 16, 17, 18.

Unit II

Connected spaces, Connected subspaces of the real line, Components and Local connectedness, Compact spaces, Compact subspaces of the real line.
Chapter 3 - Sections 23, 24, 25, 26, 27.

Unit III

Countability axioms, Separation axioms, Normal spaces, Urysohn's Lemma, Urysohn metrization theorem, Tietze extension theorem.
Chapter 4 - Sections 30, 31, 32, 33, 34, 35

Unit IV

Product topology, Tychonoff theorem.
Chapter 2 - Sections 19.
Chapter 5 - Section 37.

Unit V

Homotopy of paths, Fundamental group.
Chapter 9 - Sections 51, 52.

COURSE OUTCOMES

Students will be able to
1. Create new topological spaces by using subspace, product and quotient topology
2. Construct a variety of examples and counter examples in topology.
3. Understand the properties of the compact spaces and analyse the different types of Compactness.
4. Demonstrate the importance of Tychonoff theorem.
5. Understand the concepts of Homotopy of paths and Fundamental group.

REFERENCE BOOKS

1. James R. Munkres *"Topology"* (Second edition) PHI, 2015.
2. T.W. Gamelin and R.E. Greene, *Introduction to Topology*, The Saunders Series, 1983.

3. G.F. Simmons, *Introduction to Topology and Modern Analysis,* Mcgraw-Hill4. Dugundji, *Topology*, Prentice Hall of India.

5. J.L. Kelly, *General Topology, Springer.*
6. S. Willard, *General Topology*, Addison-Wesley.

MAPPING-COURSE OBJECTIVES WITH PROGRAMME OUTCOME

CO/PO	PO1	PO2	PO3	PO4	PO5
CO1	S	M	M	M	S
CO2	M	M	M	S	S
CO3	S	M	M	M	S
CO4	S	M	M	M	S
CO5	S	M	M	M	M

Key: S-Strong, M-Medium/Moderate, L-Low

OPERATIONS RESEARCH (MFF3C)

COURSE OBJECTIVES

1. To implement practical cases of decision making under different business environments.
2. To understand the concept of Network models.
3. To make the students understand and solve Deterministic inventory controls.
4. To understand the application of queuing theory in real life situation.
5. To understand and solve replacement problems.

SYLLABUS

Unit 1

Decision Theory:

Steps in Decision theory Approach – Types of Decision-Making Environments – Decision Making Under Uncertainty – Decision Making under Risk – Posterior Probabilities and Bayesian Analysis – Decision Tree Analysis – Decision Making with Utilities.

Chapter 10: Sec. 10.1 to 10.8

Unit 2

Network Models:

Scope of Network Applications – Network Definition – Minimal spanning true Algorithm – Shortest Route problem – Maximum flow model – Minimum cost capacitated flow problem - Network representation – Linear Programming formulation – Capacitated Network simplex Algorithm.

Chapter 6: Sections 6.1 to 6.6

H.A.Taha : Operations Research

Unit 3

Deterministic Inventory Control Models:
Meaning of Inventory Control – Functional Classification – Advantage of Carrying Inventory – Features of Inventory System – Inventory Model building - Deterministic Inventory Models with no shortage – Deterministic Inventory with Shortages
Probabilistic Inventory Control Models:
Single Period Probabilistic Models without Setup cost – Single Period Probabilities Model with Setup cost.
Chapter 13: Sec. 13.1 to 13.8
Chapter 14: Sec. 14.1 to 14.3

Unit 4

Queueing Theory:
Essential Features of Queueing System – Operating Characteristic of Queueing System – Probabilistic Distribution in Queueing Systems – Classification of Queueing Models – Solution of Queueing Models – Probability Distribution of Arrivals and Departures – Erlangian Service times Distribution with k-Phases.
Chapter 15 : Sec. 15.1 to 15.8

Unit 5

Replacement and Maintenance Models: Failure Mechanism of items – Replacement of Items that deteriorate with Time – Replacement of items that fail completely – other Replacement Problems.
Chapter 16: Sec. 16.1 to 16.5

COURSE OUTCOMES

Students will be able to

1. Explain various techniques to solve real life problems in decision theory.
2. Be able to design and solve Networks Models.
3. To know and apply the various types of inventory models.
4. To analyze the basic characteristic features of a queuing system.
5. Solve simple replacement problems.

REFERENCE BOOKS

1. H.A. Taha, *Operations Research*, 6th edition, Prentice Hall of India. (For Unit 2).
2. J.K.Sharma, *Operations Research* ,MacMillan India, New Delhi, 2001. (For all other Units)
3. F.S. Hiller and J.Lieberman -,*Introduction to Operations Research* (7th Edition), Tata McGraw Hill Publishing Company, New Delhui, 2001.
4. Beightler. C, D.Phillips, B. Wilde ,*Foundations of Optimization* (2nd Edition) Prentice Hall Pvt Ltd., New York, 1979.
5. Bazaraa, M.S; J.J.Jarvis, H.D.Sharall ,*Linear Programming and Network flow,* John Wiley and sons, New York 1990.
6. Gross, D and C.M.Harris, *Fundamentals of Queueing Theory*, (3rd Edition), Wiley and Sons, New York, 1998.

MAPPING-COURSE OBJECTIVES WITH PROGRAMME OUTCOME

CO/PO	PO1	PO2	PO3	PO4	PO5
CO1	S	M	S	S	M
CO2	S	S	M	S	S
CO3	S	M	M	S	M
CO4	S	M	M	S	S
CO5	M	S	M	M	M

Key: S-Strong, M-Medium/Moderate, L-Low

MECHANICS (MFF3D)

COURSE OBJECTIVES

1. The dynamics of system of particles motion of rigid body.
2. Lagrangian and Hamiltonian formulation of mechanics.
3. Derive the equations of motion for complicated mechanical systems using the Lagrangian and Hamiltonian formulation of classical mechanics
4. Understand the classical system of mechanics moving in constraint and their applications
5. To understand the concept like Canonical Transformation, Lagrange and Poisson brackets

SYLLABUS

Unit 1

Mechanical Systems : The Mechanical system- Generalised coordinates – Constraints - Virtual work - Energy and Momentum
Chapter 1 : Sections 1.1 to 1.5

Unit 2

Lagrange's Equations: Derivation of Lagrange's equations Examples- Integrals of motion.
Chapter 2 : Sections 2.1 to 2.3 (Omit Section 2.4)

Unit 3

Hamilton's Equations : Hamilton's Principle - Hamilton's Equation - Other variational principles.
Chapter 4 : Sections 4.1 to 4.3 (Omit section 4.4)

Unit 4

Hamilton-Jacobi Theory : Hamilton Principle function – Hamilton-Jacobi Equation - Separability
Chapter 5 : Sections 5.1 to 5.3

Unit 5

Canonical Transformation : Differential forms and generating functions – Special Transformations– Lagrange and Poisson brackets.
Chapter 6 : Sections 6.1, 6.2 and 6.3 (omit sections 6.4, 6.5 and 6.6).

COURSE OUTCOMES

Students will be able to

1. Define and understand basic mechanical concepts related to discrete and continuous mechanical systems,
2. Describe and understand the motion of a mechanical system using Lagrange-Hamilton formalism.
3. Identify canonical transformations and apply Lagrange- Poisson Brackets.
4. Able to understand the concept like Canonical Transformation, Lagrange and Poisson brackets.
5. Get a basic idea of Lagrangian and Hamiltonian formulation of classical mechanics.

REFERENCE BOOKS

1. D. Greenwood, Classical Dynamics, Prentice Hall of India, New Delhi, 1985.
2. H. Goldstein, Classical Mechanics, (2nd Edition) Narosa Publishing House, New Delhi.
3. N.C.Rane and P.S.C.Joag, Classical Mechanics, Tata McGraw Hill, 1991.
4. J.L.Synge and B.A.Griffth, Principles of Mechanics (3rd Edition) McGraw Hill Book Co., New York, 1970.

MAPPING-COURSE OBJECTIVES WITH PROGRAMME OUTCOME

CO/PO	PO1	PO2	PO3	PO4	PO5
CO1	S	M	S	S	S
CO2	S	S	M	S	S
CO3	M	M	S	S	S
CO4	S	S	S	M	S
CO5	S	M	S	S	S

Key: S-Strong, M-Medium/Moderate, L-Low

NUMBER THEORY AND CRYPTOGRAPHY (MFFAH)

COURSE OBJECTIVES

1. To introduce the concept of time, estimate for doing arithmetic.
2. To enable to handle problems related to Congruences.
3. To introduce Finite field and Quadratic residues.
4. To introduce encryption and decryption.
5. To introduce public key cryptography and RSA.

SYLLABUS

Unit 1

Elementary Number Theory : Time estimates for doing arithmetic – divisibility and the Euclidean algorithm .

Chapter 1 : Sections 1 and 2

Unit 2
Elementary Number Theory :Congruences – Some applications to factoring
Chapter 1 : Sections 3 and 4

Unit 3
Finite Fields and Quadratic Residues: Finite Fields, Quadratic residues and reciprocity
Chapter 2 : Sections 1 and 2

Unit 4
Cryptography : Some simple cryptosystems, Enciphering matrices
Chapter 3 : Sections 1 and 2.

Unit 5
Public Key : Public Key Cryptography – RSA
Chapter 4 : Sections 1 and 2

COURSE OUTCOMES

Students will be able to
1. Learn the idea to find time estimates, divisibility and Euclidean algorithm.
2. Learn Congruences, apply Fermat's and Chinese reminder theorem.
3. Know about Finite fields and Quadratic residues.
4. To learn to encipher and decipher messages.
5. To understand public key cryptography.

REFERENCE BOOKS

1. Neal Koblitz, A course in Number Theory and Cryptography, Springer – Verlag, New York, 1987
2. I. Niven and H.S.uckermann, An Introduction to Theory of Numbers (Edition 3), Wiley Eastern Ltd, New Delhi 1976.
3. D.M.Burton, Elementary Number Theory, Brown Publishers, Iowa, 1989.
4. K.Ireland and M.Rosen, A classic Introduction to Modern Number Theory, Springer – Verlag, 1972
5. N.Koblit, Algebraic Aspects of Cryptography, Springer Verlag, 1998

MAPPING-COURSE OBJECTIVES WITH PROGRAMME OUTCOME

CO/PO	PO1	PO2	PO3	PO4	PO5
CO1	S	S	S	S	S
CO2	S	M	M	S	S
CO3	M	M	M	M	S
CO4	S	S	S	S	S
CO5	S	M	M	M	S

Key: S-Strong, M-Medium/Moderate, L-Low

JAVA PROGRAMMING (MFFBD)

COURSE OBJECTIVES

1. To introduce object-oriented design techniques and problem-solving using Java
2. To provide the insight to programming language the fundamentals of Language
3. To impart the benefits of object-oriented language
4. To acquire the knowledge on Operators and Expressions
5. To gain insights in decision making, strings and arrays in Java Programming.

SYLLABUS

UNIT – I :

Overview of Java Language: Java Tokens – Java Statements.

Chapter 3 : Section 3.1 to 3.12

UNIT – II :
Constants – Variables – Data Types
Chapter 4 : Section 4.1 to 4.12

UNIT – III :
Operators - Expressions
Chapter 5 : Section 5.1 to 5.16

UNIT – IV :
Decision making and Branching
Chapter 6 : Section 6.1 – 6.9

UNIT – V :

Classes – Objects – Methods – Arrays – Strings

Chapter 8 : Section 8.1 to 8.19

Chapter 9 : Section 9.1 to 9.5

COURSE OUTCOMES:

Students will be able to
1. Use an integrated development environment to write, compile, run, and test
2. Make relational operations in Java

3. Understand the communication process through the web.
4. Develop the ability to import the components from Java library
5. Become familiar with latest software development

REFERENCE BOOKS

1. E. Balaguruswamy, Programming with Java – A primer, Tata McGraw Hill Publishing Company Limited, New Delhi, 1998
2. Mitchell Waite and Robert Lafore, Data Structure and Algorithms in Java, Tech media (Indian Edition) New Delhi, 1999
3. Adam Drozdek, Data Structures and Algorithms in Java (Brown /Cole) Vikas Publishing House, New Delhi 2001.

MAPPING-COURSE OBJECTIVES WITH PROGRAMME OUTCOME

CO/PO	PO1	PO2	PO3	PO4	PO5
CO1	S	S	S	S	M
CO2	S	S	M	S	M
CO3	S	S	S	S	S
CO4	S	S	S	S	M
CO5	S	S	S	S	S

Key: S-Strong, M-Medium/Moderate, L-Low

SEMESTER IV

COMPLEX ANALYSIS II (MFF4A)

COURSE OBJECTIVES

1. To define and recognize the basic properties of the Riemann Zeta function .
2. To enable the students to understand the concepts of Riemann mapping Theorems, conformal mappings and harmonic functions.
3. To gain knowledge about elliptic function.
4. To study and Understand Weierstrass function and its applications.
5. To acquire basic knowledge about Riemann surfaces and homotopic curves.

SYLLABUS

Unit I

Riemann Zeta Function and Normal Famalies : Product development – Extension of $\zeta(s)$ to the whole plane – The zeros of zeta function – Equicontinuity – Normality and compactness – Arzela's theorem – Families of analytic functions

Chapter 5 : Sections 4.1 to 4.4, Sections 5.1 to 5.4

Unit II

Riemann mapping Theorem : Statement and Proof – Boundary Behaviour – Use of the Reflection Principle.
Conformal mappings of polygons :Behaviour at an angle Schwarz-Christoffel formula – Mapping of a rectangle.
Harmonic Functions : Functions with mean value property – Harnack's principle.
Chapter 6 : Sections 1.1t 1.3 (Omit Section1.4) , Sections 2.1 to 2.3 (Omit section 2.4), Section 3.1,3.2

Unit III

Elliptic functions : Simply periodic functions – Doubly periodic functions
Chapter 7 : Sections 1.1 to 1.3, Sections 2.1 to 2.4

Unit IV

Weierstrass Theory : The Weierstrass$\wp$-function – The functions $\zeta(s)$ and $\sigma(s)$ – The differential equation – The modular equation $\lambda(\tau)$ – The Conformal mapping by $\lambda(\tau)$.
Chapter 7 : Sections 3.1 to 3.5

Unit V

Analytic Continuation :The Weiesrtrass Theory – Germs and Sheaves – Sections and Riemann surfaces – Analytic continuation along Arcs – Homotopic curves – The Monodromy Theorem – Branch points.
Chapter 8 : Sections 1.1 to 1.7

COURSE OUTCOMES

1. Use Riemann mapping theorem in applications.
2. Have a fundamental understanding of Elliptic functions.
3. Apply conformal mapping techniques.
4. Equips with knowledge of analytic continuation.
5. Have a good background for studying more advanced topics.

REFERENCE BOOKS

1. Lars V. Ahlfors, *Complex Analysis,* (3rd Edition) McGraw Hill Book Company, New York, 1979.
2. H.A. Priestly, *Introduction to Complex Analysis*, Clarendon Press,Oxford, 2003.
3. J.B.Conway, *Functions of one complex variable*, Springer International Edition, 2003
4. T.WGamelin, *Complex Analysis*, Springer International Edition, 2004.
5. D.Sarason, *Notes on Complex function Theory,* Hindustan Book Agency, 1998.

MAPPING-COURSE OBJECTIVES WITH PROGRAMME OUTCOME

CO/PO	PO1	PO2	PO3	PO4	PO5
CO1	S	M	S	S	M
CO2	S	M	S	S	S
CO3	S	S	M	S	S
CO4	S	M	M	S	S
CO5	S	M	S	M	S

Key: S-Strong, M-Medium/Moderate, L-Low

DIFFERENTIAL GEOMETRY (MFF4B)

COURSE OBJECTIVES

1. Understand the concept of curvature of a space curve and plane curve.
2. Compute the curvature and torsion of space curves.
3. Discuss the fundamental theorem for regular surfaces.
4. Introduced to geodesics on a surface and their characterization.
5. Introduced to isometries of metric coefficients and their derivatives

SYLLABUS

UNIT-I

Curves in the plane and in space

Curves, parametrisation, arc length, level curves, curvature, plane and space curves.
Chapters 1 and 2.

UNIT II

Surfaces in space

Surface patches, smooth surfaces, tangents, normals, orientability, examples of surfaces, lengths of curves on surfaces, the first fundamental form, isometries, surface area
Chapter 4 - 4.1, 4.2, 4.3, 4.4, 4.7 and Chapter 5 - 5.1, 5.2, 5.4

UNIT III

Curvature of surfaces:

The second fundamental form, Curvature of curves on a surface,
normal, principal, Gaussian and mean curvatures, Gauss map.
Chapter 6 - 6.1, 6.2, 6.3 and Chapter 7 - 7.1, 7.5,7.6

UNIT IV

Geodesics:

Geodesics, geodesic equations, geodesics as shortest pat geodesic coordinates.
Chapter 8 - 8.1, 8.2, 8.4, 8.5

UNIT V

Theorema Egregium of Gauss

Theorema Egregium, isometries of surfaces, Codazzi-Mainardi equations, compact surfaces of constant Gaussian curvature
Chapter 10

COURSE OUTCOMES

Student will be able to

1. Define and understand basic definition of the theory of curves.
2. Acquire knowledge on first and second fundamental forms.
3. Calculate the Gaussian curvature, the mean curvature, the asymptotic lines, the geodesics of a surface.
4. Interpret the notions of surface of revolution and direction coefficients.
5. Analyze the elements of analytic representation.

REFERENCES BOOKS

1. Pressley, Elementary Differential Geometry, Springer-Indian Edition, 2004.
2. J.A. Thorpe, Elementary Topics in Differential Geometry, Springer Indian edition.
3. E.D. Bloch, A First Course in Geometric Topology and Differential Geometry, Birkhauser, 1997.
4. M.P. do Carmo, Differential Geometry of Curves and Surfaces, Prentice-Hall, 1976

MAPPING-COURSE OBJECTIVES WITH PROGRAMME OUTCOME

CO/PO	PO1	PO2	PO3	PO4	PO5
CO1	S	M	S	S	S
CO2	M	S	M	M	M
CO3	S	M	M	M	L
CO4	M	S	L	S	S
CO5	M	S	S	S	M

Key: S-Strong, M-Medium/Moderate, L-Low

FUNCTIONAL ANALYSIS (MFF4C)

COURSE OBJECTIVES

1. To get an overview of normed spaces and familiarize on Banach space.
2. To understand the concepts of Hilbert space .
3. To apply the conjugate space
4. To understand the concepts of bounded linear operators and spectral theory
5. To study Orthogonal complements, Orthonormal sets and conjugate space

SYLLABUS

Unit 1

Normed spaces, Continuity of linear maps, Hahn-Banach Theorems, Banach Spaces.
Chapters II (omit sections 6.8, 7.11, 7.12, 8.4)

Unit 2

Uniform boundedness principle, Closed Graph and Open Mapping theorems, Bounded Inverse Theorem, Spectrum of a bounded operator.
Chapter III (omit sections 9.4 to 9.7, 11.2, 11.4, 11.5, 12.6, 12.7)

Unit 3

Duals and Transposes, Weak and weak *convergence, Reflexivity.
Chapter IV (omit sections 13.7, 13.8, 14, 15.5 to 15.7, 16.5 to 16.9)

Unit 4

Inner Product Spaces, Orthonormal sets, Best approximation, Projection and Riesz Representaion theorems.
Chapter VI (omit sections 23.2, 23.4, 23.6, 24.7, 24.8)

Unit 5

Bounded operators and adjoints, Normal, unitary and self adjoint Operators, Spectrum and Numerical range, Compact self adjoint operators
Chapter VII (omit sections 26.4, 26.5 26.6, 27.4 to 27.7, 28.7, 28.8)

COURSE OUTCOMES

Students will be able to
1. Illustrate Normed linear space and Banach space with examples.
2. Understand the concepts of Hilbert space.
3. Apply the concepts of conjugate space.
4. Discuss the concepts of bounded linear operators and spectral theory.
5. Understand Orthogonal complements, Orthonormal sets and conjugate space.

REFERENCE BOOKS

1.B.V. Limaye, Functional Analysis, New Age International, 1996.
2. W.Rudin Functional Analysis, Tata McGraw-Hill Publishing Company, New Delhi , 1973
3. G.Bachman & L.Narici, Functional Analysis Academic Press, New York , 1966.
4. C. Goffman and G.Pedrick, First course in Functional Analysis, Prentice Hall of India, New Delhi, 1987
5. E. Kreyszig, Introductory Functional Analysis with Applications, John wiley & Sons, New York.,1978.

MAPPING-COURSE OBJECTIVES WITH PROGRAMME OUTCOME

CO/PO	PO1	PO2	PO3	PO4	PO5
CO1	S	M	M	S	S
CO2	M	M	M	M	S
CO3	M	M	M	S	S
CO4	S	S	M	M	S
CO5	S	S	M	M	S

Key: S-Strong, M-Medium/Moderate, L-Low

FLUID DYNAMICS (MFFAJ)

COURSE OBJECTIVES

1. To introduce fundamental aspects of fluid flow behaviour.
2. To learn to develop steady state fluid flow, apply Eulers and Bernoullis equation of motion.
3. To learns three dimensional flows.
4. To understand axis symmetric flow, stream function and Complex velocity potential.
5. To understand stress components of fluid flow and Navier stokes equation of motion.

SYLLABUS

UNIT-I

Kinematics of Fluids in motion. Real fluids and Ideal fluids Velocity of a fluid at a point, Stream lines , path lines , steady and unsteady flows- Velocity potential - The vorticity vector- Local and particle rates of changes - Equations of continuity - Worked examples - Acceleration of a fluid - Conditions at a rigid boundary.

Chapter 2. Sec 2.1 to 2.10.

UNIT-II

Equations of motion of a fluid :Pressure at a point in a fluid at rest.- Pressure at a point in a moving fluid - Conditions at a boundary of two inviscid immiscible fluids- Euler's equation of motion - Discussion of the case of steady motion under conservative body forces.

Chapter 3. Sec 3.1 to 3.7

UNIT-III

Some three-dimensional flows. Introduction- Sources, sinks and doublets - Images in a rigid infinite plane - Axis symmetric flows - Stokes stream function

Chapter 4 Sec 4.1, 4.2, 4.3, 4.5.

UNIT-IV

Some two-dimensional flows : Meaning of two-dimensional flow - Use of Cylindrical polar coordinates - The stream function - The complex potential for two dimensional , irrotational incompressible flow - Complex velocity potentials for standard two dimensional flows - Some worked examples - Two dimensional Image systems - The Milne Thompson circle Theorem.

Chapter 5. Sec 5.1 to 5.8

UNIT-V

Viscous flows: Stress components in a real fluid. - Relations between Cartesian components of stress- Translational motion of fluid elements - 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 coefficient of viscosity and Laminar flow - The Navier – Stokes equations of motion of a Viscous fluid.

Chapter 8. Sec 8.1 to 8.9

COURSE OUTCOMES

Students will be able to

1. Describe the physical properties of a fluid and calculate the pressure distribution for incompressible fluids.
2. Apply the principles of motion for fluids and the areas of velocity and acceleration.
3. To understand two dimensional and three-dimensional flows.
4. Apply stokes stream function for axis symmetric flow and apply complex velocity potential for two-dimensional flow.
5. Understand rate of stress and strain quadric and apply Navier stokes equation.

REFERENCE BOOKS

1. F. Chorlton, *Text Book of Fluid Dynamics, CBS* Publications. Delhi ,1985.
2. R.W.Fox and A.T.McDonald. Introduction to Fluid Mechanics, Wiley, 1985.
3. E.Krause, Fluid Mechanics with Problems and Solutions, Springer, 2005.
4. B.S.Massey, J.W.Smith and A.J.W.Smith, Mechanics of Fluids, Taylor and Francis, New York, 2005
5. P.Orlandi, Fluid Flow Phenomena, Kluwer, New Yor, 2002.
6. T.Petrila, Basics of Fluid Mechanics and Introduction to Computational Fluid Dynamics, Springer, berlin, 2004.

MAPPING-COURSE OBJECTIVES WITH PROGRAMME OUTCOME

CO/PO	PO1	PO2	PO3	PO4	PO5
CO1	S	S	M	M	S
CO2	S	S	S	S	S
CO3	M	M	M	M	S
CO4	M	M	S	S	S
CO5	S	M	M	M	S

Key: S-Strong, M-Medium/Moderate, L-Low

TENSOR ANALYSIS AND RELATIVITY (MFFAM)

COURSE OBJECTIVES

1. To understand the concept of tensor variables and difference from scalar or vector variables.
2. Express the transformation of tensors. Explain the first and second kind of christoffel's symbols.
3. To study Galilean Transformations.
4. To study the Principle of Relativity and Relativistic Kinematics.
5. To understand the Principle of equivalence and accelerated systems.

SYLLABUS

Unit 1

Tensor Algebra: Systems of Different orders – Summation Convention – Kronecker Symbols - Transformation of coordinates in Sn - Invariants – Covariant and Contravariant vectors - Tensors of Second Order – Mixed Tensors – Zero Tensor – Tensor Field – Algebra of Tensors – Equality of Tensors – Symmetric and Skew-symmetric tensors - Outer multiplication, Contraction and Inner Multiplication – Quotient Law of Tensors – Reciprocal Tensor – Relative Tensor – Cross Product of Vectors.

Chapter I: I.1 – I.3, I.7 and I.8 and Chapter II: II.1 – II.19

Unit 2

Tensor Calculus: Riemannian Space – Christoffel Symbols and their properties.

Chapter III: III.1 and III.2

Unit 3

Tensor Calculus(contd): Covariant Differentiation of Tensors – Riemann–Christoffel Curvature Tensor – Intrinsic Differentiation

Chapter III:III.3 – III.5

Unit 4

Special Theory of Relativity: Galilean Transformations – Maxwell's equations – The ether Theory – The Principle of Relativity.

Relativistic Kinematics : Lorentz Transformation equations – Events and simultaneity – Example – Einstein Train – Time dilation – Longitudinal Contraction - Invariant Interval - Proper time and Proper distance - World line - Example – twin paradox – addition of velocities – Relativistic Doppler effect.

Chapter 7 : Sections 7.1 and 7.2

Unit 5

Relativistic Dynamics : Momentum – Energy – Momentum – energy four vector – Force - Conservation of Energy – Mass and energy – Example – inelastic collision – Principle of equivalence – Lagrangian and Hamiltonian formulations.

Accelerated Systems : Rocket with constant acceleration – example – Rocket with constant thrust.

Chapter 7 : Sections 7.3 and 7.4

COURSE OUTCOMES

Students will be able to

1. Demonstrate knowledge of concepts of tensors, Christoffel symbols and problems
2. Solve tensor differentiation and Christoffel curvature Tensor
3. Apply Galilean Transformations.
4. Apply the Principle of Relativity and Relativistic Kinematics.
5. Understand the Principle of equivalence and accelerated systems.

REFERENCE BOOKS

1. U.C. De, Absos Ali Shaikh and JoydeepSengupta, Tensor Calculus, Narosa Publishing House, New Delhi, 2004. (For Units I, II, III)
2. D.Greenwood, Classical Dynamics, Prentice Hall of India, New Delhi, 1985. (For Units IV, V)
3. .J.L.Synge and A.Schild, Tensor Calculus, Toronto, 1949.
4. A.S.Eddington. The Mathematical Theory of Relativitity, Cambridge University Press, 1930.
5. P.G.Bergman, An Introduction to Theory of Relativity, Newyor, 1942.
6. C.E.Weatherburn, Riemannian Geometry and the Tensor Calculus, Cambridge, 1938.

MAPPING-COURSE OBJECTIVES WITH PROGRAMME OUTCOME

CO/PO	PO1	PO2	PO3	PO4	PO5
CO1	S	S	M	S	M
CO2	S	S	S	M	M
CO3	S	S	M	S	M
CO4	S	S	M	M	M
CO5	S	S	M	M	M

Key: S-Strong, M-Medium/Moderate, L-Low

QUESTION PAPER PATTERN

CIA ASSESSMENT SPLIT UP (INTERNALS):

Assessment Procedure	Rubrics (Parameter)	Marks
Assignment	Creativity, relevance to the topic	5
Seminar	Communication Skills, Way of Presentation	5
Internal test	Students Performance in the written test	10
Attendance	Above 90% - 5; 76% to 90% - 4; 60% to 75 % - 3; Below 60% - No marks	5
Total		25

EXTERNALS :

Sec A : 5 (out of 6) x 2 = 10

Sec B : 5(out of 7) x 5 = 25

Sec C : 4 (out of 5) x 10 = 40

Total Marks = 75

SHANTHI RAVICHANDRAN

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Date: 2022.11.17 17:09:15 +05'30'

Signature of HOD

Signature of Principal