C. ABDUL HAKEEM COLLEGE [AUTONOMOUS]

[Affiliated to Thiruvalluvar University, Vellore]

MELVISHARAM – 632509

Syllabus under CBCS Pattern

Learning Outcome Based Curriculum Frame work [LOCF]

with effect from 2018 onwards

M.Sc. Mathematics

Prepared By

PG & Research Department of Mathematics

PROGRAM SPECIFIC OUTCOME

1. Create Mathematical models to solve Real world problems in appropriate context's
2. Recognize the connection between theory and application.
3. Communicate different Mathematical concepts to other disciplines and society, precisely and effectively.
4. Apply both quantitative and qualitative knowledge for their future higher studies and NET/SLET/GATE/NBHM and other competitive exams.

C. ABDUL HAKEEM COLLEGE [AUTONOMOUS]

MELVISHARAM

MASTER OF SCIENCE - DEGREE COURSE

UNDER CBCS PATTERN

[With effect from batch 2018-2019 ONWARDS]

M.Sc.,Mathematics

Year/ Semester	Part	Type	Subject	Subject Name	Ins. hrs. /	Credit	CIA	Uni. Exa	Total Mark
I Year I Semester	III	Main	P18MMA101	Algebra	6	6	25	75	100
	III	Main	P18MMA102	Real Analysis - I	6	5	25	75	100
	III	Main	P18MMA103	Ordinary Differential Equations	6	4	25	75	100
	III	Main	P18MMA104	Mechanics	6	4	25	75	100
	III	Elective	P18EMA101	(To choose 1 out of 3) A. Graph Theory B. Fuzzy Mathematics C. Formal Languages & Automata Theory	6	3	25	75	100
I Year II Semester	III	Main	P18MMA201	Real Analysis - II	6	5	25	75	100
	III	Main	P18MMA202	Partial Differential Equations	6	4	25	75	100
	III	Main	P18MMA203	Calculus of Variations and Integral	5	4	25	75	100
	III	Main	P18MMA204	Mathematical Programming	6	4	25	75	100
	III	Elective	P18EMA201	(to choose 1 out of 3) A. Difference Equations B. Analytic Number Theory C. Actuarial Mathematics	5	3	25	75	100
	IV	Main	P18CHR201	Human Rights	2	2	25	75	100
II Year III Semester	III	Main	P18MMA301	Complex Analysis - I	5	4	25	75	100
	III	Main	P18MMA302	Topology	6	5	25	75	100
	III	Main	P18MMA303	Differential Geometry	5	5	25	75	100
	III	Main	P18MMA304	Operations Research	6	4	25	75	100
	III	Elective	P18EMA301	(To choose 1 out of 3) A. Probability Theory B. Stochastic Processes	6	3	25	75	100
	III	Main	P18MMAP31	Practical - Mathematical Software - Latex	2	2	25	75	100
II Year IV Semester	III	Main	P18MMA401	Complex Analysis - II	6	5	25	75	100
	III	Main	P18MMA402	Functional Analysis	6	5	25	75	100
	III	Main	P18MMA403	Mathematical Statistics	6	5	25	75	100
	III	Main	P18MMA404	Number Theory and Cryptography	6	5	25	75	100
	III	Elective	P18EMA401	(To Choose 1 Out Of 3) A. Fluid Dynamics B. Discrete Mathematics C. Programming in C++ With Practical	6	3	25	75	100

SEMESTER I
CORE PAPER - 1
ALGEBRA

OBJECTIVES:	To have a detailed study of Group theory and Field theory
Course Outcomes: At the end of the Course, the Students will able to	
CO1	Apply Sylow's theorem to find number of p - sylow subgroups
CO2	Construct the extension field from a given field
CO3	Find the splitting field of the given polynomial over a given field and calculate its degree.
CO4	Describe the canonical form, Jordan form and Rational canonical form

UNIT-I: GROUP THEORY
Another Counting Principle - Sylow's theorem
Chapter 2: Sections 2.11 and 2.12
(Omit Second and Third Proof of Sylow's Theorem) (Omit Lemma 2.12.5)

UNIT-II: FIELDS
Extension fields - Transcendence of e - Roots of Polynomials.
Chapter 5: Section 5.1, 5.2 and 5.3.

UNIT-III: FIELDS
More about Roots - Elements of Galois theory.
Chapter 5 : Section 5.5 and 5.6

UNIT-IV:
FIELDS: Solvability of Radicals.
FINITE DIVISION RINGS: Wedderburn's theorem.
GROUP THEORY: Direct products - Finite Abelian groups.
Chapter 5: Section 5.7 (Lemma 5.7.1, Lemma 5.7.2, Theorem 5.7.1)
Chapter 7: Section 7.2 (For Theorem 7.2.1 First Proof Only)
Chapter 2: Sections 2.13 and 2.14 (Only Theorem 2.14.1)

UNIT-V: LINEAR TRANSFORMATIONS
Canonical Forms: Nilpotent Transformations - A Decomposition of a Vector Space: Jordan Form - Rational Canonical form.
Chapter 6: Sections 6.5, 6.6 and 6.7

Recommended Text:
I.N. Herstein. Topics in Algebra (II Edition) Wiley Eastern Limited, New Delhi, 1975.

Reference Books:
1. M.Artin, Algebra, Prentice Hall of India, 1991.

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

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

4. D.S.Malik, J.N. Mordeson and M.K.Sen, Fundamental of Abstract Algebra, McGraw Hill (International Edition), New York. 1997.

5. N.Jacobson, Basic Algebra, Vol. I & II W.H.Freeman ; also published by Hindustan Publishing Company, New Delhi, 1980.

CORE PAPER - 2

REAL ANALYSIS I

Objective: To have a detailed study of functions of bounded variation, Riemann – Stieltjes Integrals, double sequence, double series and uniform convergence.

COURSE OUTCOME(S) : At the end of the course the student will be able to	
CO1	Examine whether the given function is of bounded variation or not
CO2	Utilize Riemann Stieltjes Integral to integrate functions which are bounded, unbounded, countable and uncountable.
CO3	Justify whether the double sequence or double series converges or diverges
CO4	Analyze whether the given sequence and series of functions converges uniformly or not

UNIT-I: FUNCTIONS OF BOUNDED VARIATION

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

Chapter - 6 : Sections 6.1 to 6.8

UNIT-II: THE RIEMANN - STIELTJES INTEGRAL

Introduction - Notation - The definition of the Riemann - Stieltjes integral - Linear Properties - Integration by parts- Change of variable in a Riemann - Stieltjes integral - Reduction to a Riemann Integral - Setp 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: Sections 7.1 to 7.13

UNIT-III: THE RIEMANN-STIELTJES INTEGRAL

Integrators of bounded variation - Sufficient conditions for the existence of Riemann-Stieltjes integrals - Necessary conditions for the existence of 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 – Interchanging the order of Integration.

Chapter - 7: 7.15 to 7.25

UNIT-IV: INFINITE SERIES AND INFINITE PRODUCTS

Absolute and conditional convergence - Dirichlet's test and Abel's test - Rearrangement of series - Riemann's theorem on conditionally convergent series - Double sequences - Double series - Rearrangement theorem for double series - A sufficient condition for equality of iterated series - Multiplication of series - Cesaro summability - Infinite products.

Chapter 8: Sections 8.8, 8.15, 8.17, 8.18, 8.20, 8.21 to 8.26

UNIT-V: 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 - Uniform convergence and differentiation - Sufficient condition for uniform convergence of a series - Mean convergence.

Chapter – 9: Sec 9.1 to 9.6, 9.8, 9.10, 9.11, 9.13

Recommended Text:

Tom M. Apostol : Mathematical Analysis, 2nd Edition, Addison-Wesley Publishing Company Inc. New York, 1997.

Reference Books:

1. Bartle, R.G. Real Analysis, John Wiley and Sons Inc., 1976.

2. Rudin,W. Principles of Mathematical Analysis, 3rd Edition. McGraw Hill Company, New York, 1976.

3. Malik,S.C. and Savita Arora. Mathematical Anslysis, Wiley Eastern Limited.New Delhi, 1991.

4. Sanjay Arora and Bansi Lal, Introduction to Real Analysis, Satya Prakashan, New Delhi, 1991.

5. A.L.Gupta and N.R.Gupta, Principles of Real Analysis, Pearson Education, (Indian print) 2003.

CORE PAPER-3
ORDINARY DIFFERENTIAL EQUATIONS

OBJECTIVES:	To develop the strong background on finding solutions to linear differential equations with constant and variable coefficients. To study existence and uniqueness of the solutions of first order differential equations.

UNIT- I: LINEAR EQUATIONS WITH CONSTANT COEFFICIENTS

COURSE OUTCOME(S) : At the end of the course the student will be able to	
CO1	Define basic concepts of ODEs and solve homogeneous, non-homogeneous second order ODEs..
CO2	Use Wronskian in finding solutions.
CO3	Analyze second order differential equation with constant coefficients and variable coefficients extended these ideas to Legendre and Bessel's Equations.
CO4	Calculate approximation solutions, memorize and demonstrate the use of existence theorem.

Introduction - Second order homogeneous equation - 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 equation of order n - Initial value problems for n^{th} order equations - Equations with real Constant - non-homogeneous equation of order n - Annihilator method to solve non-homogeneous equation - Algebra of constant coefficient operators.
Chapter - 2: Sections 7 to 12.

UNIT- III: LINEAR EQUATION WITH VARIABLE COEFFICIENTS
Introduction - Initial value problems - Existence and uniqueness theorems - Solutions of the homogeneous equations - Wronskian and linear Independence - Reduction of the order of a homogeneous equation - Solutions of the non-homogeneous equations - 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
Introduction - Euler equation - Second order equations with regular singular points, an example and the general case - Exceptional cases – The Bessel equation.
Chapter 4: Sections 1 to 4 and 6 to 8 (Omit sections 5 and 9)

UNIT-V: EXISTENCE AND UNIQUENESS OF SOLUTIONS TO FIRST ORDER EQUATIONS
Introduction - Equation with variable separated - Exact equations - 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)

Recommended Text:
Earl A.Coddington, An introduction to ordinary differential equations (3rd Reprint) Prentice-Hall of India Ltd.,New Delhi, 2012.

Reference Books:

1. Williams E. Boyce and Richard C. DI Prima, Elementary differential equations and boundary value problems, John Wiley and sons, New York, 1967.

2. George F Simmons, Differential equations with applications and historical notes, Tata McGraw Hill, New Delhi, 1974.

3. N.N. Lebedev, Special functions and their applications, Prentice Hall of India, New Delhi, 1965.

4. W.T. Reid. Ordinary Differential Equations, John Wiley and Sons, New York, 1971

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

6. B.Rai, D.P.Choudary and H.I. Freedman, A Course in Ordinary Differential Equations, Narosa Publishing House, New Delhi, 2002.

CORE PAPER-4
MECHANICS

OBJECTIVES:	To study mechanical systems under generalized coordinate systems, virtual work, energy and momentum, to study mechanics developed by Newton, Lagrange's, Hamilton Jacobi and theory of Relativity due to Einstein.
COURSE OUTCOME(S) : At the end of the course the student will be able to	
CO1	Identify the different types of constraints and compute virtual displacement, virtual work and generalized momentum.
CO2	Use Lagrange's equation to evaluate differential equation of motions.
CO3	Apply Euler Lagrange's equation to compute the stationary values and to study Hamilton's and Jacobi's equations.
CO4	Examine the canonical Transformation by using exactness, Poisson and Lagrange Brackets and to find generating functions.

UNIT-I: MECHANICAL SYSTEMS

The Mechanical system - Generalised coordinates - Constraints - Virtual work - Energy and Momentum

Chapter 1 : Sections 1.1 to 1.5

UNIT-II: LAGRANGE'S EQUATIONS

Derivation of Lagrange's equations- Examples - Integrals of the motion.

Chapter 2 : Sections 2.1 to 2.3 (Omit Section 2.4)

UNIT-III: HAMILTON'S EQUATIONS

Hamilton's Principle - Hamilton's Equations - Other variational principles.

Chapter 4 : Sections 4.1 to 4.3 (Omit section 4.4)

UNIT-IV: HAMILTON-JACOBI THEORY

Hamilton's Principle function - Hamilton-Jacobi Equation - Separability

Chapter 5 : Sections 5.1 to 5.3

UNIT-V : CANONICAL TRANSFORMATIONS

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)

Recommended Text

D. T. Greenwood, Classical Dynamics, Prentice Hall of India, New Delhi, 1985.

Reference Books

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

ELECTIVE PAPER-1
(to choose any 1 out of the given 3)
A. GRAPH THEORY

OBJECTIVES:	To have a detailed study of Different types of graphs with properties in Graph theory
Course Outcomes: At the end of the Course, the Students will able to	
CO1	Classify the different types of graphs
CO2	Identify wheather the given graph is Eulerian or Hamiltonian graph or not
CO3	Label the chromatic number to given graph and five colour theorem.
CO4	Construct the given graph into independent sets and cliques.

UNIT-I: GRAPHS, SUBGRAPHS AND TREES
Graphs and simple graphs - Graph Isomorphism - The Incidence and Adjacency Matrices - Subgraphs - Vertex Degrees - Paths and Connection - Cycles - Trees - Cut Edges and Bonds - Cut Vertices.
Chapter 1: (Section 1.1 - 1.7) ; Chapter 2: (Section 2.1 - 2.3)

UNIT-II: 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-III: 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-IV: 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-V: 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)

Recommended Text

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

Reference Books

1. J.Clark and D.A.Holton , A First look at Graph Theory, Allied Publishers, New Delhi, 1995.
2. R. Gould. Graph Theory, Benjamin/Cummings, Menlo Park, 1989.
3. A.Gibbons, Algorithmic Graph Theory, Cambridge University Press, Cambridge, 1989.
4. R.J.Wilson and J.J.Watkins, Graphs : An Introductory Approach, John Wiley and Sons, New York, 1989.
5. R.J. Wilson, Introduction to Graph Theory, Pearson Education, 4th Edition, 2004, Indian Print.
6. S.A.Choudum, A First Course in Graph Theory, MacMillan India Ltd. 1987.

B.FUZZY MATHEMATICS

Objectives: This course aims to acquire the knowledge of Fuzzy Sets, Fuzzy Numbers and Fuzzy relations

Course Outcomes: At the end of the Course, the Students will able to	
CO1	Analyze the concepts of fuzzy sets
CO2	Apply the extension principle for fuzzifying functions where eve r possible
CO3	Give examples to each operation of fuzzy sets
CO4	Identify the concepts of fuzzy numbers and fuzzy relations

UNIT - I: FUZZY SETS

Fuzzy sets: Basic Types - Basic concepts - Characteristics and Significance of the paradigm shift - Additional properties of α-cuts.

Chapter 1: Sections 1.3 to 1.5 and Chapter 2 : Section 2.1

UNIT - II: FUZZY SETS VERSUS CRISP SETS

Representation of Fuzzy sets - Extension principle for Fuzzy sets - Types of operations - Fuzzy complements.

Chapter 2: Sections 2.2 and 2.3 and Chapter 3 : Sections 3.1 and 3.2

UNIT - III: OPERATIONS ON FUZZY SETS

Fuzzy intersections: t-norms - Fuzzy unions: t-conorms - Combinations of operations - Aggregation operations.

Chapter 3: Sections 3.3 to 3.6

UNIT - IV: FUZZY ARITHMETIC

Fuzzy numbers – Linguistic variables – Arithmetic operation on intervals and Fuzzy numbers – Lattice of Fuzzy numbers.

Chapter 4: Sections 4.1 to 4.5

UNIT - V: FUZZY RELATIONS

Crisp and Fuzzy Relations – Projections and Cylindric Extensions - Binary Fuzzy Relations – Binary Relations on a Single Set – Fuzzy Equivalence Relations – Fuzzy Compatibility Relations – Fuzzy Ordering Relations - Fuzzy Morphisms – Sup-i Compositions of Fuzzy Relations – Inf-w_i Compositions of Fuzzy Relations.

Chapter 5: Sections 5.1 to 5.10

Recommended Text:

G. J. Klir and Bo Yuan, Fuzzy Sets and Fuzzy Logic: Theory and Applications, PHI, New Delhi, 2007.

Reference Books:

1. H. J. Zimmerman, Fuzzy Set Theory and its Applications, Allied Publishers, 1996.
2. A. Kaufman, Introduction to the theory of Fuzzy Subsets, Academic Press, 1975.
3. V. Novak, Fuzzy Sets and their Applications, Adam Hilger, Bristol, 1969.

C. FORMAL LANGUAGES AND AUTOMATA THEORY

OBJECTIVES:	To obtain knowledge about finite automata, regular expressions and regular grammars, properties of context free languages.
COURSE OUTCOME(S) : At the end of the course the student will be able to	
CO1	Define basic concepts of finite automata, regular grammars.
CO2	Simplification of context-free grammars.
CO3	Classify the properties of regular sets, context – free Languages.
CO4	Identify Pushdown automata.

UNIT-I: Finite automata, regular expressions and regular grammars

Finite state systems – Basic definitions – Nondeterministic finite automata – Finite automata with ε moves – Regular expressions – Regular grammars.

Chapter 2: Sections 2.1 to2.5

Chapter 9: Section 9.1

UNIT-II: Properties of regular sets.

The Pumping lemma for regular sets – Closure properties of regular sets – Decision algorithms for regular sets – The Myhill-Nerode Theorem and minimization of finite automata.

Chapter 3 : Sections 3.1 to 3.4

UNIT-III: Context-free grammars

Motivation and introduction – Context-free grammars – Derivation trees- Simplification of context-free grammars – Chomsky normal form – Greibach normal form.

Chapter 4: Section 4.1 to 4.6

UNIT-IV: Pushdown automata

Informal description – Definitions - Pushdown automata and context - free languages - Normal forms for deterministic pushdown automat.

Chapter 5: Sections 5.1 to 5.3

UNIT-V: Properties of context-free languages

The pumping lemma for CFL's - Closure properties for CFL's - Decision algorithms for CFL's.

Chapter 6: Sections 6.1 to 6.3

Recommended Text:
John E.Hopcraft and Jeffrey D.Ullman, Introduction to Automata Theory, Languages and Computation, Narosa Publishing House, New Delhi, 1987.

Reference Books:

1. A. Salomaa, Formal Languages, Academic Press, New York, 1973.

2. John C. Martin, Introduction to Languages and theory of Computations (2nd Edition) Tata-McGraw Hill Company Ltd., New Delhi, 1997.

SEMESTER - II
CORE PAPER - 5
REAL ANALYSIS - II

Objective: To have a detailed study of Fourier Series, Fourier Transform, Multivariable differential calculus, Implicit and Extremum Problems and Measure theory.

COURSE OUTCOME(S) : At the end of the course the student will be able to	
CO1	Analyze the convergence of a Fourier Series.
CO2	Extend the notion of Partial Derivatives to functions from $\mathbb{R}^n \rightarrow \mathbb{R}^m$.
CO3	Examine whether the implicit function has a solution and check whether the given function has extremum.
CO4	Describe Lebesgue Integral and its Properties.

UNIT - I: 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 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 (Apostol)

UNIT - II: MULTIVARIABLE DIFFERENTIAL CALCULUS

Introduction - The Directional derivative - Directional derivative and continuity - The total derivative - The total derivative expressed in terms of partial derivatives - An application to Complex-valued Functions - 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 Formula for functions from R^n to R^1.

Chapter 12 : Section 12.1 to 12.14 (Apostol)

UNIT - III: IMPLICIT FUNCTIONS AND EXTREMUM PROBLEMS

Introduction - Functions with non-zero Jacobian determinants - The inverse function theorem -The Implicit function theorem - Extrema of real valued functions of one variable - Extrema of real valued functions of severable variables - Extremum problems with side conditions.

Chapter 13 : Sections 13.1 to 13.7 (Apostol)

UNIT - IV THE LEBESGUE INTEGRAL

Length of open sets and closed sets - Inner and outer measure: Measurable sets - Properties of measurable sets - Measurable functions - Definition and existence of the Lebesgue integral for bounded function.

Chapter 11 : Section 11.1 to 11.5 [R. R. Goldberg]

UNIT - V THE LEBESGUE INTEGRAL (Contd . . .)

Properties of the Lebesgue integral for bounded measurable functions - The Lebesque integral for unbounded functions - Some fundamental theorems - The metric space L^2 [a, b] - The integral on (- ∞ , ∞) and in the Plane.

Chapter 11 : Section 11.6 to 11.10 [R. R. Goldberg]

Recommended Texts:

1. Tom M. Apostol : Mathematical Analysis, 2nd Edition, Addison-Wesley Publishing Company Inc. New York, 1974. (for Units I, II and III)

2. Richard R. Goldberg, Methods f Real Analysis, Oxford & IBH Publishing, New Delhi, 1975. (for Unit IV and V)

Reference Books:

1. Burkill,J.C. The Lebesgue Integral, Cambridge University Press, 1951.

2. Munroe,M.E. Measure and Integration. Addison-Wesley, Mass.1971.

3. Roydon,H.L.Real Analysis, Macmillan Pub. Company, New York, 1988.

4. Rudin, W. Principles of Mathematical Analysis, McGraw Hill Company, New York,1979.

5. Malik,S.C. and Savita Arora. Mathematical Analysis, Wiley Eastern Limited. New Delhi, 1991.

6. Sanjay Arora and Bansi Lal, Introduction to Real Analysis, Satya Prakashan, New Delhi, 1991

CORE PAPER-6
PARTIAL DIFFERENTIAL EQUATIONS

OBJECTIVES:	This course aims to acquaint the student with various mathematical techniques to solve various boundary value problems involving parabolic, elliptic and hyperbolic differential equations which arise in many physical situation

COURSE OUTCOME(S) : At the end of the course the student will be able to	
CO1	Calculate solutions of PDE by Charpit's method and by the method of characteristic equations.
CO2	Formulate PDEs and solving compatible systems
CO3	Classify second order PDEs into parabolic, elliptic and hyperbolic.
CO4	Solve second order PDEs such as Laplace, Poisson, Diffusion and Wave equation in many physical situations.

UNIT - I: PARTIAL DIFFERENTIAL EQUATIONS OF FIRST ORDER
Formation and solution of PDE- Integral surfaces - Cauchy Problem for first order equations - Orthogonal surfaces - First order non-linear equations – Cauchy's method of Characteristics - Compatible system - Charpits 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 - BVPs - Separation of Variables - Dirichlet's Problem and Neumann Problem for a rectangle – Interior Neumann Problem for a Circle - 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 by canonical reduction – IVP; D'Alembert's solution - IVP and BVP for two-dimensional wave equation – Method of Eigenfunction - Periodic solution of one-dimensional wave equation in cylindrical and spherical Polar coordinate Systems - Uniqueness of the solution for the wave equation - Duhamel's Principle.

Chapter 4: 4.1 to 4.12 (omit 4.5, 4.6, 4.10 & 4.13)

Recommended Text:

K. Sankar Rao, Introduction to Partial Differential Equations, 2nd Edition, Prentice Hall of India, New Delhi. 2007.

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.

CORE PAPER – 7

CALCULUS OF VARIATIONS AND INTEGRAL EQUATIONS

Objectives: This course aims to get the knowledge of variational calculus and integral equations

Course Outcomes: At the end of the Course, the Students will able to	
CO1	Compute the extremum of the functional of various forms
CO2	Solve the variational problems of moving boundaries
CO3	Reduce the system of equations into integral equations
CO4	Convert the initial and boundary value problems in to Volterra and Fredholm integral equations

UNIT-I: VARIATIONAL PROBLEMS WITH FIXED BOUNDARIES

The concept of Variation and its properties - Euler's equation - Variational problems for functional - Functionals dependent on higher order derivatives - Functions of several independent variables - Some applications to problems of mechanics.

Chapter 1: 1.1 to 1.7

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.

Chapter 2: 2.1 to 2.5

UNIT – III: INTEGRAL EQUATIONS

Introduction - Definition - Regularity conditions - Special kinds of Kernals - Eigen values and eigen functions - Convolution integral - Reduction to a system of algebraic equations - Examples - Fredholm alternative - Examples - An approximation method.

Chapter 1: 1.1 to 1.5

Chapter 2: 2.1 to 2.5

UNIT – IV: METHOD OF SUCCESSIVE APPROXIMATIONS AND FREDHOLM THEORY

Method of successive approximations - Iterative scheme - Examples - Volterra integral equations - Examples - Some results about the resolvent kernel - The method of solution of Fredholm equation - Fredholm first theorem - Examples.

Chapter 3: 3.1 to 3.5

Chapter 4: 4.1 to 4.3

UNIT – V: APPLICATIONS TO ORDINARY DIFFERENTIAL EQUATIONS

Initial value problems - Boundary value problems - Examples - Singular integral equations - The Abel integral equations - Examples.

Chapter 5: 5.1 to 5.3

Chapter 8: 8.1 to 8.2

Recommended Text

1. A. S. Gupta, Calculus of Variations with Applications, PHI, New Delhi, 2005. (for Units I and II)
2. Ram P. Kanwal, Linear Integral Equations, Theory and Techniques, Academic Press, New York, 1971. (for Units III, IV and V)

Reference Books

1. M. D. Raisinghania, Integral Equations and Boundary Value Problems, S. Chand & Co., New Delhi, 2007.
2. Sudir K. Pundir and Rimple Pundir, Integral Equations and Boundary Value Problems, Pragati Prakasam, Meerut. 2005.

CORE PAPER – 8
MATHEMATICAL PROGRAMMING

OBJECTIVES:	To have a detailed study of Integer linear programming problem and Non Linear programming problem.
Course Outcomes: At the end of the Course, the Students will able to	
CO1	Locate the constraints into Integer linear programming problem by using Gomory's cutting plane method and identify the certainty in Dynamic programming problem.
CO2	Solve the Non linear programming problem by using Khun- Tucker conditions, Quadratic programming problem and Wolfe's modified simplex method.
CO3	Convert the given linear programming problem into canonical form, standard form and obtain basic feasible solution, alternative optimum solution. Also solve the linear programming problem by using dual simplex method and revised simplex method.
CO4	Identify when to replace an item, it deteriorates or fails completely.

UNIT-I
INTEGER LINEAR PROGRAMMING : Types of Integer Programming Problems – Enumeration and cutting plane solution concept- Gomory's All Integer Cutting Plane Method - Gomory's mixed Integer Cutting Plane method - Branch and Bound Method.
DYNAMIC PROGRAMMING: Dynamic Programming Terminology - Developing Optimal Decision Policy - Dynamic Programming under Certainty - DP approach to solve LPP.
Chapter-7: 7.2 - 7.6 and Chapter-20: 20.2 - 20.5

UNIT-II
CLASSICAL OPTIMIZATION METHODS : Unconstrained Optimization - Constrained Multi-variable Optimization with Equality Constraints - Constrained Multi-variable Optimization with inequality Constraints.
NON-LINEAR PROGRAMMING METHODS: Introduction:- General NLPP - Graphical solution - Quadratic Programming - Wolfe's modified Simplex Methods.
Chapter-23: 23.2 - 23.4 and Chapter-24: 24.1 - 24.4 (Omit: 24.4.3, Beale's Method)

UNIT-III : THEORY OF SIMPLEX METHOD
Canonical and Standard form of LPP - Slack and Surplus Variables - Reduction of Feasible solution to a Basic Feasible solution - Alternative Optimal solution - Unbounded solution - Optimality conditions - Some complications and their resolutions.
Chapter-25: 25.2 - 25.4, 25.6-25.9

UNIT-IV

REVISED SIMPLEX METHOD : Standard forms for Revised simplex Method - Computational procedure for Standard form I - Comparison of simplex method and Revised simplex Method.

DUAL –SIMPLEX METHOD: Introduction – Dual -simplex algorithm.

Chapter-26: 26.2 - 26.4

Chapter-27: 27.1, 27.2 (omit Appendix 27.A)

UNIT-V

REPLACEMENT AND MAINTENANCE MODELS: Introduction - Types of failure- Replacement of items whose Efficiency Deteriorates with Time-Replacement of Items that Fail completely

Chapter-17: 17.1 – 17.4.

Recommended Text:

J. K. Sharma, Operations Research, Theory and Applications, Third Edition (2007) Macmillan India Ltd.

Reference Books:

1. Hamdy A. Taha, Operations Research, (seventh edition) Prentice - Hall of India Private Limited, New Delhi, 1997.

2. F.S. Hillier & J.Lieberman Introduction to Operation Research (7th Edition) Tata- McGraw Hill ompany, New Delhi, 2001.

3. Beightler. C, D.Phillips, B. Wilde ,Foundations of Optimization (2nd Edition) Prentice Hall Pvt Ltd., New York, 1979

4. S.S. Rao - Optimization Theory and Applications, Wiley Eastern Ltd. New Delhi. 1990.

ELECTIVE PAPER-2
(to choose any 1 out of the given 3)

A. DIFFERENCE EQUATIONS

OBJECTIVES:	To Introduce the process of discretization, Discrete version of Differential Equations, Discrete oscillation and the asymptotic behavior of solutions of certain class of difference equations for linear cases only. Solution of difference equations using Z – transforms is stressed.
COURSE OUTCOME(S) : At the end of the course the student will be able to	
CO1	Solve second order and Higher order linear difference equations.
CO2	Use Putzer algorithm to find the solution of system of linear difference equation and describe Jordan form.
CO3	Define Z-transform and Inverse Z-transform and To solve linear difference equations by using Z-transform.
CO4	Analyze the Asymptotic Behavior of difference equations and oscillation theory.

UNIT-I: LINEAR DIFFERENCE EQUATIONS OF HIGHER ORDER
Difference Calculus - General Theory of Linear Difference Equations - Linear Homogeneous Equations with Constant coefficients - Linear non-homogeneous equations - Method of Undetermined coefficients, the method of variation of constants - Limiting behavior of solutions.
Chapter 2: Sections 2.1 to 2.5

UNIT-II: SYSTEM OF DIFFERENCE EQUATIONS
Autonomous System - The Basic Theory - The Jordan form - Linear periodic systems.
Chapter 3: Section 3.1 to 3.4

UNIT-III: THE Z-TRANSFORM METHOD
Definition, Example and properties of Z-transform - The Inverse Z-transform and solutions of Difference Equations: Power series method, partial fraction method, the inverse integral method - Volterra Difference Equations of convolution type - Volterra systems.
Chapter 5: Sections 5.1 to 5.3, 5.5 (omit 5.4)

UNIT-IV: ASYMPTOTIC BEHAVIOUR OF DIFFERENCE EQUATION
Tools and Approximation - Poincare’s Theorem - Asymptotically diagonal systems - Higher order Difference Equations - Second order difference equations
Chapter 8: Sections 8.1 to 8.5

UNIT-V: OSCILLATION THEORY

Three-term difference Equations - Non-linear Difference Equations - Self-Adjoint second order equations.

Chapter 7: Sections 7.1 to 7.3

Recommended Text:

Saber N. Elaydi, An Introduction to Difference Equations, Springer Verlag, New York, 1996.

Reference Books:

1. R.P.Agarwal., Difference Equations and Inequalities, Marcel Dekker, 1999.

2. S. Goldberg, Introduction to Difference Equations, Dover Publications, 1986

3. V. Lakshmi kantham and Trigiante, Theory of Difference Equations, Academic Press, New York, 1988.

4. Peterson, A Difference Equations, An Introduction with Applications, Academic Press, New York, 1991.

B. ANALYTIC NUMBER THEORY

OBJECTIVES:	Aim of this course is student will attain the knowledge of different types of function, various identities ,congruence relation and group theory elementary concept.
COURSE OUTCOME(S) : At the end of the course the student will be able to	
CO1	Relate Euler totient to the Mobius function and identify the dominate of theory of quadratic residue.
CO2	Discuss various identity satisfied by arithmetic function. Describe the average order of divisor function.
CO3	Show that congruence is an equivalence relation and test the divisibility condition for Fermat
CO4	Define some elementary part of number theory

UNIT-I
Arithmetical function and Dirichlet multiplication.
Chapter 2

UNIT-II
Averages of Arithmetical function.
Chapter 3

UNIT-III
Congruence - Finite Abelian Groups and their characters
Chapter 5 (Omit 5.10 and 5.11) ; Chapter 6: 6.1 to 6.4

UNIT-IV
Finite Abelian Groups and their characters (contd. . .) - Dirichlet's theorem on Primes in Arithmetic Progressions
Chapter 6: 6.5 to 6.10; Chapter 7: All sections except 7.9

UNIT-V
Quadratic residues and quadratic reciprocity law.
Chapter 9 (Omit 9.10 and 9.11)

Recommended Text :
Tom Apostol, Introduction to Analytic Number theory, Narosa Publications, New Delhi,

Reference Books :

1. I. Niven and Zuckermann H.S. : An Introduction to the theory of numbers, Wiley Eastern Ltd. 1972

2. C.Y. Hsiung : Elementary Theory of Numbers, Allied Publishers.

3. W.W. Adams and L. J. Goldstein, Introduction to Number Theory, Prentice Hall Inc.

4. S.G. Telang, Number Theory.

C. ACTUARIAL MATHEMATICS

OBJECTIVE: This degree prepares you for actuarial work in insurance, with pension consulting firms, investment banks and in other areas of the financial sector.

At the end of this course, students will be able to	
CO1	Recognize through a grounding in Mathematics, Statistics and Probability.
CO2	Analyze Models and Solve financial problems involving uncertainty.
CO3	Identity the difference between annuities and insurance
CO4	Relate a broad approach to actuarial problem solving by taking social sciences and humanity courses.

UNIT - I AMORTIZATION AND SINKING FUNDS

Amortization of a Debt – Outstanding Principal – Mortgages – Refinancing a Loan - Sinking Funds.

Chapter 7. Sections 7.1 to 7.5 (omit 7.6)

UNIT - II BONDS

Introduction and Terminology – Purchase price to yield a given investment rate – Callable Bonds – Premium and Discount – Price of a Bond between Bond interest dates – Finding the yield rate.

Chapter 8. Sections 8.1 to 8.6 (omit 8.7)

UNIT - III CAPITAL BUDGETING AND DEPRECIATION

Net present value – Internal rate of return – Capitalized cost and Capital Budgeting.

Chapter 9. Sections 9.1 to 9.4

UNIT - IV CONTINGENT PAYMENTS

Introduction – Probability – Mathematical Expectation – Contingent payments with Time Value.

Chapter 10. Sections 10.1 to 10.4

UNIT - V LIFE ANNUITIES AND LIFE INSURANCE

Introduction – Mortality Tables – Pure Endowments – Life Annuities – Life Insurance – Annual Premium Policies.

Chapter 11. Sections 11.1 to 10.6

Recommended Text

Petr Zima and Robert L. Brown, Theory and Problems of Mathematics of Finance, Schaum's Outlines, Tata McGraw Hill, New Delhi, 2005.

SEMESTER III
CORE PAPER – 9
COMPLEX ANALYSIS - I

Objectives: To Study Cauchy integral formula, local properties of analytic functions, general form of Cauchy's theorem and evaluation of definite integral and harmonic functions.

Course outcomes: At the end of the Course, the Students will able to	
CO1	Determine and analyze the complex integration using Cauchy Integral Formula and Residues.
CO2	Identify local properties of Analytic Functions.
CO3	Express the function in power series expansion and partial fractions.
CO4	Develop series of complex function and extend its product using Jensen's and Poisson Formula.

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 Analytic Functions
Removable Singularities. Taylors's Theorem - Zeros and poles - The local Mapping - The Maximum Principle.
Chapter 4: Section 2 : 2.1 to 2.3;
Chapter 4: Section 3 : 3.1 to 3.4

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- Multiply connected regions.
The Calculus of Residues
Residue theorem - The argument principle.
Chapter 4: Section 4 : 4.1 to 4.7;
Chapter 4: Section 5: 5.1 and 5.2

UNIT-III :
The Calculus of Residues (Continuation)
Evaluation of definite integrals.
Harmonic Functions
Definition of Harmonic function and basic properties - Mean value property - Poisson formula.
Chapter 4: Section 5 : 5.3 ;
Chapter 4: Sections 6 : 6.1 to 6.3
UNIT-IV:
Harmonic Functions (Continuation)
Schwarz theorem - The reflection principle.
Power Series Expansions
Weierstrass's theorem - Taylor Series - Laurent series.
Chapter 4: Sections 6: 6.4 and 6.5 ;
Chapter 5: Sections 1: 1.1 to 1.3

UNIT-V:

Partial Fractions and Factorization

Partial fractions - Infinite products - Canonical products - Gamma Function.

Entire Functions

Jensen's formula - Hadamard's Theorem.

Chapter 5: Sections 2: 2.1 to 2.4 (Omit: 2.5);

Chapter 5: Sections 3: 3.1 and 3.2

Recommended Text

Lars V. Ahlfors, Complex Analysis, (3rd Edition) McGraw Hill Book Company, New York, 1979.

Reference Books

1. H.A. Presfly, Introduction to complex Analysis, Clarendon Press, oxford, 1990.
2. J.B. Conway, Functions of one complex variables Springer - Verlag, International student Edition, Narosa Publishing Co.1978.
3. E. Hille, Analytic function Thorey (2 vols.), Gonm & Co, 1959.
4. M.Heins, Complex function Theory, Academic Press, New York,1968.

CORE PAPER – 10
TOPOLOGY

Objectives: To study topological spaces, continuous functions, connectedness, compactness, countability and separation axioms.

Course outcomes: At the end of the Course, the Students will able to	
CO1	Define basis and generate topology from basis, construct various topology on sets and compare them.
CO2	Define Continuous functions on topological spaces and compare the results with Metrizable spaces.
CO3	Classify whether the given topological space is connected, compact or not.
CO4	Categorize separation axioms on different topological spaces.

UNIT-I : TOPOLOGICAL SPACES
Topological spaces - Basis for a topology - The order topology - The product topology on X x Y - The subspace topology - Closed sets and limit points.

Chapter 2 : Sections 12 to 17

UNIT-II : CONTINUOUS FUNCTIONS
Continuous functions - the product topology - The metric topology.

Chapter 2 : Sections 18 to 21

UNIT-III : CONNECTEDNESS
Connected spaces - connected subspaces of the Real line - Components and local connectedness.

Chapter 3 : Sections 23 to 25

UNIT-IV : COMPACTNESS
Compact spaces - Compact subspaces of the Real line - Limit Point Compactness - Local Compactness.

Chapter 3 : Sections 26 to 29

UNIT-V: COUNTABILITY AND SEPARATION AXIOMS
The Countability Axioms - The separation Axioms - Normal spaces - The Urysohn Lemma - The Urysohn metrization Theorem - The Tietze extension theorem.

Chapter 4 : Sections 30 to 35

Recommended Text

James R. Munkres, Topology (2nd Edition) Pearson Education Pvt. Ltd., Delhi-2002 (Third Indian Reprint)

Reference Books

1. J. Dugundji , Topology , Prentice Hall of India, New Delhi, 1975.
2. George F.Sinmmons, Introduction to Topology and Modern Analysis, McGraw Hill Book Co., 1963
3. J.L. Kelly, General Topology, Van Nostrand, Reinhold Co., New York
4. L.Steen and J.Subhash, Counter Examples in Topology, Holt, Rinehart and Winston, New York, 1970.
5. S.Willard, General Topology, Addison - Wesley, Mass., 1970

CORE PAPER – 11
DIFFERENTIAL GEOMETRY

Objectives: This course introduces space curves and their intrinsic properties of a surface and geodesics. Further the non-intrinsic properties of surfaces are explored. To be able to understand the fundamental theorem for plane curves.

Course Outcomes: At the end of the Course, the Students will able to	
CO1	Explain the space curve and distinguish tangent, normal and bi normal.
CO2	Define a surface and find the surface of revolution
CO3	Differentiate the geodesics on various types of surfaces and its properties. Compute the Gaussian curvature and surface of constant curvature
CO4	Classify the curvature as principal and lines of curvature. Identify the developable associated with space curves

UNIT-I: The Theory of Space Curves
Definition of a space curve - Arc length - tangent , normal and binormal - curvature and torsion - contact between curves and surfaces - tangent surface, involutes and evolutes - Intrinsic equations - Fundamental Existence Theorem for space curves - Helices.

Chapter I: Sections 1 to 9

UNIT-II: Intrinsic Properties of a Surface
Definition of a surface - curves on a surface - Surfaces of revolution – Helicoids - Metric - Direction coefficients- Families of curves - Isometric correspondence -Intrinsic properties.

Chapter II: Sections 1 to 9

UNIT-III: Geodesics
Geodesics- Canonical geodesic equations - Normal property of geodesics - Existence Theorems - Geodesic parallels.

Chapter II: Sections 10 to 14

UNIT-IV: Geodesics (Cont. . . .)
Geodesic curvature - Gauss - Bonnet Theorem - Gaussian curvature - Surfaces of constant curvature.

Chapter II: Sections 15 to 18

UNIT-V: Non Intrinsic Properties of a Surface
The second fundamental form - Principal curvatures- Lines of curvature
- Developables - Developables associated with space curves and with curves on surfaces
- Minimal surfaces - Ruled surfaces.

Chapter III: Sections 1 to 8 (Omit Sections 9,10and 11)

Recommended Text

T.J.Willmore, An Introduction to Differential Geometry, Oxford University Press, (17th Impression) New Delhi 2002. (Indian Print)

Reference Books

1. Struik, D.T. Lectures on Classical Differential Geometry, Addison - Wesley, Mass. 1950.
2. Kobayashi. S and Nomizu. K. Foundations of Differential Geometry, Interscience Publishers, 1963.
3. Wilhelm Klingenberg: A course in Differential Geometry, Graduate Texts in Mathematics, Springer-Verlag 1978.
4. J.A. Thorpe Elementary topics in Differential Geometry, Under - graduate Texts in Mathematics, Springer - Verlag 1979.

CORE PAPER – 12
OPERATIONS RESEARCH

Objectives: To study decision theory, PERT, CPM, Inventory control, queue system and Information theory.

Course outcomes: At the end of the Course, the Students will able to	
CO1	Compare PERT and CPM. Formulate project scheduling with uncertainty activity
CO2	Classify Queuing problem using Kendal notation and Define the meaning of inventory, functional role of inventory.
CO3	Explain encoding and decoding procedure. Relate sender, receiver and channel of communication system
CO4	Sketch decision tree and solve problem of certainty and uncertainty.

UNIT-I : DECISION THEORY AND DECISION TREES

Steps of Decision –Making Process- 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-11 : 11.1 - 11.8

UNIT-II : PROJECT MANAGEMENT : PERT AND CPM

Basic Differences between PERT and CPM – Phases of Project Management- PERT/CPM Network Components and Precedence Relationships - Critical Path Analysis – Project Scheduling with Uncertain Activity Times- Project time-Cost Trade -Off - Updating of the Project Progress.

Chapter-13: 13.1 - 13.8(Omit 13.9)

UNIT-III: DETERMINISTIC INVENTORY CONTROL MODELS

The Meaning of Inventory Control - Functional Role of Inventory- Reasons for Carrying Inventory-Factors Involved in Inventory Problem Analysis- Inventory Model Building – Single Items Inventory Control Models Without Shortages-Single Item Inventory Control Models with Shortages.

Chapter-14 : 14.1 - 14.8

UNIT-IV: QUEUEING THEORY

Essential Features of a Queueing System – Performance Measures of a Queuing System-Probability Distributions in Queueing Systems - Classification of Queueing Models – Single-Server Queueing Models –Multi-Server Queuing Models-Finite Calling Population Queuing Models– Multi Phase service Queueing Model.

Chapter-16 : 16.1 - 16.9 ; Appendix 16.A , 16.B (PP 774-781)

UNIT-V: INFORMATION THEORY

Communication processes – A Measure of information – Measures of other information quantities – Channel capacity, Efficiency and Redundancy – Encoding –Shannon-Fano Encoding Procedure- Necessary and sufficient condition for noiseless encoding.

Chapter – 21 : 21.1 – 21.8.

Recommended Text:

J. K. Sharma, Operations Research Theory and Applications, Third Edition (2007), Macmillan India Ltd.

Reference Books:

1. F.S. Hillier and J.Lieberman -,Introduction to Operations Research (8th Edition), Tata McGraw Hill Publishing Company, New Delhi, 2006.

2. Beightler. C, D.Phillips, B. Wilde, Foundations of Optimization (2nd Edition) Prentice Hall Pvt Ltd., New York, 1979.

3. Bazaraa, M.S; J.J.Jarvis, H.D.Sharall, Linear Programming and Network flow, John Wiley and sons, New York 1990.

ELECTIVE PAPER-3
(to choose any 1 out of the given 3)
A. PROBABILITY THEORY

Objectives: To introduce axiomatic approach to probability theory, to study some statistical characteristics, discrete and continuous distribution functions and their properties, characteristic function and basic limit theorems of probability.

Course Outcomes: At the end of the Course, the Students will able to	
CO1	Describe the concepts of Random events and Random variables with examples.
CO2	Evaluate expectation, moments and analyze regression of the first and second types.
CO3	Recognize the importance of the central limit theorem and understand when it is appropriate to use normal approximations for the distribution of a statistic.
CO4	Compose techniques of proving theorems and thinking out counter examples.

UNIT-I: Random Events and Random Variables
Random events - Probability axioms - Combinatorial formulae - conditional probability – Baye's Theorem - Independent events - Random Variables - Distribution Function – Random variables of Discrete type and Continuous type - Functions of Random Variables – Multidimensional random variables-Marginal Distribution - Conditional Distribution - Independent random variables - Functions of Multidimensional random variables.

Chapter 1: Sections 1.1 to 1.7 Chapter 2: Sections 2.1 to 2.9 (Omit sec:2.10)

UNIT-II: Parameters of The Distribution of a Random Variable
Expected values - 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 - The characteristic function and moments - semi-invariants – The characteristic function of the sum of independent random variables - Determination of the distribution function by the Characteristic function – The characteristic function of multidimensional random vectors - Probability generating functions.
Chapter 4: Sections 4.1 to 4.7

UNIT-IV: Some Probability Distributions
One-point and two-point distributions -Binomial and generalized binomial distributions- Bernoulli and Poisson scheme-The Polya and Hypergeometric - Poisson, 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 – Bernoulli’s law of large numbers – The convergence of a sequence of distribution functions - Levy-Cramer Theorem - de Moivre-Laplace Theorem – Lindeberg – Levy Theorem – Lapunov Theorem – Poisson’s, Chebyshev’s, Khintchine’s law of large numbers – The Strong Law of large numbers.

Chapter 6 : Sections 6.2 to 6.4, 6.6 to 6.9 , 6.11 and 6.12.
(Omit Sections 6.1, 6.5, 6.10, 6.13 to 6.15)

Recommended Text

M. Fisz, Probability Theory and Mathematical Statistics, John Wiley and Sons, New York, 1963.

Reference Books

1. R.B. Ash, Real Analysis and Probability, Academic Press, New York, 1972.

2. K.L.Chung, A course in Probability, Academic Press, New York, 1974.

3. R.Durrett, Probability : Theory and Examples, (2nd Edition) Duxbury Press, New York, 1996.

4. V.K.Rohatgi An Introduction to Probability Theory and Mathematical Statistics, Wiley Eastern Ltd., New Delhi, 1988(3rd Print).

5. S.I.Resnick, A Probability Path, Birhauser, Berlin,1999.

6. B. R. Bhat, Modern Probability Theory (3rd Edition), New Age International (P)Ltd, New Delhi, 1999.

B. STOCHASTIC PROCESSES

Objectives: This course aims to introduce advanced topics in Markov process, Markov chains and Renewal theory.

At the end of the course the student will be able to	
CO1	Describe Markov Chain and its Probability Transition Matrix
CO2	Explain the concept of Markov Chain in graph theory and find Statistical Inference.
CO3	Analyze Markov Processes in discrete and Continuous state space.
CO4	Use Renewal equation to find stopping time and equilibrium renewal process.

UNIT - I: Stochastic Processes

Specification of Stochastic processes – stationary processes – Markov Chains: Definitions and Examples – Higher transition probabilities – Generalization of independent Bernoulli trials.

Chapter 2 : 2.1 to 2.4; Chapter 3 : 3.1 to 3.1

UNIT - II: Markov Chains

Stability of Markov system – Graph theoretic approach – Markov chain with denumerable number of state – Reducible chains – Statistical inference for Markov chains. specification of stochastic processes – stationary processes – Markov Chains : Definitions and Examples – Higher transition probabilities – Generalization of independent Bernoulli trials.

Chapter 3: 3.6 to 3.10

UNIT - III : Markov Process with discrete state space

Poisson process: Poisson process and related distributions – Generalizations of Poisson process – Birth and death process – Markov process with discrete state space (Continuous time Markov chain).

Chapter 4: 4.1 to 4.5

UNIT - IV: Markov Process with continuous state space

Brownian motion – Weiner process – Differential equations for Weiner Process – Kolmogorov equations – First passage time distribution for Weiner process.

Chapter 5: 5.1 to 5.5

UNIT - V: Renewal Process and Theory

Renewal process and renewal equation – Stopping time – Wald's equation – Renewal theorem – Delayed and equilibrium renewal process.

Chapter 6: 6.1 to 6.6

Recommended Text

J. Medhi, Stochastic Processes (2nd Edition), New Age International, 1992.

Reference Books

1. S. Karlin, A first course in Stochastic Processes, (2nd Edition), Academic Press, 1958.
2. U.N. Bhat, Elements of Applied Stochastic Prcesses, John Wiley Sons, 1972.
3. E. Cinlar, Introduction to Stochastic Processes, PHI publishers 1975.
4. S.K. Srinivasan and A. Vijayakumar, Stochastic Processes, Narosa Publishers, 2003.

C. TENSOR ANALYSIS AND RELATIVITY THEORY

Objectives: The course aims to develop the knowledge about Tensor analysis and Relativity theory.

Course Outcomes: At the end of the Course, the Students will able to	
CO1	Define the basic terminologies of Tensors.
CO2	Identify the Christoffel Symbols and related concepts.
CO3	State the principle of relativity and utilize where ever required.
CO4	Discuss the Relativistic dynamical concepts.

UNIT-I: TENSOR ALGEBRA

Systems of Different orders - Summation Convention - Kronecker Symbols - Transformation of coordinates in S_n - 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 of 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-II: TENSOR CALCULUS

Riemannian Space - Christoffel Symbols and their properties.

Chapter III: III.1 and III.2

UNIT-III: TENSOR CALCULUS (Contd . . .)

Covariant Differentiation of Tensors - Riemann - Christoffel Curvature Tensor - Intrinsic Differentiation.

Chapter III: III.3 - III.5

UNIT-IV: SPECIAL THEORY OF RELATIVITY

Galilean Transformation - 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-V: 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

Recommended Texts

For Units I, II and III:
U.C. De, Absos Ali Shaikh and Joydeep Sengupta, Tensor Calculus, Narosa Publishing House, New Delhi, 2004.

For Units IV and V:
D. Greenwood, Classical Dynamics, Prentice Hall of India, New Delhi, 1985.

Reference Books

1. J.L.Synge and A.Schild, Tensor Calculus, Toronto, 1949.
2. A.S.Eddington. The Mathematical Theory of Relativity, Cambridge University Press, 1930.
3. P.G.Bergman, An Introduction to Theory of Relativity, New York, 1942.
4. C.E.Weatherburn, Riemannian Geometry and the Tensor Calculus, Cambridge, 1938.

MATHEMATICAL SOFTWARES LATEX (PRACTICAL)

Objectives: This course aims to practice the students in Mathematics document preparation.

Course Outcome: At the end of the Course, the Students will able to	
CO1	Arrange Latex code for Type Setting.
CO2	Create tables, list, and Title page.
CO3	Prepare code for mathematics equation, Bibliography Management.

- Simple Typesetting
- Title Creation
- List
- Page Layout (page size, margins, page style)
- Formatting (Font size, Text Alignment)
- Tables
- Figures
- Typesetting Mathematics
- Bibliography Management.

Reference Books

Latex Tutorials – A PRIMER Indian TEX Users Group, 2002, 2003 Indian TEX Users Group Floor III SJP Buildings, Cotton Hills Trivandrum 695014, India.

CORE PAPER – 13
COMPLEX ANALYSIS - II

Objectives: To study Riemann Theta Function and normal families, Riemann mapping theorem, Conformal mapping of polygons, harmonic functions, elliptic functions and Weierstrass Theory of analytic continuation.

Course Outcomes: At the end of the Course, the Students will able to	
CO1	Identify the properties of Normal families.
CO2	Construct Riemann map and Schwartz-Chirostoffel Formula.
CO3	Classify Elliptic function and analyze their properties.
CO4	Discuss the concepts of Homotopic curves.

UNIT-I:
Riemann Zeta Function:
Product development - Extension of $\zeta(s)$ to the whole plane – The functional equation- The zeros of zeta function.
Normal Families:
Equicontinuity - Normality and compactness - Arzela's theorem - Families of analytic functions - The Classical Definition.

Chapter 5: Sections 4: 4.1 to 4.4 ;
Chapter 5: Sections 5: 5.1 to 5.5

UNIT-II:
Riemann Mapping Theorem:
Statement and Proof - Boundary Behavior - Use of the Reflection Principle.
Conformal Mappings of Polygons :
Behavior at an angle - Schwarz-Christoffel formula - Mapping on a rectangle.
A Closer Look at Harmonic Functions :
Functions with mean value property - Harnack's principle.

Chapter 6: Sections 1: 1.1 to 1.3 (Omit Section1.4) ;
Chapter 6: Sections 2: 2.1 to 2.3 (Omit section 2.4)
Chapter 6: Section 3: 3.1 and 3.2

UNIT-III: Elliptic Functions
Simply Periodic Functions:
Representation by Exponentials – The Fourier Development – Functions of Finite order.

Doubly Periodic Functions:
The period Module – Unimodular Transformations – The Canonical Basis – General Properties of Elliptic Functions.
Chapter 7: Sections 1: 1.1 to 1.3;
Chapter 7: Sections 2: 2.1 to 2.4

UNIT-IV:

Weirstrass Theory:

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

UNIT-V:

Analytic Continuation:

The Weiertrass Theory - Germs and Sheaves - Sections and Riemann surfaces - Analytic continuations along Arcs - Homotopic curves - The Monodromy Theorem - Branch points.
Chapter 8: Sections 1.1 to1.7

Recommended Text

Lars V. Ahlfors, Complex Analysis, (3rd Edition) McGraw Hill Book Company, New York, 1979.

Reference Books

1. H.A. Presfly, Introduction to complex Analysis, Clarendon Press, oxford, 1990.
2. J.B. Corway, Functions of one complex variables, Springer - Verlag, International student Edition, Narosa Publishing Co.
3. E. Hille, Analytic function Thorey (2 vols.), Gonm & Co, 1959.
4. M.Heins, Complex function Theory, Academic Press, New York,1968.

CORE PAPER – 14
FUNCTIONAL ANALYSIS

Objectives: To study the details of Banach spaces, Hilbert Spaces and Banach Algebras.

Course Outcomes: At the end of the Course, the Students will able to	
CO1	Define Banach space and Hilbert space and describe some main examples of them.
CO2	Compute the norm of a continuous linear transformation and classify various types operators on a Hilbert space.
CO3	Identify whether the given element in a Banach algebra is regular or not.
CO4	Calculate the spectral radius and the spectrum of an element in a Banach algebra.

UNIT-I : BANACH SPACES
Definition - Some examples - Continuous Linear Transformations - The Hahn -Banach Theorem - The natural embedding of N in N**.

Chapter 9 : Sections 46 to 49

UNIT-II : BANACH SPACES AND HILBERT SPACES
Open mapping theorem - conjugate of an operator - Definition and some simple properties - Orthogonal complements - Orthonormal sets.

Chapter 9 : Sections 50 and 51 ; Chapter 10 : Sections 52, 53 and 54

UNIT-III : HILBERT SPACES
Conjugate space H* - Adjoint of an operator - Self-adjoint operator - Normal and Unitary Operators – Projections.

Chapter 10 : Sections 55, 56,57,58 and 59

UNIT-IV : PRELIMINARIES ON BANACH ALGEBRAS
Definition and some examples - Regular and singular elements - Topological divisors of zero - spectrum - the formula for the spectral radius - the radical and semi-simplicity.

Chapter 12 : Sections 64 to 69

UNIT-V: STRUCTURE OF COMMUTATIVE BANACH ALGEBRAS
Gelfand mapping - Applications of the formula r(x) = lim $\|x^n\|^{1/n}$.
Involutions in Banach Algebras - Gelfand-Neumark Theorem.

Chapter 13 : Sections 70 to 73.

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. G. Bachman & L.Narici, Functional Analysis Academic Press, New York, 1966.
3. H.C. Goffman and G.Fedrick, First course in Functional Analysis, Prentice Hall of India, New Delhi, 1987.
4. E. Kreyszig Introductory Functional Analysis with Applications, John wiley & Sons, New York,1978.

CORE PAPER – 15
MATHEMATICAL STATISTICS

Objectives: This course introduces sampling theory, significance tests, and estimation, testing of hypotheses, SPRT and sequential analysis with rigorous mathematical treatment.

Course Outcomes: At the end of the Course, the Students will able to	
CO1	Recognize the notion of a sample and a statistic and manipulate the different types of distribution
CO2	Examine the nature of the samples by applying the different types of tests.
CO3	Estimate and justify the statistic of given samples
CO4	Analyze the variance and explain the sequential analysis through various types of tests.

UNIT-I: Sample Moments And Their Functions
The notion of a sample and a statistic –The Distribution of the arithmetic mean of independent normally distributed random variables -χ^2 distribution –The distribution of the statistic $(\overline{X}, S)$- Student t-distribution - Fisher's Z - distribution - Snedecor's F - distribution - Distribution of sample$(\overline{X})$ mean for some non-normal populations.

Chapter 9: Sections 9.1 to 9.8 (Omit Sections 9.9 to 9.11)

UNIT-II: Significance Tests
Concept of a statistical test - Parametric tests for small samples and large samples - χ^2test – The theorem Kolmogorov and - Smirnov - Tests of Kolmogorov and Smirnov type - The Wald-Wolfowitz and Wilcoxon -Mann-Whitney tests - Independence Tests by contingency tables.

Chapter 10: Sections 10.11Only; Chapter 12: Sections 12.1 to 12.7

UNIT-III: The Theory of Estimation
Preliminary notion – Consistent estimation - Unbiased estimates – Sufficiency, Efficiency and Asymptotically most efficient estimates - Methods of finding estimates - confidence Intervals.
Chapter 13: Sections 13.1 to 13.8 (Omit Section 13.9)

UNIT-IV: Analysis of Variance and Hypotheses Testing
One way classification and multiple classification. Power function and OC function - Most Powerful tests - Uniformly most powerful test - unbiased tests.

Chapter 15: Sections 15.1 and 15.2 (Omit Section 15.3);
Chapter 16: Sections 16.2 to 16.5 (Omit Section16.1, 16.6 and 16.7)

UNIT-V: Elements of Sequential Analysis

SPRT - Auxiliary Theorem - Fundamental identity - OC function and SPRT - E(n) and Determination of A and B - Testing a hypothesis concerning the parameter p of a 0-1 distribution and m of a Normal population.

Chapter 17: Sections 17.1 to 17.9 (Omit Section 17.10)

Recommended Text

M. Fisz ,Probability Theory and Mathematical Statistics, John Wiley and sons, New Your, 1963.

Reference Books

1. E.J.Dudewicz and S.N.Mishra ,Modern Mathematical Statistics, John Wiley and Sons, New York, 1988.

2. V.K.RohatgiAn Introduction to Probability Theory and Mathematical Statistics, Wiley Eastern New Delhi, 1988(3rd Edn).

3. G.G.Roussas, A First Course in Mathematical Statistics, Addison Wesley Publishing Company, 1973.

4. B.L.VanderWaerden, Mathematical Statistics, G.Allen&Unwin Ltd., London, 1968.

CORE PAPER – 16
NUMBER THEORY AND CRYPTOGRAPHY

Objectives: This course aims to give elementary ideas from number theory which will have applications in cryptology.

Course Outcomes: At the end of the Course, the Students will able to	
CO1	Solve the Chinese remainder theorem for congruence.
CO2	Apply the elementary concepts of number theory to find quadratic residues.
CO3	Categorize enciphering and deciphering matrices of some simple cryptosystems and public key cryptography.
CO4	Recognize the methods of primality and factoring.

UNIT-I : Elementary Number Theory
Time estimates for doing arithmetic - Divisibility and the Euclidean algorithm - Congruences - Applications to factoring.

Chapter-I (Full)

UNIT-II : Finite Fields and quadratic Residues
Finite fields - Quadratic residues and Reciprocity.

Chapter-II (Full)

UNIT-III : Cryptography
Some simple cryptosystems - Enciphering matrices.

Chapter-III (Full)

UNIT-IV : Public Key Cryptography
The idea of public key cryptography - RSA - Discrete log - Knapsack.

Chapter-IV : Sections 1 to 4 (omit sec.5)

UNIT-V : Primality and Factoring
Pseudoprimes - The rho method - Fermat factorization and factor bases - The Continued fraction method - The quadratic sieve method.

Chapter-V(Full)

Recommended Text

Neal Koblitz, A Course in Number Theory and Cryptography, Springer-Verlag, New York, 2002, Second Edition.

Reference Books

1. Niven and Zuckermann, An Introduction to Theory of Numbers (Edn. 3), Wiley Eastern Ltd., New Delhi, 1976.

2. David M.Burton, Elementary Number Theory, Wm C.Brown Publishers, Dubuque, Iowa, 1989.

3. K.Ireland and M.Rosen, A Classical Introduction to Modern Number Theory, Springer Verlag, 1972.

ELECTIVE PAPER-4
(to choose any 1 out of the given 3)
A. FLUID DYNAMICS

Objectives: To study steady and unsteady flows, Equations of motion of a fluid, stream functions, two and three dimensional flows and viscous flows.

Course Outcomes: At the end of the Course, the Students will able to	
CO1	Recognize the types of fluid.
CO2	Identify the given velocity potential is conservative or not.
CO3	Sketch source, sink and doublet problem and solve the problem.
CO4	Describe the Milne Thompson Circle Theorem and relate the stress and rate of strain of the fluid

UNIT-I KINEMATICS OF FLUIDS IN MOTION

Real fluids and Ideal fluids - Velocity of a fluid at a point-Stream lines and Pathlines; Steady and Unsteady Flows- The Velocity potential - The Vorticity vector- Local and Particle Rates of change -The Equation of Continuity - Worked Examples-Acceleration of a Fluid - Conditions at a Rigid Boundary.

Chapter 2: Sections 2.1 to 2.10 (omit 2.11).

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 a Two Inviscid Immiscible Fluids- Euler's Equations of Motion – Bernoulli's Equation-Worked Examples-Discussion of the Case of Steady Motion under Conservative Body Forces.

Chapter 3: Sections 3.1 to 3.7

UNIT-III SOME THREE DIMENSIONAL FLOWS

Introduction- Sources, Sinks and Doublets - Images in a Rigid Infinite Plane –
Axi - Symmetric Flows – Stokes's Stream Function.

Chapter 4: Sections 4.1, 4.2, 4.3, 4.5(omit 4.4).

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: Sections 5.1 to 5.8

UNIT-V: VISCOUS FLOW

Stress Components in a Real Fluid - Relations between Cartesian Components of Stress-Translational Motion of Fluid Elements - The Rate of Strain Quadric and Principal Stresses - Some Further Properties of the Rate of Strain Quadric - Stress Analysis in Fluid Motion - Relations 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: Sections 8.1 to 8.9

Recommended Text

F. Chorlton, Text Book of Fluid Dynamics,CBS Publications, Delhi,1985.

Reference Books

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

B. DISCRETE MATHEMATICS

Objectives: This course aims to explore the topics like lattices and their applications in switching circuits, finite fields, polynomials and coding theory.

Course Outcomes: At the end of the Course, the Students will able to	
CO1	Analyze the properties and operation on lattice with illustration. Construct the minimal forms of a Boolean algebra.
CO2	Apply the discrete mathematical concepts in switching circuits.
CO3	Relate the finite field theory to discrete mathematics and identify the factors of polynomials over finite fields.
CO4	Define the coding and linear codes.

UNIT - I : LATTICES

Properties and examples of Lattices - Distributive lattices - Boolean algebras - Boolean polynomials - Minimal Forms of Boolean Polynomials.

Chapters : 1 to 4 and 6. (Omit 5).

UNIT - II : APPLICATIONS OF LATTICES

Switching Circuits - Applications of Switching Circuits.

Chapters : 7 and 8 (Omit 9).

UNIT - III : FINITE FIELDS

Finite fields.

Chapter : 13.

UNIT - IV : FINITE FIELDS AND POLYNOMIALS

Irreducible Polynomials over Finite fields - Factorization of Polynomials over Finite fields.

Chapters : 14 and 15.

UNIT - V: CODING THEORY

Introduction to Coding - Linear Codes.

Chapters : 16 and 17.

Recommended Text

Rudolf Lidl & Gunter Pilz. APPLIED ABSTRACT ALGEBRA, Second Indian Reprint 2006, Springer Verlag, NewYork.

Reference Books

1. A.Gill, Applied Algebra for Computer Science, Prentice Hall Inc., New Jersey.
2. J.L.Gersting, Mathematical Structures for Computer Science(3rd Edn.), Computer Science Press, New York.
3. S.Wiitala, Discrete Mathematics- A Unified Approach, McGraw Hill Book Co.

C. PROGRAMMING IN C++ WITH PRACTICALS

(Theory 60 marks + Practical 40 Marks)

(Theory: Int.15 + Univ. Exam. 45) (Practical: Int.10 + Univ. Exam. 30)

Objectives: This course introduces a higher level language C++ and numerical methods for hands-on experience on computers. Stress is also given on the error analysis.

Course Outcomes: At the end of the Course, the Students will able to	
CO1	Describe the object oriented programming approach in connection with C++.
CO2	Apply the concepts of object oriented programming.
CO3	Illustrate the process of data file manipulation using C++.
CO4	Identify the use of pointers, virtual and pure virtual functions.

UNIT - I

Principles of OOP – Beginning with C++ - Tokens, Expressions and Control Structures.

Chapters : 1 to 3

UNIT - II

Functions in C++ - Classes and Objects.

Chapters : 4 and 5

UNIT - III

Constructors and destructors - Operator Overloading and Type Conversions.

Chapters : 6 and 7

UNIT - IV

Inheritance : Extending Classes - Pointers, Virtual Functions and Polymorphism.

Chapters : 8 and 9

UNIT - V

Managing Console I/O Operations - Working with Files.

Chapters : 10 and 11

Recommended Text

E. Balagurusamy, Object Oriented Programming with C++, Tata McGraw Hill, New Delhi, 1999.

Reference Books

D. Ravichandran, Programming with C++, Tata McGraw Hill, New Delhi, 1996.

COMPUTER LABORATORY PRACTICE EXERCISES

COMPUTER LANGUAGE EXERCISES FOR PROGRAMMING IN C++

Objectives: To develop programming skills in C++ Language and make them to solve Numerical & Mathematical problems.

Course Outcome: At the end of the Course, the Students will able to	
CO1	Write C++ program for vector manipulations.
CO2	Create C++ program for an array of integer numbers and sort it in descending order.
CO3	Compose a C++ program for the dynamic initialization of constructors.

1. Write a class to represent a vector (a series of float values). Include member functions to perform the following tasks: To create the vector, To modify the value of a given element, To multiply by a scalar value, To display the vector in the form (10, 20, 30,…). Write a program to test your class.
2. Create a class FLOAT that contains one float data member. Overload all the four arithmetic operators so that they operate on the objects of FLOAT.
3. Write a program which shows the days from the start of year to date specified. Hold the number of days for each month in an array. Allow the user to enter the month and the day of the year. Then the program should display the total days till the day.
4. Write a program to include all possible binary operators overloading using friend function.
5. Write a program to read an array of integer numbers and sort it in descending order. Use read data, put data, and array max as member functions in a class.
6. Write a program to read two character strings and use the overloaded '+' operator to append the second string to the first.
7. Develop a program Railway Reservation System using Hybrid Inheritance and Virtual Function.
8. Using overloaded constructor in a class write a program to add two complex numbers.
9. Create a class MAT of size (m,n). Define all possible matrix operations for MAT type objects.
10. Write a program that determines whether a given number is a prime number or not and then prints the result using polymorphism.
11. Write a program to illustrate the dynamic initialization of constructors.
12. Write a program to illustrate the use of pointers to objects.
13. Write a program to illustrate how to construct a matrix of size m x n.
14. Write a program to arrange the given data in ascending / descending order using various sorting algorithms.
15. Write a program to find the biggest /smallest number in the given data using various search algorithms.