**GOVERNMENT ARTS COLLEGE (AUTONOMOUS) , COIMBATORE-641 018**
**POST GRADUATE AND RESEARCH DEPARTMENT OF MATHEMATICS**
**M. Sc., MATHEMATICS**
**SCHEME OF EXAMINATION (2015 – 2016 ONWARDS)**

| Sem | Subject | Hours | Exam (Hrs) | Marks | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | SE | CA | Total | SE- Min | TPM | No. of Credits |
| I | Core-I: Modern Algebra | 6 | 3 | 75 | 25 | 100 | 38 | 50 | 5 |
| | Core- II: Real Analysis | 6 | 3 | 75 | 25 | 100 | 38 | 50 | 5 |
| | Core - III: Complex Analysis | 6 | 3 | 75 | 25 | 100 | 38 | 50 | 5 |
| | Core- IV: Differential Equations | 6 | 3 | 75 | 25 | 100 | 38 | 50 | 5 |
| | Elective- I: Advanced Numerical Analysis | 4 | 3 | 75 | 25 | 100 | 38 | 50 | 2 |
| | Seminar | 2 | | | | | | | |
| | **TOTAL** | **30** | | | | | | | **22** |
| II | Core-V: Topology | 6 | 3 | 75 | 25 | 100 | 38 | 50 | 5 |
| | Core- VI: Measure and Integration | 6 | 3 | 75 | 25 | 100 | 38 | 50 | 5 |
| | Core - VII: Operations Research | 6 | 3 | 75 | 25 | 100 | 38 | 50 | 5 |
| | Core- VIII: Object Oriented Programming With C++ | 6 | 3 | 75 | 25 | 100 | 38 | 50 | 5 |
| | Elective- II: Number Theory | 4 | 3 | 75 | 25 | 100 | 38 | 50 | 3 |
| | Seminar | 2 | | | | | | | |
| | **TOTAL** | **30** | | | | | | | **23** |
| III | Core-IX: Mechanics | 6 | 3 | 75 | 25 | 100 | 38 | 50 | 5 |
| | Core- X: Graph Theory | 6 | 3 | 75 | 25 | 100 | 38 | 50 | 5 |
| | Core - XI: Functional Analysis | 6 | 3 | 75 | 25 | 100 | 38 | 50 | 5 |
| | Core- XII: Mathematical Statistics | 6 | 3 | 75 | 25 | 100 | 38 | 50 | 5 |
| | Elective- III: Introduction to Cryptography | 4 | 3 | 75 | 25 | 100 | 38 | 50 | 2 |
| | Seminar | 2 | | | | | | | |
| | **TOTAL** | **30** | | | | | | | **22** |
| IV | Core-XIII: Operator Theory | 6 | 3 | 75 | 25 | 100 | 38 | 50 | 5 |
| | Core- XIV: Fluid Dynamics | 6 | 3 | 75 | 25 | 100 | 38 | 50 | 5 |
| | Core - XV: Fuzzy Logic and Fuzzy Sets | 6 | 3 | 75 | 25 | 100 | 38 | 50 | 5 |
| | Core- XVI: Solid Mechanics | 6 | 3 | 75 | 25 | 100 | 38 | 50 | 5 |
| | Elective- IV: Matlab | 4 | 3 | 75 | 25 | 100 | 38 | 50 | 3 |
| | Seminar | 2 | | | | | | | |
| | **TOTAL** | **30** | | | | | | | **23** |
| | **GRAND TOTAL** | **120** | | | | | | | **90** |

Sem: SEMESTER Exam (Hrs): EXAMINATION (HOURS)

SE: SEMESTER EXAMINATION CA: CONTINUOUS ASSESSMENT

SE-Min: SEMESTER EXAMINATION MINIMUM

TPM: TOTAL PASSING MINIMUM

**I SEMESTER** **CORE PAPER I**

Subject Code: 11 C

# MODERN ALGEBRA

## UNIT I

**Group Theory:** Another counting principle – Sylow's theorems

(Chapter 2 – Sections: 2.11 and 2.12)

## UNIT II

**Ring Theory:** Polynomial rings – Polynomial rings over the rational field – Polynomial rings over commutative rings.

(Chapter 3 – Sections: 3.9 to 3.11)

## UNIT III

**Fields:** Extension fields – Roots of polynomials – More about roots

(Chapter 5 – Sections: 5.1, 5.3 and 5.5)

## UNIT IV

**Fields, Finite Fields**: The Elements of Galois Theory – Finite fields

(Chapter 5 – Section: 5.6, Chapter 7 – Section: 7.1)

## UNIT V

**Modules**: Free modules – Projective modules – Tensor products – Flat modules.

(Chapter 1 – Sections: 1.1 to 1.4)

## TEXT BOOKS:

1. **TOPICS IN ALGEBRA** – I.N. HERSTEIN, Second Edition, Vikas Publishing Company, New Delhi, Second Reprint, 2006. **(For Units I to IV)**
2. **COMMUTATIVE ALGEBRA** – N.S. GOPALAKRISHNAN, Oxonian Press, New Delhi. **(For Unit V)**

## REFERENCE BOOKS:

1. **A FIRST COURSE IN ABSTRACT ALGEBRA** – JOHN B.FRALEIGH, Narosa Publishing House, New Delhi.
2. **MODERN ALGEBRA** – SURJEET SINGH AND QAZI ZAMEERUDDIN, Vikas Publishing Company, New Delhi.
3. **BASIC ABSTRACT ALGEBRA** – P.B.BHATTACHARYA, S.K.JAIN AND S.R.NAIPAUL, Cambridge University Press, New York.

**I SEMESTER** **CORE PAPER II**

Subject Code: 12 C

# REAL ANALYSIS

## UNIT I

**The Riemann-Stieltjes Integral:** The definition of Riemann-Stieltjes integral – Step function 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 – Comparison theorems – Integrators of bounded variation – Sufficient conditions for existence of Riemann-Stieltjes integrals – Necessary conditions for existence of Riemann-Stieltjes integrals – Mean value theorems for Riemann-Stieltjes integrals.

(Chapter VII – Sections: 7.3, 7.8 – 7.18)

## UNIT II

**Infinite Series and Infinite Products:** Convergent and divergent sequences of complex numbers – Limit superior and limit inferior of real-valued sequences – Monotonic sequences of real numbers – Infinite series – Inserting and removing parenthesis – Alternating series – Absolute and conditional convergence – Test for convergence of series with positive terms – The geometric series – The integral test – The big oh and little oh notation – The ratio test and the root test – Dirichlet's test and Abel's test – Rearrangement of series – Riemann's theorem on conditionally convergent series.

(Chapter VIII – Sections: 8.2 – 8.8, 8.10 – 8.15, 8.17 – 8.18)

## UNIT III

**Infinite Series and Infinite Products (Continued):** Subseries – Double sequences- Double series – Rearrangement theorem for double series – A sufficient condition for equality of iterated series – Infinite products.

**Sequences of Functions:** Pointwise convergence of sequences of functions - Examples of sequences of real-valued functions – Definition of uniform convergence

and continuity – The Cauchy condition for uniform convergence – Uniform convergence of infinite series of functions.

(Chapter VIII – Sections: 8.19 – 8.23, 8.26 and Chapter IX – Sections: 9.1 – 9.6)

## UNIT IV

**Sequences of Functions (Continued):** Uniform convergence and Riemann-Stieltjes integration – Non-uniformly convergent sequences that can be integrated term by term – Uniform convergence and differentiation – Sufficient conditions for uniform convergence of a series.

**Multivariable Differential Calculus:** The directional derivative – Directional derivatives and continuity – The total derivative – The total derivative expressed in terms of partial derivatives – The matrix of a linear function – The Jacobian matrix – The chain rule.

(Chapter IX – Sections: 9.8 – 9.11 and Chapter XII - Sections: 12.2 – 12.5, 12.7 – 12.9)

## UNIT V

**Multivariable Differential Calculus (continued):** 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 $R^1$

**Implicit Functions and Extremum Problems:** Functions with nonzero Jacobian determinant – The inverse function theorem – The implicit function theorem.

(Chapter XII – Sections: 12.11 - 12.14 and Chapter XIII – Sections: 13.2 - 13.4)

## TEXT BOOK:

**MATHEMATICAL ANALYSIS** – T.M.APOSTOL, Second Edition, Addison Wesley Publishing Company, 2002.

## REFERENCE BOOK:

**REAL AND COMPLEX ANALYSIS** – WALTER RUDIN, Tata McGraw Hill Publishing Company Limited.

**I SEMESTER** **CORE PAPER III**

Subject Code: 13 C

# COMPLEX ANALYSIS

## UNIT I

**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

**The Calculus of Residues:** The residue theorem – The argument principle – Evaluation of definite integrals.

(Chapter 4 – Sections: 4.1 to 4.5, 5.1 to 5.3)

## UNIT II

**Harmonic functions:** Definition and basic properties – The mean value property – Poisson's formula

**Power series expansions:** Weierstrass's theorem – The Taylor series – Laurent series.

(Chapter 4 – Sections: 6.1 to 6.3 and Chapter 5 – Sections: 1.1 to 1.3)

## UNIT III

**Partial Fractions and Factorization:** Partial fractions – Infinite products – Canonical products – The Gamma function.

**Entire Functions:** Jensen's formula

(Chapter 5 – Sections: 2.1 to 2.4 and 3.1)

## UNIT IV

**The Riemann Zeta Function:** The product development – Extension of $\xi(s)$ to the whole plane – The functional equation – The zeros of the zeta function.

**Normal Families:** Equicontinuity – Normality and compactness – Arzela's theorem

(Chapter 5 – Sections: 4.1 to 4.3, 5.1 to 5.3)

## UNIT V

**Simply periodic functions:** Representation by exponentials – The Fourier development – Functions of finite order.

**Doubly periodic functions**: The periodic module – Unimodular transformations – The canonical basis – General properties of elliptic functions.

(Chapter 7 – Sections: 1.1 to 1.3, 2.1 to 2.4)

## TEXT BOOK:

**COMPLEX ANALYSIS** – LARS.V.AHLFORS, Third Edition, McGraw Hill International Edition, Fifth Reprint, 1983.

## REFERENCE BOOK:

**THE ELEMENTS OF COMPLEX ANALYSIS** – B.CHOUDHARY, Wiley Eastern Limited.

**I SEMESTER** **CORE PAPER IV**

Subject Code: 14 C

# DIFFERENTIAL EQUATIONS

## UNIT I

**System of Linear Differential Equations:** Introduction – Systems of first order equations – Existence and Uniqueness theorem – Fundamental matrix.

(Chapter 4 – Sections: 4.1, 4.2, 4.4 and 4.5)

## UNIT II

Non-homogeneous linear systems – Linear systems with constant coefficients and linear systems with periodic coefficients.

(Chapter 4 – Sections: 4.6, 4.7 and 4.8)

## UNIT III

**Elliptic Differential Equations:** Occurrence of the Laplace and Poisson equations – Boundary value problems – Some important mathematical tools – Properties of harmonic functions – Separation of variables – Dirichlet problem for a rectangle – The Neumann problem for a rectangle – Interior Dirichlet problem for a circle – Exterior problem for a circle – Interior Neumann problem for a circle – Solution of Laplace equation in cylindrical co-ordinates – Solution of Laplace equation in spherical coordinates.

(Chapter 2 – Sections: 2.1 to 2.12)

## UNIT IV

**Parabolic Differential Equations:** Occurrence of the diffusion equations – Boundary conditions – Elementary solution of the diffusion equation – Dirac delta function – Separation of variables method – Solution of a diffusion equation in cylindrical co-ordinates – Solution of a diffusion equation in spherical co-ordinates – Maximum and minimum principles and consequences.

(Chapter 3 – Sections: 3.1 to 3.8)

## UNIT V

**Hyperbolic Differential Equations:** Occurrence of the wave equation – Derivation of the one dimensional wave equation – Solution of the one dimensional wave equation by canonical reduction – The initial value problem – D'Alemberts solution – Vibrating string – Forced vibrations – Boundary and initial value problems for two dimensional wave equation – Periodic solution of one dimensional wave equation in cylindrical co-ordinates – Periodic solution of one dimensional wave equation in spherical co-ordinates – Vibration of a circular membrane – Uniqueness of the solution for the wave equation – Duhamel's principle.

(Chapter 4 – Sections: 4.1 to 4.12)

## TEXT BOOKS:

1. **ORDINARY DIFFERENTIAL EQUATIONS** – S.G.DEO, V.LAKSHMI KANTHAM AND V.RAGHAVENDRA, Tata McGraw Hill Publishing Company Limited, New Delhi, Second Edition, Eighth Reprint, 2005. **(For Units I and II)**
2. **INTRODUCTION TO PARTIAL DIFFERENTIAL EQUATIONS** – K.SANKARA RAO, Prentice Hall of India Private Limited, New Delhi, Second Edition, 2008. **(For Units III, IV and V).**

## REFERENCE BOOKS:

1. **DIFFERENTIAL EQUATIONS WITH APPLICATIONS AND HISTORICAL NOTES** – GEORGE F SIMMONS, Tata McGraw Hill Publishing Company Limited, New Delhi.
2. **ELEMENTS OF PARTIAL DIFFERENTIAL EQUATIONS** – IAN SNEDDON, McGraw Hill International Company.

**I SEMESTER** **ELECTIVE PAPER I**

Subject Code: 15 E

# ADVANCED NUMERICAL ANALYSIS

## UNIT I

**Solving Non-linear Equations:** Newton's method for complex roots- Muller's method- Bairsow's method for quadratic factors- Other methods for polynomials- Multiple roots.

**Solving Sets of Equations:** The relaxation method- System of nonlinear equations.

(Chapter 1; Sections: 1.4, 1.5, 1.8 to 1.10; Chapter 2; Sections: 2.11 and 2.12)

## UNIT II

**Interpolation and Curve fitting:** Interpolation with a cubic spline – Bezier curves and B - spline curves- Polynomial approximation of surfaces- Least square approximation.

**Approximation of Functions:** Chebyshev polynomials- Economized power series- Approximation with rational functions.

(Chapter 3; Sections: 3.4 to 3.7; Chapter 4; Sections: 4.1 to 4.7)

## UNIT III

**Numerical Differentiation and Integration:** Extrapolation techniques- Gaussian quadrature- Adaptive integration- Multiple integrals- Multiple integration with variable limits- Application of cubic spline- An application of numerical integration- Fourier transforms.

(Chapter 5 – Sections: 5.4, 5.9 to 5.14)

## UNIT IV

**Numerical Solution of Ordinary Differential Equations:** Multistep methods- Adams- Moulton method- System of equations and higher order equations.

**Boundary Value Problems:** The shooting method- Solution through a set of equations- Derivative boundary conditions- Characteristic value problems.

(Chapter 6; Sections: 6.5, 6.7, 6.9; Chapter 7: 7.2 to 7.5)

## UNIT V

**Parabolic and Hyperbolic Partial Differential Equations:** Types of partial differential equations- The heat equation and the wave equation- Solutions techniques for heat equation in one dimension.

**The Finite Element Method:** The Rayleigh-Ritz method- The collocation and Galerkin methods- Finite elements for ordinary differential equations.

(Chapter 8: Sections: 8.1 to 8.3; Chapter 9: Sections: 9.1 to 9.3)

## TEXT BOOK:

**APPLIED NUMERICAL ANALYSIS** - CURTIS F.GERALD AND PATRICK O.WHEATLEY, Sixth Edition, Pearson Education Publishers, 2003.

## REFERENCE BOOK:

**NUMERICAL METHODS FOR ENGINEERS AND SCIENTISTS** - J.N.SHARMA, Second Edition, Narosa Publishers, 2007.

**II SEMESTER** **CORE PAPER V**

Subject Code: 21 C

# TOPOLOGY

## UNIT I

**Topological Spaces:** Topological spaces – Basis for a Topology – The order topology – The product topology on $X \times Y$ – 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 and its continuation.

(Chapter 2 – Sections: 18 to 21)

## UNIT III

**Connectedness and Compactness:** Connected spaces – Connected subspace of the real line – Compact spaces – Compact subspace of real line and limit point compactness.

(Chapter 3 – Sections: 23, 24, 26 to 28)

## UNIT IV

**Countability and Separation Axioms:** The countability axioms – The separation axioms – Normal spaces –The Urysohn lemma – The Urysohn metrization theorem.

(Chapter 4 – Sections: 30 to 34)

## UNIT V

**The Tychonoff theorem, Complete Metric Spaces and Function Spaces:** The Tychonoff theorem – The Stone-Cech compactification – Complete metric spaces – Compactness in metric spaces – Pointwise and compact convergence – Ascoli's theorem.

(Chapter 5 – Sections: 37, 38 and Chapter 7 – Sections: 43, 45 – 47)

## TEXT BOOK:

**TOPOLOGY** – JAMES R. MUNKRES, Second Edition, Prentice Hall of India Private Limited, New Delhi, 2009.

## REFERENCE BOOK:

**INTRODUCTION TO TOPOLOGY AND MODERN ANALYSIS** - G.F.SIMMONS, McGraw Hill International Edition, Second Reprint, 2004.

**II SEMESTER** **CORE PAPER VI**

Subject Code: 22 C

# MEASURE AND INTEGRATION

## UNIT I

**Lebesgue Measure:** Introduction – Outer Measure – Measurable sets and Lebesgue measure – Measurable functions – Littlewood's three principles.

(Chapter 3 – Sections: 1, 2, 3, 5, 6)

## UNIT II

**The Lebesgue Integral:** The Lebesgue integral of a bounded function over a set of finite measure – The integral of a non-negative function – The general Lebesgue integral – Convergence in measure.

(Chapter 4 – Sections: 2, 3, 4, 5)

## UNIT III

**Differentiation and Integration:** Differentiation of monotonic functions – Functions of bounded variation – Differentiation of an integral – Absolute continuity.

(Chapter 5 – Sections: 1, 2, 3, 4)

## UNIT IV

**Differentiation and Integration**: Convex Functions

**The Classical Banach Spaces:** The $L^p$ spaces – The Minkowski and Holder inequalities.

(Chapter 5 – Section: 5 and Chapter 6 – Sections: 1, 2)

## UNIT V

**The classical Banach Spaces:** Convergence and completeness – Approximation in $L^p$ – Bounded linear functionals on the $L^p$ spaces.

(Chapter 6 – Sections: 3 to 5)

## TEXT BOOK:

**REAL ANALYSIS** – H.L.ROYDEN, Third Edition, Prentice Hall of India Private Limited, New Delhi, 2009.

## REFERENCE BOOK:

**MATHEMATICAL ANALYSIS** – T.M.APOSTOL, Third Edition, Addison Wesley/Narosa Indian Student Edition, 2002**.**

**II SEMESTER** **CORE PAPER VII**

Subject Code: 23 C

# OPERATIONS RESEARCH

## UNIT I

**Dual Simplex Method**

**Revised Simplex Method:** Product form of the inverse – Steps of the primal revised method.

**Algebraic Sensitivity Analysis:** Changes affecting feasibility – Changes affecting optimality.

**Parametric Linear Programming:** Parametric changes in c – Parametric changes in b.

(Chapter 4: 4.4 Section – 4.4.1; Chapter 7: 7.2 Sections – 7.2.1, 7.2.2; Chapter 3: 3.6 Sections – 3.6.2, 3.6.3 and Chapter 7: 7.5 Sections – 7.5.1, 7.5.2)

## UNIT II

**Simulation:** Monte-Carlo simulation – Types of simulation – Elements of discrete event simulation – Generation of random numbers – Mechanics of discrete simulation : Manual simulation of single server model.

(Chapter 16 : Sections – 16.1 to 16.4 and 16.5.1)

**Decision Analysis:** Decision making under certainty – Analytic hierarchy process. Decision making under risk – Decision tree based expected value criterion, Variations of the expected value criterion, Decision under uncertainty.

(Chapter 13: Sections – 13.1, 13.2, 13.3)

## UNIT III

**Game Theory:** Optimal solution of two person zero sum game – Solution of mixed strategy games.

**Dynamic Programming:** Recursive nature of computations in DP – Forward and backward recursion.

(Chapter 13: Sections – 13.4 Chapter 10: Sections – 10.1 to 10.2)

## UNIT IV

**Non Linear Programming :** Introduction – Formulating a nonlinear programming problem( NLPP ) – General nonlinear programming problem – Constrained optimization with equality constraints - Constrained optimization with inequality constraints.

(Chapter 25: Sections – 27.1 to 27.5)

## UNIT V

**Non Linear Programming ( continued ):** Introduction – Graphical solution – Kuhn Tucker conditions with non negative constraints – Quadratic programming – Wolfe's modified simplex method – Beale's method – Separable convex programming - Separable convex programming algorithm.

(Chapter 28: Sections – 28.1 to 28.8)

## TEXT BOOK:

1. **OPERATIONS RESEARCH-AN INTRODUCTION** – HAMDY A. TAHA, Eighth Edition, Prentice Hall of India Private Limited, New Delhi. ( For units I, II and III )

2. **OPERATIONS RESEARCH** – KANTI SWARUP, P.K. GUPTA AND MANMOHAN, Sultan Chand and Sons, Educational Publishers, New Delhi, Fourteenth Revised Edition. (For units IV and V)

**II SEMESTER** **CORE PAPER VIII**

Subject Code: 24 C

## OBJECT ORIENTED PROGRAMMING WITH C++

### UNIT I

Beginning with C++.

Tokens, Expressions and Control structures.

(Chapter 2 and Chapter 3)

### UNIT II

Functions in C++.

Constructors and Destructors.

(Chapter 4 and Chapter 6)

### UNIT III

Classes and Objects.

(Chapter 5)

### UNIT IV

Operators overloading and Type conversions.

Pointers, Virtual functions and polymorphism.

(Chapter 7 and Chapter 9)

### UNIT V

Inheritance: Extending Classes.

(Chapter 8)

### TEXT BOOK:

**OBJECT ORIENTED PROGRAMMING WITH C++** – E.BALAGURUSAMY, Third Edition, Tata McGraw Hill Publishing Company, New Delhi, 2008.

## REFERENCE BOOKS:

1. **OBJECT ORIENTED PROGRAMMING IN TURBO C++** – ROBERT LAFORE, Wate group, 1992.
2. **THE C++ PROGRAMMING LANGUAGE** – BJARNE STROUSTROUP, Addision Wesley, 1991.
3. **TEACH YOURSELF C++** – HERBERT SCHILDT OSPORE, McGraw Hill, 1994.

**II SEMESTER** **ELECTIVE PAPER II**

Subject Code: 25 E

# NUMBER THEORY

## UNIT I

Introduction – Divisibility – Primes.

(Chapter I – Sections: 1.1 to 1.3)

## UNIT II

Congruences – Solutions of congruences – The Chinese Remainder theorem – Prime power modulus- Prime modulus.

(Chapter II – Sections: 2.1 – 2.3, 2.6, 2.7)

## UNIT III

Congruences of degree 2 – Prime modulus – Power residues – Number theory from an algebraic view point – Multiplicative groups – Rings and fields.

(Chapter II – Sections: 2.8 – 2.11)

## UNIT IV

Quadratic residues - Quadratic reciprocity – The Jacobi symbol.

(Chapter III – Sections: 3.1, 3.2and 3.3)

## UNIT V

Greatest integer function - Arithmetic functions – The Mobius inversion formula.

(Chapter IV – Sections: 4.1 to 4.5)

## TEXT BOOK:

**AN INTRODUCTION TO THEORY OF NUMBERS** – IVAN NIVEN AND HERBERT. S ZUCHERMAN, HUGH. L MONTGOMERY, Fifth Edition, Wiley Eastern Limited, New Delhi, 1972.

## REFERENCE BOOKS:

1. **INTRODUCTION TO ANALYTIC NUMBER THEORY** – T.M.APOSTOL, Springer Verlag, 1976.

2. **ELEMENTARY NUMBER THEORY AND ITS APPLICATIONS** – KENNATH AND ROSAN, Addison Wesley Pulishing Company, 1968.

3. **NUMBER THEORY – GEORGE E.ANDREWS**, Hindustan Publishing, New Delhi, 1989.

**III SEMESTER** **CORE PAPER IX**

Subject Code: 31 C

# MECHANICS

## UNIT I

**Introductory Concepts:** The mechanical system – Generalized co-ordinates – 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 – Small oscillations.

(Chapter 2 – Sections: 2 .1 to 2 .4)

## UNIT III

**Hamilton's Equation:** Hamilton's principle – Hamilton's equations – Phase space.

(Chapter 4 – Sections: 4.1, 4.2 and 4.4)

## UNIT IV

**Hamilton-Jacobi Theory:** Hamilton's principle function – The Hamilton-Jacobi equation – Separability.

(Chapter 5 – Sections: 5.1 to 5.3)

## UNIT V

**Introduction to Relativity:** Introduction – Relativistic kinematics – Relativistic dynamics.

(Chapter 7 – Sections: 7.1 to 7.3)

## TEXT BOOK:

**CLASSICAL DYNAMICS** – DONALD T. GREENWOOD, Prentice Hall of India Private Limited, New Delhi, 1985.

## REFERENCE BOOKS:

1. **CLASSICAL MECHANICS** – HERBERT GOLDSTEIN, Narosa Publishing House, Second Edition, 1990.

2. **THEORETICAL MECHANICS** – MURRAY R. SPIEGEL, Tata McGraw Hill Education Private Limited, New Delhi, 2006.

**III SEMESTER** **CORE PAPER X**

Subject Code: 32 C

# GRAPH THEORY

## UNIT I

**Fundamental Concepts:**

What is a graph- Paths, cycles and trails- Vertex degrees and counting

(Chapter 1: Sections: 1.1 to 1.3)

## UNIT II

**Trees and Distance:** Basic properties – Spanning trees and enumeration

(Chapter 2: Sections: 2.1, 2.2)

## UNIT III

**Matchings and Factors:** Matchings and covers- Matchings in general graphs

**Connectivity and Paths:** Cuts and connectivity - K - connected graphs.

(Chapter 3: Sections: 3.1, 3.3; Chapter 4: Sections: 4.1, 4.2)

## UNIT IV

**Coloring of Graphs:** Vertex colorings and upper bounds-Structure of K-Chromatic graphs.

(Chapter 5: Sections: 5.1, 5.2)

## UNIT V

**Edges and Cycles**: Line graphs and edge coloring- Hamiltonian cycles.

**Planar Graphs:** Embedding and Euler's formula.

(Chapter 6: Section: 6.1; Chapter 7; Sections: 7.1, 7.2)

All starred items, optional sections and applications are omitted

## TEXT BOOK:

**INTRODUCTION TO GRAPH THEORY** – DOUGLAS B. WEST, Second Edition, PHI Learning Private Limited, New Delhi, 2009.

## REFERENCE BOOKS:

1. **GRAPH THEORY**, NARSINGH DEO, Prentice Hall of India Private Limited, New Delhi, 1987
2. **GRAPH THEORY**, FRANK HARARY, Narosa Publishing House, New Delhi.

**III SEMESTER** **CORE PAPER XI**

Subject Code: 33 C

# FUNCTIONAL ANALYSIS

## UNIT I

**Banach Spaces:** The definition and some examples – Continuous linear transformations – The Hahn Banach theorem.

(Chapter 9 – Sections: 46, 47, 48)

## UNIT II

The natural imbedding of N in $N^{**}$ – The open mapping theorem – The conjugate of an operator.

(Chapter 9 – Sections: 49 to 51)

## UNIT III

**Hilbert Spaces:** The definition and some simple properties – Orthogonal complements – Orthonormal sets – The conjugate space $H^*$.

(Chapter 10 – Sections: 52 to 55)

## UNIT IV

The adjoint of an operator – Self adjoint operators – Normal unitary operators – Projections.

**(**Chapter 10 – Sections: 56 to 59)

## UNIT V

**Finite Dimensional Spectral Theory:** Matrices – Determinants and the spectrum of an operator – The spectral theorem.

(Chapter 11: Sections: 60 to 62)

## TEXT BOOK:

**INTRODUCTION TO TOPOLOGY AND MODERN ANALYSIS** – G.F.SIMMONS, McGraw Hill, Second Reprint, 2004.

## REFERENCE BOOKS:

1. **A FIRST COURSE IN FUNCTIONAL ANALYSIS** – C.GOFFMAN AND G.PEDRICK, Prentice Hall of India, New Delhi, 1987.
2. **INTRODUCTION TO FUNCTIONAL ANALYSIS** – A.E.TAYLOR, John Wiley and Sons, New York, 1988.

**III SEMESTER** **CORE PAPER XII**

**SUBJECT CODE: 34C**

## MATHEMATICAL STATISTICS

### UNIT I

**Random Events**: The system of axioms of theory of Probability – Conditional Probability – Baye's theorem – Independent events.

**Random Variables**: The concept of random variable – The distribution function - Random Variables of discrete type and the continuous type – Functions of random variables – Multidimensional random variables – Marginal distributions – Conditional distributions – Independent random variables.

(Chapter 1 (except section 1.4); Chapter 2- sections: 2.1 to 2.8)

### UNIT II

**Parametric of the distribution of a random variable**: Expected values – Moments – The Chebychev inequality – Absolute moments –Order parameters- Moments of random vectors- Regression of first type- Regression of Second type.

(Chapter 3- sections: 3.1 to 3.8)

### UNIT III

**Characteristic functions**: Properties of Characteristic functions – The Characteristic functions and moments – Semi invariance- The Characteristic function of the sum of Independent random variables – Determinations of the distribution function by the Characteristic function

**Some probability distributions**: One point and two point distributions – The Bernoulli scheme – The binomial distribution – The Poisson scheme – The generalized binomial distribution – The Poisson distribution – The uniform, Normal, Gamma , Beta, Cauchy and Laplace distributions.

(Chapter 4: Sections: 4.1 to 4.5 ; Chapter 5: Sections: 5.1 to 5.10)

**UNIT IV**

**Limit Theorems**: Stochastic convergence – Bernoulli's law of large numbers – The Levy-Cramer theorem- De Moivre-Laplace theorem – The Lindeberg – Levy theorem – The Lapunov theorem. (Chapter 6 – sections: 6.1 to 6.9)

**UNIT V**

**Sample moments and their functions** : The notion of a sample – Notion of a statistic – Distribution of arithmetic mean of Independent normally distributed random variables – The chi-square distribution – Distribution of the statistic ( X, s) – Student's t- distribution – Fisher's Z- distribution

**Significance Test**: The Concept of a statistical test – Parametric tests for small samples - Parametric test for large samples – The chi-square test.
( Chapter 9 – sections: 9.1 – 9.7; Chapter 12 – sections: 12.1 – 12.4)

**TEXT BOOK**:

PROBABILITY THEORY AND MATHEMATICAL STATISTICS – MAREK FISZ, John Wiley and Sons, Third Edition, 1963.

**REFERENCE BOOK:**

FUNDAMENTALS OF MATHEMATICAL STATISTICS – V.K.KAPOOR AND S.C.GUPTA, Sultan and Sons, Eleventh Edition.

**III SEMESTER** **ELECTIVE PAPER III**

Subject Code: 35 E

# INTRODUCTION TO CRYPTOGRAPHY

## UNIT I

**Introduction:** Encryption and secrecy – Objective of cryptography – Attacks – Cryptographic protocols – Provable security.

**Symmetric-key Encryption:** Stream ciphers – Block ciphers – DES – Modes of operation.

**Public-key Cryptography:** Concept of public-key cryptography – RSA: Key generation and encryption – Digital signatures – Attacks against RSA – Secure application of RSA encryption.

(Chapter 1 – Sections: 1.1 to 1.5; Chapter 2 – Sections: 2.1, 2.2 and Chapter 3 – Sections: 3.1 and 3.3)

## UNIT II

**Public-key Cryptography (continued):** Hash Functions: Merkle's meta method – Construction of hash functions – Probabilistic signatures.

Discrete Logarithm: ElGamal's encryption – ElGamal's signature scheme – Digital signature algorithm.

Modular squaring: Rabin's encryption- Rabin's signature scheme

(Chapter 3 – Sections: 3.4 to 3.6)

## UNIT III

**Cryptographic Protocols:**

Key exchange and entity authentication: Kerberos – Diffie-Hellman key Agreement-key exchange and Muthal Authentication – Station- to- Station Protocol– Public key management techniques.

**Identification Schemes:** Interactive proof systems – Simplified Fiat-Shamir identification scheme - Zero-knowledge – Fiat-Shamir identification scheme and Signature scheme.

(Chapter 4 – Sections: 4.1 – 4.2)

## UNIT IV

**Cryptographic Protocols (Continued):** Commitment schemes: Based on quadratic residues – Based on discrete logarithms. Homomorphic commitments.

Electronic Elections: Secret sharing – Multi-Authority election scheme – Proofs of knowledge.

Digital cash: Blindly issued proofs-A fair electronic cash system.

(Chapter 4 – Sections: 4.3 to 4.4.3, 4.5.1, 4.5.2)

## UNIT V

**Probabilistic Algorithms:** Coin-Tossing algorithms – Monte Carlo and Las Vegas algorithms.

**Provably Secure Encryption:** Classical information- Theoretic security – Perfect secrecy and probabilistic attacks - Public key one-time pads

(Chapter 5 – Sections: 5.1, 5.2 and Chapter 9 – Sections: 9.1 to 9.3)

## TEXT BOOK:

**INTRODUCTION TO CRYPTOGRAPHY** – HANS DELFS AND HELMUT KNEBL, Springer Verlag, 2002.

## REFERENCE BOOKS:

1. **CRYPTOGRAPHY AND NETWORK SECURITY** - WILLIAMS STALLINGS, Pearson Education, Fourth Edition, 2006.

2. **APPLIED CRYPTOGRAPHY** - BRUCE SCHNEIER, John Wiley and Sons, Second Edition, 1994.

3. **HANDBOOK OF APPLIED CRYPTOGRAPHY** - ALFRED J MENEZES, PAUL C VAN OORSCHOT AND SCOTT A VANSTONE, CRC Press, Fifth Edition, 2000.

4. **PUBLIC-KEY CRYPTOGRAPHY, THEORY AND PRACTICE** - ABHIJITH DAS AND C.E.VENI MADHAVAN, Pearson Education, First Edition, 2009.

**IV SEMESTER** **CORE PAPER XIII**

Subject Code: 41 C

# OPERATOR THEORY

## UNIT I

**Fundamental properties of bounded linear operators**

**Bounded linear operators on a Hilbert space:** Norm of bounded linear operators – Adjoint operators – Generalized polarization identity and its applications – Several properties on projection operators – Generalized Schwarz inequality and square root of positive operator – spectral representations of self adjoint operator.

(Chapter 2 – Section: 2.1)

## UNIT II

**Partial isometry operator:**

Partial isometry operator and its characterization

**Polar decomposition of an operator**: Invariant subspace and reducing subspace – Polar decomposition of non-normal operator – Hereditary property on the polar decomposition of an operator.

(Chapter 2 – Sections: 2.2, 2.3)

## UNIT III

**Spectrum of an operator**: Two kinds of classification of spectrum – Spectral mapping theorem

**Numerical range of an operator:** Numerical range is a convex set – Numerical radius is equivalent to operator norm – The closure of numerical range includes the spectrum – Normaloid operator and spectraloid operator.

(Chapter 2 – Sections: 2.4, 2.5)

## UNIT IV

**Relations among several classes of non-normal operators**: Paranormal operators – **Characterizations of convexoid operators**: some examples related to hyponormal, paranormal, normaloid and convexoid operators – Relations among several non-normal operators.

(Chapter 2 – Sections: 2.6, 2.7)

## UNIT V

**Further development of bounded linear operators**: Young inequality and Holder – McCarthy inequality – Aluthge transformation on p-hyponormal operators and log-hyponormal operators.

(Chapter 3 – Sections: 3.1 to 3.4)

## TEXT BOOK:

**INVITATION TO LINEAR OPERATORS** – TAKAYUKI FURUTA, Taylor and Francis, 2001.

## REFERENCE BOOK:

**HILBERT SPACE PROBLEM BOOK** – P.R.HALMOS, Springer Verlag, New York.

**IV SEMESTER** **CORE PAPER XIV**

Subject Code: 42 C

# FLUID DYNAMICS

## UNIT I

**Kinematics of fluids:** Methods of describing fluid motion. Lagrangian method – Eulerian method – Translation, Rotation and rate of deformation – Stream lines, path lines and streak lines – Material derivatives and acceleration – Vorticity.

**Fundamental Equations of the flow of viscous compressible fluids:** The equation of continuity – Conservation of mass – The equation of motion – Conservation of momentum, the equation of energy – Conservation of energy,

(Chapter 3 – Sections: 3.1, 3.1a, 3.1b, 3.2, 3.3a, 3.3b, 3.3c, 3.4, 3.5 and Chapter 5 – Sections: 5.1 to 5.3)

## UNIT II

**One dimensional Inviscid incompressible flow:** The equation of continuity – Stream tube flow; equation of motion – Euler's equation – The Bernoulli's equation – flow from a tank through a small orifice – Trajectory of a free jet – The momentum theorem.

**Two and three dimensional Inviscid incompressible flow:** Equation of continuity – Eulerian equation of motion - Circulation theorem (Kelvin's) – Velocity potential – Irrotational flow – Integration of the equations of motion – Bernoulli's equation – The momentum theorem – The moment of momentum theorem.

(Chapter 6 – Sections: 6.1 to 6.3, 6.4a, 6.4b, 6.6 and Chapter 7 – Sections: 7.1, 7.2, 7.3a, 7.3b, 7.3c, 7.4, 7.5, 7.5a, 7.5b, 7.6, 7.7)

## UNIT III

Laplace equation – Boundary conditions – Stream function in two dimensional motion – The flow net – Stream function in three dimensional motion – two dimensional flow examples – Rectilinear flow – Source and sink – Radial flow –

Vortex flow – Doublet – Three dimensional axially symmetric flow –Uniform flow – Radial flow – Radial flow (source or sink) – Doublet.
(Chapter 7 – Sections: 7.8a, 7.8b, 7.9 to7.11, 7.12a, 7.12b, 7.12c, 7.12d, 7.13a, 7.13b, 7.13c)

## UNIT IV

**Laminar flow of viscous incompressible fluids:** Similarity of flows – The Reynolds number – Flow between parallel flat plates – Coutte flow – Plane Poiseuille flow – Steady flow in pipes – Flow through a pipe – The Hagen-Poiseuille flow – Flow between coaxial cylinders.
(Chapter 8 – Sections: 8.1, 8.3, 8.3a, 8.3b, 8.4a and 8.4b)

## UNIT V

**Boundary Layer Theory:** Boundary layer concept – Boundary layer equations in two dimensional flow – The Boundary layer along a flat plate – The Blasius solution – Boundary layer thickness – Boundary layer on a surface with pressure gradient – Momentum integral theorem for the boundary layer – The Von Karman Integral Relation.
(Chapter 9 – Sections: 9.1, 9.2, 9.3a, 9.3b, 9.4, 9.5a)

## TEXT BOOK:

**FOUNDATION OF FLUID MECHANICS** – S.W.YUAN, Prentice Hall of India Private Limited.

## REFERENCE BOOK:

**INTRODUCTION TO FLUID MECHANICS** – G.K.BATCHALOR, Cambridge University Press.

**IV SEMESTER** **CORE PAPER XV**

Subject Code: 43 C

# FUZZY LOGIC AND FUZZY SETS

## UNIT I

**Crisp Sets and Fuzzy Sets:** The notion of Fuzzy sets – Basic concepts.

**Operations on Fuzzy Sets:** Fuzzy Complement – Fuzzy Union – Fuzzy Intersection – Combination of operations – General aggregation operations.

(Chapter 1 – Sections: 1.3, 1.4 and Chapter 2 – Sections: 2.2 – 2.6)

## UNIT II

**Fuzzy Relations:** Crisp and Fuzzy relations – Binary relations on a single set – Equivalence and similarity relation – Compatibility or tolerance relations – Orderings, morphisms, Fuzzy relation equations.

(Chapter 3 – Sections: 3.1 - 3.8)

## UNIT III

**Fuzzy Measures:** General discussion – Belief and Plausibility measures – Probability measures – Possibility and Necessity measures – Relation among classes of fuzzy measures.

(Chapter 4 – Sections: 4.1 - 4.5)

## UNIT IV

**Uncertainty and Information:** Types of uncertainty – Measures of fuzziness, Classical measures of uncertainty – Measures of dissonance – Confusion and non specificity.

(Chapter 5 – Sections: 5.1 - 5.6)

## UNIT V

**Applications:** General discussion – Natural life and Social Sciences – Management and Decision making – Computer Science.

(Chapter 6 – Sections: 6.1, 6.2, 6.5, 6.6)

## TEXT BOOK:

**FUZZY SETS, UNCERTAINTY AND INFORMATION** – GEORGE J.KLIR AND TINA A.FOLGER, Prentice Hall of India, New Delhi, 2007.

## REFERENCE BOOK:

1. **FUZZY SETS AND FUZZY LOGIC THEORY AND APPLICATIONS** – GEORGE J.KLIR AND BO YUAN, Prentice Hall of India, New Delhi, 2006.
2. **FUZZY LOGIC WITH ENGINEERING APPLICATIONS**, Timothy J. ROSS WILLEY, India Pvt. Ltd., NewDelhi, Second Edition Reprint, 2009.

**IV SEMESTER** **CORE PAPER XVI**

Subject Code: 44 C

# SOLID MECHANICS

## UNIT I

**Analysis of Stress:** Body Force – Surface force and stress vector – The state of stress at a point – Normal and shear stress components – Rectangular stress components – Stress components on an arbitrary plane – Digression on ideal fluid – Equality of cross shears – A more general theorem – Principal stresses – Stress invariants – Principal planes are orthogonal – Cubic equation has three real roots – Particular cases – Recapitulation – The state of stress referred to principal axes – Mohr's circles for the three dimensional state of stress – Mohr's of stress plane – Planes of maximum shear – Octahedral stresses – The state of pure shear – Decomposition into hydrostatic and pure shear states – Cauchy's stress quadric – The plane state of stress – Differential equations of equilibrium – Equilibrium equations for plane stress state – Boundary conditions – Equations of equilibrium in cylindrical coordinates - Problems

(Chapter 1 – Sections: 1.1 – 1.30)

## UNIT II

**Analysis of Strain:** Deformations – Deformation in the neighborhood of a point. Change in length of a linear element: Change in length of a linear element – Linear components – Rectangular strain components – The state of strain at a point – Interpretation of $\gamma_{xy}, \gamma_{yz}, \gamma_{xz}$ as shear strain components – Change in direction of a linear element – Cubical dilatation – Change in the angle between two line elements – Principal axes of strain and principal strains – Plane state of strain – The principal axes of strain remain orthogonal after strain – Plane strains in polar co-ordinates – Compatibility conditions – Strain deviator and its invariants – Problems.

(Chapter 2 – Sections: 2.1 - 2.17)

## UNIT III

**Stress – Strain Relations for Linearly Elastic Solids:** Generalized statement of Hooks's law – Stress-strain relations for isotropic materials – Modulus of rigidity – Bulk modulus – Young's modulus and Poisson's ratio – Relations between the elastic constants – Displacement equations of equilibrium – Problems.
(Chapter 3 – Sections: 3.1 – 3.8)

## UNIT IV

**Axisymmetric Problems:** Thick-walled cylinder subjected to internal and external – Pressures – Lame's problems – Stresses in composite tubes – Shrink fits – Sphere with purely radial displacements – Stresses due to gravitation – Rotating disks of uniform thickness – Disks of variable thickness – Rotating shafts and cylinders – Summary of results for use in problems – Problems.
(Chapter 8 – Sections: 8.1 – 8.9)

## UNIT V

**Thermal Stresses:** Thermo elastic stress – Strain relations – Equations of equilibrium – Strain displacement relations – Some general results – Thin circular disk; Temperature symmetrical about centre – Long circular cylinder – Problem of a sphere – Normal stresses in straight beams due to thermal loading – Stresses in curved beams due to thermal loading – Problems.
(Chapter 9 – Sections: 9.1 – 9.10)

## TEXT BOOK:

**ADVANCED MECHANICS OF SOLIDS** – L.S.SRINATH, Tata McGraw Hill Education Private Limited, New Delhi, Third Edition, 2011.

## REFERENCE BOOKS:

1. **SOLID MECHANICS** – S.M.A.KAZIMI, Tata McGraw Hill Education Private Limited, New Delhi, First Revised Edition, 1974.
2. **THEORY OF ELASTICITY** – P.S.D.VERMA, Vikas Publishing House Private Limited, New Delhi, 1998.

**IV SEMESTER** **ELECTIVE PAPER IV**

Subject Code: 45 E

# MATLAB

## UNIT I

Basics of MATLAB – Creating and working with arrays of numbers – Creating and printing simple plots – Creating, saving and executing a script file – Creating and executing a function file – Working with arrays and matrices – Symbolic computation – Publishing reports.

(Chapter 1 – Section: 1.6 and Chapter 2 – Sections: 2.1 - 2.6, 2.8 and 2.11)

## UNIT II

Matrices and vectors – Matrix and array operations – Character strings – A special note on array operations – Command line functions – Using built-in functions and online help – Plotting simple graphs.

(Chapter 3 – Sections: 3.1 - 3.6, 3.8)

## UNIT III

Script files – Function files – Language-specific features – Advanced data objects

(Chapter 4 – Sections: 4.1 – 4.4)

## UNIT IV

Applications – Linear algebra – Curve fitting and interpolation – Data analysis and statistics – Numerical integration

(Chapter 5 – Sections: 5.1 – 5.4)

## UNIT V

Ordinary Differential Equations – Nonlinear algebraic equations – Advanced topics – Basic 2-D plots.

(Chapter 5 – Sections: 5.5.1, 5.5.2, 5.6, 5.7 and Chapter 6 – Section: 6.1)

## TEXT BOOK:

**GETTING STARTED WITH MATLAB, UPDATED FOR VERSION 7.8** – RUDRA PRATAP, Oxford University Press 2010.

## REFERENCE BOOKS:

1. **MATLAB, AN INTRODUCTION WITH APPLICATIONS** – AMOS GILAT, Wiley Student Edition.
2. **NUMERICAL COMPUTING WITH MATLAB** – CLEVE B.MOLER, Web Edition, Published by the Mathworks, Inc.

**I SEMESTER** **CORE PAPER**

**Subject code: 13C**

**MATHEMATICAL FOUNDATIONS FOR COMPUTER SCIENCE**
**(For MCA)**

## UNIT I

**Mathematical Logic:** Introduction – Connectives, NAND & NOR connectives-Tautology and Contradiction-Truth tables-Equivalence formulae-Normal forms-Principal disjunctives normal forms-Principal conjunctive normal forms
(Chapter: Sections:1.1 to 1.2,1.2.1 to 1.2.4,1.2.6,1.2.8 to 1.2.11,1.3,1.3.1 to 1.3.4)

## UNIT II

**Theory of Inference for Statement Calculus**: Rules of inference-Direct and indirect method of proof. (Chapter 1: Sections 1.4)
**Finite Automata:** Deterministic finite automata-Non-deterministic automata.
- Introduction to compatibility theory (Chapter 6: sections:6.1)

## UNIT III

**Vector Algebra:** Definition – Addition and subtraction of vectors – Position vector – Composition of vectors – Rectangular unit vectors – Vector product – Scalar product – Cross product – Scalar triple product – Vector triple product.
(Chapter 8: Sections 1 to 8)

## UNIT IV

**The Solution of Numerical Algebraic and transcendental equations**: Bisection method-Iteration method-Regula falsi method-Newton-Raphson method. (Chapter 3-sections:3.1,3.1.1,3.2,3.3,3.4)

## UNIT V

**Solution of Simultaneous Linear Algebraic equations:** Direct method:Gauss elimination method-Gauss Jordon method.Indirect method:Gauss Jacobi method-Gauss Seidel method of iteration. (Chapter 4-ections:4.1,4.2,4.2.1,4.7 to 4.9)

## TEXT BOOKS:

1. **DISCRETE MATHEMATICAL STRUCTURES WITH APPLICATIONS TO COMPUTER SCIENCE**-J.P.TREMBLAY AND R.MANOHAR,Tata McGraw Hill Publishing Company Limited,Tenth Reprint 2000**.(For Units I and II)**

2. **ANCILLARY MATHEMATICS - VOL II** – S.NARAYANAN, R.HANUMANTHA RAO and T.K.MANICAVACHAGAM PILLAY, S.VISWANATHAN Printers and Publishers PVT Ltd, 2011**.** **(For Unit III)**

3. **NUMERICAL METHODS-** K.P.KANDASAMY,DR.K.THILAGAVATHY AND DR.K.GUNAVATHY,S.Chand and Company Limited, New Delhi, Revised edition 1999.**(For Unit IV and V)**

## REFERENCE BOOK:

**DISCRETE MATHEMATICS WITH GRAPH THOERY AND COMBINATORICS**- T. VEERARAJAN, Tata McGraw Hill Publishing Company, New Delhi, Fifth Reprint, 2008

**II SEMESTER** **CORE PAPER**

**Subject code:**

# OPERATIONS RESEARCH
**(For MCA)**

## UNIT I

Linear Programming Problem – Formulation of L.P.P – Graphical solutions of L.P.P – Simplex Method. Charnes Penality Method (or) Big – M Method –Duality in L.P.P – Primal and Dual Problems.

(Chapter 2 – Sections:2.1 to 2.4;Chapter 3 – Sections: 3.1 and 3.2; Chapter 4 – Sections:4.1 to 4.4;Chapter 5 – Sectionos :5.1 to 5.4)

## UNIT II

The transportation problems – Basic feasible solution by L.C.M – NWC – VAM – Optimum solutions – Unbalanced- Transportation problems. The Assignment problems – Introduction – Mathematical formulation – Hungarian assignment method.

(Chapter 10 – Sections:10.1 to10.10, 10.13 ; Chapter 11 – Sections: 11.1 to 11.3)

## UNIT III

**Replacement model**: Introduction – Replacement of items that deteriorates gradually- value of money does not change with time-value of money changes with time- Replacement of items that fails suddenly.

Individual Replacement- Group replacement.

(Chapter 18-Sections:18.1 to 18.3)

## UNIT IV

**Network scheduling by PERT/CPM** – Introduction-Network and basic component -Rules of network construction – time calculation in Networks-CPM. PERT-PERT calculations.

(Chapter 25 – Sections:25.1 to 25.8)

## UNIT V

**Queuing theory**: Introduction-Charateristics of Queuing system- Problems from single server:finite and infinite population model-Problems from multi server:finite and infinite Population model.

(Chapter 21-Sections:21.1 to 21.9)

## TEXT BOOKS:

**OPERATIONS RESEARCH-KANDISWARUP,P.K.GUPTA AND MAN MOHAN**, S. Chand & Sons education Publications, New Delhi, Fourteen Revised Edition. Reprint 2009

## REFERENCE BOOKS:

1. **OPERATIONS RESEARCH-AN INTRODUCTION** –HAMDY A.TAHA, Seventh Edition, Pearson Education, Reprint 2005.

2. **INTRODUCTION TO OPERATIONS RESEARCH**-FREDRICK S.HILLIER GERALD J.LIEBERMAN, Seventh Edition, Tata McGraw Hill Publishing Company Limited, Reprint 2001.

3. **OPERATIONS RESEARCH THEORY AND APPLICATIONS**-J.K.SHARMA Macmillian India Limited, Second Edition, Reprint 2003.

4. **PROBLEMS IN OPERATIONS RESEARCH** – P.K.GUPTA AND D.S.HIRA, Third Edition, S.Chand and Company Limited, Reprint 2005