TUMKUR UNIVERSITY

Department of Studies & Research in Mathematics

M.Sc. MATHEMATICS - SYLLABI

(Academic Year 2014-15)

Choice Based Credit System (CBCS)
Semester Scheme

TUMKUR UNIVERSITY

Department of Studies & Research in Mathematics

Choice Based Credit Systems (CBCS) –PG Semester Course MATHEMATICS

Name of the Course: M. Sc., Mathematics

Medium of Instruction: The medium of instruction shall be English.

Duration: The M.Sc. Degree Course is of two years duration, spread over four semesters each of four months duration.

Attendance: Every student must have at least 75% attendance in each of the courses (Theory & Practical) in each semester.

Abbreviated Course Subject Codes:

CPT: Core Paper Theory
CPP: Core Paper Practical
OEPT: Open Elective Paper Theory
SPT: Special Paper Theory

Special Paper Theory (SPT) Selection:

One Special Paper Theory (SPT) has to be chosen from two given Special papers in II, III and IV – Semester M.Sc., Mathematics as per the availability of faculties in respective specialization.

Computer Programming Practicals:

In II Semester CPP- 2. 4. 2 and III Semester CPP -3. 4. 2, each student will have 4 hours of Practical per week. Practical classes will be conducted in batchewise as per the availability of computers in Laboratory.

Examination & Dissertation: Shall be follows as per Tumkur University CBCS regulation.

Internal Assessment Marks allotment **Total = 20 Marks**

1st Test for 10 Marks + 2nd Test for 10 Marks Average of two tests = **10 Marks**

Seminar/ Assignment/Attendance/Extra activities = **10 Marks**

Internal Assessment Marks allotment of Practical/Practical based theory

One theory based test (in CPT-2.4.1 and CPT-3.4.1 each) and **One** laboratory test (in CPP-2.4.2 and CPP-3.4.2 each) should be conducted for 10 Marks.

TUMKUR UNIVERSITY

Department of Studies & Research in Mathematics

M. Sc., Mathematics - Choice Based Credit System (CBCS)- Course Contents

I Semester

Sl. No.	Paper	Title of the paper	Instruction Hrs per Week	No. of Credits	Duration of the Exam.	Marks		
						IA	Sem. End Examn.	Total Marks
1	CPT-1.1	Algebra	4	4	3 Hrs	20	80	100
2	CPT-1.2	Real Analysis	4	4	3 Hrs	20	80	100
3	CPT-1.3	General Topology	4	4	3 Hrs	20	80	100
4	CPT-1.4	Differential Equations	4	4	3 Hrs	20	80	100
5	CPT-1.5	Discrete Mathematics	4	4	3 Hrs	20	80	100
6	CPT-1.6	Classical & Continuum Mechanics	4	4	3 Hrs	20	80	100
		Total	**24**	**24**				**600**

II Semester

Sl. No.	Paper	Title of the paper	Instruction Hrs per Week	No. of Credits	Duration of the Exam.	Marks		
						IA	Sem. End Examn.	Total Marks
1	CPT-2.1	Advanced Algebra	4	4	3 Hrs	20	80	100
2	CPT-2.2	Complex Analysis	4	4	3 Hrs	20	80	100
3	CPT-2.3	Functional Analysis	4	4	3 Hrs	20	80	100
4	CPT-2. 4. 1	Numerical Analysis	2	2	2Hrs	10	40	50
	CPP-2. 4 .2	Computer Programming Lab.-I **(Based on CPT -2.4.1)**	4	2	2Hrs	10	40	50
5	SPT-2.5(A)	Theory of Numbers	4	4	3 Hrs	20	80	100
	SPT-2.5(B)	Operations Research						
6	OEPT-2.6*	***To be offered by other departments for M.Sc.(Maths.) students**						
		Foundations of Mathematics **(Only for other than M.Sc., Maths. students)**	4	4	3Hrs	20	80	100
		Total	**26**	**24**				**600**

III Semester

Sl. No.	Paper	Title of the paper	Instruction Hrs per Week	No. of Credits	Duration of the Exam.	Marks		
						IA	Semester End Examn.	Total Marks
1	CPT-3.1	Linear Algebra & its Applications	4	4	3 Hrs	20	80	100
2	CPT-3.2	Advanced Topology	4	4	3 Hrs	20	80	100
3	CPT-3.3	Fluid Mechanics	4	4	3 Hrs	20	80	100
4	CPT-3.4. 1	Advanced Numerical Analysis	2	2	2Hrs	10	40	50
	CPP-3. 4. 2	Computer Programming Lab.-II **(Based on CPT -3.4.1)**	4	2	2Hrs	10	40	50
5	SPT-3.5(A)	Non linear Dynamics	4	4	3 Hrs	20	80	100
	SPT-3.5(B)	Fuzzy Mathematics						
6	OEPT-3.6**	****To be offered by other departments for M.Sc.(Maths.) students**						
		Elements of Applied Mathematics **(Only for other than M.Sc., Maths. students)**	4	4	3hrs	20	80	100
		Total	**26**	**24**				**600**

IV Semester

Sl. No.	Paper	Title of the paper	Instruction Hrs per Week	No. of Credits	Duration of the Exam.	Marks		
						IA	Sem. End Examn.	Total Marks
1	CPT-4.1	Measure & Integration	4	4	3 Hrs	20	80	100
2	CPT-4.2	Differential Geometry	4	4	3 Hrs	20	80	100
3	CPT-4.3	Advanced Graph theory	4	4	3 Hrs	20	80	100
4	CPT-4.4	Mathematical Methods	4	4	3Hrs	20	80	100
5	SPT-4.5(A)	Magneto hydrodynamics	4	4	3 Hrs	20	80	100
	SPT-4.5(B)	Probability & Statistics						
6	CPD	Dissertation/Project	4	4	3hrs	20 **(Viva-voce)**	80 **(Report)**	100
		Total	**24**	**24**				**600**

IA: Internal Assessment **CPT:** Core Paper Theory **CPP:** Core Paper Practical
SPT: Special Paper Theory **CPD:** Core Paper Dissertation **OEPT:** Open Elective Paper Theory

FIRST SEMESTER M. Sc. – MATHEMATICS (CBCS)

CPT-1.1: ALGEBRA

Recapitulation: Groups, Subgroups, Cyclic group, Normal subgroups, Quotient groups, Homomorphism, Fundamental Theorem of Homomorphism. (After UNIT-1). **4hrs.**

UNIT-1. **15hrs.**

Elements of Number theory, Congruences, residue classes, theorems of Fermat, Euler and Wilson, linear congruences, Chinese Remaider theorem, elementary arithmetical functions, primitive roots, quadratic residues and the law of quadratic reciprocity.

UNIT-2. **15hrs.**

Isomorphism theorems, Automorphisms, Groups of automorphisms and inner automorphisms and their relation with centre of a group. Permutation groups, Symmetric groups, Dihedral groups,Cayley's theorem, Direct Products of groups.

UNIT-3. **15hrs.**

Conjugate, normalizer and conjugacy class of an element in a group. Class equation of a finite group and its applications. The p-groups, Cauchy's theorems andSylow'stheorems for a finite group and their applications.

UNIT-4. **15hrs.**

Finite simple groups, Finite abelian group, fundamental theorem on finite abelian groups. Normal series, Solvable groups, examples of solvable groups, Jordan-Holder theorems.

TEXT BOOKS

1. D. M. Burton : Elementary Number Theory, Tata McGraw-Hill, New Delhi, 6th Ed.,
2. I.N.Herstein : Topics in Algebra, 2nd Edition, Vikas Publishing House, 1976.
3. J.B.Fraleigh : A first course in Algebra, 3rd Edition, Narosa, 1996.
4. I. Niven, H. S. Zuckerman and H. L. Montgomery : An Introduction to the Theory of Numbers, New York, John Wiley and Sons, Inc., 2004, 5th Ed.,

REFERENCE BOOKS

1. M. Artin : Algebra, Prentice Hall of India, 1991.
2. D. S. Dummit and R. M. Foote – Abstract Algebra, John Wiley and Sons, 1999.
3. J. A. Gallian – Contemporary Abstract Algebra, Narosa Publishing House, 4th Ed.,
4. N. Jacobson : Basic Algebra-I, HPC, 1984.

CPT-1.2: REAL ANALYSIS

Recapitulation: Real number system as a complete ordered field, Archimedean property, supremum, infimum, sequence and series of real numbers, convergence, limsup, liminf (without proofs of theorems). **4hrs.**

UNIT-1. **15hrs.**

Introduction, compact sets, k-cell, Heine - Borel theorem, perfect sets, connected sets. Continuity, continuous functions, continuity and compactness, continuity and connectedness.

UNIT-2. **15hrs.**

Riemann-Stielje integral; definition and existence of the integral, linear properties, change of variables, integral as a limit of sum. Integration and differentiation, integration of vector valued functions, functions of bounded variations, mean value theorems, integration by parts.

UNIT-3. **15hrs.**

Sequences and series of functions: Discussion of main problem, uniform convergence, uniform convergence and continuity, uniform convergence and continuity, uniform convergence and differentiation, Equicontinuous family of functions.

UNIT-4. **15hrs.**

Functions of several variables: Explicit and implicit functions, continuity and differentiability of explicit functions of two variables with examples. Linear transformations, differentiation of vector valued functions, partial derivatives, inverse function theorem and implicit function theorem.

TEXT BOOKS

1. W. Rudin: Principles of Mathematical Analysis, McGraw-Hill, 1983.
2. S. C. Malik and Savita Arora: Mathematcal Analysis, 2nd ed., New Age Intn. (P) Ltd., 1992

REFERENCE BOOKS

1. T. M Apostol: Mathematical Analysis, 2nd ed. Narosa, 1988
2. S. Goldberg: Methods of Real Analysis, OUP, 1970

CPT-1.3: GENERAL TOPOLOGY

UNIT- 1. **16hrs.**

Finite and infinte sets, equivalent sets, countable and uncountable sets, Schroeder-Bernstein theorem, cardinal numbers, Cantor's theorem, Continuum hypothesis, Zorn's lamma and its applications.

UNIT- 2. **16hrs.**

Definition of metric, open and closed balls, Cauchy and convergent sequence, complete metric space, continuity, contraction mapping theorem, bounded and totally bounded sets, closed sets, Cantor's intersection theorem, nowhere dense sets, Baire Category theorem, Isometry, embedding of metric space in a complete metric space.

UNIT- 3. **16hrs.**

Topological spaces, Basis for a topological space, order topology, product topology on X×Y, subspaces, limit points, closure, interior and boundary of a sets, continuous functions, Homeomorphism, Pasting lemma.

UNIT- 4. **16hrs.**

Connected spaces, connected sets in real line, disconnected spaces, components of a space, totally disconnected space, locally connected space, compact space.

TEXT BOOKS

1. G. F. Simmons: Introduction to Topology and Modern Analysis, McGraw Hill, 1963.
2. J. R. Munkers: A First Course in Topology, PHI, 1975.
3. W. J. Pervin: Foundations of General Topology, AP, 1972.

REFERENCE BOOKS

1. J. L. Kelly: General Topology, Van Nostrand, 1955.
2. J.Dugundji: Topology, Allyn & Bacon, 1966.
3. K D Joshi: Introduction to General Topology, New Age Intn. (P) Ltd., 1983.

CPT-1.4: DIFFERENTIAL EQUATIONS

Recapitulation: Elementary concepts of ordinary and partial differential equations. **4hrs.**

UNIT-1. **15hrs.**

Ordinary Differential Equations: Linear differential equations, Fundamental sets of solutions, Adjoint, Self-adjoint equations, Zeros of solutions, Comparison and separation theorems, Initial value problems, Eigen value problems, Sturm-Liouville problems, Greens functions, Eigen values and eigen functions and expansion formulae. Existence and Uniqueness Theorem.

UNIT-2. **15hrs.**

Power series solution- solution near an ordinary point and a regular singular point. Frobenius method, Hypergeometric and Chebyshev equations and their polynomial solutions.

UNIT-3. **15hrs.**

Partial Differential Equations: Cauchy's problems and characteristics, classification of second order PDE's, reduction to canonical forms. Initial and Boundary value problems and their solutions by separation of variable method. Laplace equation-Dirichlet's and Neumann's problems for a rectangular and for a circle-Solution in cylindrical and spherical polar coordinates.

UNIT-4. **15hrs.**

The wave equation- elementary solutions-Periodic Solutions in cylindrical and spherical polar coordinates.The diffusion equation-elementary solutions - Solutions in cylindrical and spherical polar coordinates.

TEXT BOOKS

1. M.S.P. Eastham: Theory of Ordinary Differential Equations, Van Nostrand. London.1970.
2. Ian Sneddon: Elements of Partial Differential Equations, International Student Edition.

REFERENCE BOOKS

1. S. L. Ross: Differential equations, 3rd ed., John Wiley & Sons, New York, 1984.
2. E. D. Rainville and P. E. Bedient: Elementary Differential Equations, McGraw-Hill, New York, 1969.
3. E. A. Coddington: Theory of Ordinary Differential Equations, McGrawHill, 1955.
4. A. C. King, J. Billingham and S. R. Otto: Differential Equations, Cambridge University. Press, 2006.
5. Gupta, Malik and Mittal: Differential Equations, 3rd ed., Pragati Prakashan, 1995.

CPT-1.5: DISCRETE MATHEMATICS

Recapitulation: Mathematical Logic, Mathematical Induction, Basic counting principles. (No proofs of theorems). **4hrs.**

UNIT-1. **15hrs.**

Recurrence relations, Modeling with recurrence relations with examples of Fibonacci numbers. Generating functions, definition with examples. List of generating functions. Definition and types of relations. Representing relations using matrices and digraphs. Closures of relations, Paths in digraphs, Transitive closures. Warshall's Algorithm.

UNIT-2. **15hrs.**

Partial Ordered sets, Hasse diagrams, Isomorphism, Extremal elements in poset, Lattice, Distributive lattice, Complemented lattice, Boolean lattices, Boolean Algebras, Boolean functions, Applications to Switching circuits.

UNIT-3. **15hrs.**

Introduction to graph theory, types of graphs, Subgraphs, Degree, Distance, Standard graphs, Bipartite graph, Regular graph, Complement of a graph, Graph isomorphism, Graph Operations. Eulerian and Hamiltonian graphs, Traveling Salesman's Problem.

UNIT-4. **15hrs.**

Trees, Characterization of trees, Eccentricity, Radius, Diameter and Centre. Rooted trees, Binary trees, Spanning trees, Minimal Spanning trees. Prims and Kruskul Algorithms. Covering and independence number of a graph.

TEXT BOOKS

1. C. L. Liu: Elements of Discrete Mathematics, Tata McGraw-Hill, 2000.
2. F. Harary: Graph Theory, Addition Wesley, 1969.
3. G. Chartrand and P. Zhang. Introduction to Graph Theory, Tata McGraw-Hill, 2006.

REFERENCE BOOKS

1. N. Chandrasekaran and M. Umaparvathi: Discrete Mathematics, PHI, New Delhi, 2010.
2. J. A. Bondy and U. S. R. Moorthy: Graph theory with applications. Elsevier Sc., 1982.
3. Kenneth Rosen: WCB McGraw-Hill, 6th ed., 2004.

CPT- 1.6: CLASSICAL AND CONTINUUM MECHANICS

UNIT-1. **16hrs.**

Co-ordinate transformations, Cartesian tensors, Basic properties, Transpose of a tensor, Symmetric and Skew tensors, Dual vector of a skew tensor, scalar, vector and tensor functions, Comma notations, Gradient, Divergence and curl in tensor calculus, integral theorems.

UNIT-2. **16hrs.**

Generalized coordinates, Lagrange's equations, Hamilton Canonical equations, Hamilton's principle and principle of least action, Two dimensional motion of rigid bodies, Euler's dynamical equations for the motion of a rigid body about an axis, theory of small oscillations.

UNIT-3. **16hrs.**

Continuum Hypothesis, Deformation gradient, Stretch and rotation, Strain tensors, Strain-displacement relations, Infinitesimal strain tensor, compatibility conditions, Principal strains. Material and local time derivatives, path lines, stream lines and vortex lines, Transport formulas. Vorticity and Circulation.

UNIT-4. **16hrs.**

Body forces and surface forces, Stress components and stress tensor, Normal and shear stresses, Principal stresses. Stress deviator, Boundary condition for the stress tensor. Laws of conservation of mass, Principles of Linear and angular momentum, Balance of energy.

TEXT BOOKS

1. D. S. Chandrasekharaiah and L. Debanath: Continuum Mechanics, Academic Press, USA, 1994.
2. V B Bhatia: Classical Mechanics, Narosa Publishing House.

REFERENCES

1. P. Chadwick : Continuum Mechanics, Allen and Unwin, 1976.
2. L. E. Malvern : Introduction to the Mechanics of a Continuous Media, Prentice Hall, 1969.
3. T. J. Chung: Applied Continuum Mechanics, Cambridge University Press, 1996.
4. H Goldstien: Classical Mechanics, Narosa Publishing House.

SECOND SEMESTER M. Sc. – MATHEMATICS (CBCS)

CPT-2.1: ADVANCED ALGEBRA

Recapitulation: Rings, Some special classes of rings(Integral domains, Division rings, Fields), Sub rings, Ideals, Quotient rings, Homomorphism of rings, Fundamental Theorem of Homomorphism, Isomorphism of rings (without proofs of theorems). **4hrs.**

UNIT-1. **15hrs.**

Principle Ideals, Maximal ideals and Prime ideals (with theorems), Field of Quotients of an Integral Domain, imbedding of rings. Euclidean domains and Principle Ideal domains with examples, prime and irreducible elements of an Euclidean domain, unique factorization theorem, factorization in Gaussian integers, Fermat's theorem.

UNIT-2. **15hrs.**

Polynomial rings, the division algorithm, polynomial rings over the rational field, factorization of polynomials, zeros of polynomials, primitive polynomials, Gauss lemma, irreducibility criterion: Mod *p* irreducibility test, Eisenstein's Criterion, Polynomial rings over commutative rings, unique factorization domains.

UNIT-3. **15hrs.**

Extension fields, finite and algebraic extensions. Degree of extension, algebraic elements and algebraic extensions, adjunction of an element of a field. Splitting fields, construction with straight edge and compass, simple and separable extensions, finite fields.

UNIT-4. **15hrs.**

Elements of Galois Theory, Fixed fields, Normal extension, Fundamental theorem of Galois theory, Galois groups over the rationals.

TEXT BOOKS

1. D. S. Dummit and R. M. Foote: Abstract Algebra, John Wiley and Sons, 1999
2. J. A. Gallian: Contemporary Abstract Algebra, Narosa Pub., 4th Ed.,
3. I.N.Herstein: Topics in Algebra, 2nd Edition, Vikas Pub., 1976.
4. V. K. Khanna and S. K. Bhambri: A Course in Abstract Algebra, 3rd Ed., Vikas Pub., 2008.

REFERENCE BOOKS

1. M. Artin: Algebra, Prentice Hall of India, 1991.
2. Joseph Rotman: Galois Theory, Universitext, Springer, 1998.
3. J. B. Fraleigh: A first course in Algebra, 3rd Ed., Narosa,

CPT- 2.2: COMPLEX ANALYSIS

Recapitulation: Complex Numbers, algebra of complex numbers, analytic functions, multi-valued functions (No proofs of theorems). **4hrs.**

UNIT-1. **15hrs.**

Complex integration: Contour integrals, antiderivatives, Cauchy-Goursat theorem for simply and multiply connected domains, winding numbers, Cauchy integral formula, derivatives of analytic functions, Liouville's theorem and fundamental theorem of algebra, maximum modulli of functions, Schwartz lemma.

UNIT-2. **15hrs.**

Power series, radius of convergence of a power series, uniform convergence of power series, power series representation of analytic functions, Taylor's series, Laurent series, Residues, classification of singularities, residues at poles, zeros and poles of order m, conditions under which $f(z) \equiv 0$, behavior of $f(z)$ at infinity, Hadamard three circle theorem.

UNIT-3. **15hrs.**

Evaluation of definite integrals involving sines & cosines, evaluation of improper integrals and Cauchy's principal value, integrals involving rational functions, integrals involving sines and cosines, integrals along indented contours, integration along branch cut.

UNIT-4. **15hrs.**

Meromorphic functions, Argument principle and Rouche's theorem, analytic continuation, harmonic functions, Poisson integral formula, infinite products, canonical products, Weirstrauss factorization theorem, entire functions, Phragman-Lindelof theorem, Jensen's formula.

TEXTBOOKS:

1. J. W Brown and R. V. Churchill, Complex Variables and Applications, McGraw Hill, 1996
2. H. S. Kasana, Complex Variables: Theory and Applications, PHI, 2000.
3. J. B Conway, Functions of one Complex Variable, Narosa, 1987.

REFERENCE BOOKS:

1. L. V. Ahlfors, Complex analysis, McGraw Hill, 1966
2. S. Ponnusamy, Functions of Complex Variables, Narosa Pub.
3. S. Lang, complex Analysis, 3rd ed. Springer, 1993

CPT-2.3: FUNCTIONAL ANALYSIS

Recapitulation: Inner Product, Vector space, Inner Product Space and Normed linear spaces. (No proofs of theorems). **4hrs.**

UNIT-1. **15hrs.**

Banach Spaces, Definition and examples. Quotient Spaces. Convexity of the closed unit sphere of a Banach Space. Examples of normed linear spaces which are not Banach. Holder's inequality. Minkowski's inequality. Linear transformations on a normed linear space and characterization of continuity of such transformations.

UNIT-2. **15hrs.**

The set $B(N , N')$ of all bounded linear transformations of a normed linear space N into normed linear space N'. Linear functionals, The conjugate space N*. The natural imbedding of N into N**. Hahn-Banach Theorem and its consequences, Projections on a Banach space. The Open Mapping Theorem, The Closed Graph Theorem, Uniform Boundedness Theorem. The Conjugate of an Operator, Properties of Conjugate Operator.

UNIT-3. **15hrs.**

Hilbert Spaces, Definition and Examples, Schwarz's inequality. Parallelogram Law, Polarization identity. Convex sets, a closed convex subset of a Hilbert Space contains a unique vector of the smallest norm Orthogonal sets in a Hilbert space. Bessel's inequality. Orthogonal complements, complete orthonormal sets, Orthogonal decomposition of a Hilbert space.

UNIT-4. **15hrs.**

The conjugate space H* of a Hilbert space H. Representation of a functional f as f(x) = (x, y) with y unique. The Hilbert space H*. Interpretation of T* as an operator on H. The adjoint operator T - T* on B (H). Self-adjoint operators, Positive operators. Normal operators. Unitary operators and their properties. Projections on a Hilbert space. Finite dimensional spectral theorem.

TEXT BOOKS

1. G. F. Simmons: Introduction to Topology and Modern Analysis, McGraw-Hill Ed.
2. A. E. Taylor: Introduction to Functional Analysis, Wiley, New York, 1958.
3. B. V. Limaye: Functional Analysis (Wiley Eastern).

REFERENCE BOOKS

1. G. Backman and L. Narici: Functional Analysis (Academic).
2. P.R. Halmos: Finite dimensional vector paces, Van Nostrand, 1958.
3. J. B. Conway: A Course in Functional Analysis, GTM, Vol. 96, Springer, 1985.
4. E. Kreyszig : Introduction to Functional Analysis with Applications, John Wiley & Sons

CPT- 2.4.1: NUMERICAL ANALYSIS

Recapitulation: Nonlinear equation, rank, consistency and inconsistency of system of equations, symmetric, Hermitian, positive definite, permutation matrix, spectral radius of matrix. Newton Cotes formula. **2 hrs**.

UNIT-1. **6hrs.**

Nonlinear Equations in One Variable: Newton - Raphson's methods- Convergence criterion. Fixed point iterative method –convergence Criterion. Aitken's Δ^2- process. Sturm sequence method to identify the number of real roots.

UNIT- 2. **8hrs.**

Linear System of Equations: Direct methods: Gauss Eliminations with PivotalStrategy, LU - decomposition methods (Crout's, Cholesky methods). Iteration methods: matrix norm, consistency and ill conditioned system of equations, Jacobi, Gauss Seidel, Over Relaxation methods Iterative Methods with convergence criterion. Eigenvalue and Eigen Vectors: Householder's method.

UNIT -3. **8hrs.**

Interpolation: Lagrange, Hermite, Cubic-spline, error of interpolation, Orthogonal polynomials,Least Square approximation. Grams-Schmidt Orthogoralization process, Legendre, Chebyshev polynomial approximation.

UNIT- 4. **8hrs.**

Numerical Integration: Gaussian quadrature, Gauss-Legendre, Gauss-Chebyshev formulas, Gauss Laguerre, Gauss Hermite and Spline integration–Romberg integration, multiple integration by Trapezoidal, Simpson's methods.

TEXT BOOK

1. M. K. Jain, S. R. K.Iyengar and R.K.Jain: Numerical Methods for Scientific & Engineering Computation, 3rd Ed.Wiley Eastern Ltd. 1993.
2. Burden R and Faires J. D.: Numerical Analysis, P.W.S. 4th Ed.Kent Pub. Co., Boston, 1989.
3. Atkinson K.E.: An Introduction to Numerical Analysis, 3rd Ed., John Weiley & Sons, 1989.

REFERENCE BOOKS:

1. S. C. Chapra and P.C. Raymond: Numerical Methods for Engineers, Tata McGraw Hill, New Delhi, 2000.
2. Conte S.D. and De Boor: Introduction to Numerical Analysis. McGraw Hill.
3. Hilderband F.B.: Introduction to Numerical Analysis, 5th Ed., Tata McGraw Hill, New Delhi, (1986).
4. Gerald C. F. and Wheatly P. O.: Applied Numerical Methods, 6th Ed., Low Price Ed., Pearson Ed. Asia, 2002.

CPP- 2. 4. 2 : COMPUTER PROGRAMMING – I (Based on CPT- 2. 4. 1)

Recapitulation: Introduction to computer, evolution of computers, basic concept of hardware and software. **2hrs.**

UNIT- 1. **15hrs.**

Operating systems Programming concept, Assembler and compiler, developing algorithms and flow charts, Introduction to C, History of C, C Program structure.

Input-output concept, strings, header file, library functions, Identifiers, reserved words, constants and variables, Data type, operators,, size of storage location, types of statements, Declaration and Initialization, comments.

Types of operators, Classification of operators, Type conversion, Conditional statements, Looping statement, break and continue, Return statement, functions and array.

UNIT-2. Computer Practicals **15hrs.**

1. Sum to *n*-terms : Sine/Cosine series
2. Factorial of a number
3. Solution of a quadratic equation (incorporating all the conditions)
4. Check whether a given number is prime or not.
5. Fixed-point iterative method
6. Bisection Method
7. Newton-Raphson Method
8. Lagrange's interpolation
9. Numerical Integration-Tropezoidal Rule, Simpson's $1/3^{rd}$, Simpson's $3/8^{th}$ rule, Weddle's rule.

TEXT BOOKS

1. V. Rajaraman, Fundamentals of Computers, PHI, 1991.
2. B. S. Gottfried, Programming with C, Tata McGraw Hill, Schaum's Outlines, 1998.

REFERENCE BOOKS:

1. E. Balagurusamy, Programming in ANSI – C, Tata McGraw Hill Pub. Co. 1992.
2. B. W. Kernighan and D. M. Ritchie, The C programming Language, PHI, 1998.

SPT- 2.5(A): THEORY OF NUMBERS

Recapitulation: Elementary concepts of number theory. **4hrs.**

UNIT-1. **15hrs.**

Prime numbers, The Fundamental theorem of Arithmetic, The series of Reciprocals of primes,The Euclidean Algorithm. Fermat and Mersenne numbers. Farey series, Farey dissection of the continuum, Irrational numbers-Irrationality of m^{th} root of N, e and π.

UNIT-2. **15hrs.**

Arithmetical Functions – The Mobius function, The Euler' function and Sigma function, The Dirichlet product of Arithmetical functions, Multiplicative functions. Averages of Arithmetical functions – Euler summation formula, Some elementary asymptotic formulas, The average orders of $d(n)$, $\sigma(n)$, $\varphi(n)$, $\mu(n)$.

UNIT-3. **15hrs.**

Partitions-Partitions of numbers, the generating function of $p(n)$, other generating functions, Two Theorem of Euler, Jacobi's triple product identity, its proof and its applications.

UNIT-4. **15hrs.**

Continued fractions - Finite continued fractions, Convergent of a continued fraction, Continued fractions with positive quotients. Simple continued fractions, The representation of an irreducible rational fraction by a simple continued fraction. The continued fraction algorithm and Euclid's algorithm. The difference between the fraction and its convergent, Infinite simple continued fractions, the representation of an irrational number by an infinite continued fraction, Equivalent numbers and periodic continued fractions, some special quadratic surds.

TEXT BOOKS

1. G. H. Hardy and E. M. Wright - An introduction of Topology of Numbers.
2. G. E. Andrews - Encyclopedia of Mathematics and its applications.

REFERENCE BOOKS

1. Niven and Zuckarman: Elementary Number Theory.
2. Bruce C Berndt: Ramanujan's notebooks, Volumes 1 to 5.
3. T. M. Apostol: Introduction to Analytic Number Theory, Narosa Pub. House, New Delhi.

SPT- 2.5(B): OPERATION RESEARCH

Recapitulation: Linear programming problems (LPP), graphical method, simplex method, Big-M method of solving LPP. **4hrs.**

UNIT- 1. **15hrs.**

Revised Simplex Method, Parametric Linear Programming, Linear Fractional Programming, Duality Theorem, Dual Simplex Methods, Post-Optimal Analysis.

UNIT- 2. **15hrs.**

Integer Programming Problems , Solutions methods of integer programming problem, Branch and Bound Technique, Cutting plane algorithm, game theory, games without saddle point, mixed strategy, algebraic method, graphical method, dominance property, solution of a game by L.P. method.

UNIT- 3. **15hrs.**

Introduction to Transportation Problem, Initial Basic Feasible solution, Moving towards Optimality, Degeneracy in Transportation Problems, Unbalanced Transportation Problem, Assignment Problems, Job Sequencing.

UNIT-4. **15hrs.**

Elementary queuing and inventory models. Steady-state solutions of Markovian queuing models: M/M/1, M/M/1 with limited waiting space, M/M/C, M/M/C with limited waiting space, M/G/1.

Non Linear programming problems, Necessary and sufficient conditions for extrema, Constrained extremal problems, Kuhn Tucker conditions, Quadratic Programming**.** Dynamic Programming, Solution of LPP by Dynamic programming.

TEXTBOOKS

1. Hamdy A Taha: Operations Research, Prentice Hall of India, 1995.
2. KantiSwarup, P. K. Gupta, ManMohan: Operations Research, Sultan Chand & Sons, 1995.

REFERENCE BOOKS

1. G Hadley: Linear Programming, Narosa Publishing House, 2002.
2. K. V. Mittal and C. Mohan: Optimization Methods in Operation Research & System Analysis, New Age Publishers, 1996.

OEPT-2.6: FOUNDATIONS OF MATHEMATICS

UNIT-1. **16hrs.**

Brief History of Mathematics.

Number Theory: Natural numbers, integers, Real numbers, GCD, LCM, Prime numbers. Surds, Indices, Logarithms, Progressions, Arithmetic Progression, Geometric Progression, Harmonic Progression,

UNIT-2 **16hrs.**

Set Theory: Operations of Union, Intersection, Complementation.

Relations & Functions: Types of relations One-one, onto, Many-one functions, graphs of functions.

Mathematical Logic: Propositions, logical connectives, Methods of proofs.

UNIT-3 **16hrs.**

Matrix Algebra: Definition, types of matrix, transpose of a matrix, determinants, properties of determinants, co-factors matrix, Cramer's Rule, adjoint matrix, inverse of a matrix, singular & non-singular matrix.

UNIT-4. **16hrs.**

Quantitative Aptitude: Arithmetic Ability, Percentage, Profit and Loss, Ratio and Proportion, Time and Work, Partnership, Simple and Compound Interest, Volume surface and area, Stocks and Shares, Bankers Discount, Tabulation, Bar graph, Pie graph, Line graphs.

TEXT BOOKS

1. Kolman and Busby: Discrete Mathematics , PHI
2. R. S. Agarawala: Quantitative Aptitude, S. Chand & Co.
3. S. L. Loney: The Elements of Coordinate Geometry, London Macmillan & Co.
4. S. L. Loney: Plane Trigonometry, Reem Publications Pvt. Ltd.

REFERENCE BOOKS

1. B. S. Grewal: Higher Engineering Mathematics, 36th Ed., Khanna Pub.
2. S. Lipschutz and M. Lipson: Theory and Problems of Discrete Mathematics. Schaum Series. 2nd Ed. Tata McGraw Hill.

THIRD SEMESTER M. Sc. – MATHEMATICS (CBCS)

CPT-3.1: LINEAR ALGEBRA AND ITS APPLICATIONS

Recapitulation: Vector Spaces, Subspaces, Linear Combinations and Systems of Linear Equations. (Without proofs of theorems). **4hrs.**

UNIT-1. **15hrs.**

Linear Dependence and Linear Independence, Bases and Dimension, Maximal linearly independent subsets. Direct sums. Linear Transformations. Properties of Linear Transformation. The algebra of Linear Transformations. Regular and Singular of Linear Transformations. The Range and Rank of a linear transformation. Dual Space.

UNIT-2. **15hrs.**

Characteristic roots and Characteristic vectors of a linear transformation. Matrices of Linear transformation. Elementary Matrix Operations and Elementary Matrices, The Rank of a Matrix and Matrix Inverses, Systems of Linear Equations. Determinants. Properties of Determinants.

UNIT-3. **15hrs.**

Inner Products and Norms, The Gram-Schmidt Orthogonalization Process, Orthogonal Complements. Orthogonal Projection. Spectral Theorem. Types of Linear Transformation, Hermitian, Unitary and Normal Transforms.

UNIT-4. **15hrs.**

Canonical Forms, Invariant subspaces, Triangular Canonical Form, Nilpotent canonical form, Jordan canonical form and Rational Canonical forms. Bilinear Form, Real Quadratic forms, The Sylvester Law of Inertia.

TEXT BOOKS

1. S. Friedberg, A. Insel, and L. Spence: Linear Algebra, Fourth Edition, PHI, 2009.
2. Jimmie Gilbert and Linda Gilbert: Linear Algebra and Matrix Theory, Academic Press, An imprint of Elsevier.
3. I. N. Herstein: Topics in Algebra, Vikas Pub. House, New Delhi.

REFERENCE BOOKS

1. Hoffman and Kunze: Linear Algebra, 2ND Ed. Prentice-Hall of India, 1978.
2. P. R. Halmos: Finite Dimensional Vector Space, D. Van Nostrand, 1958.
3. S. Kumeresan: Linear Algebra- A Geometric approach, Prentice Hall India, 2000.
4. V. K. Khanna and S. K. Bhambri: A Course in Abstract Algebra, 3rd Ed., Vikas Pub., 2008.

CPT-3.2: ADVANCED TOPOLOGY

Recapitulation: Element of General Topology. (As First Semester CPT-1.3). **4hrs.**

UNIT-1. **15hrs.**

Compact sets in the real line, Limit point compactness, Local compactness, Alexandroff one point compactification, Sequential compactness, Lebesgue number. Equivalence in metric spaces.

UNIT-2. **15hrs.**

Countability axioms, Lindelof space, Separable spaces and their equivalence in metric space, compactness and completeness, Totally bounded spaces, separation axioms, T_o, T_1 and Hausdorff spaces, Regular spaces, T_3 axiom.

UNIT-3. **15hrs.**

Normal spaces, Uryson's lemma, Tietz's extension theorem, complete normal spaces, Complete regular spaces, T_4, T_5 spaces.

UNIT-4. **15hrs.**

Urysohn imbedding theorem, Stone-cech Compactification, Projections on product space XxY, Product invariant properties for XxY, Homotopy and Fundamental group.

TEXT BOOKS

1. J. R. Munkers, Topology - A First Course, PHI, 1996.
2. G. F. Simmons, Introduction to Topology and Modern Analysis, McGraw Hill, 1963.
3. W. J. Pervin, Foundation of General Topology, AP, 1964.

REFERENCE BOOKS

1. J. Dugundji: Topology, PHI, 1975.
2. M. C. Gemignani: Elementary Topology, Addition-Wesley, Reading Mass, 1972.
3. S. Willard: General Topology, Addison Wesley, Reading Mass, New York, 1968.

CPT-3.3: FLUID MECHANICS

Recapitulation: Elementary concepts of Classical & Continuum Mechanics. **4hrs.**

UNIT-1. **15hrs.**

Motion of inviscid fluids: Euler's equation of motion, Bernoulli's equation in standard forms, Illustrative examples of theorems. Pressure at a point in a fluid at rest and that in motion. Vortex motion, Circulation, Kelvin's circulation theorem, Helmhotzvorticity equation, Permanance of vorticity and circulation.

UNIT- 2. **15hrs.**

Two dimensional flow of inviscid fluids: Meaning of two-dimensional flow. Examples. Sream function. Complex potential, source and sinks in two dimensions, complex potential due to a source, Doublet in two dimensions, Images, Image of a doublet with respect to a line, The Milne-Thomson circle theorem, Blasius theorem and applications.

UNIT-3. **15hrs.**

Motion of viscous fluids: Stress & strain components in a real fluid. Relation between stress & strain components. Geometrical interpretation of the components of strain. Thermal conductivity of fluid, Navier-stokes equation & energy equation. Physical significances of non- dimensional numbers. Standard applications of Navier-Stokes equation.

UNIT-4. **15hrs.**

Boundary layer concepts: Prandtl's boundary layer concept. Derivation of two dimensional boundary layer equation for velocity & temperature by order magnitude approach. Boundary layer flow past a fiat plate- Blasius solution, Von-Karman momentum integral equation, Von-Mises transformations.

TEXT BOOKS

1. G. K. Batchelor: An Introduction to Fluid Mechanics, Foundation Books, New Delhi,1994.
2. F. Chorlton: Text book of Fluid Dynamics, CBS publishers, Delhi, 1985.
3. S. W. Yuan: Foundations of Fluid Mechanics, PHI Pvt. Ltd., New Delhi, 1976.
4. R. K. Rathy: AnIntroduction to Fluid Dynamics, Oxford and IBM Pub. Co., New Delhi,1976.

REFERENCES

1 L. D. Landau and E. M. Lipschitz: Fluid Mechanics, Pergamon press, London, 1995.
2 H. Schlichting: Boundary Layer Theory, McGraw Hill Book Company, New York,1979.
3 A.D.Young: Boundary Layers AJAA Education series, Washington DC 1989.
4 L. Popenhead: Laminar Boundary Layer, Clearan Don press Oxford.

CPT-3.4.1 : ADVANCED NUMERICAL ANALYSIS

Recapitulation: Taylor's formula, Classification of PDE, Classification of physical problems. **2hrs.**

UNIT-1. **8hrs.**

Numerical Solution of Ordinary Differential Equations: Single Step methods: Explicit Runge-Kutta methods of second and fourth order for simultaneous and higher order differential equations. Multi step methods: Adam Bashforth's, Adam Moulton's and Milne's predictor-corrector methods,(Convergence and Truncation error for the above methods). Boundary Value problems: Second order finite difference method, linear shooting method.

UNIT-2. **8hrs.**

Numerical solution of Partial differential equations: Finite difference approximations to derivatives. Difference methods for Elliptic partial differential equations –Laplace and Poisson's equations.

UNIT- 3. **8hrs.**

Difference methods for parabolic equations in one-dimensional space- Schmidt, Laasonen, Crank-Nicolson formulae, Gauss-Seidal iterative scheme for Crank-Nicholson method. Stability and convergence analysis for Schmidt and Crank–Nicolson methods.

UNIT-4. **6hrs.**

Explicit finite difference schemes for hyperbolic equations in one dimensional space. Stability of explicit finite- difference method. Implicit method.

TEXT BOOKS

1. M. K. Jain, S. R. K.Iyengar and R.K.Jain : Numerical Methods for Scientific and Engineering Computation, Wiley Eastern Ltd. 3rd Ed. 1993.
2. Burden R. and Faires J. D. : Numerical Analysis, P.W.S. Kent Pub. Co. 4th Ed., Boston, 1989.
3. Atkinson K. E. : An Introduction to Numerical Analysis, 3rd Ed.,John Weiley and Sons, 1989.

REFERENCE BOOKS:

1. S. C. Chapra, and P. C. Raymond: Numerical Methods for Engineers, Tata McGraw Hill, New Delhi, 2000.
2. Conte S. D. and De Boor. Introduction to Numerical Analysis. McGraw Hill.
3. Hilderband F. B. : Introduction to Numerical Analysis, 5th Ed., Tata McGraw Hill, New Delhi, 1986.
4. Gerald C. F. and Wheatly P. O.: Applied Numerical Methods, 6th Ed. Low Priced Ed., Pearson Education Asia, 2002.

CPP-3.4. 2: COMPUTER PROGRAMMING-II(Based on CPT- 3. 4.1)

Recapitulation: Fundamentals of C-programming-I (As in II Semester CPP- 2. 4. 2). **2hrs.**

UNIT- 1. **15hrs.**

Arrays, processing with arrays, arrays and functions, multidimensional array, character array, Sorting, Bubble sort, selection & Quick sort.Searching, Linear and binary search, Pointers declaration, Pointer arithmetic, Pointers and functions. Call by value & call by reference, Pointers and array.

UNIT-2. C- Program Practical **15hrs.**

1. Sum, difference and product of Matrices
2. Gauss - elimination method
3. Gauss - Siedel method
4. Runge - Kutta second & fourth order methods
5. Predictor - Corrector methods – Adam-Bashforth, Adams-Moulton methods
6. B.V.P. - Solution of Laplace's equation on a rectangle with Dirichlet Boundary conditions.
7. Solution of one-dimensional parabolic equation (Temperature changes in rod)by Schmidt and Crank - Nicolson schemes.

TEXT BOOKS

1. V. Rajaraman: Fundamentals of Computers. PHI, 1991.
2. B. S. Gottfried: Programming with C, Tata McGraw Hill, Schaum's Outlines, 1998.

REFERENCE BOOKS:

1. E. Balagurusamy: Programming in ANSI – C, Tata McGraw Hill Pub. Co. 1992.
2. B. W. Kernighan and D. M. Ritchie: The C programming Language, PHI, 1998.

SPT- 3.5(A): NONLINEAR DYNAMICS

Recapitulation: History of dynamics**,** importance of being nonlinear, linearity and nonlinearity in physics and the other sciences. **4hrs.**

UNIT-1. **15hrs.**

Non-linear equations. Autonomous systems, Phase plane, Critical points, stability and paths of Linear and Non-Linear systems, Liapunov direct method, limit cycles and periodic solution. Poincare Bendixion theorem.

UNIT-2. **15hrs.**

Discrete Systems, Examples of discrete systems, some terminology, linear discrete systems, nonlinear discrete systems, quadratic maps.

UNIT-3. **15hrs.**

Introduction of Bifurcations. Saddle-node bifurcation, transcritical bifurcation, Pitchfork bifurcation, Hopf bifurcation.

UNIT-4. **15hrs.**

Chaos. Logistic map, Lyapunov exponents, chaotic attractors, Lorenz equations. Case study-population growth, insect outbreak, shallow water model.

TEXT BOOKS

1. E. A. Coddington: Theory of Ordinary Differential Equations, McGraw-Hill, 1955.
2. J. Berry and Arnold: Introduction to Non-Linear Systems, Great Britain 1996.
3. S. H. Strogatz: Non Linear Dynamics and Chaos, Addision Wesley, Pub. Co., USA, 1994.

REFERENCE BOOKS

1. S. Wiggins: Introduction to Applied Non-Linear Dynamical systems and Chaos. TAM, Springer-Verlag, Vol-2 NewYork, 1990.
2. M. W. Hirsch, S. Smale, and R. L. Devaney: Differential Equations, Dynamical Systems and an Introduction to Chaos, Elsevier, 2004.
3. M. Lakshmanan and S. Rajasekar:Nonlinear Dynamics,Integrality, Chaos and Patterns, Springer Intrn. Ed., 2009.
4. G. B. Whitham: Linear and Nonlinear Waves, John Wiley & Sons, New York.

SPT- 3.5(B): FUZZY MATHEMATICS

UNIT -1. **16hrs.**

Basic Concepts of Fuzzy Sets: Crisp set, Fuzzy sets, types of Fuzzy sets, basic, concepts, properties of a α-cuts, representation of Fuzzy sets, extenstion principle of Fuzzy sets, standard fuzzy operations.

UNIT-2. **16hrs.**

Operations on Fuzzy Sets: Types of operations Fuzzy complements, Fuzzy intersections, t-norms. Fuzzy unions; t-co-norms, combinations of operations, aggregation operations.

UNIT-3. **16hrs.**

Fuzzy Arithemetic: Fuzzy numbers. Linguistic variables. Arithematic operations on Fuzzy numbers. Lattice of Fuzzy numbers, Fuzzy equations.

UNIT-4. **16hrs**

Fuzzy Relations: Crisp versus fuzzy relation, Projections and cylindric extensions, Binary fuzzy relations, Binary relations on a single set, fuzzy equivalence relations, fuzzy compatibility relations, fuzzy ordering relations.

TEXT BOOKS

1. George J. Klir and Yuan Fuzzy sets and Fuzzy logic, Theory and Applications. PHI.
2. George J. Klir and Tina A. Fotger: Fuzzy sets uncertainty and information. PHI, 1994
3. Kaufmann, A., Introduction to the Theory of Fuzzy subsets-vol. Academic press, 1975

REFERENCE BOOKS

1. B. Kosko & others, Fuzzy logic with engineering Applications. PHI.
2. H. J. Zimmermann: Fuzzy Set Theory and its Applications, 3rd Ed. Kluwer Acad., 1992.

OEPT-3.6: ELEMENTS OF APPLIED MATHEMATICS

UNIT-1. Calculus: 16hrs.

Graphs of functions.

Limits- Definitions and Examples,

Continuity: Continuous and Discontinuous functions,

Differentiation: Rules of differentiation, Maximum and minimum of function of two variables.

Integration: Definition, Rules of integration, Definite and Indefinite integration, some applications.

UNIT-2. Differential Calculus & Differntial Equations 16hrs.

Rolle's Theorem, Lagrange's Theorem, Cauchy's Mean Value Theorem, Taylors Theorem, Maclaurin's form (Without proofs of theorems, only problems).

Partial differentiation of Homogeneous functions, Eulers Theorem (No proof), Total differentiations, Errors and Approximations.

First order Ordinary Differential Equations and their Applications.

UNIT-3 Statistics 16hrs

Frequency distribution, Measures of central tendency, Measures of dispersion, Moments, Curve fitting, y=a+bx, y=a+bx+cx^2, $y = a^x$, Correlation and Regression.

UNIT-4. Probability 16hrs.

Probability of events, conditional probability, Baye's theorem, Distribution function-Binomial, Poission, Normal distribution.

TEXT BOOKS

1. B. S. Grewal: Higher Engineering Mathematics, 36th Ed., Khanna Pub.
2. Seymour Lipschutz: Probability, Schaum' s series.
3. V K Kapoor and S C Gupta: Fundamentals of Mathematical Statistics, S Chand Publication.

REFERENCE BOOKS

1. B. V. Ramana: Higher Engineering Mathematics, Tata Mc Graw Hill.
2. Matrices: Shanti Narayan, S Chand.

FOUTH SEMESTER M. Sc. – MATHEMATICS (CBCS)

CPT-4.1: MEASURE AND INTEGRATION

Recapitulation: Riemann integration, Sequence and series of functions, uniform convergence (Without Proofs of Theorems). **4hrs.**

UNIT-1. **15hrs.**

Ring of a set, σ-ring of sets, algebra of sets, sigma algebras, open subsets of the real line. Fer and Ger sets, Borel sets, Lebesgue measure, Outer measure, relation between Lebesgue outermeasure and length of an interval, Countable sub-additivity of Lebesgue outer measure, translation invariance.

UNIT-2. **15hrs.**

Measurable sets: algebra of measurable sets, the class of measurable sets as algebra, the measure of the intersection of decreasing sequence of measurable sets, a non-measurable set. Measurable functions; Measurability of continuous functions, almost everywhere property, Characteristic functions, Simple functions, Littlewood's three Principles and applications.

UNIT-3. **15hrs.**

Lebesgue Integral; Lebesgue integral of a bounded function defined on a closed interval, Lebesgue integral of a non-negative function, Comparison with the Riemann integral, Lebesgue integral of a measurable function, Properties of Lebesgue integral.Convergence Theorems and Lebesgue integral, the Bounded convergence theorem, Fatou's Lemma, Monotone convergence theorem, Lebesgue convergence theorem.

UNIT-4. **15hrs.**

Differentiation of Monotone functions. Vitali covering lemma. Functions of Bounded variation. Differentiability of an integral. Absolute continuity and indefinite integrals.L_p spaces. Holder and Minkowski inequalities. Convergence and completeness, Riesz – Fischer Theorem. Bounded linear functional, Riesz representation theorem and illustrative examples. Measure spaces, Signed measures, the Radon Nikodyn theorem.

TEXT BOOKS

1. H. L. Royden: Real Analysis, Prentice Hall, 3rd Ed.,
2. G. de Barra: Measure Theory and Integration, Wiley Eastern Limited.
3. Inder K. Rana: An Introduction to Measure and Integration, Narosa, 1997.

REFERENCE BOOKS

1. Paul R. Halmos. Measure theory D, van. Nostrand Co. Inc, NY & Affiliated East-west presses Pvt., Ltd, New Delhi, 1966.
2. Harold Wodom: Lectures on Measure &Integration, Van Nostrand Reinhold Co., New York.
3. K.P.Gupta, Measure Theory, Krishna Prakashan Media, Pvt. Ltd.II, Meerut, India

CPT-4.2: DIFFERENTIAL GEOMETRY

Recapitulation: Elements of Calculus, Linear Algebra and Geometry. **4hrs.**

UNIT-1. **15hrs.**

Calculus on Euclidean Space, Directional derivatives and their properties. Curves in E^3. Velocity and speed of a curve. Reparametrization of a curve. 1-forms and Differential forms. Wedge product of forms. Mappings of Euclidean spaces. Derivative map.

UNIT-2. **15hrs.**

Frame Fields**,** Arc length parametrization of curves. Vector field along a curve. Tangent vector field, Normal vector field and Binormal vector field. Curvature and torsion of a curve. The Frenet formulas Frenet approximation of unit speed curve and Geometrical interpretation. Properties of plane curves and spherical curves. Arbitrary speed curves. Covariant derivatives and covariant differentials. Connection forms. Attitude Matrix. Isometries of E^3.

UNIT-3. **15hrs.**

Calculus on a Surface, Coordinate patch. Monge patch. Surface in E^3. Special surfaces-sphere, cylinder and surface of revolution. Parameter curves, velocity vectors of parameter curves, Patch computation. Parametrization of surfaces - cylinder, surface of revolution and torus. Tangent vectors, vector fields and curves on a surface in E^3. Directional derivative of a function on a surface of E^3. Differential forms and exterior derivative of forms on surface of E^3. Pull back functions on surfaces of E^3.

UNIT-4. **15hrs.**

Shape Operators, Shape operators of sphere, plane, cylinder and saddle surface. Normal curvature, Normal section. Principal curvature and principal direction. Umbilic points of a surface in E^3. Euler's formula for normal curvature of a surface in E^3. Gaussian curvature, Mean curvature and Computational techniques for these curvatures. Minimal surfaces.

TEXT BOOKS

1. Barrett O' Neil: Elementary Differential Geometry. Academic Press, New York & London, 1966
2. T. J. Willmore: An introduction to Differential Geometry. Clarendon Press, Oxford 1959.

REFERENCE BOOKS

1. D. J. Struik: Lectures on Classical Differential Geometry, Addison Wesley, Reading Mass, 1961.
2. NirmalaPrakassh: Differential Geometry- AnIntegrated approach. Tata McGraw-Hill, New Delhi, 1981.

CPT-4.3: ADVANCED GRAPH THEORY

Recapitulation: Elementary concepts of graph theory, Cut- vertex, Bridge, Blocks, Vertex-connectivity, Edge-connectivity (no proofs of theorems). **4hrs.**

UNIT-1. **15hrs.**

Planarity, Plane and Planar graphs, Euler Identity, Non planar graphs, Maximal planar graph Outer planar graphs, Maximal outer planar graphs, Characterization of planar graphs, Geometric dual, Crossing number.

UNIT-2. **15hrs.**

Colorings, Vertex Coloring, Color class, n-coloring, Chromatic index of a graph, Chromatic number of standard graphs, Bichromatic graphs, Colorings in critical graphs, Relation between chromatic number and clique number/independence number/maximum degree, Edge coloring, Edge chromatic number of standard graphs Coloring of a plane map, Four color problem, Five color theorem, Uniquely colorable graph. Chromatic polynomial.

UNIT-3. **15hrs.**

Domination concepts and other variants, Dominating sets in graphs, domination number of standard graphs, Minimal dominating set, Bounds of domination number in terms of size, order, degree, diameter, covering and independence number, Domatic number, Independence domination number. Total domination number. Connected domination number.

UNIT-4. **15hrs.**

Adjacency matrix, Power of Adjacency matrix, Edge sequence in adjacency matrix Incidence matrix, Circuit matrix, Characteristic polynomials. Introduction to the laplacian and eigen values. Basic facts about the spectrum of a graph. Eigen values of weighted graphs. Eigen values and its related problems.

TEXT BOOKS

1. F. Harary: Graph Theory, Addison -Wesley,1969
2. G. Chartrand and P. Zhang: Introduction to Graph Theory. McGraw-Hill Intrn. Ed., 2005.
3. J. A. Bondy and V.S.R.Murthy: Graph Theory with Applications, Macmillan, London.
4. D. Cvetkovic, M. Doob, I. Gutman and A. Torgasev, Recent Results in Theory of Graph Spectra, Annulus of Discrete Mathematics, No.36. Elsevier Science, Pub.BV.1991.

REFERENCE BOOKS

1. N.Deo: Graph Theory: PHI Pvt. Ltd. New Delhi, – 1990
2. T.W. Haynes, S.T. Hedetneime and P. J. Slater: Fundamental of Domination in graphs, Marcel Dekker. Inc. New York.1998.
3. J. Gross and J. Yellen: Graph Theory and its application, CRC Press LLC, BR, Florida, 2000.

CPT- 4.4: MATHEMATICAL METHODS

Recapitulation: Laplace transforms, Inverse Laplace Transforms, Fourier Transforms, Finite Fourier Transforms. **4hrs.**

UNIT-1. **15hrs.**

Integral Transforms and Calculus of Variations: General definition of Integral transforms, Kernels, etc. Z-Transform, Hankel and Mellin transforms.

Variation of a functional, Euler- Lagrange equation, necessary and sufficient conditions for extrema. Variational methods for boundary value problems in ODE's and PDE's.

UNIT-2. **15hrs.**

Integral Equations: Definition, Volterra and Fredholm integral equations. Solution by separable kernel, Neumann' s series resolvent kernel and transform methods, Convergence for Fredholm and Volterra types. Reduction of IVPs BVPs and eigenvalue problems to integral equations. Theory of symmetric kernels.

UNIT-3. **15hrs.**

Asymptotic Methods: Asymptotic expansion of functions, power series as asymptotic series, Asymptotic forms for large and small variables. Asymptotic expansions of integrals; Method of integration by parts (include examples where the method fails), Laplace method and Watson's lemma, method of stationary phase and steepest descent.

UNIT-4. **15hrs.**

Perturbation Methods: Perturbation series, Classification, perturbation problems. Introductory examples of boundary layer, matched asymptotic expansion. Applications of differential equations. WKB approximation and solution. Poincare-Lindstedt method. (Duffing's equation and Vanderpol oscillator).

TEXT BOOKS

1. R.P. Kanwal: Linear integral equations theory and techniques, Academic Press, Ny, 1971.
2. C.M. Bender and S.A. Orszag: Advanced Mathematical Methods for Scientists and Engineers, McGraw- Hill, New York, 1978.

REFERENCES

1. H.T. Davis:Introduction to nonlinear differential and integral equations, Dover Pub.1962.
2. A.H. Nayfeh: Perturbation Methods, John Wiley &Sons New York, 1973
3. Don Hong, J. Wang and R. Gardner. Real analysis with Introduction to Wavelets & Applications, Academic Press, Elsevier, 2006.
4. R.V. Churchill: Operational Mathematics, Mc. Graw Hill, New York, 1958
5. I.N. Sneddon – The Use of Integral Transforms, Tata McGraw Hill, New Delhi, 1974.

SPT-4.5(A): MAGNETO HYDRODYNAMICS

UNIT-1. **16hrs.**

Electrodynamics: Electrostatics, Coulomb's law, derivation of Gauss's law, electric potential, dielectrics, polarization, bound charges, Gauss law in the presence of dielectrics, magneto statics, Faraday's law, Ampere's law, vector potential, conservation of charges, electromagnetic units.

UNIT-2. **16hrs.**

Basic equations of MHD, Magnetic induction equation, Lorentz force, MHD approximations, non-dimensional numbers, velocity temperature and magnetic field boundary conditions, electro-magnetic interface conditions.

UNIT-3. **16hrs.**

Hartmann flow, temperature distributions in Hartmann flow, Couette flow, Hagen-Poiseuille flow, concepts in classical MHD, Alfven theorem

UNIT-4. **16hrs.**

Alfven waves, cause for Alfven waves, equipartition of energy, dissipation of energy by Alfven waves, reflection and transmission of Alfven waves, applications.

TEXT BOOKS

1. V.C. A Ferraro and Plumpton: Introduction to Magnetofluidmechanics, Clarendon Press, 1966.
2. David J Griffiths: Introduction to electrodynamics, PHI,1997
3. Allen Jeffrey: Magneto hydrodynamics

REFERENCE BOOKS

1. Sutton and Sherman: Magneto hydrodynamics, McGraw Hill, 1965.

SPT-4.5(B): PROBABILITY & STATISTICS

UNIT-1. **16hrs**

Introduction to descriptive statistics and exploratory data analysis, sample space, discrete probability, independent events, Bayes theorem, random variables distribution functions, expectation and moments, marginal probability distribution, central limit theorem.

UNIT-2. **16hrs**

Theoritical distributions, standard discrete and continuous univariate distributions, sampling distributions, standard errors such as statistical, biased or unbiased etc…, methods of estimation, properties of estimators, confidence intervals, tests of hypothesis.

UNIT-3. **16hrs**

Large sample tests, tests of single proportions, difference of proportions, tests of significance for single mean, difference of mean and difference of standard deviation. Chi-square distribution, goodness of fit, Chi-square test for independence of attributes, degree of freedom, population variance.

UNIT-4. **16hrs**

Tests of significance based on t, F and Z distributions.

TEXT BOOKS

1. S. C. Gupta: Fundamentals of Statistics. Himalaya Publishing House, 1981.
2. Richard A. Johson, Miller and Freunots: Probability and Statistics for Engineers.

REFERENCE BOOKS

1. B. Rosuer: Fundamentals of Biostatistics, Duxbury Thompson Learning, 2000.

THEORY QUESTION PAPER PATTERN

Duration of Examination: 3 hrs **Max. Marks** = 80

Note: Answer any **five** questions. Question No. 1 is compulsory.

1. Answer any **Eight** questions (Which includes all units) 8X2=16
    a.
    b.
    c.
    d.
    e.
    f.
    g.
    h.
    i.
    j.

Answer any **four** of the following questions:

2. Descriptive type question (From Unit-1) 16
3. Descriptive type question (From Unit-2) 16
4. Descriptive type question (From Unit-3) 16
5. Descriptive type question (From Unit-4) 16
6. Answer any **four** of the following (Which includes all units) 4X4=16
    a.
    b.
    c.
    d.
    e.

Note: Equal weightage to be given to each unit while preparing the question paper. Question No. 2 to 5 must include atleast two subsections.

PRACTICAL BASED THEORY QUESTION PAPER PATTERN

Duration of Examination: 2 hrs **Max. Marks** = 40

Note: Answer any **five** questions. Question No. 1 is compulsory.

1. Answer any **four** questions (Which includes all units) 4X2=8
   a.
   b.
   c.
   d.
   e.
   f.

Answer any **four** of the following questions:

2. Descriptive type question (From Unit-1) 8
3. Descriptive type question (From Unit-2) 8
4. Descriptive type question (From Unit-3) 8
5. Descriptive type question (From Unit-4) 8
6. Descriptive type question (Which includes all units) 8

PRACTICAL QUESTION PAPER PATTERN

Duration of Examination: 2 hrs **Max. Marks** = 40

1. Experiments, Spotting, Demonstrations & Executions. **30 Marks**
2. Records (which includes Logic, Algorithm, Flowchart, Programs & sample outputs) and submission. **5 Marks**
3. Viva-voce **5 Marks**
