M.A./MSc-I (2005-2006)

PAPER I

Abstract Algebra & Discrete Mathematics

1. Ideals, principle and maximal ideal, quotient rings over the rational field, Homomorphism and Embedding of ring, fundamental theorem on homomorphism and isomorphism.

2. Euclidean rings, Polynomial rings, polynomial over the rational fields, irreducible polynomials, and its roots.

3. Field extension, roots of polynomials, splitting fields, separable and inseparable extension, Galois theory, radical extension and solvability.

Discrete Mathematics: 40%

1. Mathematical logic, equivalence and logical equivalence, OR, AND, NOR, exclusive OR, and NOT.

2. Partial order sets, lattices as algebraic systems, duality, sublattices, and construction by ruler and compass.


Text Books:
1. T.N. Herstein: Topics in Algebra
2. M. Artin: Algebra
3. S. Lang: Algebra
4. Quazi Zameeruddin: Elements of Discrete Mathematics
5. Klaasen & Blambli: Modern Algebra
PAPER II
FLUID DYNAMICS


II. Theory of irrotational motion, Kelvin's circulation theorem and minimum energy theorems, Mean value of velocity potential theorem, Uniqueness theorem of irrotational flow. Motion in two dimensions, Source, Sinks and doublets, Their images with respect to a plan and sphere, Milne, Circle theorem, Blasius theorem.

III. Motion of cylinder (circular & elliptic) and sphere in two dimensions.

IV. Waves in liquids: progressive and stationary waves, Group velocity, General theory of stresses and strain, principle stresses and direction.

V. Navier-Stoke's equations, Diffusion of vorticity, Energy equation, Energy dissipation due to viscosity, some exactly solvable problem in viscous flow, Steady flow between parallel plates, Poiseuille flow, Steady flow between concentric rotating cylinders.

Text Books:
2. F. Chorlton : Text Book of Fluid Dynamics
3. Bansi Lal : Theoretical Hydro-Dynamics

PAPER III
COMPLEX ANALYSIS & MATHEMATICAL METHODS

Complex Analysis (50%)

I. Residues and poles, Classification of isolated singularities, Taylor's & Laurent's series, Cauchy's residues theorem.

II. Application of residue theorem in evaluation of improper real integrals & Evaluation of sum.

III. Conformal mapping properties, Mobius transformation, elementary examples.


Special Functions (40%)

V. Hermite, Laguerre, Chebyshef, Legendre and Bessel Functions.

Boundary Value Problems (10%)

VI. Variable separation solution of one & two dimension, Heat flow problems, One & two dimension wave equation, Two and three dimension Laplace equation.

Text Books:
1. Rudin : Real and Complex Analysis.
2. J.B. Convey : Complex Analysis.
3. B.Chodhary : Complex Analysis.
5. S.Ponnusamy : Foundation of Complex Analysis.
PAPER IV

OPERATIONS RESEARCH


II. Dual simplex methods, Revised simplex methods, Game theory, Dominance property, Graphical algebraic & linear programming methods.

III. Transportation & transshipment problem, Degeneracy in transportation, assignment problem, Traveling salesman problem.

IV. Integer Programming, Nonlinear programming (Kuhn-tucker condition) Quadratic programming.

V. Inventory control: Type inventory, Deterministic inventory models, EOQ models, EOQ, model with price breaks, Production model.

VI. Queuing theory: Symbols and notation, Poisson process & exponential distribution, classification of queue, M/M/1 queuing system, non-Poisson queuing system, M/G/1 queuing system, M/E/1 queuing system.

Text Books:

PAPER V (Optional)

(a) CALCULAS OF VARIATION

I. Variation of function: Necessary condition for an extremum, Euler’s equation, fixed end point problem for unknown functions. Variational problems in parametric form. Functional depending on higher order derivatives and variational problems with subsidiary condition.

II. The isoperimetric problem, Invariance of Euler’s equation under coordinate transformation, General variational of functional, Variable end point problems. Transversality condition transversal theorem, Weierstrass Endmann corner condition.


IV. The second variation of a functional and the formula for second variation, Legendre’s necessary condition, Jacobi’s necessary condition, Conjugate point, Sufficient condition for a weak extremum.


Text Books:
1. Gelfran and Fomin: Calculus of Variation.
2. Escolar: Calculus of Variation.

PAPER V (Optional)

(b) GRAPH THEORY

I. Concept of graph and sub graph: Incidence Adjacency & Degree, Regular, Null Bipartite graphs and isomorphism. Walk, Trail & path, Cycle and its components partitions and composition.

II. Operation on graphs: Union, intersection, Ring sum, Wedge union, cartesian products composition, Normal product, tensor product, Euler and Hamiltonian graphs.


IV. Matrix representation of graphs.
V. Coloring, covering and partitioning: Chromatic number, Chromatic polynomials matching, Covering, Chromatic partitioning.

VI. Directed graphs digraph and binary relations: Euler digraph, directed path & connectedness, acyclic digraphs.

VII. Spanning tree algorithms, Kruskal, Prim's, Dijkstra algorithm.

Text Books:
1. N. Deo: Graph Theory.
2. Hary: Graph Theory.
3. Parathaswarthy: Basis Graph Theory.

PAPER V (Optional)
(c) GENERAL RELATIVITY & COSMOLOGY


IV. Cosmology-mach's principle, Einstein modified field equation with cosmological terms, Static cosmological models of Einstein and desitter, their derivation, properties and comparison with the universe.


Text Books:
1. H. Stephey: General relativity: An Introduction to Theory of the Gravitational Field
2. A.S. Eddington: The Mathematical Theory of Relativity
5. J.V. Narlikar: Introduction to Cosmology.

PAPER V (Optional)
(d) FUZZY SET THEORY

I. Fuzzy set: Basic definition, a-level sets, convex fuzzy sets, basic operation on fuzzy sets, type of fuzzy sets, Cartesian products, Algebraic products, bounded sum and differences, t-norms and t-corners.

II. The extension principle: The Zadeh's extension principle, Images and inverse images of fuzzy sets, Fuzzy numbers, Element of fuzzy arithmetic.


IV. Possibility theory: Fuzzy measure, Evidence theory, Necessary measure, possibilities measure, possibilities theory and fuzzy sets, possibility theory versus probability theory.

V. Fuzzy Logic: An overview of classical logic, multivalued logic, Fuzzy propositions, Fuzzy qualifiers, Linguistic variables and hedge.

VI. An introduction to Fuzzy control: Fuzzy controllers, Fuzzy rule base.
Fuzzy interference engine, Fuzzification, Defuzzification and the various
Defuzzification methods.

**Text Books:**

1. G.J. Klir & B. Yuan: *Fuzzy Sets and Fuzzy Logic*
2. H.J. Zimmermann: *Fuzzy Set Theory and its Applications*

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**M.A./MSc.II (2006 - 2007)**

**PAPER VI:**

**GENERAL TOPOLOGY**

I. Metric spaces: open sets, closed sets, limit point, closure, interior, exter-
ior, dense and non-dense sets, sequence and subsequence in metric
spaces, complete metric spaces, Cantor's intersection theorem, Baire's
category theorem.

II. Definition and example of topological spaces, closed sets, closure, dense
subset, neighborhood, interior and boundary, accumulation points and
derived sets, base and sub-bases, subspaces and relative topology,
Kuratowski closer operator and neighborhood system.

III. Continuity and homeomorphism.

IV. Connectedness: connected and disconnected sets, local connected-
ness, component and path components, continuity and connectedness,
totally disconnected spaces.

V. Compactness: local compactness, sequential compactness, continuity
and compactness, Bolzano-Weierstrass property, Heine-Borel's theorem.

VI. Countability and separation axiom, first countable and second count-
able spaces, Hausdorff spaces, regular spaces, normal spaces, Urysohn's
Lemma and motorization theorem, Tychonoff's spaces.

VII. Product spaces, Nets, Filters.

**Text Books:**

1. James R Munkres: *Topology: A First Course*
2. J.L. Kelly: *General Topology*
3. W.J. Pervin: *Foundation of General Topology*
4. K.D. Joshi: *Introduction to General Topology*
5. Seymour Lipschutz: *General Topology*
6. G.F. Simmons: *Topology and Modern Analysis*

**PAPER VII**

**DIFFERENTIAL GEOMETRY & TENSOR ANALYSIS**


II. Metric, local and intrinsic properties of surface: Envelopes, Developable surface, Ruled surface, edge of regression, 1st Fundamental and 2nd fundamental forms with geometric interpretation and fundamental theorem. Direction coefficient, Angle between two directions, family of curves, orthogonal trajectories and condition for orthogonalities for double family of curves.

III. Local non-Intrinsic properties of surface: Normal curvature, Meusnier’s theorem, Euler’s theorem, principle curvature & directions, lines of curvature, Rodrigue’s formula, Minimal Surface, Mean, First and Gaussian curvature, Dupin’s indicatrix, Third fundamental form, Conjugate, Asymptotic lines, Curvature lines & torsion of asymptotic lines, Beltrami & Enneper theorem, Gauss characteristic equation of surface, Bonnet surface.

IV. Geodesics: Definition and Differential equation, Canonical Geodesic equation, Clairaut’s Theorem, Normal properties of Geodesics Torsion and curvature of Geodesics, Tensor Algebra, type of tensors, Contraction, Quotient law and tensor algebra.

V. Riemannian metric and Christoffel symbols, Covariable differentiation curvature tensor.

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1. T.J. Willmore: *Differential Geometry.*
2. C.E. Weatherburn: *An Introduction of Riemannian Geometry and Tensor Calculus.*
5. A. Goetz: *Introduction to Differential Geometry.*

**PAPER VIII**

**ADVANCED REAL ANALYSIS**

I. Structure of point-sets: neighborhood of a point, interior of a point, limit point, open & closed sets, properties of derived sets, closure, Bolzano-Weierstrass theorem.

II. Functions of several variable: Limits, continuity & differentiability, implicit and inverse function theorem, The rank theorem, change of variable, Schwarz theorem, Young theorem, Taylor theorem (for two variable).

III. Countable & Uncountable sets, cardinal number, continuum hypothesis.

IV. Lebesgue outer measure, measurable sets, properties of measurable sets, Borel sets and their measurability, non measurable sets.

V. Measurable functions and their properties, step function, simple function, set of measure zero.

VI. Lebesgue integrals of bounded function, comparison of Riemann & Lebesgue integrals, properties of Lebesgue integrals, integral of non negative function, the general integrals.

VII. Convergence in measure, almost uniform convergence, Egorov’s theorem, Fatou’s lemma, convergence theorems.
VIII. Dini derivatives, functions of bounded variation, differentiation of an integral, absolutely continuous function & their properties, Lebesgue differentiation theorem, Lebesgue sets, integrals of a derivative.


Text Books:
1. G. DeBarra : Measure Theory and Integration.
3. H.L. Royden : Real Analysis.
6. S.K. Berberian : Measure and Integration.

PAPER IX (Optional)
(a) FUNCTIONAL ANALYSIS


II. Bonded linear operators: Space of bounded linear operator, linear functionals, Finite dimensional normed space & compactness. Open mapping theorem, closed graph theorem, Uniform bound ness principle.


IV Hilbert space: Completion of inner product spaces, product spaces, orthogonality, Riesz- representation theorem, complete orthogonal sets.

V. Bounded operators on Hilbert spaces: self-adjoint operators, normal operators, unitary operators, orthogonal projection operators.

VI. Spectral theory:- spectrum of bounded linear operators, spectral properties of bounded linear operators, complex analysis & spectral theory.

Text Books:

PAPER IX (Optional)
(b) LINEAR INTEGRAL EQUATIONS

I. Classification of Integral Equations, Relation between Differential and Integral equations. Green’s function.

II. Solution of Fredholm Integral Equations.

III. Solution of Volterra Integral Equations.

IV. Hilbert-Schmidt Theory & classical theory of Fredholm.

V. Singular Integral Equation and Numerical solution of Integral Equations.

Text Books:
2. V.Lovitt : Linear Integral Equations.
PAPER IX (Optional)

(e) BIOMECHANICS


IV. Mass transpose in capillaries, Tissues, Interstitial Space, Lymphatics. Indicator, Dilution Method, and peristalsis, Description of Internal deformation, and Forces.

V. Stress, Strain, and Stability of Organs, Strength, Trauma, and Tolerance, Biomechanical Aspects of Growth, Engineering of blood vessels, Tissue Engineering of Skin.

Text Books:


PAPER IX (Optional)

(d) CODING THEORY

I. The communication channel. The coding problem, Types of codes, Block code, Error detecting and error correcting codes, Linear codes, The Hamming metric, Description of linear block code by matrices, Dual

Mathematics (14)

codes, Standard array, Syndrome, Step-by-step Decoding modular representation, Error correction capabilities of linear codes, Bounds on minimum distance for block codes. Plorkin Bounds, Hamming sphere packing bound, Varshamov-Gilbert-Sacks bound, Bound for Burst-error detecting and correcting codes. Important linear block codes, Hamming codes, Golay codes, Perfect codes, Quasi-Perfect codes, Reed-Muller codes, Codes derived from Hadamard matrices, Product codes, Concatenated codes.


Text Books:

1. Raymend Hill : A First Course in Coding Theory.

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