

MM-05
OPTION (I). DIFFERENTIAL EQUATIONS

M.M. 100

(Questions will be set from each unit/section)

Units	Topics
I	Homogenous Linear Equation with Variable coefficient Simultaneous differential equation, Total differential Equation.
II	Picard's Method of Integration, successive Approximation, Existence Theorem, Uniqueness Theorem. Existence & Uniqueness theorem (All Proof by Picard's method).
III	Dependence on initial conditions and parameters; Preliminaries. Continuity. Differentiability. Higher Order Differentiability. Poincare-Bendixson Theory-Autonomous systems. Umlaufsatz. Index of a stationary point. Poincare-Bendixson theorem. Stability of periodic solutions, rotation point, foci, nodes and saddle points.
IV	Linear second order equations-Preliminaries, Basic facts. Theorems of Sturm. Sturm-Liouville Boundary Value Problems. Numbers of zeros. Nonoscillatory equations and principal solutions. Nonoscillation theorems.
V	Partial differential Equation of first & Second order. Linear partial differential Equation with constant coefficient.

MM-05
OPTION (II). ADVANCED DISCRETE MATHEMATICS

M.M. 100

(Questions will be set from each unit/section)

Units	Topics
I	Formal Logic - Statements. Symbolic Representation and Tautologies. Quantifiers, Predicates and Validity. Propositional Logic. Semigroups & Monoids-Definitions and Examples of Semigroups and Monoids (including those pertaining to concatenation operation). Homomorphism of semigroups and monoids. Congruence relation and Quotient Semigroups. Subsemigroup and submonoids. Direct products. Basic Homomorphism Theorem.
II	Lattices - Lattices as partially ordered sets. Their properties. Lattices as Algebraic systems. sublattices, Direct products, and Homomorphisms. Some Special Lattices e.g., Complete, Complemented and Distributive Lattices. Boolean Algebras - Boolean Algebras as Lattices. Various Boolean Identities. The Switching Algebra example. Subalgebras, Direct Products and Homomorphisms. Join-irreducible elements, Atoms and Minterms. Boolean Forms and Their Equivalence. Minterm Boolean Forms, Sum of Products Canonical Forms. Minimization of Boolean Functions. Applications of Boolean Algebra to Switching Theory (using AND, OR & NOT gates). The Karnaugh Map method.)

- III **Graph Theory**- Definition of (undirected) Graphs, Paths, Circuits, Cycles & Subgraphs. Induced Subgraphs. Degree of a vertex. Connectivity. Planar Graphs and their properties. Trees. Euler's Formula for connected Planar Graphs. Complete & Complete Bipartite Graphs. Kuratowski's Theorem (statement only) and its use. Spanning Trees. Cut-sets, Fundamental Cut-sets, and Cycles. Minimal Spanning Trees and Kruskal's Algorithm. Matrix Representations of Graphs. Euler's Theorem on the Existence of Eulerian Paths and Circuits. Directed Graphs. Indegree and Outdegree of a Vertex. Weighted undirected Graphs. Dijkstra's Algorithm. Strong Connectivity & Warshall's Algorithm. Directed Trees. Search Trees. Tree Traversals.
- IV **Introductory Computability Theory** - Finite State Machines and their Transition Table Diagrams. Equivalence of Finite State Machines. Reduced Machines. Homomorphism. Finite Automata. Acceptors. Non-deterministic Finite Automata and equivalence of its power to that of Deterministic Finite Automata. Moore and Mealy Machines.
Turing Machine and Partial Recursive Functions.
- V **Grammars and Languages - Phrase** - Structure Grammars. Rewriting Rules. Derivations. Sentential Forms. Language generated by a Grammar. Regular; Context-Free, and Context Sensitive Grammars and Languages. Regular sets, Regular Expressions and the Pumping Lemma. Kleene's Theorem.
Notions of Syntax Analysis. Polish Notations. Conversion of Infix Expressions to Polish Notations. The Reverse Polish Notation.

MM-05

OPTION (III). DIFFERENTIAL GEOMETRY OF MANIFOLDS

M.M. 100

(Questions will be set from each unit/section)

Units	Topics
I	Definition and examples of differentiable manifolds. Tangent spaces. Jacobian. One parameter group of transformations. Lie derivatives. Immersions and imbeddings. Distributions Exterior algebra. Exterior derivative.
II	Topological groups. Lie groups and lie algebras. Products of two Liegroups. One parameter subgroups and exponential maps. Examples of Liegroups. Homomorphism and Isomorphism. Lie transformation groups. General linear groups. Principal fibre bundle. Linear frame bundle. Associated fibre bundle. Vector bundle. Tangent bundle. Induced bundle. Bundle homomorphisms.
III	Riemannian manifolds. Riemannian connection. Curvature tensors. Sectional Curvature. Schur's theorem Geodesics in a Riemannian manifold. Projective curvature tensor. Conformal curvature tensor.
IV	Submanifolds & Hypersurfaces. Normals. Gauss formulae. Weingarten equations. Lines of curvatur. Generalized Gauss and Mainardi-Codazzi equations.
V	Almost Complex manifolds. Nijenhuis tensor. Contravariant and covariant almost analytic vector fields. F-connection.