MM-03
TOPOLOGY

M.M. 100

(Questions will be set from each unit/section)

Units	Topics
I	Countable and uncountable sets. Infinite sets and the Axiom of Choice. Cardinal numbers and its arithmetic. Schroeder-Bernstein theorem. Cantor's theorem and the continuum hypothesis. Zorn's lemma. Well-ordering theorem.
	Definition and examples of topological spaces. Closed sets. Closure. Dense subsets. Neighbourhoods. Interior, exterior and boundary. Accumulation points and derived sets. Bases and Sub-bases. Subspaces and relative topology.
II	Alternate methods of defining a topology in terms of Kuratowski Closure Operator and Neighbourhood Systems.
	Continuous functions and homeomorphism.
	First and Second Countable spaces. lindelof's theorems. Separable spaces. Second Countability and Separability.
III	Separation axioms T_0, T_1, T_2, $T_{3½}$, T_4; their Characterizations and basic properties. Urysohn's lemma. Tietze extension theorem.
	Compactness. Continuous functions and compact sets. Basic properties of compactness. Compactness and finite-intersection property. Sequentially and countably compact sets. Local compactness and one point compactification. Stone-vech compactification. Compactness in metric spaces. Equivalence of compactness, countable compactness and sequential compactness in metric spaces.
IV	Connected spaces. Connectedness on the real line. Components. Locally connected spaces.
	Tychonoff product topology in terms of standard sub-base and its characterizations. Projection maps. Separation axioms and product spaces. Connectedness and product spaces. Compactness and product spaces (Tychonoff's theorem). Countability and product spaces.
	Embedding and metrization. Embedding lemma and Tychonoff embedding. The Urysohn metrization theorem.
V	Nets and filters. Topology and convergence of nets. Hausdorffness and nets. Compactness and nets. Filters and their convergence. Canonical way of converting nets to filters and vice-versa. Ultra-filters and Compactness.
	Metrization theorems and Paracompactness-Local finiteness. The nagata-Smirnov metrization theorem. Paracompactness. The Smirnov metrization theorem.
	The fundamental group and covering spaces - Homotopy of paths. The fundamental group. Covering spaces. The fundamental group of the circle and the fundamental theorem of algebra.