1 Topology

1.1 Set theory

Cardinal Numbers, Schröder-Bernstein Theorem, Cantor's Theorem, Cardinal Arithmetic, Continuum Hypothesis, Zorn's Lemma, Axiom of Choice, Well-Ordered Sets, Maximum Principle, Ordinal Numbers.

1.2 Topological spaces

Definition and examples of topological spaces, closed sets, closure, dense subsets, neighborhood, interior, exterior and boundary, accumulation point, derived set, bases and subbases, subspace topology, finite product of topological spaces, neighbourhood system.

1.3 Functions on topological spaces

Open, closed and continuous functions and homeomorphism, topological invariants, isometry and metric invariants.

1.4 Countability and separability

Countability Axioms: First and second countability, separability and Lindelöf property, Hausdorff spaces. Separation Axioms: Regularity, normality (Definitions).

1.5 Compactness

Compactness: Characterisations and basic properties, Alexander subbase theorem, compactness and separation axioms, compactness and continuous functions, sequentially, Frechet and countably compact spaces, compactness in metric spaces. Characterisation of compact metric spaces, equicontinuity, Ascoli-Arzela Theorem, Stone-Weirstrass Theorem.

1.6 Connectedness

Connectedness: Connected sets and their characterisations, connectedness of the real line, components, totally disconnected space, locally connected space, path connectedness, path components, locally path connected space. Quotient topology.