Course Title: Topology

Course Code: MATH-306

Course Type: Major Math

Prerequisites: N/A

Credit Hours: 3 (3 + 0)

Course Objectives: After completion of this course, the students will be able to:

- Define and distinguish between different types of topological spaces
- Apply the concepts of compactness and connectedness to solve problems
- Analyze and determine the continuity of functions in metric and topological spaces
- Recognize and create homeomorphisms
- Construct and identify examples of new topological spaces

Course Contents:

Topology: Definition and examples, Open and closed sets, Neighborhoods, Limit points, Closure of a set, Interior, Exterior and boundary of a set.

Bases and Subbases: Base and subbases, Neighborhood bases, First and second axioms of countability, Separable spaces, Lindelf spaces, Continuous functions and homeomorphism, Topological properties and classification of topological spaces.

Metric Spaces: Definition and examples, Open Ball, Closed Ball, Open Set, Metric topology, Metrizable topological spaces.

Construction of New Topological Spaces: Cartesian products, Induced topology, Ordered topology and quotient topology, Examples of topological spaces like $\mathbb{R}, \mathbb{R} \times \mathbb{R}, S^1, S^2$, torus, Cylinder and finite product spaces.

Separation Axioms: Separation axioms, Regular spaces, Completely regular spaces, Normal spaces.

Connectedness: Connected spaces, Connected components, Properties of connectedness, Image of a connected set through a continuous map, Path-connectedness, Examples of path-connected spaces, Connected subspaces of $\mathbb{R}$ under usual topology.

Compactness: Basic definition and examples of compact spaces, Key properties of a compact space, Image of a compact set through a continuous map, Compact subspaces of $\mathbb{R}^n$.

Recommended Books:

1. Dugundji, *Topology*, Allyn and Bacon Inc., Boston 1966.
2. Munkres, J., *Topology, a first course*, Prentice Hall Inc., 2nd edition, 2003.
3. Morris, S. A., *Topology Without Tears*, University of New England, 2018.

4. Simmon, G. F., *Introduction to Topology and Modern Analysis*, McGraw Hill Book Company, New York, 1963.

5. Willard, S., *General Topology*, Addison-Wesley Publishing Co., London, 1970.

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