# Fourth Year First Semester

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| **Course Title** | Fundamental of Topology | **ISCED Code** | 0541-411 |
| | | **Course Code** | MTH 411 |
| **Course Type** | Core | **Course Status** | Theory |
| **Course Hour** | 3.0 Hr./Week | **Credit Value** | 3.0 |
| **Prerequisite** | Calculus, Real Analysis and Abstract Algebra | **Total Marks** | 100 |

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| ***Course Description*** | **General Topology** is a major/compulsory/core course for undergraduate students in the B. Sc. (Honours) program. It carries **3.0 credits** and **42 hours** of effective teaching over **14 weeks**. Course grades will be assessed through participation, class presentations, quizzes, assignments, two midterms, and comprehensive examinations. This course is an introductory course to advanced analysis. However, it requires **Calculus, Real Analysis, and Abstract Algebra.** |
| ***Rationale*** | The fundamentals of topology provide a framework for understanding the topological properties of spaces, such as connectedness, compactness, and continuity. These properties are essential for many areas of mathematics, including analysis, geometry, and algebraic topology. |
| ***Course Objectives*** | The main objective of the General Topology course is to provide a rigorous foundation for the study of topological space and its properties. This includes defining key concepts such as open sets, limits, continuity and convergences and developing methods for comparing and classifying topological spaces based on their properties. By studying General topology, students can develop a deep understanding of the structure and properties of topological spaces and apply this knowledge to a wide range of mathematical problems and applications. |
| ***Course Learning Outcomes (CLOs)*** | On satisfying the requirements and successful completion of this course, students will have the knowledge and skills to- |

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| CLO1 | Articulate the fundamental properties of metric spaces that are used in image processing to analyze and manipulate images. |
| CLO2 | Understand the properties of topology, which are used in algorithms and data structures. |
| CLO3 | Illustrate the compact spaces that play a key role in differential manifolds. |
| CLO4 | Demonstrate the axiom separations, used in formal languages and automata theory. |
| CLO5 | Apply the connected spaces used in graph theory and network analysis. |

***Course Contents***

| | Course Contents | Hours | CLOs |
|---|---|---|---|
| 1. | **Metric Spaces:** Definition and examples, Open sets, Closed sets, Convergence, Completeness, Baire's theorem, Continuous mappings, Spaces of continuous functions, Euclidean and Unitary spaces. | **6 Hrs.** | CLO1 |
| 2. | **Topological Spaces:** Definition and examples, Elementary concepts, Bases and sub-bases, Weak topologies and Function algebra. | **10 Hrs.** | CLO2 |

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| | 3. | **Compactness:** Compact spaces, Product spaces, Tychonoff's theorem, Locally compact spaces and Compactness for metric spaces. | **10 Hrs.** | CLO3 |
| | 4. | **Separation:** $T_1$-spaces and Hausdorff spaces, completely regular spaces and Normal spaces. | **10 Hrs.** | CLO4 |
| | 5. | **Connectedness:** Connected spaces, locally connected spaces and Pathwise connectedness. | **6 Hrs.** | CLO5 |

***Alignment of CLOs VS PLOs***

**Mapping of Course Learning Outcomes (CLOs) to Program Learning Outcomes (PLOs)**

| PLOs/ CLOs | PLO1 | PLO2 | PLO3 | PLO4 | PLO5 | PLO6 | PLO7 | PLO8 | PLO9 | PLO10 | PLO11 | PLO12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CLO1 | ♦ | ♦ | ♦ | ♦ | - | ♦ | - | ♦ | ♦ | - | - | - |
| CLO2 | ♦ | ♦ | ♦ | ♦ | - | ♦ | ♦ | ♦ | ♦ | - | - | - |
| CLO3 | ♦ | ♦ | ♦ | ♦ | - | ♦ | - | ♦ | ♦ | - | - | - |
| CLO4 | ♦ | ♦ | ♦ | ♦ | - | ♦ | - | ♦ | ♦ | - | - | - |
| CLO5 | ♦ | ♦ | ♦ | ♦ | - | ♦ | - | ♦ | ♦ | - | - | - |

*♦: Aligned -: Not-aligned*

***Learning Materials***

**Recommended Readings:**


i. **Simmons G.F.,** Introduction to Topology and Modern Analysis, *Krieger Publishing Company*, 2003.

ii. **Willard S.,** General Topology, *Dover Publications*, 2004.

iii. **Chowdhury M. R., and Chowdhury F.,** Topology and Functional Analysis,

iv. **Woddor I.,** Elements of Functional Analysis, *Cambridge University Press*, 1989.

v. **Bradle T. D., Bryson T., and Terilla J.,** Topology: A Categorical Approach, *the MIT Press*, 2020.

vi. **Baker C. W.,** Introduction to Topology, *Krieger Pub. Co.*, 1996.

vii. **Singh T. B.,** Introduction to Topology, *Springer*, 2019.

viii. **Yang C.-N., Ge M.-L., and He Y.-E.,** Topology and Physics,*WSPC*,2018.


**Supplementary Readings:**


i. **Lipschutz S.,** General Topology, *Schaum's Outline Series*, 2011.

ii. **Prasolov V. V.,** Intuitive Topology.*American Mathematical Society*, 1995.

iii. **Weeks J R.,** The Shape of Space, *2nd ed. Marcel Dekker*, 2002.

iv. **Moraleda R. R., Valous N., Xiong W., and Halama N.,** Computational Topology for Biomedical Image and Data Analysis: Theory and Applications, *CRC Press*, 2019.

v. **Khanna M. L.,** Functional Analysis,

vi. **Boules A. N,** Fundamental of Mathematical Analysis, *the Oxford University Press*, 2021.


***Teaching-Learning and Assessment Strategy***

**Mapping of Course Learning Outcomes (CLOs) with the Teaching-Learning & Assessment Strategy**

| CLOs | Teaching-Learning Strategy | Assessment Strategy |
|---|---|---|
| CLO1 | Lecturing and Student Activity | Quiz/ Homework (Formative) |
| CLO2 | Lecturing, Discussion and Student Activity | Midterm (Summative) |
| CLO3 | Lecturing, Discussion and Student Activity | Assignment (Formative) and Midterm (Summative) |
| CLO4 | Lecturing and Visual Presentation | Midterm and Final Exam (Summative) |
| CLO5 | Lecturing, Discussion and Student Activity | Presentation and Final Exam (Summative) |