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| **Course Code** | **Course Title** | **L** | **P** | **U** |
| MA557 | Topology | 4 | 0 | 4 |

**Objectives of the course :**

The aim of this course is to introduce topology, covering the topics of fundamental to modern analysis and geometry.

 **Objective 1 :** Students will learn the fundamentals of point-set topology.

 **Objective 2 :** Students will learn the fundamentals of separation axioms and algebraic topology.

 **Objective 3 :** Students will be learning some special topics which will be required to begin research.

**Course learning outcome:** Upon completion of this course, the student will be able to:

1. Understand basic terms and properties of Topology, such as its base and sub-base, discrete and indiscrete topology, finer and coarser topology etc.
2. Classify and explain open and closed sets, usual topology, upper limit topology, lower limit topology, limit points, convergence, perfect set, denseness, nowhere denseness, $F\_{σ}$ and $G\_{δ}$-sets etc.
3. Know how completeness, continuity and other notions are generalized from the real line to topology.
4. Recognize the difference between $T\_{i}$-spaces, also between regular space and normal space.
5. Illustrate the effect of topological properties on subspace.
6. To understand some concepts that will be required to start a research.

**Mapping of Course Outcome(s):**

|  |  |
| --- | --- |
| PO/CO | Program Outcomes |
| PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 |
| Course Outcomes | CO1 | S |  |  | L |  |  |  |
| CO2 | S |  |  | L |  |  | L |
| CO3 | M |  |  |  |  |  | L |
| CO4 | M |  |  | M |  | M |  |
| CO5 | M |  |  |  |  | M |  |
| CO6 | S |  |  | S |  |  |  |

L-Low, M-Medium, S-Strong

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| --- | --- | --- |
| **Text Books** | **T1** | R.Engelking, General Topology, Berlin: Heldermann, 1989. |
| **Reference books** | **R1** | R. Munkres, Topology, 2nd edition, Pearson. |

**Course Contents**

**Unit I :** Topological spaces –Open and closed sets, Interior and closure of a set, Limit point and derived set of a set, Boundary point and boundary of a set, G-delta sets and F-sigma sets. **(12 hours).**

**Unit II :** Base and subbase of a topological space, dense sets, Subspace of a topological space, Hereditary properties, Finite product of toplogical spaces. **(12 hours).**

**Unit III :** Separation axioms, connectedness and compactness. Metrizable spaces. 1st countability, 2nd countability. **(12 hours).**

**Unit IV :** Separability and Lindeloff property of a topological space–related theorems and examples, Sequence and its convergence in a topological space. **(12 hours).**

**Unit V :** Continuous map, Open and closed map on a topological space–examples. Homeomorphism and homeomorphic spaces –examples. Topological properties – examples. **(12 hours).**

**LECTURE-WISE PLAN**

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| --- | --- | --- | --- |
| **Lecture No.** | **Learning outcomes** | **Topics to be covered** | **Books** |
|  |  |  |  |
| 1 | Understand basic terms and properties of Topology, such as its base and sub-base, discrete and indiscrete topology, finer and coarser topology etc. | introduction | T1 |
| Discrete and indiscrete topology | T1 |
| Base, sub-base | T1 |
| 2 | Finer, coarser topology | T1 |
| 3 | Related theorems | T1 |
| 4 | Usual topology, upper and lower limit topology | T1 |
| 5 | Sub-base related theorems | T1 |
| 6 | Classify and explain open and closed sets, usual topology, upper limit topology, lower limit topology, limit points, convergence, perfect set, denseness, nowhere denseness, $F\_{σ}$ and $G\_{δ}$-sets etc. | Open set, interior,& their properties | T1 |
| 7 | Boundary and properties | T1 |
| 8 | Regular open, closed sets, denseness, no where dense sets | T1 |
| 9 | first category sets, second category sets and their properties | T1 |
| 10 | G-delta, F-sigma sets and their properties | T1 |
| Theorems related to G-delta, F-sigma sets. | T1 |
| 11 | Accumulation points and derived sets. | T1 |
|  12 | Perfect, dense in itself, isolated sets and properties. | T1 |
| 13 | Internal Exam | T1 |

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| **Lecture No.** | **Learning outcomes** | **Topics to be covered** | **Books** |
|  |  |  |  |
| 14 | Know how completeness, continuity and other notions are generalized from the real line to topology | Convergence | T1 |
| 15 | limit point and related theorems | T1 |
| 16 | convergence and limit points (examples) | T1 |
| 17 | open and closed mapping | T1 |
| 18 | Continuous mapping | T1 |
| 19 | Homomorphism | T1 |
| 20 | Subspace topology | T1 |
| 21-24 | Recognize the difference between $T\_{i}$-spaces, also between regular space and normal space | Separation Axioms (T0,T1) | T1 |
| 25-26 | Separation Axioms (T1,T2) | T1 |
| 27-28 | Sep. Axioms T3,T4 | T1 |
| 29-30 | theorems of T0 | T1 |
| 31-33 | theorems of T1 and T2 | T1 |
| 34 | Regular Space | T1 |
| 35 | Normal Space | T1 |
| 36 | internal exam | T1 |
| 37 | Illustrate the effect of topological properties on subspace | Subspace of T\_i spaces | T1 |
| 38 | To understand some concepts that will be required to start a research | compact space | T1 |
| 39 | countable spaces | T1 |
| 40 | Separability, separability-Theorem | T1 |
| 41 | Lindel\"ofness, product space | T1 |
| 42 | Net | T1 |
| 43 | filter | T1 |

**36: Evaluation Scheme :**

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| **Component** | **Duration** | **Marks** | **Remarks** |
| **Internal I** | 30 minutes | 15 | Closed Book |
| **Mid Term Examination** | 2 hours | 30 | Closed Book |
| **Internal II** | 30 minutes | 15 | Closed Book |
| **Comprehensive Examination** | 3 hours | 40 | Closed Book |

1. **Attendance Policy :** A student must normally maintain a minimum of **75% attendance** in the course without which he/she will be disqualified from appearing in the respective examination.
2. **Make-up Policy :**  A student, who misses any component of evolution for genuine reasons, must immediately approach the instructor with a request for make-up examination. **The decision of the instructor in all matters of make-up will be final.**
3. **Chamber Consultation Hours :** During the chamber consultation hours, the student can consult the respective faculty in his or her chamber without any prior appointment.