MATH-957 Algebraic Topology

Credit Hours: 3-0

Prerequisite: None

Course Objectives: The objective of this course is to introduce the basic concepts about homotopy and homotopy type, fundamental group and covering spaces to use in his/her research and in other areas like differential geometry, algebraic geometry, physics etc.

Core Contents: Connected spaces, Path connected spaces, Compact spaces, Homotopy equivalence, Path homotopy, Fundamental group, Induced homomorphism, Van Kampen's Theorem, Covering spaces, Singular homology, Homotopy invariance, Homology long exact sequence.

Detailed Course Contents: Topological spaces, Closure and interior points, Bases, Continuity, Homeomorphism, Compactness, Path connectedness, Connectedness, Relationship between connectedness and path connectedness, History of algebraic topology, Homotopy, Homotopy classes, Path homotopy, Fundamental group, Fundamental group of a circle, Induced homomorphism, Van Kampen's theorem, Covering space, Universal cover, Classification of Covering spaces, Deck transformation, Covering space action, Idea of Homology, Simplicial homology, Singular homology, Chain homotopy, Homotopy invariance of Homology, Exact sequence, Degree and Cellular homology, Application of homology in group.

Learning Outcomes: On successful completion of this course students will be able to:

- Understand the definitions of homotopy, homotopy equivalence, fundamental group.
- Understand methods to construct and classify covering spaces for known spaces, and for otherspaces whenever it is possible.
- Understand the relation between singular homology and fundamental group.
- Understand the homology of a group.

Textbooks:

Andrew H. Wallace, (AW) “An Introduction to Algebraic Topology”, Dover Publisher, (2007)Allen Hatcher, (AH) “Algebraic Topology”, Cambridge University Press, (2002)

Reference Books:

1. Joseph J. Rotman, “An Introduction to Algebraic Topology”, Springer, (1988)
2. J. Peter May, “A Concise Course in Algebraic Topology”, Chicago University Press, (1999)
3. R. Brown, “Topology and Groupoids”, Book Surge Publishing, (2006)

ASSESSMENT SYSTEM

Nature of assessment	Frequency	Weightage (%age)
Quizzes	Minimum 3	10-15
Assignments	-	5-10
Midterm	1	25-35
End Semester Examination	1	40-50
Project(s)	-	10-20

Weekly Breakdown		
Week	***Section***	***Topics***
1	(AW) 2.1-2.8	Definition of Topology, Open sets, Subspace, Limit and Closurepoints, Bases
2	3.1-3.2	Continuous Mapping, Homeomorphism, Compactness
3	3.3	Pathwise Connectedness and Related Results
4	3.4	Connectedness, Examples, Relationship between Connectedness andPathwise connectedness
5	4.1	History of Algebraic Topology, Homotopy and Results, Homotopy
6	4.2	Homotopy classes, Path Homotopy and Results
7	4.3-4.4	Fundamental Groups, Fundamental group of a Circle
8	(AH) 1.1.3	Induced Homomorphism and Results
9	**Mid Semester Exam**	

10	1.2.1, 1.2.2	Free Product of Groups, Van Kampen's theorem and Application
11	1.3.1, 1.3.2	Covering Spaces and Lifting Criterion, Universal Cover
12	1.3.3	Classification of Covering space, Deck Transformation and Groupactions
13	2.1.1, 2.1.2	Homology, Types of Homology, Simplicial Homology
14	2.1.3	Singular Homology, Chain Homotopy
15	2.1.4-2.1.5	Homotopy invariance of Homology, Exact Sequence
16	2.2.1-2.2.2,	Degree and Cellular homology, Homology of a group
17	-	Review
18	**End Semester Exam**	