MATH-946 Category Theory

Credit Hours: 3-0

Prerequisite: Fundamental knowledge of Topology & Algebra

Objectives and Goals: This course aims at introducing students to the concepts of categories, functors and natural transformations. On successful completion of this course, students will know categories, discrete objects, indiscrete objects, functors, properties of functors, natural transformations, products, co-products, equalizers, co-equalizers, pullbacks, pushouts, limits and co- limits.

Course Contents: Categories, morphisms, concrete categories, abstract categories, sections,retractions, isomorphism, monomorphisms, epimorphisms, initial objects, final objects and zero objects, functors, hom- functors, Properties of functors, natural transformations and natural isomorphisms, equalizer and coequalizer, products and coproducts, discrete and indiscrete objects, sources and sinks, pullbacks, pushouts, limit, co-limits.

Course Outcomes: Students are expected to understand:

- Categories, morphisms, abstract and concrete categories
- Sections, Retractions, Isomorphism, Mono and Epimorphism
- Initial, Final and Zero Objects
- Functors and Properties of Functors
- Natural transformations and Natural isomorphism
- Equalizer, Coequalizer, Product and Coproduct
- Discrete and Indiscrete objects
- Sources and Sinks
- Pullbacks and Pushouts
- Limits and Colimits

Text Books:

S. Awodey, “Category Theory”, Oxford University Press (2nd edition), 2010.

J. Adamek, H. Herrlich, and G. E. Strecker, “Abstract and Concrete Categories, The Joy of Cats",Dover Publications, 2009.

Reference Books:

1. G. Preuss, “Foundations of Topology”, Kluwer Academik Publisher, 2002.
2. S. Mac Lane, “Categories for working mathematicians”, Springer, 2nd Edition, 1997.
3. D. I. Spivak, “Category theory for the Sciences”, MIT press, 2013
4. M. Barr and C. Wells, “Category theory for Computing Science”, Prentice hall internationalUK, 1990

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	***Topics***
1	Sets, Classes and conglomerates categories, Morphisms
2	Concrete Categories, Abstract Categories
3	Section, Retractions, Monomorphisms
4	Epimorphisms and Isomorphisms
5	Functors, Hom-functors
6	Properties of functors
7	Initial objects, Final objects and Zero objects
8	Fixed morphisms, Zero morphisms and Point categories
9	**Mid Semester Exam**
10	Natural transformation, Natural isomorphisms
11	Discrete and Indiscrete objects
12	Equalizer, Coequalizer
13	Products and Coproducts

14	Pullbacks, Pushouts
15	Sources and Sinks
16	Limit, Co-limits,
17	Review
18	**End Semester Exam**