MATH-242 Real Analysis-I

Credit Hours: 3-0

Prerequisites: MATH-111 Calculus-I

Course Objectives: This is the first rigorous course in analysis and has a theoretical emphasis. It rigorously develops the fundamental ideas of calculus and is aimed to develop the students' ability to deal with abstract mathematics and mathematical proofs.

Core Contents: The Real Number System, Continuity and Limits, Basic Properties of Functionson R, Elementary Theory of Differentiation.

Detailed Course Contents: The Real Number System and Monotone sequences: Real Numbers, Natural Numbers and Sequences, Increasing sequence and its limits.

The Limits of a sequence: Continuity, Limits, One-Sided Limits, Limits at Infinity; Infinite Limits, Limits of Sequences.

Basic Properties of Functions on R: The Intermediate-Value Theorem, Least Upper Bound; Greatest Lower Bound, The Bolzano–Weierstrass Theorem, The Boundedness and Extreme- Value Theorems.

Uniform Continuity, The Cauchy Criterion, The Heine–Borel Theorem.

Differentiation: Local Properties: The Derivative in R, Differentiation formulas, Derivatives and local properties.

Differentiation: Global Properties: The Mean value theorem and its applications, Extension of mean value theorem.

Course outcomes: Students are expected

- To understand rigorously developed fundamental ideas of calculus
- To understand basic properties of functions of single variables, theory of differentiationand integration.

Text Book: Arthur Mattuck, Introduction to Analysis, 1999 Prentice Hall, New Jersey.

Reference Books: R. L. Brabenec: Introduction to Real Analysis, 1997, PWS Publishing Co.

1. E. D. Gaughan: Introduction to Analysis (5th edition), 1997, Brooks/Cole.
2. R. G. Bartle and D. R. Sherbert: Introduction to Real Analysis (3rd edition), 1999, JohnWiley & Sons.

Weekly Breakdown		
Week	***Section***	***Topics***
1	1.1, 1.2, 1.3	Real Numbers, Increasing sequences, Limit of increasing sequences
2	1.6	Decreasing sequences, Completeness property
3	3.1, 3.2, 3.3	Definition of limit, Uniqueness of limits, Infinite limits
4	3.4,3.6,3.7	Limit of a^n, Some limits involving integrals
5	5.1,5.2,5.3, 5.4,5.5	Limits of sums, products, and quotients, Comparison theorem, Location theorem, Sub sequences: Non-existence of limits
6	6.1,6.2.6.3, 6.4,6.5	Nested Intervals, Cluster points of sequences, The Bolzano–WeierstrassTheorem, Cauchy Sequences, Completeness property for sets
7	7.1,7.2,7.3	Series and sequences, Elementary convergence tests, The convergenceof series with negative terms
8	7.4,7.5,7.6	Convergence tests, The integral and asymptotic comparison test, series with alternating signs, Cauchy test
9	**Mid Semester Exam**	
10	11.1, 11.2, 11.3	Continuous functions, Limits of functions, Limit theorems for functions
11	11.4, 11.5	Limits and continuous functions, Continuity and sequences
12	12.1,12.2	The existence of zeros, Applications of Bolzano's theorem
13	13.1, 13.2	Compact Intervals, Bounded continuous functions
14	13.3, 13.5	Extremal points of continuous functions, Uniform continuoty
15	14.1,14.2, 14.3	The derivative, Differentiation formulas, Derivatives and local properties
16	15.1,15.2,	The mean value theorem, Applications of the mean value theorem,
17	15.3,15.4	Extension of mean value theorem, L'Hospital rule
18	**End Semester Exam**	