Real Analysis I

Programme(s) in which it is offered: B.Sc.B.Ed. Mathematics

Course Category: Core	**Schedule of Offering**: Even
Course Credit Structure: 4	**Course Code:** MTH1211
Total Number of Hours: 5	**Contact Hours Per Week:** 5
Lecture: 3, 3	**Tutorial:** 1, 2
Practical: 0, 0	**Medium of Instruction:** English
Date of Revision:	**Skill Focus:** Others
Short Name of the Course: Real Analysis I	**Course Stream** *(Only for Minor Courses)*:
Grading Method: Regular	**Repeatable:** Credit
Course Level: Beginner	

Course Description

This is a core course for B.Sc. B.Ed. Mathematics students. This course discusses the fundamental construct of real numbers and operations on them.

Course Introduction

This is an introductory course in Real analysis – study of real numbers and their properties. This course introduces the learners to topology of real line, sequences and series of real numbers, their convergence and divergence, and the theory of Riemann integration. This course discusses the fundamental construct of real numbers and operations on them.

Course Objective

The objectives of the course are:

1. To explore the topological aspects of real line
2. To discuss sequences and series of real numbers, and their convergence
3. To discuss the theory of Riemann integration
4. Provide the tools of mathematical analysis that are key to understand the construct and the functioning of real numbers and functions of real variables.

Course Outcome

At the end of the course students will be able to

1. Visualize the major topological aspects of the real line
2. Determine the convergence and divergence of a given sequence of reals
3. Determine the convergence and divergence of a given series of reals
4. Apply the basic axioms and theorems of analysis as tools to explore properties of real numbers
5. Apply the properties of Riemann integration in understanding the theory of general integration

PO-CO Mapping

<This should explain how the Course Outcomes (CO) are mapped with the Programme Outcomes (PO). All programmes to have two generic POs which can map to all minors/proficiency courses and foundation/self-immersion courses. Please tick the respective cells only; leave the other cells blank.>

PO-CO Mapping Matrix

CO/PO Mapping	PO1	PO2	PO3	PO4	PO5	PO6
CO1						
CO2						
CO3						
CO4						
CO5						

Prerequisites and other constraints

This course is offered to all students of B.Sc.B.Ed. Mathematics. There is no prerequisite course.

Pedagogy

The teaching-learning of the course is organized through lectures, problem-solving sessions and student presentations. Guided discovery approach and problem posing/solving approaches are the key strategies to be employed.

Suggested Reading:

1. Kumar & Kumaresan (2014). Real Analysis. CRC Press.
2. Tao (2006). Analysis I. Hindustan Book Agency.
3. Tao (2006). Analysis II. Hindustan Book Agency.
4. Bartle & Sherbert (2017). Introduction to Real Analysis. Wiley India.
5. Malik and Arora (2017). Mathematical Analysis. New Age International Pvt. Ltd.
6. Apostal (2002). Mathematical Analysis. Narosa.

Evaluation Pattern

Evaluation Matrix

	Component Type	**Weightage Percentage**	**Total Marks**	**Tentative Dates**	**Course Outcome Mapping**
Continuous Internal Assessment (CIA) Components*	Mid-semester exam	33% of CIA	50	Around 9th week	1, 2,
	Assignment	67% of CIA	30	End of each module	1, 2, 3, 4, 5
	Quizzes/ Problem Solving		10	Every two weeks	1, 2, 3, 4
	Presentations		10	End of two modules	1, 2, 3, 4, 5
	CIA Marks	30%	**100**		
ESE		70%	**100**	End of the semester	1, 2, 3, 4, 5

Module Sessions

Module 1: Topology of Real line (20 Hours)

The field axioms; Theorems on field properties, Order in **R**, Absolute value, Completeness, some important subsets, Intervals, uncountability of **R**. Neighbourhoods, Open Sets, Closed Sets, Limit points of a set, Closure of a set, Interior of a set, Compactness and Connectedness (Definition and Examples only).

Reading:

1. Kumar and Kumaresan
2. Bartle and Sherbert
3. Tao

Activities:

a. Quiz
b. Assignment

Module 2: Sequences of Real Numbers (17 Hours)

Introduction to sequences, Convergent sequences, Divergent sequences, Oscillatory sequences, Bounded sequences, Some important limit theorems, Cauchy sequences, Monotonic sequences, Sub-sequences, Cluster points of a sequence, Limit superior and Limit inferior of a sequence.

Reading:

1. Kumar and Kumaresan
2. Bartle and Sherbert
3. Apostol

Activities:

a. Quiz
b. Assignment
c. Presentation

Module 3: Series of Real Numbers (20 Hours)

Introduction to Infinite series, Sequence of partial sums of a series, Convergent series, Cauchy's general principle for convergence of a series, A necessary condition for convergence, Series of positive terms, A fundamental result for series of positive terms, Geometric series, Comparison test, Cauchy's nth root test, D' Alembert's Ratio test, Raabe's test (Statement Only) and Maclaurin's test (Statement Only).

Reading:

1. Kumar and Kumaresan

2. Bartle and Sherbert
3. Tao

Activities:

a. Quiz
b. Assignment

Module 4: Riemann Integration (18 Hours)

Riemann Integration: Upper and lower sums, Criterion for integrability, Integrability of continuous functions and monotonic functions, Fundamental theorem of Calculus, Change of variables, Integration by parts. First and Second Mean Value Theorems of Integral Calculus.

Reading:

1. Kumar and Kumaresan
2. Malik and Arora

Activities:

a. Quiz
b. Assignment
c. Presentation