

**Bachelors with Mathematics as Major**  
**4<sup>th</sup> Semester**

**MMT422J1: Mathematics/Applied Mathematics: Real Analysis-I**

**Credits: 3 THEORY + 1 TUTORIAL**

**Theory: 45 Hours & Tutorial: 15 Hours**

**Course Objectives:** To make students learn (i) basic concepts and properties of real numbers, (ii) the behavior of sequences and series in real system.

**Course Outcome:** After the completion of this course, students shall be able to (i) apply these concepts to determine convergence and divergence of real sequences and infinite series (ii) explore new ideas in mathematical and modern analysis.

**Theory: 3 Credits**

**Unit –I**

Real Numbers, Field and Order structure, Bounded and unbounded sets of real numbers, supremum and infimum (lub and glb), Order completeness of  $\mathbb{R}$ , Archimedean property, Rational and Irrational density theorems, Dedekind's property,  $\mathbb{R}$  as ordered field, Incompleteness of the set of rational numbers.

**Unit –II**

Sequences of real numbers, bounded sequences, Convergence of sequences, Limit points of sequences, subsequences, Bolzano-Weirstrass theorem, limit inferior and limit superior, Theorems on limit and convergence of sequences, Cauchy's criteria for convergence of sequences, Cauchy sequences, Bounded monotonic sequences, Nested Interval theorem.

**Unit –III**

Infinite Series: Convergence and Divergence of a series, Necessary Condition for Convergence of a series, Cauchy's Criteria for Convergence of a series, Geometric Series, Series of positive terms, Test for convergence: Comparison test, Cauchy's root test, D-Alembert's ratio test, Raabe's test.

**Tutorial: 1 credit**

**Unit –IV**

Open and Closed sets: Neighbourhood of a point, Interior of a set, Open sets, Problems based on limit point of a set, Bolzano-Weirstrass theorem property, Closed sets, Closure of a set and related results. Cardinality of a set, countable and uncountable sets, Countability of the set of Rational numbers and uncountability of reals, some simple related results.

**Books Recommended**

1. S. C. Malik and S. Arora, Mathematical Analysis, New Age International (P) Ltd, Publishers, 2005.
2. T. M. Apostol, Mathematical Analysis, Narosa Publications, 2002.
3. R. Goldberg, Methods of Real Analysis, Oxford IBM Publication, 1970
4. W. Rudin, Principles of Mathematical Analysis, McGraw Hill, Indian Edition, 2017