

**Bachelor of Arts/Science (Mathematics)**  
**3rd SEMESTER**  
**DISCIPLINE SPECIFIC COURSE (CORE-3)**  
**(& GENERIC ELECTIVE COURSE FOR HONOURS PROGRAMMES)**

**MM320: MATHEMATICS: REAL ANALYSIS**

**CREDITS: THEORY-4, TUTORIAL: 2**  
**THEORY: MAXIMUM MARKS: 60, MINIMUM MARKS: 24**

**Objectives:** The objective of this course is:

- i) To analyse the validity of the fundamental concepts and scope.
- ii) To apply the concepts in other branches of the subject.

**UNIT-1 (15 HOURS)**

Finite and infinite sets, countable and uncountable sets, countability of rationals, uncountability of reals, bounded sets, suprema and infima, completeness property of  $\mathbb{R}$ , Archimedean property of  $\mathbb{R}$ , Cluster points, Nested interval Theorem, Bolzano-Weierstrass theorem.

**UNIT-2 (15 HOURS)**

Sequences, types of sequences (bounded, unbounded, Cauchy, convergent, divergent, oscillatory sequences), Cauchy convergence criterion of sequences and related results, limit superior and limit inferior, Cauchy's theorem on limits, monotone sequences and their convergence.

**UNIT-3 (15 HOURS)**

Infinite series, convergence and divergence of an infinite series, Cauchy convergence criterion for series, positive term series, geometric series, comparison tests, Root test, Ratio test, Integral test, Raabe's test, Gauss's test, alternating series, Leibnitz's test, absolute and conditional convergence.

**UNIT-4 (15 HOURS)**

Riemann integration, lower and upper sums, refinement of a partition, behaviour of lower and upper sums under refinement, definition and existence of the Riemann integral, necessary and sufficient condition for  $\mathbb{R}$ -integrability of a bounded function,  $\mathbb{R}$ -integrability of sum, difference, product and quotient of two functions,  $\mathbb{R}$ -integrability of continuous, monotone and discontinuous functions (having finite number of discontinuity) in an interval, Mean Value Theorem for integrals.

**TUTORIALS (2 CREDITS: 30 HOURS)      Maximum Marks: 30 Minimum Marks: 12**

9. Tutorials based on Unit I & II - **1 credit**
10. Tutorials based on Unit III & IV - **1 credit**.

**Books recommended**

1. T.M.Apostol, *Calculus* (Vol I), John Wiley and Sons (Asia) P. Ltd., 2002.
2. R.G.Bartle and D.R. Sherbert, *Introduction to Real Analysis*, John Wiley and Sons (Asia) P. Ltd., 2000.
3. S.C Malik, *Mathematical Analysis*, Narosa publications.
4. K.A.Ross, *Elementary Analysis – The Theory of Calculus Series*- Undergraduate Texts in Mathematics, Springer Verlag 2003.