B.A. (2019 Pattern) (Semester - I)

Subject : Mathematics   Paper Code: 122B-I

Title of the Paper: Mathematics Paper II : Calculus – I

Unit 1: Real Numbers

1.1 The Algebriac and Order Properties of R:

Algebraic properties of R, Order properties of R, Well-Ordering Property of N.

Arithmetic mean-Geometric mean inequality, Bernoulli's inequality

(Revision: essential properties should be revised with illustrative examples)

1.2 Absolute Value and the Real Line:

Absolute value function and its properties, triangle inequality and its consequences, neighbourhood of a point on real line

1.3. The Completeness Property of R:

Definitions of Upper bound, Lower bound, supremum, infimum of subsets of R, completeness property of R

1.4 Applications of the Supremum Property:

Archimedean property and its consequences, The density theorem (without proof).

Unit 2. Sequences

2.1 Sequences and Their Limits:

Definition and examples of sequences of real numbers, Definition of limit of sequence and uniqueness of limit, Examples on limit of sequence

2.2 Limits Theorems:

Definition of bounded sequence, Every convergent sequence is bounded, Algebra of limits.

2.3 Monotone Sequences:

Definition and examples of monotone sequences, Monotone convergence theorem & examples.

2.4 Subsequences and Bolzano -Wierstrass Theorem:

Definition of subsequence and examples, Divergence criteria, Monotone Subsequence theorem (without proof), Bolzano -Wierstrass theorem (first proof).

Unit 3. Limits

3.1 Functions and their Graphs:

Functions, domain and range, graphs of functions, representing a function numerically, Vertical line test, Piecewise defined functions, increasing and decreasing functions, even and odd functions symmetry, common functions

3.2 Limits of Functions:

Definition of cluster point and examples, definition of limit of a function, sequential criterion for limits, divergence criteria

3.3 Limit Theorems:

Algebra of limits (proofs using sequential criterion), Squeeze theorem

3.4 Some extension of limit concepts:

One-sided limits, infinite limits (without proof)

Unit 4: Continuity

4.1 Continuous Functions:

Definition of continuous function at a point, sequential criterion for continuity, Divergence criterion, combination of continuous functions

4.2 Continuous Functions on Intervals:

Properties of continuous functions on an interval, Boundedness theorem (without proof), The minimum-maximum theorem (without proof), Location of root theorem (Without proof), Bolzano's intermediate value theorem. Continuous function maps closed bounded interval to closed bounded interval, Preservation of interval theorem.