



**SRI VENKATESWARA UNIVERSITY - TIRUPATI**  
**Syllabus for 4-Year UG Honors in B.Sc. (Mathematics) as Major**  
**in consonance with Curriculum framework**  
**(W.E.F. AY-2026-27)**

**COURSE STRUCTURE (for Semester III)**

| Year | Semester | Course | Title of the Course    | No. of Hrs /Week | No. of Credits |
|------|----------|--------|------------------------|------------------|----------------|
| II   | III      | 5      | Ring Theory            | 5                | 4              |
|      |          | 6      | Advanced Real Analysis | 5                | 4              |
|      |          | 7      | Theory of Matrices     | 5                | 4              |

### SEMESTER-III

## COURSE 6: ADVANCED REAL ANALYSIS

**Theory**

**Credits: 4**

**5 hrs/week**

### Course Objectives

This course is designed to:

1. Develop a deep understanding of infinite series with non-negative terms and apply various convergence tests.
2. Introduce the concepts of limits and continuity, including their behaviour at finite and infinite points.
3. Explore types of discontinuities and apply fundamental theorems related to continuous functions.
4. Understand differentiability and apply Mean Value Theorems in problem-solving.
5. Introduce Riemann integration and explore key properties and theorems of integrable functions.

### Course Outcomes

Upon successful completion of this course, students will be able to:

1. Apply convergence tests such as P-test, Cauchy's root test, D'Alembert's ratio test, and Leibnitz test to analyze series.
2. Understand and evaluate limits of real-valued functions, including one-sided and infinite limits, and solve problems involving indeterminate forms.
3. Demonstrate knowledge of continuity, identify types of discontinuities, and apply theorems like Heine's, Borel's, and Bolzano's in analysis.
4. Understand and analyze differentiability, distinguish it from continuity, and apply Rolle's, Lagrange's, and Cauchy's Mean Value Theorems.
5. Evaluate Riemann integrals, verify conditions for integrability, and apply the Fundamental Theorem of Calculus in integration problems.

## **Course Content**

### **Unit – 1**

Alternating Series – Leibnitz Test – Absolute and conditional convergence – Theorems and problems relating to them — Abel's test (Problems only)

### **Unit – 2**

Real valued Functions - Boundedness of a function - Monotone functions - Limit of a function - Algebra of limits -- Limits of some standard functions – forms – Infinite limits – Limits at infinity.

### **Unit – 3**

Continuity and discontinuity of a function and examples - Heine's theorem- Modulus of a continuous function is a continuous function - Borel's theorem- Every continuous function is bounded - Every continuous and bounded function defined on  $[a, b]$  attains its bounds -Bolzano's theorem - Bolzano's intermediate value theorem – Uniform continuity – Every continuous function on closed interval is uniformly continuous.

### **Unit - 4**

The derivability of a function at a point and on an interval - Derivability and continuity of a function - Darboux's theorem (statement only) - Mean value Theorems: Rolle's theorem, Lagrange's theorem, Cauchy's Mean value theorem – Problems

### **Unit – 5**

Riemann Integration – Upper and lower Riemann sums, and integrals - Riemann integrable functions - Necessary and sufficient condition for integrability – Continuous function on closed interval is integrable - Monotonic function on closed interval is integrable- Fundamental theorem of integral calculus – Problems.

### **Activities**

The activities include quizzes, assignments, seminars, and student presentations. Additional tasks involve mini projects, concept flowcharts, operator method charts, peer teaching, LMS-based quizzes, board work challenges, poster presentations, and visual aids like chalk talks to enhance learning and engagement.

### **Text Book**

An Introduction to Real Analysis by Robert G.Bartle and Donlad R. Sherbert, John Wiley and sons Pvt. Ltd

### **Reference Books**

1. Elements of Real Analysis by Shanthi Narayan and Dr. M.D. Raisinghania, S. Chand. & Company Pvt. Ltd., New Delhi.
2. Principles of Mathematical Analysis by Walter Rudin, McGraw-Hill Ltd.

# Model Question Paper

## SECTION – A

Answer any FIVE questions. Each question carries 3 marks.

5 × 3 = 15 Marks

1. State Abel's test for convergence.
2. Give an example of an alternating series that is conditionally convergent.
3. Define monotone function and give one increasing and one decreasing example.
4. Find the limit  $\lim_{x \rightarrow 1} \frac{(x^3-1)}{x-1}$
5. When is a function said to be discontinuous? Give an example.
6. State Borel's theorem on boundedness of continuous functions.
7. What is uniform continuity? Give an example of a uniformly continuous function.
8. If a function is differentiable, show that it is continuous.
9. State Darboux's theorem.
10. State the necessary and sufficient condition for Riemann integrability of a bounded function.

## SECTION – B

Answer ALL questions. Each question carries 12 marks.

5 × 12 = 60 Marks

11. (a) State and prove Leibnitz's test for alternating series.

OR

- (b) Apply Abel's test to determine the convergence of the series  $\sum_{n=1}^{\infty} \frac{(-1)^{n-1} \sin n}{n}$

12. (a) Evaluate: (i)  $\lim_{x \rightarrow \infty} \frac{2x^2+3x}{x^2+5}$  (ii)  $\lim_{x \rightarrow 0} (1+x)^{\frac{1}{x}}$  and discuss the concept of infinite limits.

**OR**

- (b) Discuss the existence of the following limits:

(i)  $\lim_{x \rightarrow 1} \frac{1 - \cos x}{x^2}$  (ii)  $\lim_{x \rightarrow \infty} \frac{(3x^3 + 5)}{(x^3 - 2x + 1)}$

13. (a) Prove that the modulus of a continuous function is continuous.

**OR**

- (b) State and prove that every continuous and bounded function defined on  $[a, b]$  attains its bounds.

14. (a) State and prove Rolle's Theorem. Give one example verifying it.

**OR**

- (b) State and prove the relation between differentiability and continuity of a function.

15. (a) Prove that every monotonic function on a closed interval is Riemann integrable.

**OR**

- (b) State and prove the Fundamental Theorem of Integral Calculus and solve one related problem.

**4- Year UG Honours, Major**  
**Syllabus**  
**(2026-27)**  
**Semester-III**

**Model Question Paper**

**Time : 3hrs**

**Marks:75**

**Part-A**

**Answer any Five Questions. Each Question carries 3 Marks.**

**5x3=15**

- 1.
- 2.
- 3.
- 4.
- 5.
- 6.
- 7.
- 8.
- 9.
- 10.

**Answer the following questions. Each question carries 12 Marks**

**5x12=60**

11. a) Unit-I  
(Or)  
b) Unit-I

12. a) Unit-II  
(Or)  
b) Unit-II

13. a) Unit-III  
(Or)  
b) Unit-III

14. a) Unit-IV  
(Or)  
b) Unit-IV

15. a) Unit-V  
(Or)  
b) Unit-V