



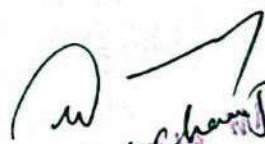
SRI VENKATESWARA UNIVERSITY - TIRUPATI
Syllabus for 4-Year UG Honors in B.Sc. (Mathematics) as Major
in consonance with Curriculum framework
w. e. f. AY 2025-26

COURSE STRUCTURE (for Semester I to VI)

Year	Semester	Course	Title of the Course	No. of Hrs /Week	No. of Credits
I	I	1 ✓	Differential Equations	5	4
		2 ✓	Solid Geometry	5	4
	II	3 ✓	Group Theory	5	4
		4 ✓	Elementary Real Analysis	5	4
II	III	5	Ring Theory	5	4
		6	Advanced Real Analysis	5	4
		7	Theory of Matrices	5	4
	IV	8	Linear algebra	5	4
		9 ✓	Vector Calculus	5	4
		10	Linear Programming Problems	5	4
III	V	11 ✓	Special Functions	5	4
		12 A ✓	Laplace Transforms	5	4
		OR			
		12 B ✓	Foundations of Automata Theory	5	4
		13 A ✓	Numerical Methods	5	4
		OR			
		13 B ✓	Mathematical Methods using MATLAB	5	4

Year	Semester	Course	Title of the Course	No. of Hrs /Week	No. of Credits
	VI				
		14 A ✓	Integral Transforms	5	4
		OR			
		14 B ✓	Statistical Analysis using R	5	4
		15 A	Advanced Numerical Methods	5	4
		OR			
		15 B	Mathematical Computations using Python	5	4

Note: In the III Year (during the V and VI Semesters), students are required to select a pair of electives from one of the **Two** specified domains. For example: if set 'A' is chosen, courses 12 to 15 to be chosen as 12 A, 13 A, 14 A and 15 A. To ensure in-depth understanding and skill development in the chosen domain, students must continue with the same domain electives in both the V and VI Semesters.


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SEMESTER-II

COURSE 4: ELEMENTARY REAL ANALYSIS

Theory

Credits: 4

5hrs/week

Course Objectives

This course designed

1. To develop a strong foundation in the real number system and its axiomatic structure.
2. To introduce the concepts of order, bounds, completeness, and related foundational properties of real numbers.
3. To explore the properties of sets in real analysis, including neighborhoods, limit points, open and closed sets.
4. To build analytical skills in handling sequences, convergence criteria, and monotonicity.
5. To understand the behavior of infinite series and apply standard convergence tests effectively.

Course Outcomes

After successful completion of this course, the student will be able to

1. Understand the real number system, its axioms, and properties, including completeness, supremum, and infimum.
2. Apply the Archimedean property, denseness, and concepts of neighborhoods, limit points, and derived sets in problem-solving.
3. Analyze sequences for boundedness and convergence using definitions and the Cauchy criterion.
4. Understand the concept of sub sequences, apply the Bolzano-Weierstrass theorem, and test convergence using Cauchy's general principle.
5. Determine the convergence of infinite series using various tests and solve related analytical problems.

Course Content

Unit – 1

Real number system - Field axioms – Properties of real numbers - Order axioms – Properties of Order relation - Principal of induction - Extended real number system – Modulus of a real number – Properties of modulus – Triangle property (**No question is to be set from these topics**)

Aggregates – Finite and infinite aggregates – Boundedness of an aggregate – Least upper bound (supremum) and greatest lower bound (infimum) of an aggregate – Properties of boundedness – Completeness axiom – Dedekind's theorem - Theorem on Dedekind's axiom and completeness axiom.

Unit – 2

Archimedean Property - It's corollaries – Integral part of a real number - Denseness of the real number system (**No question is to be set from these topics**)

Intervals – Neighbourhood of a point - Limit point of an aggregate – Derived Set - Bolzano - Weierstrass theorem – Interior point of a set - Open and closed Sets – It's properties (without proofs) - Countable and uncountable sets - Properties of countable sets.

Unit – 3

Sequences – Operations of sequences – Sub-sequences - Range and Boundedness of Sequences - Limit of a sequence and Convergent sequence – Divergent sequence – Uniqueness of a limit – Sandwich theorem on sequences - Monotone sequences – Problems

Unit – 4

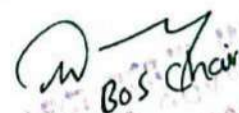
Limit Point of a Sequence – Bolzano - Weierstrass theorem on sub-sequences – Cauchy Sequences – Cauchy's general principle of convergence - Problems

Unit – 5

Infinite Series – Convergence and divergence of series - Cauchy's general principle of convergence for series (**Without proof**) – Series of non-negative terms - Convergence of geometric series – p - series test - comparison test – D'Alembert's ratio test – Cauchy's n^{th} root test – problems.

Activities

The activities include quizzes, assignments, seminars, and student presentations. Additional tasks involve mini projects, concept flowcharts, operator method charts, peer teaching, LMS-


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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 Donald 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.


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Model Question Paper
SRI VENKATESWARA UNIVERSITY - TIRUPATI
Course : 4, ELEMENTARY REAL ANALYSIS Max. Marks: 75

SECTION - I

I. Write any FIVE of the following. Each question carries 3 marks. $5 \times 3 = 15$ Marks

1. Define the least upper bound of a set and give an example.
2. State the Bolzano–Weierstrass theorem for sets in $\mathbb{R}$.
3. Define a Cauchy sequence and state why every convergent sequence in $\mathbb{R}$ is Cauchy.
4. State the ratio test for infinite series and give a brief criterion.
5. Define an infimum of a bounded set and show with an example how it differs from a minimum.
6. What is meant by a monotone increasing sequence? State a necessary condition for its convergence.
7. Define the derived set of an aggregate.
8. Define an open set in $\mathbb{R}$ and give one example and one non-example.
9. State the n th-root test for series of non-negative terms.
10. What is meant by a neighbourhood of a point in the real line?

SECTION - II

II. Answer ALL questions. Each question carries 12 marks. $5 \times 12 = 60$ Marks

11. A) Prove that every non-empty bounded above subset of the real numbers has a Supremum.

(OR)

- B) Let A be a non-empty set of real numbers which is bounded below. Define infimum and prove that $\inf A = -\sup\{-a : a \in A\}$.

12. A) State and prove Bolzano – Weierstrass theorem.

(OR)

- B) Let $E \subseteq \mathbb{R}$. Define interior point, open set and closed set. Prove that the complement of an open set is closed and give an example.

13. A). Let (x_n) be a sequence defined by $x_n = \frac{n}{(n+1)}$. Show that (x_n) is monotone increasing and bounded above. Find its limit.

(OR)

- B). Prove the sandwich (squeeze) theorem for sequences.
14. A). Prove that every Cauchy sequence in $\mathbb{R}$ is bounded. Then give an example of a Cauchy sequence which is not convergent in $\mathbb{Q}$ but convergent in $\mathbb{R}$.

(OR)

- B). Prove that a sequence converges if and only if every subsequence converges to the same limit. Then show that if a sequence has two different subsequential limits it cannot be convergent.
15. A). Consider the infinite series $\sum \frac{1}{2^n}$. Prove its convergence and compute its sum.
- Then apply the comparison test to show that $\sum \frac{1}{3^n}$ also converges.

(OR)

- B). State and prove D'Alembert's Ratio test.