



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 5: RING THEORY

Theory

Credits: 4

5 hrs/week

Course Objectives

1. The course aims to:
2. Introduce the fundamental concepts and properties of rings, fields, and integral domains.
3. Explain the structure and significance of subrings and ideals, including prime and maximal ideals.
4. Construct quotient rings and develop composition tables for finite rings.
5. Explore ring homomorphisms, isomorphisms, and apply the fundamental theorems of ring homomorphisms.
6. Study polynomial rings, including operations, division algorithm, irreducibility, and ideal structures.

Course Outcomes

1. Upon successful completion of this course, students will be able to:
2. Understand and differentiate between rings, integral domains, and fields, and describe their algebraic properties.
3. Identify and construct subrings and various types of ideals, and determine when a ring qualifies as a field.
4. Analyze quotient rings, build composition tables for finite rings, and distinguish between prime and maximal ideals.
5. Apply ring homomorphisms and isomorphisms effectively, and interpret the fundamental homomorphism theorems.
6. Solve problems involving polynomial rings over fields, including division algorithms, factorization, and irreducibility criteria.

Course Content

Unit – 1

Definition of a Ring and Examples – Basic properties – Commutative ring - Boolean ring – Zero Divisors of a ring - Cancellation Laws – Integral Domain – Division ring – Field - Idempotent and nilpotent elements in a ring and integral domain.

Unit – 2

The Characteristic of a Ring - The characteristics of integral domain, field, Boolean ring - Definition and examples of Subrings – Necessary and sufficient condition for a nonempty subset to be a subring – Algebra of Subrings – Ideals – Algebra of ideals – A commutative ring with unity and without proper ideals is a field.

Unit – 3

Principal ideal – Principal ideal ring: definition and theorems Cosets in ring structure - Quotient ring: definition, examples and theorems– Euclidean rings: definition, examples and theorems.

Unit– 4

Homomorphism of Rings – Definition and Elementary properties – Kernel of a homomorphism – Isomorphism – Fundamental theorem of homomorphism of rings – Maximal and prime Ideals.

Unit – 5

Polynomials over a ring – Algebra of polynomials –Degree of a polynomial and related problems -- The Division Algorithm in $F[x]$ – Remainder and Factor Theorems– Irreducible Polynomials – Ideal structure in $F[x]$ – Uniqueness of Factorization in $F[x]$.

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

Modern Algebra by A.R.Vasishta and A.K.Vasishta, Krishna Prakashan Media Pvt. Ltd.

Reference books

- 1.A First Course in Abstract Algebra by John. B. Farleigh, Narosa Publishing House.
- 2.Linear Algebra by Stephen. H. Friedberg and Others, Pearson Education India.

S.V UNIVERSITY, MODEL PAPER

THREE YEAR B.A./B.Sc. DEGREE EXAMINATIONS

III SEMESTER

Subject: MATHEMATICS

Paper: RING THEORY

Time: 3 Hours

Max Marks:75

SECTION-A

I. Answer any “Five” of the following questions

5X3=15M

- 1) Define a zero divisor in a ring and give an example of a ring with zero divisors.
- 2) Define an integral domain and give an example of an integral domain that is not a field.
- 3) Prove that a nonempty subset S of a ring R is a subring if and only if S is closed under subtraction and multiplication.
- 4) Define the characteristic of a ring and give examples of rings with different characteristics.
- 5) Define a principal ideal ring and give examples of principal ideal rings.
- 6) Prove that every principal ideal ring is a commutative ring with unity.
- 7) Define an isomorphism of rings and give examples of isomorphic rings.
- 8) Prove the fundamental theorem of homomorphism of rings.
- 9) Find the roots of the polynomial $x^2 + 2x + 1$ in Z_3 .
- 10) Prove that a polynomial $f(x)$ is irreducible over F if and only if $F[x]/(f(x))$ is a field.

SECTION-B

II. Answer any “Five” of the following questions

5X12=60M

11 a) Let R be a ring and $a, b \in R$. Prove that $(a + b)^2 = a^2 + ab + ba + b^2$.

(OR)

b) Show that the set of all 2×2 matrices with real entries, $M_2(R)$, is a non-commutative ring.

12 a) Let R be a ring with characteristic n . Prove that $na = 0$ for all $a \in R$.

(OR)

b) Show that the set of all even integers, $2\mathbb{Z}$, is a subring of $\mathbb{Z}$.

13 a) Let R be a principal ideal ring and I be an ideal of R . Prove that R/I is a principal ideal ring.

(OR)

b) Show that the set of all polynomials with integer coefficients, $\mathbb{Z}[x]$, is a principal ideal ring.

14 a) State and prove, first isomorphism theorem of rings.

(OR)

b) Show that every maximal ideal is prime, but the converse is not.

15 a) Let $f(x)$ and $g(x)$ be polynomials over a field F . Prove that $\deg(f(x)g(x)) = \deg(f(x)) + \deg(g(x))$.

(OR)

b) Show that the polynomial $x^2 + 1$ is irreducible over $\mathbb{R}$.

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