



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 IV)

Year	Semester	Course	Title of the Course	No. of Hrs /Week	No. of Credits
II	IV	8	Linear algebra	5	4
		9	Vector Calculus	5	4
		10	Linear Programming Problems	5	4

SEMESTER-IV

COURSE 8: LINEAR ALGEBRA

Theory

Credits: 4

5 hrs/week

Course Objectives

1. To introduce the fundamental concepts of vector spaces, subspaces, and their algebraic structure.
2. To develop an understanding of basis and dimension of vector spaces and their associated theorems.
3. To explore linear transformations and their properties, including rank, nullity, and the Rank-Nullity Theorem.
4. To apply the Cayley-Hamilton Theorem to compute powers and inverses of matrices without using direct methods.
5. To understand the structure of inner product spaces and study orthogonality and related geometric properties.

Course Outcomes

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

1. Understand and apply the definitions and properties of vector spaces, subspaces, linear combinations, and linear span.
2. Determine the basis and dimension of vector spaces and subspaces, and apply related theorems including those on quotient spaces.
3. Define linear transformations and operators, compute rank and nullity, and apply the Rank-Nullity Theorem.
4. Use the Cayley-Hamilton Theorem to verify matrix equations and to compute matrix inverses and higher powers.
5. Understand inner product spaces, verify orthogonality, and apply key inequalities such as Schwarz's and Triangle inequalities.

Course Content

Unit –1

Vector Spaces - General properties of vector spaces - n-dimensional Vectors - Addition and scalar multiplication of Vectors - Vector subspaces -Algebra of subspaces - Linear Sum of two subspaces - linear combination of Vectors- Linear Span - Linear independence and Linear dependence of Vectors.

Unit-2

Basis of a Vector space –Problems on basis of a vector space - Finite Dimensional Vector spaces - Basis existence theorem – Extension and uniqueness theorems and problems on them -Dimension of a Vector space - Dimension of a subspace.

Unit –3

Linear transformations - linear operators- Properties of L. T- Sum and product of L.Ts - Algebra of Linear Operators - Range and null space of linear transformation - Rank and Nullity of linear transformation - Rank- Nullity Theorem.

Unit –4

Cayley Hamilton Theorem– Verification Problems – Finding inverse using Cayley Hamilton Theorem - Inner product spaces- Euclidean and Unitary spaces- Norm or length of a Vector - Problems

Unit –5

Schwartz inequality- Triangle Inequality- Parallelogram law- Orthogonal and Orthonormal sets and problems on them – Gram Schmidt orthogonalization Process (only 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

Linear Algebra by J.N. Sharma and A.R. Vasishtha, published by Krishna Prakashan Media (P) Ltd.

Reference Books

1. Linear Algebra by Stephen H. Friedberg et. al. published by Prentice Hall of India Pvt. Ltd. 4th Edition, 2007
2. Linear Algebra by Kenneth Hoffman and Ray Kunze, published by Pearson education low priced edition), New Delhi.
3. Matrices by Shanti Narayana, published by S. Chand Publications

S.V UNIVERSITY, MODEL PAPER
THREE YEAR B.A/B.Sc DEGREE EXAMINATIONS
IV SEMESTER
Subject: MATHEMATICS
Paper: LINEAR ALGEBRA

Time: 3 Hours

Max.Marks:75

SECTION-A

I. Answer any "Five" of the following questions

5X3=15M

1. Let $V(F)$ is a vector space and W_1 and W_2 are two subspace of $V(F)$ then prove that $W_1 \cap W_2$ is a subspace of $V(F)$.
2. Examine the following vectors are linearly dependent or linearly independent
 $(1,2, -1,1), (2,1,0,3), (1,1,0,0)$.
3. Show that the vectors $(1,2,1) (2,1,0) (1,-1,2)$ form a basis of $\mathbb{R}^3$.
4. Find the coordinates of $(2i,3+4i,5i)$ w.r.t the basis $S= \{(1,0,0), (1,1,0), (1,1,1)\}$ of $C^3(C)$.
5. Let $T: U(F) \rightarrow V(F)$ be linear transformation. If U is finite dimensional then the range space $R(T)$ is a finite dimensional subspace of $V(F)$.
6. The mapping $T: V_3(\mathbb{R}) \rightarrow V_2(\mathbb{R})$ is defined by $T(x, y, z) = (x-y, x-z)$. Show that T is a linear transformation.
7. Let $V(F)$ be an inner product space and $\alpha \in V, \alpha \in F$, then prove that
i) $\|\alpha\| \geq 0$ and $\|\alpha\| = 0 \Leftrightarrow \alpha = \bar{0}$ ii) $\|a\alpha\| = |a| \|\alpha\|$.
8. If $\alpha = (2,1,1+i)$ is a vector in C^3 with standard inner product find $\|\alpha\|$ and unit Vector of α .
9. State and prove Triangle inequality in an inner product space $V(F)$.
10. Find a unit vector orthogonal to $(4,2,3)$ in $\mathbb{R}^3$.

SECTION-B

II. Answer any "Five" of the following questions

5X12=60M

- 11 a) Prove that a non-empty subset W of a vector space $V(F)$ is a subspace of V if $a \in F, \alpha, \beta \in W \Rightarrow a\alpha + \beta \in W$.

(OR)

b) If S and T are two subset of a vector space $V(F)$ then show that

$$L(S \cup T) = L(S) + L(T).$$

12 a) Prove that every finite dimensional vector space has atleast one basis.

(OR)

b) Let W_1 and W_2 are subspaces $V_4(R)$ generated by the sets

$$\{(1,1,0,-1), (1,2,3,0), (2,3,3,-1)\} \text{ and } \{(1,2,2,-2), (2,3,2,-3), (1,3,4,-3)\}$$

Respectively. Find the dimension of W_1 , W_2 , $W_1 \cap W_2$.

13 a) Show that the mapping $T: R^3 \rightarrow R^3$ defined by $T(x,y,z) = (x+2y-z, y+z, x+y-2z)$ is a

Linear transformation. Find its rank, nullity and verify $\text{rank } T + \text{nullity } T = \dim R^3$.

(OR)

b) Verify the Rank-nullity theorem for the linear map $T: V_4 \rightarrow V_3$ defined by $T(e_1) =$

$$f_1 + f_2 + f_3, T(e_2) = f_1 - f_2 + f_3, T(e_3) = f_1 + f_3 \text{ when } \{e_1, e_2, e_3\} \text{ and } \{f_1 + f_2 + f_3\} \text{ are}$$

standard basis V_4 and V_3 respectively.

14 a) If $A = \begin{bmatrix} 1 & -1 & 0 \\ 0 & 1 & 1 \\ 2 & 1 & 2 \end{bmatrix}$ verify Cayley- Hamilton theorem. Find also A .

(OR)

b) Show that the equations $x+2y-z=3$, $3x-y+2z=1$, $2x-2y+3z=2$, $x-y+z=-1$

are consistent and solve them.

15 a) Apply the Gram-Schmidt process to the vectors $(1,2,0)$, $(3,1,1)$, $(-2,1,4)$

to obtain an orthonormal basis for $V_3(R)$ with the standard inner product.

(OR)

b) Apply Gram Schmidt process obtain an orthonormal basis of R^3 from the

basis $\{(1, 0, 1), (1, 0, -1), (0, 3, 4)\}$.

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

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