



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 9: VECTOR CALCULUS

Credits: 4

5 hrs/week

Course Objectives

1. To introduce the concept of vector differentiation and the use of vector operators such as gradient, divergence, and curl.
2. To extend the concept of definite integrals to functions of multiple variables through double and triple integrals.
3. To apply double and triple integrals in evaluating areas and volumes in different coordinate systems.
4. To provide knowledge on evaluating line, surface, and volume integrals using vector calculus techniques.
5. To understand and apply major vector integration theorems like Gauss's Divergence Theorem, Green's Theorem, and Stokes's Theorem.

Course Outcomes

1. Understand and compute vector derivatives, including gradient, divergence, and curl, and apply vector identities in problem-solving.
2. Evaluate double integrals over various regions and use polar coordinates when appropriate.
3. Compute triple integrals in Cartesian and polar coordinates, and apply them to find volumes of solids.
4. Evaluate line, surface, and volume integrals using the appropriate vector calculus methods and geometric interpretations.
5. Apply Gauss's, Green's, and Stokes's theorems to relate different types of integrals and solve physical and geometrical problems.

Course Content

Unit – 1

Vector differentiation – ordinary derivatives of vectors – Differentiability – Gradient – Divergence – Curl operators – Relations involving the operators – Problems.

Unit – 2

Introduction to double integrals – Evaluation of double integrals – Properties of double integrals – Region of integration – Double integration in Polar Co-ordinates – Jacobian and change of variables.

Unit – 3

Triple integral – Region of integration – Change of variables – Evaluation of triple integrals both in Cartesian and polar coordinates – Jacobian and change of variables.

Unit – 4

Line Integrals with examples – Surface Integral with examples – Volume Integral with examples.

Unit – 5

Gauss theorem and applications of Gauss theorem – Green's theorem in the plane and applications of Green's theorem – Stokes's theorem and applications of Stokes theorem.

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

A Text Book of Higher Engineering Mathematics by B.S. Grewal, Khanna Publishers, 43rd Edition.

Reference Books

1. Vector Calculus by P.C. Matthews, Springer Verlag publications.
2. Vector Analysis by Murray Spiegel, Schaum Publishing Company, New York.

SRI VENKATESHWARA UNIVERSITY-TIRUPATI

B.Sc(Honours) -Mathematics (Major)

IV Semester

Course 9: VECTOR CALCULUS

Time: 3 Hours

Max. Marks: 75

SECTION – A

(Answer Any five questions)

Each question carries 3 marks

(5 × 3 = 15 Marks)

1. 1. Define Gradient, Divergence and Curl.
2. 2. Find the curl of the vector $F = (x^2yz) i + (xy^2z) j + (xyz^2) k$.
3. 3. State and explain the properties of double integrals.
4. 4. Evaluate $\iint_R (x + y) dA$, where R is the region bounded by $x = 0$, $y = 0$, and $x + y = 1$.
5. 5. Define triple integral and mention its applications.
6. 6. Evaluate $\iiint_V (x^2 + y^2 + z^2) dV$, where V is the region bounded by $x, y, z = 0$ and $x + y + z = 1$.
7. 7. Define Line, Surface, and Volume Integrals with examples.
8. 8. Evaluate $\int_C (x^2 + y^2) dx + (x + y^2) dy$, where C is the line joining $(0,0)$ to $(1,1)$.
9. 9. State Gauss's Divergence Theorem.
10. 10. State and prove Stokes's Theorem.

SECTION – B

(Answer any ONE question from each unit)

Each question carries 12 marks

(5 × 12 = 60 Marks)

- 11.(a) Show that $\nabla \cdot (\nabla \times A) = 0$ and $\nabla \times (\nabla \phi) = 0$.

(OR)

- (b) Find the gradient of $\phi = x^2y + y^2z + z^2x$ at the point $(1, -1, 2)$.

- 12.(a) Evaluate $\iint_R (x^2 + y^2) dA$, where R is bounded by $y = x$ and $y = x^2$.

(OR)

- (b) Evaluate $\iint_R y dx dy$, where R is bounded by $x = 0$, $y = 0$, $x + y = 1$ using change of variables.

- 13.(a) Evaluate $\iiint_V (x + y + z) dV$, where V is bounded by $x = 0$, $y = 0$, $z = 0$, and $x + y + z = 1$.

(OR)

(b) Transform $\iiint_V (x^2 + y^2 + z^2) dV$ to spherical coordinates and evaluate over a unit sphere.

14.(a) Evaluate $\iint_S \mathbf{F} \cdot \mathbf{n} dS$ for $\mathbf{F} = (x + y) \mathbf{i} + (y + z) \mathbf{j} + (z + x) \mathbf{k}$, where S is the surface of the cube bounded by $x, y, z = 0$ and 1 .

(OR)

(b) Evaluate the line integral $\int_C (x^2 + y^2) dx + (2xy) dy$ where C is from $(0,0)$ to $(1,1)$.

15.(a) Verify Green's Theorem for $\oint_C (x^2 - y^2) dx + 2xy dy$, where C is bounded by $x = 0$, $y = 0$, and $x + y = 1$.

(OR)

(b) Verify Gauss Divergence Theorem for $\mathbf{F} = x\mathbf{i} + y\mathbf{j} + z\mathbf{k}$ over the cube $0 \leq x, y, z \leq 1$.

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