

Sardar Patel University

B.Sc. (Semester-V) Examination Oct-2025 (NC) OLD COURSE

Paper Code: US05CPHY22

Paper Title: Mathematical Physics

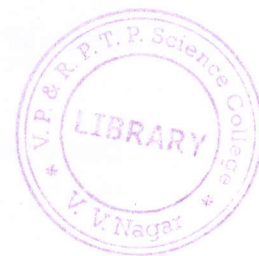
Date: 06/10/2025: Monday

Time: 10:00 AM to 1:00 PM

Maximum Marks: 70


Q-1 Multiple Choice Questions. (10)

1. A square matrix $A = [a_{ij}]$ is known as singular matrix if its determinant $|A| =$ _____.
 (a) 0 (b) 1
 (c) double (d) infinity
2. If $A^T = -A$ then A is called _____.
 (a) Unit Matrix (b) singular matrix
 (c) zero matrix (d) non-singular matrix
3. Matrices obtained by changing rows and columns are called _____.
 (a) rectangular matrix (b) transpose
 (c) symmetric (d) unit matrix
4. Transpose of a row matrix is _____.
 (a) row matrix (b) diagonal matrix
 (c) column matrix (d) zero matrix
5. The generating function of Bessel's equation is _____.
 (a) e^x (b) $e^{\frac{x}{2}(t-1/t)}$
 (c) $e^{\frac{x}{2}}$ (d) $e^{\frac{x}{2}}(t)$
6. $\frac{\partial^2 y}{\partial x^2} = a^2 \frac{\partial^2 y}{\partial x^2}$ is the equation of the _____.
 (a) Fourier equation of Heat flow (b) Diffusion equation
 (c) Thermal state (d) Transverse vibration of a string
7. Lagrange's interpolation formula is mainly used when the values are _____.
 (a) Unevenly (b) equal
 (c) same (d) ellipse
8. $Y = ax^2 + bx + c$ is an equation of _____.
 (a) straight line (b) hyperbola
 (c) parabola (d) ellipse
9. The forward difference operator Δ is defines as _____.
 (a) $\Delta y_i = y_{i+1}$ (b) $\Delta y_i = y_{i+2} - y_i$
 (c) $\Delta y_i = y_{i+1} - y_i$ (d) $\Delta y_i = y_{i-1}$
10. For a polynomial of degree 'n', the nth-order forward difference is _____.
 (a) Equal to zero (b) Constant
 (c) Zero, if the data is for a degree less than n (d) A function of x



[P.T.O.]

Q-2

Answer in short. (Any Ten)

1. Write 3 X 3 unit matrix and 3 X 3 null matrix.
2. Define unitary matrix and normal matrix.
3. Define curvilinear co-ordinates.
4. Show that $P_n(-\mu) = (-1)^n P_n(\mu)$.
5. Explain three dimensional diffusion equations.
6. Explain one dimensional wave equations.
7. Write down Hermite's diffusion equation.
8. Write Telegraphy equation.
9. Write any two application of Fourier series.
10. Write down successive four steps of power method.
11. Define: Interpolation.
12. Write down trapezoidal Rule.



Q-3

- (a) Discuss the cylindrical co-ordinates as a special curvilinear system.
- (b) Derive an expression of Curl in terms of curvilinear coordinates.

(05)

(05)

OR

- (a) Derive an expression of Divergence in terms of orthogonal curvilinear system.
- (b) Derive an expression of gradient in terms of orthogonal curvilinear co-ordinates.

(05)

(05)

Q-4

Derive the series solution of Bessel's differential equation in form of ascending power of x.

(10)

OR

Solve Hermite's differential equation. Discuss the orthogonal properties of Hermite's polynomial of first kind.

(10)

Q-5

- (a) Obtain the Fourier series for the expansion of $f(x) = x \sin x$ in the $(-\pi, \pi)$.
- (b) Write a note on application of Fourier series involving phase angles.

(05)

(05)

OR

- (a) Derive diffusion equation in terms of Fourier equation of heat flow.
- (b) Solve the one dimensional wave equation in terms of Fourier equations.

(05)

(05)

Q-6

- (a) Explain the least square method to fit a curve for a given data.
- (b) Derive Newton forward difference interpolation formula.

(05)

(05)

Q-6 (a)

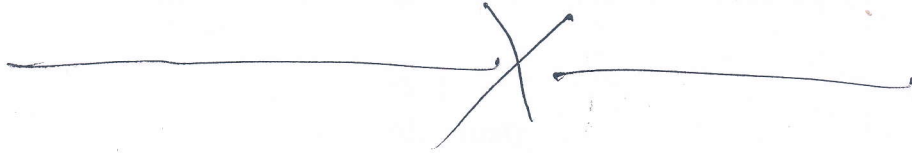
OR

Determine the Eigen values and Eigen vectors of the matrix $A = \begin{bmatrix} 3 & 1 & 4 \\ 0 & 2 & 6 \\ 0 & 0 & 5 \end{bmatrix}$ (05)

(b) Find all Eigen values and the corresponding Eigen vectors of the matrix

(05)

$A = \begin{bmatrix} 1 & \sqrt{2} & 2 \\ \sqrt{2} & 3 & \sqrt{2} \\ 2 & \sqrt{2} & 1 \end{bmatrix}$ by Jacobi's method.



(3)

