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Sardar Patel University, Vallabh Vidyanagar

SEAT No. _____

T. Y. B.Sc. Physics (5th Semester) Theory
US05CPHY52: Mathematical Methods

No. of Printed Pages : 2

Date: 6/10/2025

Time: 10:00 am to 1:00 pm

Total Marks: 70

(10)

Q-1 Multiple Choice Questions.

- 1 The curvilinear co-ordinate system will be orthogonal if the ----- of two perpendicular vector is zero.
(a) cross product (b) dot product (c) sum (d) none
- 2 Gamma of zero is -----.
(a) zero (b) infinity (c) one (d) none
- 3 To obtain Rodrigue's formula, we use ----- theorem.
(a) Newton's (b) Stoke's (c) Leibnitz's (d) Green's
- 4 $H_4(x) = \text{-----}$.
(a) $4x^2 - 2$ (b) $16x^4 - 48x^2 + 12$ (c) 1 (d) $8x^3 - 12x$
- 5 $P_3(\mu) = \text{-----}$.
(a) μ (b) $\frac{3\mu^2 - 1}{2}$ (c) $\frac{5\mu^3 - 3\mu}{2}$ (d) $\frac{5\mu^3}{2}$
- 6 Eigen value of the vibrating string is -----.
(a) $\lambda_n = \frac{n\pi c}{l}$ (b) $\lambda_n = \frac{n\pi l}{c}$ (c) $\lambda_n = \frac{n\pi h}{l}$ (d) $\lambda_n = \frac{n\pi l}{h}$
- 7 For steady state heat flow; three-dimensional Laplace's equation is -----.
(a) $\frac{\partial u}{\partial t} = \nabla^2 U$ (b) $\nabla U = 0$ (c) $\nabla^2 U = 0$ (d) none
- 8 $Y = ax^2 + bx + c$ is an equation of -----.
(a) parabola (b) straight line (c) logarithm] (d) exponential curve
- 9 First Backward Difference operator ∇ expressed as -----.
(a) $\nabla y_i = y_i - y_{i-1}$ (b) $\nabla y_i = y_{i+1} - y_i$ (c) $\nabla y_i = y_{i+1} + y_i$ (d) none
- 10 $E f(x) = f(x+h)$ is ----- operator's equation.
(a) shift (b) average (c) differential (d) none

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Q.2 Short answer questions (Attempt any ten)

- 1 Define Beta and Gamma function.
- 2 Find the relation of Beta and Gamma function.
- 3 State condition for orthogonality for orthogonal curvilinear co-ordinate.
- 4 State Bessel's differential equation and its solution.
- 5 State Hermite's differential equation and its solution.
- 6 Show that: $xJ_n'(x) = -nJ_n(x) + xJ_{n-1}(x)$.
- 7 Find a cosine series for $f(x)$ when $0 \leq x \leq n$.
- 8 Find a sine series for $f(x)$ when $0 \leq x \leq n$.
- 9 Give the physical interpretation of Fourier's series with reference to phase angle.
- 10 Find an equation of the form $y = ae^{bx}$.
- 11 Write Newton's forward and Backward difference formula for interpolation $f(x)$.
- 12 Write Newton- Cotes integration formula by using Lagrangian approximation.

(1)

[P.T.O.]

- Q-3(a) Obtain an expression of Curl in terms of orthogonal curvilinear co-ordinates. (05)
 (b) Obtain condition for orthogonality for orthogonal curvilinear co-ordinates. (05)

OR

- Q-3(c) Obtain an equivalent expressions: $\nabla\phi$, $\nabla.F$, $\nabla \times F$ for cylindrical co-ordinates as a special curvilinear system. (05)
 (d) Derive fundamental properties of Gamma function. (05)

- Q-4(a) Solve Legendre's differential equation of descending power. (05)
 (b) Discuss the orthogonal properties of Bessel's polynomial of first kind. (05)

OR

- Q-4(c) Define Hermite's Polynomials and deduce Rodrigue's formula. (05)
 (d) Obtain Recurrence formula for $H_n(x)$ by using Hermite equation and polynomial. (05)

- Q-5(a) Discuss complex representation of a Fourier's series and find cosine and sine series for $f(t)$ when $0 \leq t \leq \pi$. (05)
 (b) Give the physical interpretation of complex Fourier's series with reference to transvers vibration of strings. (05)

OR

- Q-5(c) Derive one dimensional diffusion equation in terms of Fourier's equation of heat flow when electricity is in a long insulated cable. (05)
 (d) Solve one dimensional wave equation in terms of Fourier's equation. (05)

- Q-6(a) Deduce Lagrange's interpolation formula. (05)
 (b) Explain the least square method to fit a curve for a given data. (05)

OR

- Q-6(c) Derive the Trapezoidal rule to evaluate the definite integral. (05)
 (d) Derive the Simpson's $\frac{1}{3}$ rule to evaluate the definite integral. (05)



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