KAMARAJ COLLEGE (Autonomous)

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THOOTHUKUDI – 628 003

(5 Pages) **Reg.No:……………………………………..**

Question. Code No : 25EO3306 **Sub Code : 24PMPH11**

PG DEGREE - END SEMESTER EXAMINATIONS – April 2025

First Semester

M.Sc. PHYSICS

Major-Mathematical Physics

(For those who joined in July 2024 onwards)

Time : 3 Hours **Maximum : 75 Marks**

PART – A (10 × 1 = 10 Marks)

Answer all questions
Choose the correct answer :

1. The curl of the vector field can be expressed as

   (a) Curl A (b) $\vec{\nabla} \times \vec{A}$

   (c) $\vec{\nabla} \cdot \vec{A}$ (d) $\vec{\nabla} \ \vec{A}$

2. The amount of flux diverging from a point per unit area per second is called

(a) Divergence of a vector field
(b) Divergence of a scalar field
(c) Curl of a vector field
(d) Curl of a scalar field

3. Analytic function is
(a) Single valued
(b) Bounded
(c) Differentiable
(d) None of these

4. Which of the following is an analytic function?
(a) F(z)=ReZ
(b) F(z)=Im(Z)
(c) Z
(d) F(z)=sinZ

5. If A=$\begin{bmatrix} 1 & 0 \\ 0 & i \end{bmatrix}$ then A^{-1} will be
(a) $\begin{bmatrix} i & 1 \\ 0 & i \end{bmatrix}$
(b) $\begin{bmatrix} i & 0 \\ 1 & 1 \end{bmatrix}$
(c) $\begin{bmatrix} 1 & 0 \\ 0 & -i \end{bmatrix}$
(d) $\begin{bmatrix} 1 & i \\ 0 & -i \end{bmatrix}$

6. From the following type of matrix, the diagonal elements of which matrix must be pure imaginary numbers or zero
(a) Skew Hermitian
(b) Symmetric
(c) Hermitian
(d) Skew symmetric

7. Laplace transform of e^{-at}
(a) $\frac{1}{1-s}$
(b) $\frac{1}{s}$
(c) $\frac{1}{s-a}$
(d) 1

8. Which of the following is a even function?

(a) X^3 (b) Sinx

(c) Tanx (d) Cosx and secx

9. The value of $J_{-1/2}(\frac{\pi}{2})$

(a) 0 (b) 1

(c) $\frac{\pi}{2}$ (d) 2

10. The Generating function of Hermite polynomial is

(a) e^{2zx-x^2} (b) e^{-zx-x^2}

(c) e^{-zx-x^2} (d) e^{zx-x^2}

PART – B (5 X 5 = 25 Marks)

Answer all questions choosing either (a) or (b).
Answer should not exceed 250 words.

11. (a) Check whether the vectors are linearly dependent or Independent [1,2,4], [1,0,0], [0,1,0][0,0,1]

(OR)

(b) Explain Schmidt's orthogonalization procedure.

12. (a) Check whether w= f(z)= Sinz is analytic or not.

(OR)

(b) Find the Laurent series function of F(z)=$\frac{1}{(1-z^2)}$ with centre at z=1.

13. (a) State and prove Cayley Hamilton theorem.

(OR)

(b) Find the Eigen values and Eigen vectors of the following

Matrix. $\begin{bmatrix} cos\theta & -sin\theta \\ sin\theta & cos\theta \end{bmatrix}$

14. (a) Give any two properties of Fourier transform.

(OR)

(b) Find the inverse Laplace transform of $\frac{1}{(s+1)(s^2+1)}$.

15. (a) Show that $\int_{-1}^{+1} P_{m(x)} P_{n(x)}$ dx=0

(OR)

(b) Show that $H_n(-x)= (-1)^n H_n(x)$.

PART – C (5 X 8 = 40 Marks)

Answer all questions choosing either (a) or (b).
Answer should not exceed 600 words.

16. (a) Find a unit vector perpendicular to the surface

$x^2+y^2 -z^2=11$ at the point(4,2,3).

(OR)

(b) What is linear vector space? Give any three examples of linear vector space.

17. (a) Derive Cauchy integral formula.

(OR)

(b) Find the residues of $\frac{Ze^{iz}}{z^4+a^4}$ at its poles.

18. (a) Find the eigen values and eigen vectors of the matrix

$$A=\begin{pmatrix} 1 & 0 & 0 \\ 0 & 1 & 1 \\ 0 & 1 & 1 \end{pmatrix}$$

(OR)

(b) Find the characteristic equation of the following matrix and verify Cayley- Hamilton's theorem.

$$\begin{pmatrix} 1 & 2 & 3 \\ 2 & -1 & 4 \\ 3 & 1 & 1 \end{pmatrix}$$

19. (a) Define Dirac delta function. Prove that x δ(x)=0, where δ(x) is dirac delta function.

(OR)

(b) Find the Laplace transform of $\frac{sinat}{t}$. Does the transform of $\frac{cosat}{t}$ exist?

20. (a) Derive the generating function of Hermite polynomial.

(OR)

(b) Obtain the power series solution of Legendre differential Equation.