KAMARAJ COLLEGE (Autonomous)

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THOOTHUKUDI – 628 003

5 Pages **Reg. No: ....**

Question. Code No : 24O0331 **Sub Code : 24PMPH11**

PG Degree - End Semester Examinations, November 2024

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. ∇ log r will be equal to

   (a) $\vec{r}$ (b) $\frac{\vec{r}}{r^3}$

   (c) $\frac{\vec{r}}{r^2}$ (d) $\frac{\vec{r}}{r^4}$

2. If a is a constant vector, then $\vec{r}$ x $\vec{a}$ is

(a) solenoidal (b) irrotational

(c) Both solenoidal and irrotational (d) Neither solenoidal nor irrotational

3. Taylor's series expansion of tanz about z=0 is

(a) $1-\frac{z}{3}-\frac{z^2}{18}+$---- (b) $1+\frac{z}{3}-\frac{z^2}{18}+$----

(c) $1+\frac{z}{3}+\frac{z^2}{18}+$----- (d) $1-\frac{z}{3}+\frac{z^2}{18}+$----

4. Analytic function is

(a) Single valued (b) bounded

(c) differentiable (d) All of these

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. Inverse of the matrix exists if

(a) Matrix is singular (b) Matrix is non-singular

(c) Matrix is Hermitian (d) Matrix is skew Hermitian

7. L{f(at)} will be equal to

(a) $\frac{1}{2}f(\frac{s}{a})$ (b) $\frac{1}{a}f(\frac{s}{a})$

(c) $\frac{1}{a}f(s)$ (d) $af(\frac{s}{a})$

8. The Laplace transform of sinh at, is if s>a

(a) $\frac{s^2-a^2}{a}$ (b) $\frac{a}{s^2-a^2}$

(c) $\frac{1}{s^2-a^2}$ (d) $\frac{a}{s^2+a^2}$

9. The value of $P_{2m+1}(0)$ is

(a) 0 (b) 1

(c) $\frac{\pi}{2}$ (d) None of above

10. $H_n(-x)$ will be equal to

(a) $(-1)^n H_n(x)$ (b) $H_n(x)$

(c) $-H_n(x)$ (d) Zero

PART B - (5X5=25Marks)

Answer ALL Questions choosing either (a) or (b).

(Answer should not exceed 250 words.)

11. (a) Define Bra and Ket notation.

(OR)

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

12. (a) Derive Cauchy's Integral formula

(OR)

(b) Find the residue of f(z) = $\frac{e^z}{z^2+a^2}$at it singularities

13. (a) Find the Eigen values and Eigen values of the Matrix

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

(OR)

(b) Find the rank of the matrix$\begin{bmatrix} 2 & 1 & -1 \\ 0 & 3 & -2 \\ 2 & 4 & -3 \end{bmatrix}$

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

(OR)

(b) Find the inverse Laplace Transform of $\frac{1}{\sqrt{(2s+5)}}$

15. (a) Prove that $H_n'(x)-2nH_{n-1}(x)$

(OR)

(b) Prove that $P_{2m+1}(0)=0$

PART C – (5 × 8 = 40 Marks)

Answer ALL Questions choosing either (a) or (b).

(Answer should not exceed 600 words.)

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

(OR)

(b) Check the following vectors are linearly dependent or independent (1,2,-3) (2,5,1) (-1,1.4)

17. (a) Check whether the following are analytic functions of complex variable.

i) f(z)= sinz ii) f(z)= R_ez

(OR)

(b) Define Isomorphic and homomorphic groups. Give any two properties.

18. (a) Find the characteristic equation of the following matrix and verify cayleyHamilton theorem.

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

(OR)

(b) Show that the

(i) All the eigen values of a Hermitian matrix are real and

(ii) The eigen vectors corresponding to distinct eigen values corresponding to distinct eigen values are orthogonal.

19. (a) Obtain Laplace transform of the function f(t)= sinh at sin at

(OR)

(b) Give the properties of Inverse Laplace transform.

20. (a) Derive the orthogonal property of Hermite polynomial

(OR)

(b) Give the orthogonal property of legendre polynomial

$$\int_{-1}^{+1} P_{m(x)}\, P_{n(x)}\, dx=0 \qquad \text{for } m\neq n$$

$$\int_{-1}^{1}[p_n(x)]^2 dx=\frac{2}{2n+1}$$