Roll No. .... Total Printed Pages - 9

F - 301

M.Sc. (First Semester)
EXAMINATION, Dec. - Jan., 2021-22
PHYSICS
Paper First
Mathematical Physics

Time : Three Hours] **[Maximum Marks : 80**

Note : Attempt all sections as directed.

Section - A

(Objective/Multiple Choice Questions)

(1 mark each)

Note: Attempt all questions.

Choose the correct answer.

1. In vector subspace·w, +, is with in -

   (A) (F, +, ·)

   (B) (V, +)

   (C) (F, +, · and V, +)

   (D) None of the above

2. The value of $(AB)^T$ is equal to -

   (A) $(A^T \cdot B^T)^T$

   (B) $(A^T \cdot B)$

   (C) $(A + B)^T$

   (D) $B^T \cdot A^T$

3. The value of $(A+B)^*$ is equal to -

   (A) $A^* + B^*$

   (B) $(A^* - B^*)^*$

   (C) $A^* \cdot B$

   (D) None of the above

4. The Eigen vectors of a Hermition matrix are -

   (A) Real

   (B) Imaginary

   (C) Complex

   (D) None of the above

5. The analytic function f(z) whose real part is $x^2 - y^2$ is:

   (A) Z

   (B) Z^2

   (C) Z^3

   (D) None of the above

6. The value of integral $\oint_c \dfrac{dz}{z-3}$ if C is the circle $|z-2|=5$ is -

(A) πi

(B) $2\pi i$

(C) 0

(D) 2π

7. If Z_1 and Z_2 are two complex numbers, the current relation is -

(A) $|Z_1 + Z_2| = |Z_1| \pm |Z_2|$

(B) $|Z_1 + Z_2| \geq |Z_1| - |Z_2|$

(C) $|Z_1 + Z_2| \leq |Z_1| + |Z_2|$

(D) $|Z_1 + Z_2| < |Z_1| + |Z_2|$

8. $\dfrac{d^2 y}{dx^2} + \left(\dfrac{dy}{dx}\right)^2 + ny = 0$ is a differential equation of order :

(A) First

(B) Second

(C) Third

(D) Zero

9. In a Fourier series for a continuous function b_n is :

(A) $b_n = \dfrac{1}{\pi} \int\limits_{-\pi}^{\pi} f(x)\sin nx\,dx$

(B) $b_n = \dfrac{1}{2\pi} \int\limits_{-\pi}^{\pi} f(x)\sin nx\,dx$

(C) $b_n = \pi \int\limits_{-\pi}^{\pi} f(x)\sin nx\,dx$

(D) $b_n = 2\pi \int\limits_{-\pi}^{\pi} f(x)\sin x\,dx$

10. Complementary function of differential equation is -

(A) $(C_1 + C_2 x)e^x$ (B) $(C_1 + C_2)xe^x$

(C) $(C_1 + C_2)e^x$ (D) None of the above

11. Which of the following represents Finite Fourier transform ?

(A) $f_s(n) = \int\limits_0^l F(x)\sin\left(\dfrac{\pi x}{L}\right).dx$

(B) $f_s(n) = \int\limits_0^l F(x)\sin\left(\dfrac{n\pi x}{L}\right)dx$

(C) $f_s(n) = \int\limits_0^l F(x)\sin\left(\dfrac{nx}{L}\right)dx$

(D) $f_s(n) = \int\limits_0^l F(x)\sin\left(\dfrac{x}{L}\right)dx$

12. Formula of Fourier Integral is -

(A) $f(x) = \dfrac{1}{\pi} \int\limits_{-\infty}^{\infty} f(t) \left[\int\limits_{-\infty}^{\infty} \sin u(x-t) du \right] dt$

(B) $f(x) = \dfrac{1}{2\pi} \int\limits_{-\infty}^{\infty} f(t) \left[\int\limits_{-\infty}^{\infty} \cos u(x-t) du \right] dt$

(C) $f(x) = \dfrac{1}{2\pi} \int\limits_{-\infty}^{\infty} f(t) \left[\int\limits_{-\infty}^{\infty} \cos u.x.du \right] dt$

(D) None of the above

13. Formula of Laplace Transform is -

(A) $f(s) = \int\limits_{0}^{\infty} e^{st} F(t) dt$

(B) $f(s) = \int\limits_{0}^{\infty} e^{-st} F(t) dt$

(C) $f(s) = \int\limits_{0}^{\infty} e^{-sta} F(t) dt$

(D) None of the above

14. Laplace transform of sin at is -

(A) $1/(s^2 + a^2)$

(B) $a/(s^2 + a^2)$

(C) a/s^2

(D) None of the above

15. Value of Laplace transform of $L\{e^{at} \cdot t^n\}$ is :

(A) $\dfrac{n!}{(s-a)^{n+1}}$

(B) $1/(s-a)^{n+1}$

(C) $n!/(s+a)^{n+1}$

(D) None of the above

16. The general solution of a linear differential equation with constant coefficient is equal to -

(A) CF + PI

(B) CF - PI

(C) CF $\times$ PI

(D) None of the above

17. Which of the following equation is linear differential equation?

(A) $dy/dx + y \cos x = \sin x$

(B) $d^4 y/dx^4 = [K + (y')^2]^{3/2}$

(C) $d^4 y/dx^4 = \cos\left(\dfrac{dy}{dx}\right)$

(D) None of the above

18. The vector (1,0,1), (0,1,1), (1,1,0) are -

(A) Linearly independent

(B) Linearly dependent

(C) Orthogonal

(D) None of the above

19. The product of two unitary matrices A and B is -

   (A)   Unitary

   (B)   Symmetric

   (C)   Anti symmetric

   (D)   Orthogonal

20. The value of magnitude of the integral:

$$\int_C \frac{dz}{Z} \quad \text{where } C \text{ is } |Z| = r \text{ is:}$$

   (A) $2\pi r$

   (B) 2π

   (C) π

   (D)   None of the above

Section - B

(Very Short Answer Type Questions)

(2 marks each)

Note: Attempt all questions.

1. Define inner product.

2. Define Eigen value.

3. Define Orthogonal Matrix.

4. Define Fourier Series.

5. State Orthogonal property of Laugerre palynomial.

6. What do you mean by Laplace transform?

7. What is significance of generating function?

8. What is Hermite Function?

F - 301   **P.T.O.**

Section - C

(Short Answer Type Questions)

(3 marks each)

Note: Attempt all questions.

1. Define a linear differential equation.

2. State Cauchy-Riemann condition for analyticity of complex variable in cartesian and polar co-ordinate.

3. Write Legendre equation of nth order.

4. Explain convolution theorem.

5. Explain vector subspaces.

6. Prove that, $P_n(x) = (-1)^n P_n(-x)$

7. What do you mean by order and degree of differential equation?

8. Explain Laplace Transform of Derivative.

Section - D

(Long Answer Type Questions)

(5 marks each)

Note: Attempt any four questions.

1. Apply the method of contour integration to evaluate.

$$\int_0^{2\pi} \frac{1}{5 - 4\sin\theta} \, d\theta$$

2. Show that: $(1 - 2xz + z^2)^{-\frac{1}{2}} = \sum_{0}^{\infty} z^n P_n(x)$.

F - 301

3. Find the solution of differential equation.

$$\frac{d^2 y}{dx^2} + 4.\frac{dy}{dx} + 4y = x^2, \quad \text{When } y(0) = 0 \text{ and } y'(0) = \tfrac{1}{2}$$

4. Find the Laplace transform of $F(t) = \int_{0}^{t} \frac{\sin u}{u} du$

5. The set of all ordered n tuples form a vector space with respect to addition of n tuples and multiplication of n tuples by an element of the field.