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(FOR THE CANDIDATES ADMITTED DURING THE ACADEMIC YEAR 2023 ONLY)

SUBJECT CODE 23PPS101

REG.NO.

N.G.M.COLLEGE (AUTONOMOUS) : POLLACHI

END-OF-SEMESTER EXAMINATIONS : NOVEMBER – 2023

M.Sc. – PHYSICS **MAXIMUM MARKS: 75**

SEMESTER - I **TIME : 3 HOURS**

MATHEMATICAL PHYSICS

SECTION – A (10 X 1 = 10 MARKS)

ANSWER THE FOLLOWING QUESTIONS.

MULTIPLE CHOICE QUESTIONS (k1)

1. The value of $P_n(1)$ is

   (a) 0 (b) 1 (c) -1 (d) (-1)n

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

   (a) z (b) z^2 (c) z/2 (d) z-2

3. The solution of Laplace's equation in spherical polar coordinates will involve

   (a) Legendre polynomial (b) Bessel polynomial

   (c) Hermite Polynomial (d) Laguerre polynomial

4. The Fourier transform of the function $f(x) = e^{-ax}$ is

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

5. Kronecker delta is

   (a) scalar (b) vector (c) tensor of rank 1 (d) tensor of rank 2

ANSWER THE FOLLOWING IN ONE (OR) TWO SENTENCES (K2)

6. Write the recurrence formula for Hermite polynomials.
7. What are the two types of singularities of an analytic function?
8. Write the Laplace differential equation?
9. State the linearity theorem of Fourier transform.
10. Define covariant vectors.

SECTION – B (5 X 5 = 25 MARKS)

ANSWER EITHER (a) OR (b) IN EACH OF THE FOLLOWING QUESTIONS. (K3)

11. a) Prove $nP_n = (2n-1)\, xP_{n-1} - (n-1)\, P_{n-1}$

(OR)

b) Show that $J_{1/2}(x) = \frac{\sqrt{2}}{\pi x \sin x}$

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12. a) State and prove Cauchy's integral theorem

(OR)

b) Find Laurent's series expansion of the function $f(z) = \frac{1}{(1-z)(2-z)}$ valid for $0 < |z-1| < 1$.

13. a) Derive the Fourier equation of heat flow.

(OR)

b) Solve the Laplace's differential equation $\nabla^2 V = 0$ in spherical polar coordinates and prove that $\int\int_s S_n S_m \, ds = 0$

14. a) Find the Fourier transform of $e^{-|t|}$.

(OR)

b) Obtain an expression for infinite Fourier sine and cosine transform.

15. a) Explain symmetric tensors.

(OR)

b) Discuss the evaluation of beta function

SECTION – C (5 X 8 = 40 MARKS)

ANSWER EITHER (a) OR (b) IN EACH OF THE FOLLOWING QUESTIONS.

(K4 (Or) K5)

16. a) Derive an expression for the generating function for the Legendre polynomial.

(OR)

b) Evaluate $J_{3/2}(x)$ and $J_{-3/2}(x)$.

17. a) State and Prove Cauchy's integral formula.

(OR)

b) Find the Taylor series expansion of a function of the complex variable $f(z) = 1/(z-1)(z-3)$ about the point z=4. Find its region of convergence.

18. a) Discuss the general solution of Laplace's equation in spherical polar coordinates.

(OR)

b) A long cylinder is made of two halves thermally insulated from each other, the upper half is at temperature T1 and the lower half at temperature T2, Find the steady state temperature inside the cylinder.

19. a) State and explain Parseval's theorem for Fourier transform.

(OR)

b) Find Fourier sine and cosine transform of $f(t) = e^{-pt}$, P>0.

20. a) Describe contravariant, covariant and mixed tensors.

(OR)

b) Find the relation between beta and gamma function. Discuss the transformation of gamma function.

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