

(FOR THE CANDIDATES ADMITTED IN
DURING THE ACADEMIC YEAR 2018 ONLY)

NO. OF PAGES : 2

18 PPS 101

REG No.

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

END-OF-SEMESTER EXAMINATIONS : JUNE – 2021

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.

- The variable z in Legendre's equation is cosine of polar angle in spherical polar coordinates _____.
a) $-1 < z < 1$ b) $1 < z < 1$ c) $-1 > z > 1$ d) $1 > z < 1$
- Which of the following is an analytic function?
a) $|Z|$ b) $\text{Re}(Z)$ c) Z^{-1} d) none of these
- The partial differential equation $\frac{\partial^2 u}{\partial t^2} - c^2 \frac{\partial^2 u}{\partial x^2} = 0$ is a _____.
a) Wave equation b) Heat equation c) Laplace equation d) Helmholtz equation
- The Fourier transform of the function $f(x) = x, |x| \leq a$, and 0, otherwise is _____.
a) $\sqrt{\frac{2}{\pi}}$ b) $\sqrt{\frac{2}{\pi\omega}}$ c) $\sqrt{\frac{\pi}{2}}$ d) None of these
- The value of $\Gamma(-n)$ is _____.
a) 0 b) 1 c) -1 d) ∞

SHORT ANSWERS.

- What is the value of the Bessel function $J_2(x)$?
- Write down the Cauchy Riemann equations in polar form.
- Write down the Laplace's equation in cylindrical coordinates.
- What is Fourier integral?
- What is Einstein's summation convention?

SECTION – B

(5 X 5 = 25 MARKS)

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

11. (a) Show that $\int_{-1}^{+1} x P_n(x) P_{n-1}(x) dx = \frac{2n}{4n^2-1}$

(OR)

(b) Prove the recurrence relation $2x H_n(x) = 2n H_{n-1}(x) + H_{n+1}(x)$

(CONTD2)

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

(OR)

(b) Evaluate the integral $\int_C \frac{4-3z}{z(z-1)(z-2)} dz$ where C is the circle $|z| = \frac{3}{2}$

13. (a) A neutral conducting sphere is placed in a uniform electric field. Find the new perturbed electrostatic potential.

(OR)

(b) Find the solution of heat flow equation by the method of separation of variables.

14. (a) Express the function $f(x) = e^{-kx}$ as a Fourier integral when $x > 0$ and $f(-x) = f(x)$, $k > 0$

(OR)

(b) Find finite Fourier sine transform of the function

$$f(x) = x^2; 0 < x < 4$$

15. (a) Construct a scalar from the tensor A_{kl}^{ij}

(OR)

(b) Derive the relation between beta and gamma functions.

SECTION – C

(4 X 10 = 40 MARKS)

ANSWER ANY FOUR QUESTIONS. (Q. No 16 IS COMPULSARY AND ANSWER ANY THREE QUESTIONS FROM Q. No 17 – 21)

16. Evaluate $\int_0^{2\pi} \frac{4}{5+4 \sin \theta} d\theta$ using calculus of residues.

17. Solve the Bessel's differential equation and obtain its most general solution.

18. (i) Determine the analytic function whose real part is $x^3 - 3xy^2 + 3x^2 - 3y^2 + 1$

(ii) Find the Laurent's series expansion of $f(z) = \frac{1}{(z+1)(z+3)}$ valid for $|z| < 1$

19. Obtain the solution of Laplace's equation in spherical polar coordinates.

20. Find Fourier transform of the function

$$f(x) = 1 - x^2; -1 < x < 1$$

$$= 0; |x| = 1$$

$$\text{and hence evaluate } \int_0^\infty \left(\frac{x \cos x - \sin x}{x^3} \right) \cos \frac{x}{2} dx$$

21. If A^μ is an arbitrary contravariant vector and $C_{\mu\nu} A^\mu A^\nu$ is an invariant then show that $(C_{\mu\nu} + C_{\nu\mu})$ is a covariant tensor of second order.
