

Reg. No.			,	

I Semester M.Sc. Degree Examination, March/April - 2025 PHYSICS

Mathematical Methods of Physics - I (CBCS New Scheme 2019-20 Onwards)

Paper: PHY 101

Time: 3 Hours

Maximum Marks: 70

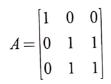
Answer all questions.

 $(3 \times 15 = 45)$

- 1. a) Verify Stoke's theorem for the vector field $A = (3x 2y)\hat{i} + x^2z\hat{j} + y^2(Z+1)\hat{k}$ for a plane rectangular area with vertices (0,0),(1,0),(1,2) and (0,2) in the X-Y plane.
 - b) Find the components of a vector $\vec{A} = 2y\hat{i} 3\hat{j} + 2z\hat{k}$ in cylindrical polar coordinate system. (10+5)

(OR)

2. a) Find the eigen values and eigen vectors of the matrix.





(OR)

- b) Show that the eigen vectors are orthogonal for unitary matrix. (10+5)
- 3. a) Find the general solution of Bessel's differential equation $x^2 \frac{d^2 y}{dx^2} + x \frac{dy}{dx} + \left(x^2 n^2\right) y = 0 \text{ as a power series method.}$
 - b) Using the generating function of Legendre polynomial, prove that $nP_n(x) = (2n-1)xP_{n-1}(x) (n-1)P_{n-2}(x)$ (10+5)
- 4. a) Show that the real and imaginary parts of the function log(z) satisfy the Cauchy-Riemann equations when z is not zero.
 - b) Determine the analytic function f(z) = u + iv where v = 6xy 5x + 3 (10+5)

P.T.O.

- 5. a) Find the Fourier integral of the function $f(x) = \begin{cases} 0 \text{ when } x < 0 \\ \frac{1}{2} \text{ when } x = 0 \\ e^{-x} \text{ when } x > 0 \end{cases}$
 - b) Find the Fourier transform of the Gaussian distribution function $f(x) = Ne^{-ax^2}$ where N and α are constants. (10+5)

(OR)

- 6. a) Obtain the Laplace transform of a second derivate and apply it to solve the harmonic oscillator equation, $m \frac{d^2 x(t)}{dt^2} + Kx(t) = 0$
 - b) State and prove Parseval's theorem.

(10+5)

7. Answer any Five of the following:

(5x5=25)

- a) Show that the product of orthogonal matrices is also orthogonal.
- b) Prove that the vectors (1, 2, -3), (2, 5, 1) and (-1, 1, 4) are linearly independent.
- c) Prove that the recurrence formula for Laguerre polynomial $(n+1)L_{n+1}(x) = (2n+1-x)L_n(x) nL_{n-1}(x)$
- d) Using Cauchy's integral theorem, evaluate the integral $\oint_c \frac{1}{z} dz$ where C is a simple closed curve.
- e) Find the Fourier series of the function e^x in the interval $-\pi < x < \pi$
- f) Find the inverse Laplace transform of $\frac{1}{S^2 + a^2}$