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LB—07—2023

FACULTY OF SCIENCE

M.Sc. (First Year) (First Semester) EXAMINATION

APRIL/MAY 2023

(NEW/CBCS PATTERN)

PHYSICS

Paper (PHY-101)

(Mathematical Methods in Physics)

(Wednesday, 3-05-2023) **Time : 10.00 a.m. to 1.00 p.m.**

Time— Three Hours *Maximum Marks*—75

N.B. :— (*i*) *All* questions are compulsory.

(*ii*) Each question carries equal mark.

(*iii*) Use of non-programmable calculator is allowed.

1. Explain different types of matrices and solve the following system of linear equation : 15

$$x + 3y - 2z = 0$$

$$2x - y + 4z = 0$$

$$x - 11y + 14z = 0$$

Or

(*a*) Find the eigen values and eigen vectors of the following matrix : 8

$$A = \begin{bmatrix} 1 & 1 & 3 \\ 1 & 5 & 1 \\ 3 & 1 & 1 \end{bmatrix}$$

(*b*) Describe Gram Schmidt's orthogonalization process. 7

P.T.O.

2. Explain orthogonality condition of Legendre's polynomial $P_n(x)$ and find the values of $P_0(x)$, $P_1(x)$, $P_2(x)$ and $P_3(x)$. 15

Or

(*a*) Obtain Rodrigues formula of $H_n(x)$? 8

(*b*) Show that : 7

(*i*) $(n + 1)P_{n+1}(x) = (2n + 1)xP_n(x) - nP_{n-1}(x)$

(*ii*) $nP_n(x) = xP_n'(x) - P_{n-1}'(x)$.

3. Define Laplace transform of '$F(t)$' and obtain the Laplace transform of : 15

(*i*) $F(t) = 1$

(*ii*) $F(t) = e^{at}$

(*iii*) $F(t) = \sin at$

(*iv*) $F(t) = \cos at$

(*v*) $F(t) = \cos^2 t$.

Or

(*a*) If $F(s)$ is the Fourier transform of $F(x)$, then show that : 8

$$F[F(x) \cos ax] = \frac{1}{2}[F(s+a) + F(s-a)]$$

(*b*) Using Laplace transform, find the solution of initial value problem : 7

$$y'' + 25y = 10 \cos 5t$$

$$y(0) = 2 \text{ and } y'(0) = 0$$

4. Show that if F(z) is analytic in and on the closed curve (c) and if (a) is any point on (c), then : 15

$$F(a) = \frac{1}{2\pi i}\int_c \frac{f(z)}{z-a}dz$$

and evaluate $\int_c \frac{2z^3+3z+5}{z-2}dz$, where c : $|z| = 3$.

Or

(a) Show that the function $u(x, y) = 2x - 2xy$ is harmonic and find its conjugate harmonic function ? 8

(b) If F(z) is analytic in a closed curve 'c' except at a finite number of poles within 'c', then $\int_c f(z)dz = 2\pi i$ [sum of Residues]. 7

5. Write short notes on (any *three*) : 3×5=15

(a) Rotation of a Matrix

(b) Harmonic function

(c) Properties of Fourier transform

(d) Rodrigues formula of Legendre polynomial.