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NEPWT—61—2024

FACULTY OF SCIENCE

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

NOVEMBER/DECEMBER, 2024

PHYSICS

Paper SPHYC-401

(Mathematical Methods in Physics)

(Thursday, 12-12-2024)

Time : 10.00 a.m. to 1.00 p.m.

Time—3 Hours

Maximum Marks—80

N.B. :— (1) *All questions carry equal marks.*

(2) Question No. 1 is compulsory.

(3) Solve any *three* of the remaining five questions (Q. No. 2 to Q. No. 6).

(4) Figures to the right indicate full marks.

1. Solve the following questions : 20

(a) Symmetric and skew-symmetric with suitable examples.

(b) Rodrigues formula and Laguerre's polynomial.

(c) Fourier series for discontinuous function.

(d) Complex function and relation between circular and hyperbolic function.

P.T.O.

2. (a) Discuss inverse of a matrix and find the inverse of the following matrix : 20

$$A = \begin{bmatrix} 1 & 2 & 3 \\ 1 & 2 & 1 \\ 2 & 1 & 3 \end{bmatrix}$$

- (b) Find the eigen values and eigen vectors of the following matrix :

$$A = \begin{bmatrix} 1 & 0 & 0 \\ 2 & 3 & 0 \\ 0 & 4 & 5 \end{bmatrix}$$

3. (a) Show that : 20

(i) $J_{\frac{1}{2}}(x) = \sqrt{\frac{2}{\pi x}} \sin x$

(ii) $J_{\frac{-1}{2}}(x) = \sqrt{\frac{2}{\pi x}} \cos x$

- (b) Obtain the orthogonality condition of Legendre polynomial.

4. (a) Define the Fourier series and Fourier coefficient and find the values of a_0 , a_n and b_n in the interval 0 to 2π . 20

- (b) Explain the change of scale property of Laplace transform and find the Laplace transform of :

(i) $f(t) = e^{at} \cosh bt$

(ii) $f(t) = e^{-at} \sinh bt$.

5. (a) Show that the sufficient condition for a function $f(z) = u + iv$ to be analytic at all points in the region 'R' are : 20

(i)
$$\frac{\partial u}{\partial x} = \frac{\partial v}{\partial y}$$

(ii)
$$\frac{\partial u}{\partial y} = -\frac{\partial v}{\partial x}$$

(iii)
$$\frac{\partial u}{\partial x}, \frac{\partial u}{\partial y}, \frac{\partial v}{\partial x}, \frac{\partial v}{\partial y}$$

are continuous functions of x and y in the region 'R'.

- (b) Show that the function $u(x, y) = \frac{1}{2} \log(x^2 + y^2)$ is harmonic and find its conjugate harmonic and also check the given function is analytic or not :

$$f(z) = \sin z.$$

6. Write short notes on : 20

- (a) Gram-Schmidt's orthogonalization process
- (b) Generating function of Bessel polynomial
- (c) Fourier complex integral
- (d) Types of singularity.