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NEPRT—16—2024

FACULTY OF SCIENCE

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

APRIL/MAY, 2024

PHYSICS

SPHYC–401

(Mathematical Methods in Physics)

(Friday, 19-4-2024) **Time : 10.00 a.m. to 1.00 p.m.**

Time—3 *Hours* *Maximum Marks*—80

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

(*ii*) Question No. **1** is compulsory.

(*iii*) Solve any *three* of the remaining five questions (Q. Nos. **2** to **6**).

(*iv*) Figures to the right indicate full marks.

1. Solve the following questions : 20

(*a*) Inverse of a matrix

(*b*) Recurrence relations of Legendre's polynomial

(*c*) First and second shifting properties of Laplace's transform

(*d*) Limit and continuity of a complex function.

P.T.O.

2. (*a*) Solve the following system of linear non-homogeneous equations : 20

$$x + y + z = 6$$

$$x - y + z = 2$$

$$2x + y - z = 1$$

(*b*) Let R^{3-} be the Euclidean inner product use the Gram-Schmidt's orthogonalization process to transform the vectors $u_1 = (1, 2, 1)$, $u_2 = (2, 1, 4)$ and $u_3 = (4, 5, 6)$ into orthogonal basis (v_1, v_2, v_3).

3. (*a*) Find the solution of differential equation of Legendre's polynomial : 20

$$(1 - x^2)y'' - 2xy' + n(n + 1)y = 0.$$

(*b*) Discuss the orthogonality condition of Bessel polynomial.

4. (*a*) Find the Fourier series of the given function : 20

$$f(x) = \pi - x, \quad 0 < x < \pi$$

(*b*) Explain the first and second shifting properties of inverse Laplace transform and find the inverse Laplace of the following :

(*i*) $\dfrac{1}{(S + 2)^5}$

(*ii*) $\dfrac{1}{9S^2 + 6S + 1}$.

5. (*a*) If $f(z)$ is analytic in a closed curve '*c*' except at a finite no. of poles within '*c*', then show that : 20

$$\int_c f(z)dz = 2\pi i \text{ [sum of residues at the poles in '}c\text{']}$$

(*b*) (*i*) Check whether the given function is analytic or not $f(z) = z^2$

(*ii*) Solve $\int_C \frac{z^2+1}{z^2(z-2)}\, dz$, where $c : |z| = 1$.

6. Write short notes on the following : 20

(*a*) Types of matrices

(*b*) Recurrence relation of Hermite polynomial

(*c*) Fourier complex integral

(*d*) Harmonic function.