

Roll No. ....

(12/24)

**15401**

**M.Sc. EXAMINATION**

(For Batch 2021 & Onwards)

(First Semester)

**PHYSICS**

M.Sc/PHY/1/CC1

Mathematical Physics

*Time : Three Hours*

*Maximum Marks : 70*

**Note :** Attempt *Five* questions in all, selecting *one* question from each Unit. Q. No. 1 is compulsory.

**(Compulsory Question)**

1. (a) Give some important applications of Laplace Transform.
- (b) Justify the word rotation used for the curl of a vector quantity.
- (c) Prove that :

$$H_{2n}(0) = (-1)^n 2^{2n} \left(\frac{1}{2}\right)^n$$

- (d) Determine whether  $1/z$  is analytic or not.
- (e) Write down the condition, when is a group said to be a Semi-group ?

5×2=10

**Unit I**

2. (a) Verify that  $A = \frac{1}{3} \begin{bmatrix} 1 & 2 & 2 \\ 2 & 1 & -2 \\ -2 & 2 & -1 \end{bmatrix}$  is orthogonal.

8

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- (b) Prove that every elementary row transformation of a matrix can be affected by pre-multiplication with the corresponding elementary matrix. 7
3. What is Laplace Transform ? Define its important formulae and prove each of them. 15

### Unit II

4. Define Legendre's polynomial  $P_n(x)$  and its second kind function  $Q_n(x)$ . Using these functions, express Rodrigue's formula and its solution. 15
5. (a) With the help of the Bessel function and its recurrence relation, Prove that : 5  

$$J_3(x) \neq 3J'_0(n) + 4J''_0(n)$$
- (b) Define the Laguerre's function and its orthogonal properties. 10

### Unit III

6. What is an analytic function ? State and prove the necessary and sufficient condition for  $f(z)$  to be analytic. 15
7. (a) Find the residue of  $\frac{z^3}{(z-1)^4(z-2)(z-3)}$  at a pole of order 4. 7
- (b) Use contour integration to evaluate the real integral : 8

$$\int_0^\infty \frac{dx}{(1+x^2)^3}.$$

### Unit IV

8. Explain with properties : 15
- (a) Rotational groups of SO (3)
- (b) Special unitary group SU (2).
9. Discuss in detail the elements of the group of the Schrödinger equation. Also, define the elementary Probability theorem. 15