 Roll No. ----------------

MPHY-501

Mathematical Physics

M.Sc. Physics (MSCPHY-20)

I^{st} Semester, Examination, June 2022

Time : 2 Hours Max. Marks : 40

Note : This paper is of Forty (40) marks divided into two (02) Sections A and B. Attempt the questions contained in these sections according to the detailed instructions given therein.

SECTION – A

(Long-answer – type questions)

Note : Section 'A' contains Five (05) long-answer-type questions of Ten (10) marks each. Learners are required to answer any Two (02) questions only.

(2×10=20)

1. (a) State and prove the orthogonality of Legendre's polynomials

   (b) Solve Bessel's differential equation

   $x^2 \frac{d^2y}{dx^2} + \frac{dy}{dx} + (x^2 - x^2)y = 0$ and determine its solution when x is an integer.

P.T.O.

2. (a) Find the Fourier transform of (x) = $\begin{cases} 1 - x^2 & x < 1 \\ O & x > 1 \end{cases}$

(b) Apply Laplace transform to solve:

$$\frac{d^2y}{dx^2} + y = 6 \text{ Cos} 2t$$

Given that :

$$Y = 3, \quad \frac{dy}{dx} = 1 \text{ When } t = 0$$

3. Find the Fourier cosine transformation of e^{-t^2} (Gaussian).

4. Find the solution of the Laplace's equation in Cartesian coordinate system.

5. Define the covariant and contravariant tensors and discuss the contraction and extension of the rank of tensors.

SECTION – B

(Short – answer – type questions)

Note : Section 'B' contains Eight (08) short – answer type questions of Five (5) marks each. Learners are required to answer any Four (04) questions only. (4×5 = 20)

P.T.O.

1. Show that :-

$Hn(-x) = (-1)^x \ Hn(x)$

2. Using Rodrigue's formula show that :

$$\int_{-1}^{+1} P_n(x)\,dx = 0 \ \text{f or} \ (n \neq 0)$$

3. Show that when n is a positive integer $J_n(x) = (-1)^n \ J_n(x)$

4. State and prove the frequency shifting property in Fourier transformation.

5. Explain the simple properties of Laplace transforms.

6. Explain summation convention and define Kronecker delta function.

7. Discuss chriostofell symbols with applications.

8. Show that the Fourier transform of Gaussian function is also Gaussian in the corresponding Fourier space.
