M.Sc. DEGREE EXAMINATION – APRIL 2022
PHYSICS
SECOND SEMESTER

COURSE   : MAJOR CORE
PAPER   : MATHEMATICAL PHYSICS - II
TIME   : 3 HOURS   MAX. MARKS: 100

SECTION A   **(10x3= 30)**

I. ANSWER ALL QUESTIONS

1. Find the Fourier transform of the Gaussian distribution function $f(x) = Ne^{-\alpha x^2}$ where N and α are constants.

2. Find the Laplace transform of $\cos at$.

3. Classify the Partial differential equation $\frac{\partial^2 u}{\partial t^2} + t\frac{\partial^2 u}{\partial x \partial t} + x\frac{\partial^2 u}{\partial x^2} + \partial\frac{\partial u}{\partial t} + \frac{\partial u}{\partial x} + 6u = 0$

4. Give examples of partial differential equations in physics.

5. Obtain the generating function of Hermite polynomial.

6. Find $L_n{}'(x)$.

7. Give an example of cyclic group with the generator i.

8. What are conjugate elements? How will you construct a class?

9. Write short notes on binomial distribution.

10. Bring out the fallacy, if any, in the following statement: The mean of binomial distribution is 5 and its standard deviation is 3.

SECTION – B   **(5x5= 25)**

II. ANSWER ANY FIVE QUESTIONS

11. Obtain the Laplace transform of Dirac delta function.

12. Solve the differential equation $\frac{dx}{dt} + \alpha x = 0$ by Laplace transform method subject to the initial condition that $x = x_0 \ at \ t = 0$.

13. Using the method of separation of variables, solve $\frac{\partial u}{\partial x} = 2\frac{\partial u}{\partial t} + u$ where $u(x,0) = 6e^{-3x}$

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14. Derive the Rodrigue's formula for Hermite polynomial.

15. State and prove the orthogonal property of Laguerre polynomial.

16. Construct a group multiplication table for Group D_3 and obtain the classes.

17. Arrive at an equation for Poisson's distribution.

SECTION – C (3x15= 45)

III.ANSWER ANY THREE QUESTION

18. Solve the differential equation with the help of Laplace transform

(i) $\frac{d^2y}{dx^2} + 2\frac{dy}{dx} + 5y = e^{-x}\sin x$ where $y(0) = 0$ and $y'(0) = 1$

(ii) $t\frac{d^2x}{dt^2} + \frac{dx}{dt} + 4tx = 0$ when $x(0) = 3$ and $x_1(0) = 0$

19. (i) Find the temperature in a bar of length 2 whose ends are kept at zero and lateral surface insulated, if the initial temperature is $sin\frac{\pi x}{2} + 3sin\frac{5\pi x}{2}$

(ii) Solve the equation $\frac{\partial u}{\partial t} = \frac{\partial^2 u}{\partial x^2}$ with the boundary conditions $u(x, 0), u(l, t) = 0$ where $0 < x < l$

20. Obtain the solution of Hermite differential equation.

21. Construct the character table of C_{4v} group symmetry.

22. Derive an equation for the normal distribution.

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