LOYOLA COLLEGE (AUTONOMOUS), CHENNAI – 600 034

M.Sc. DEGREE EXAMINATION – **PHYSICS**

SECOND SEMESTER – NOVEMBER 2016

PH 2815 - MATHEMATICAL PHYSICS - II

Date: 12-11-2016   Dept. No.   Max. : 100 Marks
Time: 01:00-04:00

PART A

Answer all questions   **10 x 2 = 20**

1. Find the Laplace transform of $[2e^{-3t}]$

2. Find $L^{-1}\left[\frac{s}{s^2+1}\right]$

3. Show that if $f(s)$ is the Fourier transform of $f(x)$, then $\frac{1}{b}f\left(\frac{s}{b}\right)$ is the Fourier transform of $F(bx)$

4. Sketch the graph for $y = \frac{\sin x}{x}$

5. Draw the graph for error function and complementary error function

6. Write the polynomials $L_2(x)$ and $L_3(x)$ where L stands for Laguerre polynomial

7. Identify the point groups present in the water and nitrogen trifluoride molecules.

8. Prove that every subgroup of an Abelian group is Abelian.

9. Write a note on Chi-square distribution.

10. Define the terms "equally likely events" and "sample space".

PART B

Answer any four questions   **4 x 7.5 =30**

11. An inductor of 25 H is in series with a resistance of 20 ohm and an emf of 240 volts. Assuming that at t=0, the current is zero, find the current at time t>0

12. Find the Fourier sine and cosine transform of $f(x) = 2e^{-5x} + 5e^{-2x}$

13. Derive the Recurrence relation $L_{n+1}(x) = (2n + 1 - x)L_n(x) - n^2 L_{n-1}(x)$ where L's stand for Laguerre polynomials.

14. Construct group multiplication table for C_{2v} point group.

15. A car hire firm has two cars which it hires out day by day. The number of demands for a car on each day is distributed as a Poisson distribution with mean 1.25. Calculate the number of days in a year on which (i) car is not used (ii) the number of days in a year on which some demand is refused.

16. a) Write the recurrence formula associated with Poisson distribution.

    b) If the variance of the Poisson distribution is 2, find the probabilities for $r = 1,2,3,4,5$ from the recurrence relation of the Poisson distribution. Also find $P(r \geq 5)$.

PART C

Answer any four questions $\qquad$ **4 x 12.5 = 50**

17. Find the Laplace transform of the rectangular wave given by $f(t) = \begin{cases} 3, & 0 < t < b \\ -3, & b < t < 2b \end{cases}$

18. Use Finite Fourier transform to solve the equation $\frac{\partial V}{\partial t} = \frac{\partial^2 V}{\partial x^2}, 0 < x < 9, t > 0$ and $V_x(0,t) = 0 = V_x(9,t), V(x,0) = 8x$

19. Derive the recurrence relations for Hermite polynomials. Show that the polynomials satisfy their own differential equations.

20. State and prove great orthogonality theorem.

21. i) In a normal distribution, 31% of the items are under 45 and 8% are over 64. Find the mean and standard deviation of the distribution.

    ii) The number of arrivals of customers during any day follows Poisson distribution with a mean value of 5. What is the probability that the total number of customers on two days selected at random is less than 2?

22. Using Frobenius power series method, solve Laguerre differential equation.

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