LOYOLA COLLEGE (AUTONOMOUS), CHENNAI – 600 034

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

SECOND SEMESTER – APRIL 2017

PH 2815- MATHEMATICAL PHYSICS - II

Date: 02-05-2017   Dept. No.   Max. : 100 Marks
01:00-04:00

PART A

Answer ALL questions: **10 x 2 = 20 marks**

1. Arrive at the Laplace transform of $f(x) = \left(\frac{\sin at}{t}\right)$

2. Find $L^{-1}\left(\frac{1}{s(s+3)}\right)$

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

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 $L_1(x)$ and $L_2(x)$ where L stands for Laguerre polynomial

7. Identify the point groups present in the molecules Toluene and 0-Dichlorobenzene

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

9. If a book of 600 pages contains 40 printing mistakes what is the probability that 10 pages selected at random will be free of errors, assuming number of errors per page has a Poisson distribution.

10. Define the terms mean and variance.

PART B

Answer ANY FOUR questions   **2x7.5=15 marks**

11. An inductor of 13 henrys is in series with a resistance of 30 ohm and an emf of 140 volts. Assuming when t=0, the current is zero, find the current at any time t>0.

12. Find the Fourier cosine transform of $f(x) = \begin{cases} \cos x, & 0 < x < a \\ 0, & x \geq a \end{cases}$

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_{4v} point group.

15. The probability that a man aged 60 will live to be 70 is 0.65, what is the probability that out of 10 men, at least 7 will live to be 70.

16. The probability that machine A will be performing an usual function in 5 years time is $\frac{1}{4}$, while the probability that machine B will still be operating usefully at the end of the period is $\frac{1}{3}$. Find the Probability in the following cases that in 5 years time:
    a. Both machines will be performing an usual function
    b. Neither will be operating
    c. Only machine B will be operating
    d. At least one of the machines will be operating

PART –C

Answer any FOUR questions: **4 x 12.5 = 50 marks**

17. Find the Laplace transform of the rectangular wave given by $f(t) = \begin{cases} 1, & 0 < t < b \\ -1, & b < t < 2b \end{cases}$

18. Using suitable Fourier transformation, Solve $\frac{\partial u}{\partial t} = 2\frac{\partial^2 u}{\partial x^2}$ if $u(x,t)$ is bounded and

$u(0,t) = 0; u(x,0) = e^{-x}$.

19. Derive the orthogonality relation for Hermite polynomials.

20. Establish the symmetry elements present in C_{3v} point group. Hence identify the classes present.

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

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

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

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