



LOYOLA COLLEGE (AUTONOMOUS), CHENNAI – 600 034

M.Sc. DEGREE EXAMINATION – PHYSICS

SECOND SEMESTER – APRIL 2016

PH 2815 - MATHEMATICAL PHYSICS - II

Date: 22-04-2016
Time: 01:00-04:00

Dept. No.

Max. : 100 Marks

PART A

Answer **ALL** questions:

10 x 2 = 20 marks

1. State Convolution theorem
2. State first shifting theorem
3. Sketch the graph of $f(x) = \frac{\sin ax}{x}$
4. Write the Fourier sine transformation and its inverse transformation rule.
5. Write any two recurrence relations of associated Laguerre polynomials.
6. Prove that $H_{2n}(0) = \frac{(-1)^n (2n)!}{n!}$
7. Identify the point group of i) water molecule and ii) methyl chloride
8. Show that every cyclic group is Abelian but converse is not true.
9. Define the terms exhaustive events and equally like events.
10. Find the probability of throwing i) 5 ii) an even number, with an ordinary six faced dice.

PART B

Answer **ANY FOUR** questions

4x7.5=30 marks

11. Define periodic function. Show that Laplace transform of a periodic function $f(t) = \frac{1}{1-e^{-sp}} \int_0^p e^{-st} f(t) dt$, where 'p' is the period.
12. Find the finite cosine transform of $\left(1 - \frac{x}{\pi}\right)^2$
13. Derive the recurrence relations of Hermite polynomials
 - a. $H_n'(x) = 2nH_{n-1}(x)$
 - b. $H_{n+1}(x) = 2xH_n(x) - 2nH_{n-1}(x)$
14. Construct group multiplication table for C_{4v} point group.
15. If the probability that an individual suffers a bad reaction from a certain injection is 0.001, determine the probability that out of 2000 individuals
 - i) exactly 3 individuals
 - ii) more than 3 individuals
 - iii) none, will suffer a bad reaction
16. Expand $f(x) = x^3$ in a series of Laguerre polynomials.

PART –C

Answer any **FOUR** questions:

4 x 12.5 = 50 marks

17. A mass m moves along the x -axis under the influence of a force which is proportional to its instantaneous speed and in a direction opposite to the direction of motion. Assuming that $t = 0$, the particle is located at $x = a$ and moving to the right with a speed V_0 . Find the position where the mass comes to rest.
18. Find the Fourier sine and cosine transform of $f(x) = x^2, 0 < x < 4$
19. Solve the Hermite's differential equation using Frobenius power series method.
20. What is Transformation matrix? Derive the transformation matrix for identity element and Plane of symmetry and for Axis of symmetry.
21. A student takes his examination in four subjects P, Q, R, S. He estimates his chances of passing in P as $\frac{4}{7}$, in Q as $\frac{3}{4}$, in R as $\frac{5}{9}$ and S as $\frac{1}{3}$. To qualify, he must pass in P and at least two other subjects. What is the probability that he qualifies?
22. A skilled typist, on routine work, kept a record of mistakes made per day during 300 working days.

| | | | | | | | |
|----------------|-----|----|----|----|---|---|---|
| Mistakes a day | 0 | 1 | 2 | 3 | 4 | 5 | 6 |
| No. of days | 143 | 90 | 42 | 12 | 9 | 3 | 1 |

Fit a Poisson distribution to the above data and hence calculate the theoretical frequencies.
