 LOYOLA COLLEGE (AUTONOMOUS), CHENNAI – 600 034

**M.Sc.** DEGREE EXAMINATION - **PHYSICS**

SECOND SEMESTER – **APRIL 2012**

# PH 2812 - MATHEMATICAL PHYSICS

Date : 21-04-2012 Dept. No. Max. : 100 Marks

Time : 9:00 - 12:00

**PART - A**

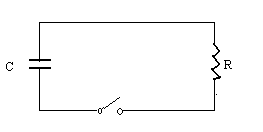
**Answer ALL questions: (10x2=20)**

1. Evaluate the complex line integral  around the closed loop C: **|**z**|** = 1.
2. Determine the residue at Z= 0 and at Z = I of the complex function f (z) = .
3. Define Dirac delta function . What is its Laplace transform?
4. Express the function f (t) = 2 if 0<t<π, f(t) = 0 if π<t<2π and f(t) = sin t if t >2π in terms of the unit step function.
5. What are the two possible initial conditions in the vibration of a rectangular membrane? Explain the symbols used
6. Solve .
7. Use the Rodrigue’s formula to evaluate the 3rd degree Legendre polynomial .
8. State the orthonormality property of the Hermite polynomials.
9. List the four properties that are required by a group multiplication.
10. What is irreducible representation of a group?

**PART – B**

**Answer any FOUR questions: (4x7.5 = 30)**

1. Verify the Cauchy’s integral theorem for the contour integral  for the contour C: the triangle with vertices at 0, 1, and 1+i.
2. A capacitor of capacitance C is charged so that its potential is V0. At t = 0 the switch in figure is closed and the capacitor starts to discharge through the resistor of resistance R. using the Laplace transformation, find the charge q(t) on the capacitor.



1. Use the method of separation of variables to solve the partial differential equation , where u( x,0) = 6 e-3x.
2. (a) Prove that J-n(x) = (-1)n Jn(x) if n is a positive integer where Jn(x) is the Bessel function of first kind.

(b) Determine the value of J -1/2(x). ( 4 ½ +3)

1. Work out the multiplication table of the symmetry group of the proper covering operations of a square. Write down all the subgroups and divide the group elements into classes. What are the allowed dimensionality of the representation matrices of the group?

**PART – C**

**Answer any FOUR questions: (4x12.5 =50)**

1. (a) Using the contour integration, evaluate the real integral, 

(b) Evaluate the following integral using Cauchy’s integral formula dz, where C is the circle |Z |= 3/2. ( 6 ½ + 6)

1. Find the Fourier transform of (i) f(x) = exp( -x2) and (ii) f(x) =1 – |x| if |x| <1 and f(x) = 0 for |x| >1

( 6 ½ + 6)

1. Solve the one- dimensional wave equation  by the separation of variable technique and the use of Fourier series. The boundary conditions are u(0,t) =0 and u(L,t) = 0 for all t and the initial conditions are u ( x,0) = f(x) and ∂u/∂t = g(x) at t =0. ( Assume that u (x,t) to represent the deflection of stretched string and the string is fixed at the ends x = 0 and x = L)
2. (a) Solve the Legendre differential equation (1 – x2)  – 2x  + n (n+1)y = 0 by the power series method.

(b) Establish the orthonormality relation where  is the Legendre polynomial of order n. ( 6 ½ + 6)

1. (a) Prove that any representation by matrices with non-vanishing determinants is equivalent to

a representation by unitary matrices.

(b) Enumerate and explain the symmetry elements of CO2, H2O and NH3 molecules. ( 6 ½ +6)

\*\*\*\*\*\*\*\*\*\*\*