M. Sc. DEGREE END SEMESTER EXAMINATION MAY - 2015
M. Sc. PHYSICS   SEMESTER – 2
COURSE: P2PHYT05 - MATHEMATICAL METHODS IN PHYSICS – II

Time 3 Hours   Max. Marks 75

PART A (Objective)

(Answer all questions. Each question carries 1 mark)

1. The function $\dfrac{1}{\sqrt{z-1}}$

   (a) Is analytic in the region $|z|< 2$ (b) has a pole at $z = 1$

   (c) Has a branch at $z = 1$ (d) has an essential singularity at $z = 1$

2. The Laplace transform of $e^{-at}(1\text{-at})$ is

   (a) $\dfrac{s}{(s+a)^2}$ (b) $\dfrac{a}{(s+a)^2}$ (c) $\dfrac{s}{(s-a)^2}$ (d) $\dfrac{a}{(s-a)^2}$

3. Using Fourier series, the value of $\displaystyle\sum_{n=1}^{\infty}\dfrac{1}{(2n-1)^2}$ is

   (a) ½   (b) $\pi^2/8$ (c) $\pi^2/6$ (d) $\pi^2/2$

4. Rank of SU(2) group is
   (a) 0   (b) 1   (c) 2   (d) 3

5. Initial conditions are – Kind of boundary conditions.
   (a) Cauchy's Boundary condition.   (b) Neumann boundary condition

   (c) Dirichlet boundary condition   (d) not a boundary condition.

                                                                                      (1 x 5 = 5)

PART B (short answer)

(Answer any 5 questions. Each question carries 2 marks)

6. Write the necessary conditions for a complex function to be analytic in the polar form.
7. Explain single valued and multiple valued complex functions.
8. What is the Laplace transform of sin (kt)?
9. What is Dirac's delta function? Give one application?
10. State the theorem of subgroups with one example.
11. Group with its order prime number is always cyclic. Why?
12. Define Lie group. How the order of a Lie group is is defined?
13. What are the various types of partial differential equations?

(PTO)

PART C (Problem/short essay)
Answer any 3 questions. Each question carries 4 marks)
14. Prove that the function $f(z) = z^2$ is analytic whereas $f(z) = z^*$ is not.

15. Study LCR circuit with Laplace transform method?
16. Write a note on three dimensional rotation groups.

17. Show that for a finite group every representation is equivalent to a unitary representation.
18. State and explain any four different differential equations that occur in Physics and the phenomena to which they are applied.
$$(4 \times 3 = 12)$$

PART D (Essay)

(Answer all questions. Each question carries 12 Marks)

19.   (a) Derive an expression for the Laurentz series expansion of a complex function.

Expand $\dfrac{z^2-1}{(z+2)(z+3)}$ as a Laurentz series about the contours

(i) $|z|<2$ (ii) $2<|z|<3$ (iii) $|z|>3$

OR

(b) State and prove Cauchy's residue theorem. Using contour integration method show that

(i) $\displaystyle\int_{-\infty}^{\infty} \dfrac{dx}{(1+x^2)^3} = \dfrac{3\pi}{8}$ (ii) $\displaystyle\int_{0}^{2\pi} \dfrac{d\theta}{2+cos\theta} = \dfrac{2\pi}{\sqrt{3}}$

20.   (a) Solve the differential equation for the transmission of electromagnetic waves in a
dispersive medium using Laplace transforms.
OR
(b) Obtain the Fourier transform of the output voltage of a full wave rectifier.

21.   (a) State and prove Schur's lemma II.
OR
(b) Discuss the irreducible representation of SU(2) group.

22. (a) Derive and solve two dimensional heat flow equation.

OR

(b) Discuss the general form of the Green's function for a self adjoint differential operator.

(12 x 4 = 48)

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