K24P 0867

Reg. No. : ....

Name : ....

II Semester M.Sc. Degree (C.B.S.S. – Supple. (One Time Mercy Chance)/ Imp.) Examination, April 2024
(2014 to 2022 Admissions)
PHYSICS
PHY 2C07 : Mathematical Physics – II

Time : 3 Hours Max. Marks : 60

SECTION – A

Answer **both** the questions (**Either a** or **b**).

1. a) i) Write down the Laplace equation in spherical polar coordinates and find its solution.

ii) Solve the following boundary value problem $\frac{\partial u}{\partial x} = 4\frac{\partial u}{\partial y}$, given $u(0, y) = 8e^{-3y}$, by the method of separation of variables.

OR

b) i) What is Geometric series ? Under what condition a geometric series is convergent, divergent or oscillatory ?

ii) State and explain any three methods for testing the convergence or divergence of a series.

2. a) i) State and prove Schur's lemmas for the irreducible representations of a group.

ii) Deduce the orthogonality theorem of the irreducible representation of a group.

OR

b) Write a short note on :

i) Special Unitary Group SU(2)

ii) Abelian Group

iii) Orthogonality theorem for characters

iv) Rearrangement theorem. **(2×12=24)**

P.T.O.

SECTION – B

Answer **any four** questions (**1** mark for Part **a**, **3** marks for Part **b**, **5** marks for Part **c**).

3. a) Show that the series 5 – 4 – 1 + 5 – 4 –1 + 5 – 4 – 1 +..........∞ is oscillatory.

   b) "The nature of an infinite series remains unaltered by addition or removal of finite number of terms". Justify.

   c) Apply D' Alembert's ratio test to show that the series

      i) $\frac{n^2}{2^n}$ converges and

      ii) $\frac{2^n}{n^3}$ diverges.

4. a) How many irreducible representations are possible for the C_{3V} point group.

   b) Illustrate the method of splitting partial differential equation into ordinary differential equations by taking Helmholtz equation as example.

   c) Solve the following equation $\frac{\partial^2 z}{\partial x^2} - 2\frac{\partial z}{\partial x} + \frac{\partial z}{\partial y} = 0$ by the method of separation of variables.

5. a) Write any one property of a Green's function.

   b) What is Green's function ? State and explain its symmetry property.

   c) Explain the solution of Poisson's equation $\nabla^2\phi = -\frac{\rho(r)}{\epsilon_0}$ using Green's function.

6. a) Define a Cyclic group.

   b) Show that three cube root of unity (1, ω, ω^2) where $\omega^3 = 1$, form an Abelian finite group under multiplication.

   c) "The symmetry transformations of an equilateral triangle form a group". Comment.

7. a) What is meant by self-reciprocal with respect to a Fourier Transform ?

b) Explain the convolution theorem on Fourier transform.

c) Find the Fourier transform of the function $f(x) = \begin{cases} l + \frac{x}{a}, & -a < x < 0 \\ l - \frac{x}{a}, & 0 < x < a \\ 0, & \text{otherwise} \end{cases}$.

8. a) Find the Laplace transform of e^{-at}.

b) Calculate the inverse Laplace transform of $F(s) = \frac{\log(s+a)}{\log(s+b)}$.

c) State and prove first and second shifting property of Laplace transform.

(4×9=36)