Progressive Education Society's
Modern College of Arts, Science & Commerce Ganeshkhind, Pune – 16
(Autonomous)
End Semester Examination: OCT / NOV 2024
Faculty: Science and Technology

Program: B.Sc. Code (Gen03)   **Semester: V**   **SET: A**
Program (Specific): General B.Sc.   **Course Type: Core course**
Class: T.Y.BSc (Gen)   **Max.Marks: 35**
Name of the Course: Mathematical Methods in Physics-II
Course Code: 24-PHY-351   **Time: 2Hr**
Paper: I

Instructions to the candidate:

1) *There are four sections in the question paper. Write each section on separate page.*
2) *All Sections are compulsory.*
3) *Figures to the right indicate full marks.*
4) *Draw a neat, labelled diagram wherever necessary.*

SECTION: A

Q1) Answer the following: **5**

     i)   Define metric coefficients.
    ii)   Define proper length.
   iii)   Define inertial frame of reference.
    iv)   What is an ordinary differential equation?
     v)   State the postulates of special theory of relativity.

Q2) Answer the following (Any four):   **4**

     i)   Write expression for Grad ψ.
    ii)   Write Galilean transformation equations.
   iii)   Write the relation between Cartesian co-ordinates and spherical polar co-ordinates.
    iv)   Draw a neat, labelled diagram of cylindrical co-ordinate system.
     v)   Write equation of generating function for Legendre polynomial.
    vi)   State order and degree of following differential equation $d^4y/dx^4 - \sqrt{y^2 - 5} = 0$.

SECTION: B

Q3) Answer the following (Any four):   **8**

     i)   What is the meaning of mass-energy equivalence?
    ii)   A meter stick is projected into space at so great a speed that the length appears contracted to only 75 cm. How fast is it going?
   iii)   What do you mean by special functions? State their importance in Physics.
    iv)   Explain the terms: linearity and homogeneity.
     v)   The rest mass of an electron is 9.1 x 10^{-31} kg. What would be its mass if it was moving with a speed 4/5th the speed of light?
    vi)   Draw a neat diagram for the volume element in cylindrical co-ordinate system.

SECTION: C

Q4) Answer the following (Any two):   8

     i)   Obtain the expression for gradient in curvilinear co-ordinate system.
     ii)   Obtain the expression for length contraction.
     iii)   Find the solution for one- dimensional wave equation using separation of variables.
     iv)   Explain singularity of differential equation at $x = x_o$. State Fuchs's theorem.

SECTION: D

Q5) Answer the following (Any two):   10

     i)   Show that the point $x = 0$ is regular singular point of the Lauguerre's differential equation $xy'' + (1-x)y' + \lambda y = 0$.
     ii)   Given points A ($x = 2$, $y = 3$, $z = -1$) and B ($r = 4$, $\theta = 25^o$, $\phi = 120^o$)
                     Find: (a) Spherical co-ordinates of A
                        (b) Cartesian co-ordinates of B.
     iii)   Describe Michelson Morely experiment and state physical significance of negative results.
     iv)   Show that $P_n'(1) = \frac{n\,(n+1)}{2}$ and prove that $np_n(x) = xP_n'(x) - nP_{n-1}'(x)$.

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