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PG CBCS
M.Sc. Semester-II Examination, 2021
PHYSICS
PAPER: PHS 201

Full Marks: 40 **Time: 2 Hour**

Write the answer for each unit in separate sheet

The figures in the right-hand margin indicate full marks.
Candidates are required to give their answers in their own words as far as practicable

201.1: Quantum Mechanics

Marks: 20

Answer any TWO questions of the following: **2x10=20**

1. A 2x2 matrix is defined by

   $U = (a_0 + i\,\sigma.a)/(a_0 + i\,\sigma.a)$

   where a_0 is a real number and a is a 3-dimensional with real components

   i) Prove that u is unitary and Unimodular.

   ii) If U represents a rotation in 3-dimension find the axis and angle of rotation.
2. Show that spin-orbit interaction is a consequence of the Dirac equation.
3. Consider a Spin 1 particle. Evaluate the matrix element of S_z (S_z +ħ) (S_z-ħ) and S_x (S_x +ħ) (S_x-ħ).
4. Set up the Dirac equation for free particle and obtain its solution.

201.2: METHODS OF MATHEMATICAL PHYSICS - II

Marks: 20

Answer any TWO questions of the following: **2x10=20**

1. The displacement of a damped harmonic oscillator as a function of time is given by

   $f(t) = 0$ for $t<0$

   $e^{-t/\tau} \sin \omega_0 t$ for $t>0$

   Were ω_0 and τ are positive real constants.

   Find out the fourier transform of the function.

(P.T.O.)

2. Find out the Green's function G(x,a). Corresponding to non- homogeneous differential equation

$$\frac{d^2y}{dx^2} - y = f(x)$$

Subjected to the Boundary condition

$$y(\pm\alpha) = 0.$$

3. The symmetry elements of a square ABCD form a group G={C_4^1, C_4^2, C_4^3, C_4^4, σ_x, σ_y, σ_{AC}, σ_{BD} }

Under multiplication, where C_4^1, C_4^2, C_4^3, C_4^4 are the rotational symmetry elements and σ_x, σ_y, σ_{AC}, σ_{BD} are reflection symmetry elements.

Find out the equivalents operation of the following

(a) $C_4^2\sigma_x$, (b) $C_4^3\sigma_y$, (c) $C_4^2\sigma_{AC}$, (d) $\sigma_{AC}\sigma_{BD}$

4. Discuss the steps for finding Reducible and Irreducible representation for a given molecular point group.

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