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PG CBCS
M.SC. Semester-I Examination, 2021
DEPARTMENT OF PHYSICS
PAPER: PHS 103
(ELECTRODYNAMICS &
MATERIALS PREPARATION & CHARACTERIZATION)

Full Marks: 40   **Time: 2 Hours**

<u>Write the answer for each unit in separate sheet</u>
<u>PHS 103.1 (ELECTRODYNAMICS)</u>

Answer any <u>TWO</u> questions of the following: **2X10=20**

1. a) Derive the invarience Maxwell field equation in terms of four vector.   (6)

   b) Derive the electric field and magnetic field in terms of **A** and ϕ.   (4)

2. a) Explain the covarience of Maxwell equation in tensor form.   (7)

   b) Proved that $C^2\mathbf{B}^2$-$\mathbf{E}^2$ and **E.B** is invarient in electromagnetic field.   (3)

3. a) Show that the equation of continuity is itself in the homogeneour pair of Maxwell field equation.   (5)

   b) Derive the lorentz force in covarient form.   (5)

4. a) Expalin the physical meaning of fourth component of force density four vector? (2)

   b)Derive the lorentz gauge condition using the Maxwell equation.   (6)

   c) Prove that the gauge is invarient under the electromagnetic field.   (2)

5. a) In an inertial frame S there is an electromagnetic field characterised by the field vector **E** and **B** with **E.B**$\neq$0. Find an inertial frame S' in which the field vector are parallel to each other.   (3)

   b) Find the equation of motion of charge 'e' and rest mass 'm' in a uniform static magnetic field **B** and also find the gyration frequency. Show that the trajectory of circle if the initial velocity of the particle is parpendicular to the direction of the field.   (5+2)

<u>PHS 103.2 (MATERIALS PREPARATION & CHARACTERIZATION)</u>

Answer any <u>TWO</u> questions of the following: **2X10=20**

1. Describe in details the symmetry elements associated with point group. Explain also the two new symmetry elements associated with space group. Show the stereogram and matrix representation of point group 222.   (4+4+2)

2. Derive the Laue equation considering the scattering of X-rays from a crystal. Express Laue equation also involving reciprocal lattice vector. (9+1)

3. Derive the dispersion relation for linear one dimensional diatomic lattice in vibration. Explain optical and acoustical branch. Also Find their frequency at k=0 and k=π/a. Assume nearest neighbour distance is a/2. (5+2+3)

4. Express structure factor in terms of fractional coordinate. Find the structure factor of FCC crystal and hence find the condition for systematic absence. Explain Debye Waller effect. (2+4+4)

5. Describe in details the essential features of Kronig Penney Model. E-k relation in a particular solid is given by $E = AK^2 + BK^3$, where A & B are positive constants. Find the wave vectors for which electron group velocity is zero. (8+2)

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