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PG (NEW) CBCS
M.Sc. Semester-I Examination, 2018
PHYSICS
PAPER: PHS-103

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

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.

PHS 103.1: ELECTRODYNAMICS

Marks: 20

1. **Attempt any <u>two</u> of the following**   **(2 × 2 = 4)**
   a. Show that charge is invariant but charge density is not invariant under Lorentz transformation.
   b. Show that the electromagnetic potentials form four vector.
   c. Show that **E.B** is invariant under L. T.
   d. What do you mean by electromagnetic field tensor $F_{\mu\vartheta}$?

2. a. i. What physical system is represented by the following scalar (φ) and vector potential (**A**)?

   Given $\varphi = 0$

   And $\mathbf{A(r, t)} = -(qt/4\pi\epsilon_0 r^3)\mathbf{r}$, use the gauge transformation function

   $\psi = -(qt/4\pi\varepsilon_0 r)$ to comment on the answer.   **(2)**

   ii. The regions of space z<0 and z>0 are filled with materials having permeability $2\mu_0$ and $5\mu_0$ respectively. The magnetic field in the region z > 0 is $\mathbf{B_2} = \mu_0 (75\ \mathbf{i} + 40\ \mathbf{k})$ Tesla and there is a surface current distribution **K** = - 10**j** A/m at z=0. Find the possible magnetic field in the region z<0.   **(2)**

   b. i. On the basis of Rayleigh Scattering explain why the colour of rising and setting Sun is crimson red.   **(2)**

   ii. Explain normal dispersion and anomalous dispersion by drawing the variation of refractive index.   **(2)**

   c. What are plasma parameters? Show that $\dfrac{D_i}{\mu_i} = \dfrac{kT_i}{e}$

   Notations have their usual meanings.   **(1+3)**

   d. Obtain the Maxwell equation in four vector form.   **(4)**

3. **Answer any one question.**

   a. Find the electric field and magnetic field from an oscillating electric dipole hence obtain the expression for power radiated by the dipole.   **(3+3+2)**

   b. Obtain the expression for the intensity of radiation coming from an accelerated charge particle with high velocity. Hence obtain the expression for Larmour's formula for non-relativistic case.   **(6+2)**

(Turn Over)
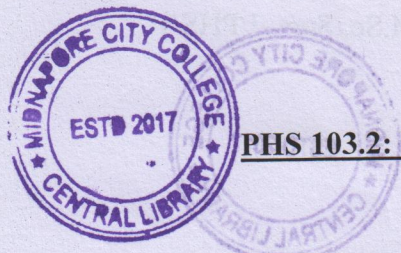
PHS 103.2: MATERIALS: PREPARATION AND CHARACTERIZATION

Marks: 20

1. Answer any two questions (2x2)

   a. Write advantage and disadvantage of neutron diffraction and X-ray diffraction.

   b. What is Molecular Beam Epitaxy (MBE)?

   c. What is nano-material? Why quantum effect is noticed in those materials?

   d. What is lithography? What are the different types of lithography?

2. Answer any two questions (4x2)

   a. Compare SEM and TEM. Also write down the working principle of AFM.

   b. Write short note on STM.

   c. Mention the advantage and disadvantage of sol-gel technique for the preparation of the films.

   d. What is reactive sputtering? RF sputtering is preferred for insulating targets – explain. (1+3)

3. Answer any one question (8)

   a. Describe the working principle of SEM with schematic diagram. What is the electron beam energy required for SEM? What are electron gun and FESEM? Write down the resolution of SEM. (4+1+2+1)

   b. i. What are the main differences between AFM and STM? (2)

     ii. How can you study the crystallographic structure by using X-ray diffraction method? (2)

     iii. What is photo luminiscence? Compare it with Raman scattering. (2)

     iv. How can you study phase change by thermal method? (2)

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