End-semester Examination (Remote mode) 2021

PH110: Waves and Electromagnetics

Time: 60 Minutes **Marks: 60**

- **All questions are compulsory and their marks is indicated in square bracket.**
- **<u>All questions needs to be answered sequentially</u> without fail. Non-compliance of instruction will invite deduction in marks.**
- **In case you feel any question/s is/are incorrect or have insufficient instruction then write in the answer book with your justification without wasting any time**
- **Submission Time: 10:30 AM -10:45 AM (Only PDF files, no other form of submission is allowed)**
- **Submission Link:** https://forms.gle/VZQnMNrHxZx1pH8Y8
- **File Name: 20205XYYY_Name_PHY110**

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1. **[6+9=15 Marks]**

(a) STATE THE DIFFERENTIAL FORM OF MAXWELL'S EQU^N FOR FREE SPACE AND CONDUCTORS. USING THE INTEGRAL FORM OF MAXWELL'S EQU^N, COMPARE THE BOUNDARY CONDITIONS FOR BOTH CASES.

(b) CONSIDER THE CHARGING OF A CAPACITOR GIVEN BELOW.

(i) FIND THE $\vec{E}$ and $\vec{B}$ in the gap as the function of time 't' and distance (s) from the axis.

(ii) Find the energy density and Poynting Vector in the gap.

(iii) Calculate total power flowing into the gap.

2. **[9+6=15 Marks]**

(a) THE MAGNITUDE OF $\vec{J}_b$ AND $\vec{K}_b$ DEPENDS ON ---------? DISCUSS THE AMPERE LAW IMPACT OF BOUND CURRENT ON AMPERE'S LAW?

(b) IMAGINE A UNIFORM MAGNETIC FIELD POINTING IN THE Z-DIRECTION AND FILLING ALL SPACE ($\vec{B} = B_0 \hat{z}$). A POSITIVE CHARGE ON REST, AT ORIGIN NOW, MAGNETIC FIELD IS TURNED OFF, THEREBY INDUCING ELECTRIC FIELD? IN WHAT DIRECTION DOES THE CHARGE MOVE?

3. **[8+7=15 Marks]**

(a) DISCUSS THE PHYSICAL SIGNIFICANCE OF EQUATION OF CONTINUITY. CONSIDER BOTH MAGNETOSTATIC AND ELECTRO-DYNAMIC SCENARIOS.

(b) WHAT DO YOU UNDERSTAND FROM MAGNETIC VECTOR POTENTIAL? SHOW THAT MAGNETIC FIELD OF A DIPOLE CAN BE WRITTEN IN CO-ORDINATE FREE FORM:

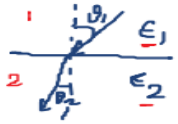
$$\vec{B}_{dip}(\vec{r}) = \frac{\mu_0}{4\pi}\frac{1}{r^3}\left[3(\vec{m}\cdot\hat{r})\hat{r} - \vec{m}\right].$$

Symbols have usual physical meaning.

4. **[10+5=15 Marks]**

(a) BOUND AND FREE CHARGES ARE NOT SAME. (TRUE/FALSE) JUSTIFY YOUR ANSWER. FURTHER, DISCUSS IMPACT OF BOUND CHARGES ON GAUSS LAW & BOUNDARY CONDITIONS.

(b) AT THE INTERFACE BETWEEN ONE LINEAR DIELECTRIC AND ANOTHER, THE ELECTRIC FIELD LINES BEND. SHOW THAT



$$\frac{\tan\theta_2}{\tan\theta_1} = \frac{\epsilon_2}{\epsilon_1}$$

WITH $\rho_f = 0$.

End