Mid-semester Examination (Remote mode) 2021

PH110: Waves and Electromagnetics

Time: 40 Minutes **Marks: 36**

- **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: 10:40 AM -11:00 AM (Only PDF files, no other form of submission is allowed)**
- **Submission Link:** https://forms.gle/A9h9BfXbSAL6XpUi7
- **File Name: 20205XYYY_Name_PHY110**

1.

(a) Show that $\vec{F} = yz\,\hat{x} + zx\,\hat{y} + xy\,\hat{z}$ can be expressed as the curl of a vector and as gradient of a scaler. Find the Scaler and Vector potentials for this function.

(b) Letus consider a function $\Theta(z) \equiv \begin{cases} 1, & \text{if } z > 0 \\ 0, & \text{if } z \leq 0 \end{cases}$. Show the first order derivative of $\Theta(z)$ is equal to $\delta(z)$.

[6+4=10 Marks]

2.

Let $\vec{F} = \frac{1}{4\pi\epsilon_0} \cdot \frac{q_1 q_2}{r^2}\left[1 + \frac{r}{\lambda}\right] e^{-r/\lambda}\,\hat{r}$ REPRESENTS THE FORCE OF ATTRACTION BETWEEN TWO POINT CHARGES AND 'λ' IS A CONSTANT.

(a) USING THIS, CALCULATE ELECTRIC FIELD OF A CHARGE DISTRIBUTION. DOES THIS FIELD ADMIT SCALAR POTENTIAL? EXPLAIN.

(b) WITH THIS MODIFIED FORCE FORM, DOES GAUSS LAW CHANGES? EXPLAIN YOUR ANSWER.

[5+5=10 Marks]

3.

A PURE DIPOLE 'p' IS SITUATED AT THE ORIGIN, POINTING IN THE Z-DIRECTION. (a) WHAT IS THE FORCE ON A POINT CHARGE "4q" AT (4,0,0) CARTESIAN COORDINATES? (b) WHAT IS THE FORCE ON "4q" at (0,0,4)? HOW MUCH WORK DOES IT TAKE TO MOVE "4q" FROM (4,0,0) TO (0,0,4)?

[6 Marks]

4.

(a) DISCUSS THE IMPACT OF ELECTRIC FIELD ON DIELECTRICS. DOES THE GAUSS'S LAW AND BOUNDARY CONDITIONS REMAIN SAME FOR CONDUCTOR AND DIELECTRIC?

(b) EXPRESS ATOMIC POLARIZIBILITY IN TERMS OF ELECTRICAL SUSCEPTIBILITY. JUSTIFY YOUR ANSWER.

[5*2=10 Marks]

End