Ahmedabad University

School of Arts and Sciences

Mathematical & Physical Sciences

PHY112 Electromagnetic Theory

Mid Semester Examination 2022-23 (Monsoon Semester)

BS Physics

Total Marks = 30 **Time – 2 hours**

Ahmedabad University Student ID: _AU_____

Date: 21-09-2022

Number of printed pages: 2

Main question paper

A. Short answer questions (8-10 lines) - attempt any 5 questions out of 6 in this section
Total marks for this section: 15 (3 marks per question)

i. Draw the schematic and write the expressions for the electric field, at an arbitrary point P: i) due to a point charge situated at the origin; and ii) due to a volume having a volume charge distribution ρ.

ii. Explain the divergent behavior of $\hat{r}/r^2$ at origin and elsewhere?

iii. Write any four characteristics of an ideal conductor.

iv. What are conditions which must be specified in order to uniquely determine a potential in a volume or electric field in a volume surrounded by conductors?

v. How does the potential and electric field vary with distance for a monopole, dipole, and quadrupole?

vi. Write the expressions for the electric field and potential inside and outside of a spherical shell, having radius R and a uniform surface charge.

B. Solve the following: (15 marks) – Marks are distributed for using correct equations, explanation of the symbols, units, step by step solution, and correct answer.

i. Three positive charges of magnitude $3*10^{-6}$, $2*10^{-6}$, and $2*10^{-6}$ coulombs, are located at three corners of an equilateral triangle with side 0.2 meters. Calculate the force on each charge. What will be the magnitude of the electric field at the centre of the triangle? **(2 + 3 marks)** $(1/4\pi\epsilon_0) \sim 9\times10^9$ Nm²/C ²

ii. A thin rod, with a linear charge density λ, is kept along the z-axis from z = a to z = - a. Calculate potential at a point A) P1 lying on the z-axis at (0, 0, 2a) and B) a general point P2 on the x-axis so that potential at P2 is equal to potential at P1. **(2 + 3 marks)**

iii. A single point charge Q is located a distance d from each of the xy, xz, and yz planes. These planes are made of metal and welded together at the intersections. Use method of images to find the magnitude and direction of force on Q. **(5 marks)**