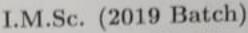
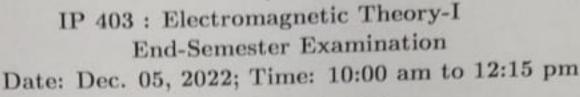
UNIVERSITY OF HYDERABAD

School of Physics





Total Marks: 45

Answer all the questions.

N.B.: Symbols have their usual meaning.

• 1. Starting from Coulomb's law show that the electric field satisfies $abla imes ec{E} = 0$ and $\nabla \cdot \vec{E} = \frac{\rho(\vec{r})}{\epsilon_0}$ for any arbitrary static charge distribution in the free space.

5 + 5

 2. Derive boundary conditions for the normal and transverse components of the electric field at the interface of two media as an application of Gauss's law for electrostatics.

3 + 2

 3. Find the formal solution of the electrostatic potential (φ(r̄)) to Poisson's equation $\nabla^2 \phi = -\frac{\rho(\vec{r})}{\epsilon_0}$ for the Dirichlet boundary conditions.

10

 4 A. Determine the dipole moment for the charge distribution with the charge density $ho(ec{r}') = q\delta(x')\delta(y')[\delta(z'-a)-2\delta(z')+\delta(z'+a)].$

B. Determine the quadrupole moment Q_{12} for the charge distribution with the charge density $ho(\vec{r}')=q\delta(x')\delta(y')[\delta(z'-a)-2\delta(z')+\delta(z'+a)].$

4 + 6

• 5 A. Consider the electrostatic potential due to an electric dipole as $\phi(\vec{r}) = \frac{1}{4\pi\epsilon_0} \frac{\vec{p} \cdot \vec{r}}{r^3}$. Determine the electric field at \vec{r} due to the dipole.

B. Consider the electrostatic potential $\phi(\vec{r}) = \frac{q}{4\pi\epsilon_0} \left[\frac{1}{|\vec{r} - d\vec{k}|} \right]$ z>0 and $\phi(\vec{r})=0$ for z<0. Determine the total charge distributed on the x-y plane.

5 + 5