

Electrodynamics(H2) (SC1.102a)
IIIT-H, Semester Winter 24, Assignment 2

Submission deadline: 18th April 2024

1. In the ground state of hydrogen atom the charge density of the electron cloud is given as

$$\rho(r) = \frac{q}{\pi a^3} e^{-2r/a},$$

where q is the charge of an electron, and a is the (so called Bohr) radius. Find the atomic polarizability of hydrogen atom. *Hint: Calculate the electric field E_e due to the electron cloud at some distance r from the center. Once external electric field E is applied the nucleus will shift from $r = 0$ to $r = d$. At $r = d$, E_e cancels the external field E .*

2. Show that the energy of a dipole \vec{p} , kept in an electric field is \vec{E} is $U = -\vec{p} \cdot \vec{E}$. *Hint: Torque acting on the dipole is $\vec{N} = \vec{p} \times \vec{E}$. Energy is the work to rotate the dipole to align with the field.*
3. Find the electric field due to a uniformly charged sphere. *Hint: You first need to calculate the surface and volume charge density.*
4. An infinitely long cylinder carries a uniform magnetization \vec{M} parallel to the axis. Calculate the magnetic field due to \vec{M} inside and outside the cylinder.