PHY 303 : Assignment 2

Submit by 18 September 2024 midnight

1. A cube's two opposite faces are maintained at constant potentials V_0 while all other surfaces are grounded. How much of electrostatic energy this cube is storing ?

2. Two identical flat conducting plates of infinite length and width b are kept parallel to each other in the $(yz-)$ planes at a $x = 0$ and $x = \ell$ respectively. One of the plate is grounded while the other one is maintained at a constant potential V_0. What kind of field configuration is in the interior ?

3. The caps of a cylindrical shell of length ℓ and radius R are maintained at potentials 0 and $V_0(1 - \rho/R)$ respectively while its curved surface is grounded. Find out the potential in the interior region.

4. The curved surface of an infinite cylinder is having a potential $V_0 \sin\theta$ where θ is the azimuthal cylindrical coordinate. Find out the electrostatic energy density inside the cylinder.

5. If the angular and the $z-$ component of the electrostatic potential inside a cylinder are expressed in the basis $\{e^{im\theta}, e^{-im\theta}\}$ and $\{\cos kz, \sin kz\}$ respectively, then find out the differential equation satisfied by its radial part. On the other hand if the radial and the z-component were expressed in the basis $\{J_m(k\rho), N_m(k\rho)\}$ and $\{\cos kz, \sin kz\}$ respectively, what basis could be suitable for the the θ component ? In what condition we should use this new basis ?

Useful formulae if you need:

$$\int yJ_0(y)dy = yJ_1(y)$$