

**DEPARTMENT OF PHYSICS**  
**INDIAN INSTITUTE OF TECHNOLOGY, MADRAS**

PH5020 Electromagnetic Theory

Problem Set 6

Feb. 23, 2018

(Will be discussed on **Feb 28, 2018**)

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1. A dielectric medium carries a *uniform* polarization  $\mathbf{P}_0$ . A spherical cavity is scooped out inside the medium. Find (i) the bound surface charge density on the surface of the cavity, and (ii) the electric field at the centre of the cavity due to this surface charge.
2. A very long cylinder, of radius  $R$  and length  $L$ , carries a uniform polarisation  $\mathbf{P}$  parallel to its axis of symmetry. Find the electric field along the axis of the cylinder for points inside and outside the cylinder.
3. A very long cylinder, of radius  $R$ , carries a uniform polarisation  $\mathbf{P}$  perpendicular to its axis of symmetry. Find the electric field inside and outside the cylinder.
4. A very long cylinder (radius =  $R$  and length  $L$ ) of LIH dielectric material (with dielectric constant  $\epsilon$ ) is placed in an otherwise uniform electric field  $\mathbf{E}_0$  such that its axis is parallel to  $\mathbf{E}_0$ . Find the electric field along the axis of the cylinder inside and outside the cylinder.
5. A very long cylinder (radius =  $R$ ) of LIH dielectric material (with dielectric constant  $\epsilon$ ) is placed in an otherwise uniform electric field  $\mathbf{E}_0$  such that its axis is perpendicular to  $\mathbf{E}_0$ . Find the electric field inside and outside the cylinder.
6. A point charge  $q$  is placed at the centre of a sphere (of radius  $R$ ) containing a LIH dielectric with dielectric constant  $\epsilon$ . Find the magnitudes of the displacement vector and the electric field in the entire space.