PH 202 Course coordinator/ Instructor**: Alika Khare**

Problem Set no. III **Due date: Monday, Feb 05, 2024**

Note: . Please submit the solutions of at least two of the problems, one each from problem no.1 and2 and from 3and 4. on Monday, Feb 05, 2024, during the class. The solutions can be submitted in a group of maximum of four students. Name and Roll no. of all the group members should be written clearly on the top. If solutions are found to be reasonably correct then 10 marks (five marks each) will be awarded and in case of non submission/wrong solution zero marks.

1. The problem of conducting sphere of radius *a*, maintained at a potential V_o, and is surrounded by a thin concentric spherical shell of radius *b*, carrying a surface charge density $\sigma(\theta) = k\cos\theta$, where *k* is a constant was discussed in the class (on Wednesday, Jan 31, 2024), Write down the expression for all the non zero coefficients and hence show that In the region $a \leq r \leq b, V(r,\theta) = \frac{aV_o}{r} + \frac{k}{3\varepsilon_o}\left(r - \frac{a^3}{r^2}\right)cos\theta$ and for $r \geq b, V(r,\theta) = \frac{aV_o}{r} + \frac{(b^3-a^3)k}{3r^2\epsilon_o}cos\theta$. Explain the physical meaning of both the terms in the potential (for both regions). Work out the expression for the surface charge density on the metallic sphere and identify the terms due to the potential V_o at $r=a$ and that of due to $\sigma(\theta)$.

2. Potential at the surface of a sphere of radius R is given by $V(\theta)=k\cos(3\theta)$, where *k* is a constant. Find the potential everywhere and the surface charge density on the sphere.

3. Potential on the rim of a disk (lying in x-y plane) of unit radius is given by $V(\varphi)=2\cos(5\varphi)$. Obtain the potential inside the rim.

4. A grounded conducting sphere of radius R is kept in an electrostatic field given by $\vec{E} = y\hat{\imath} + x\hat{\jmath}$. Obtained the expression for the electric field outside the sphere and induced charge density on the surface of the sphere.