INDIAN INSTITUTE OF TECHNOLOGY PATNA

PH103 : Physics
Tutorial 2

1. Describe and plot the surfaces with the given cylindrical equations.
   - $\phi = \pi/4$
   - $\rho^2 + z^2 = 9$
   - $z = \rho$
   - $\rho = 6$

2. Convert the rectangular coordinates $\left(-1, 1, \sqrt{6}\right)$ to both spherical and cylindrical coordinates.

3. An ant crawls on the surface of the ball of radius in a manner such that the ant's motion is given in spherical coordinate system by the equation :

$$r = b \qquad \phi = \omega t \qquad \theta = \frac{\pi}{2}\left[1 + \frac{1}{4}\cos(4\omega t)\right]$$

   Find the speed of the ant as a function of the time t. What sort of path is represented by above equation?

4. The equation for the outer edge of a sphere of radius R is given by

$$x^2 + y^2 + z^2 = a^2$$

   Find the volume of sphere in Cartesian, Cylindrical and Spherical coordinate system.

5. Find the potential of a uniformly charged spherical shell having a surface charge density σ of radius R at point P as shown in below figure.
   Hint

   Use the law of cosines to express r :

$$r^2 = R^2 + z^2 - 2Rz\cos\theta'$$