# INDIAN INSTITUTE OF TECHNOLOGY PATNA

## PH103 : Physics Tutorial 2

1. Write the components of $\vec{A} = 2y\hat{e_x} - z\hat{e_y} - x\hat{e_z}$ in cylindrical and spherical polar co-ordinates

2. Determine $\vec{A}$ in terms of spherical and cylindrical polar co-ordinates if $\vec{A} = (y-z)\hat{e_x} + x\hat{e_y}$ passes through the point P(-3,2,4)

3. Sketch the following surfaces
   (a) (i) $\rho = 5$ (ii) $\phi = \frac{\pi}{4}$ (iii) $z = 5$, where $\rho$,$\phi$,z represent cylindrical polar co-ordinates
   (b)(i) r=1 (iii) $\phi = \frac{\pi}{3}$ (iii) $\theta = \frac{\pi}{4}$, where r,$\phi$,$\theta$ represent spherical polar co-ordinates

4. A bird of weight 3 N is tracing a downward path on a cylindrical helix as shown in figure 1. The rate of descent is $\frac{dz}{dt}$ =-2m/s with zero acceleration in the z-direction. The speed is v=10m/s and $\frac{d\theta}{dt} = 0.05$ rad/s (where '$\theta$" is the polar angle). Find the following
   (a) Radius of helix
   (b) Find the force the bird need to apply to maintain the motion as described in the figure 1
   (c) Find the angle of descend of the bird, see figure 2

5. A particle moves in such a way that in the spherical polar coordinate system, its motion is described by the properties that $\phi$ is constant, and $r = r_0 e^{\epsilon t}$. Both $r_0$ and $\epsilon$ are positive constants. (a) Determine the condition on $\epsilon$ such that the particle's radial acceleration becomes zero. (b) When the radial acceleration is zero, is the radial velocity constant? [Caution. Write down the vector expressions for velocity and acceleration before you attempt a quick answer to this question].

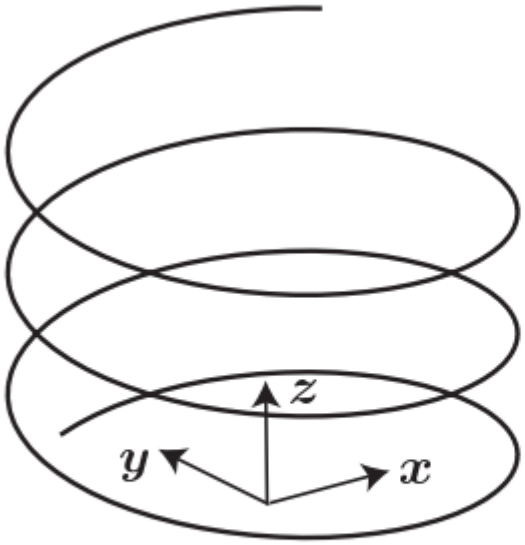


Figure 1:

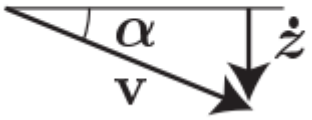


Figure 2: