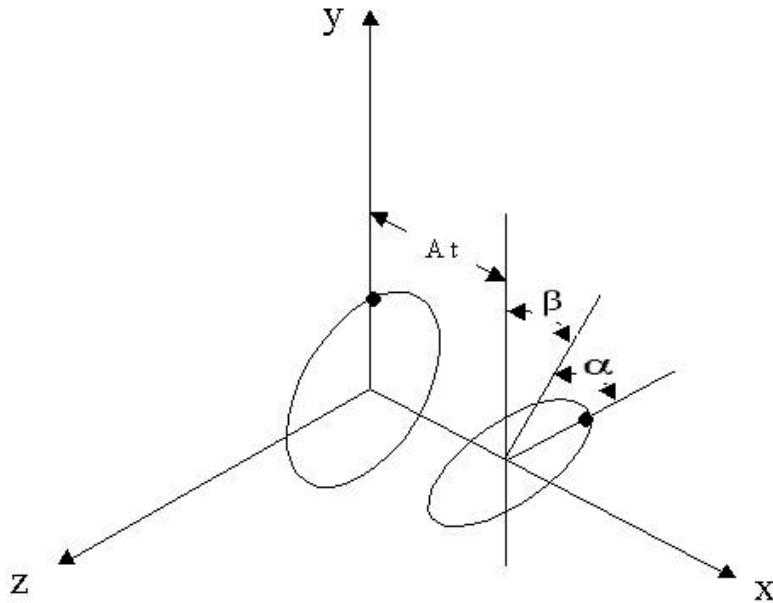


# EQUATIONS OF MOTION SIMULTANEOUS ROTATION OF A PARTICLE ABOUT TWO AXES



Rotation about primary (X) axis

$$\begin{aligned} X1 &= 0 \\ Y1 &= r \cos \alpha \\ Z1 &= -r \sin \alpha \end{aligned}$$

Rotate above system about secondary (Z) axis

$$\begin{aligned} X2 &= Y1 \sin \beta \\ Y2 &= Y1 \cos \beta \\ Z2 &= Z1 \end{aligned}$$

Add translation along X axis

$$\begin{aligned} X &= A(t) + X2 \\ Y &= Y2 \\ Z &= Z2 \end{aligned}$$

Where  $A = \text{some constant}$

Total equation of motion for particle as function of time (t):

For the case under consideration:  $A = 1$   
 $r = 0.5$   
 $\beta = 22.5(t)$  degrees  
 $\alpha = 2\beta$

Thus:

$$\begin{aligned} X &= t + 0.5 \cos(45t)\sin(22.5t) \\ Y &= 0.5 \cos(45t)\cos(22.5t) \\ Z &= -0.5 \sin(45t) \end{aligned}$$

**Background of Theory and Author follows on next page**