

2.) Using 3D transformation calculate the translated value of the given homogenous co-ordinate $P(12, 36, 24, 4)$ where $t_x = 2$, $t_y = 3$, $t_z = 1$

i) Now calculate scaled co-ordinate of the above resulted translated value 4x4 matrices where $S_x = 2$, $S_y = 0.5$, $S_z = 3$

ii) Rotate the scaled co-ordinate using 4x4 matrices around Y-axis where $\theta_y = 60^\circ$

Solution! i) Here, $P(12, 36, 24, 4)$ or $(3, 9, 6, 1)$

$$\therefore \begin{bmatrix} x' \\ y' \\ z' \\ w' \end{bmatrix} = \begin{bmatrix} 1 & 0 & 0 & 2 \\ 0 & 1 & 0 & 3 \\ 0 & 0 & 1 & 1 \\ 0 & 0 & 0 & 1 \end{bmatrix} \begin{bmatrix} 3 \\ 9 \\ 6 \\ 1 \end{bmatrix} = \begin{bmatrix} 3+2 \\ 9+3 \\ 6+1 \\ 1 \end{bmatrix} = \begin{bmatrix} 5 \\ 12 \\ 7 \\ 1 \end{bmatrix}$$

\therefore After translate the point is $(5, 12, 7, 1)$

$$ii) \begin{bmatrix} x'' \\ y'' \\ z'' \\ w'' \end{bmatrix} = \begin{bmatrix} 2 & 0 & 0 & 0 \\ 0 & 0.5 & 0 & 0 \\ 0 & 0 & 3 & 0 \\ 0 & 0 & 0 & 1 \end{bmatrix} \begin{bmatrix} 5 \\ 12 \\ 7 \\ 1 \end{bmatrix} = \begin{bmatrix} 10 \\ 6 \\ 21 \\ 1 \end{bmatrix}$$

\therefore After scale the point is $(10, 6, 21, 1)$

$$iii) \begin{bmatrix} x''' \\ y''' \\ z''' \\ w''' \end{bmatrix} = \begin{bmatrix} \cos 60 & 0 & -\sin 60 & 0 \\ 0 & 1 & 0 & 0 \\ \sin 60 & 0 & \cos 60 & 0 \\ 0 & 0 & 0 & 1 \end{bmatrix} \begin{bmatrix} 10 \\ 6 \\ 21 \\ 1 \end{bmatrix} = \begin{bmatrix} 5 - 18 \cdot 187 \\ 6 \\ 8 \cdot 66 + 10 \cdot 5 \\ 1 \end{bmatrix} = \begin{bmatrix} -13 \cdot 187 \\ 6 \\ 19 \cdot 16 \\ 1 \end{bmatrix}$$

\therefore After rotate the point is $(-13 \cdot 187, 6, 19 \cdot 16, 1)$

3) i) Using 4x4 matrices calculate the rotated value of the given homogenous co-ordinate $P(21, 35, 49, 7)$ around z-axis where $\theta_z = 90^\circ$

ii) Now calculate the scaled co-ordinate of the