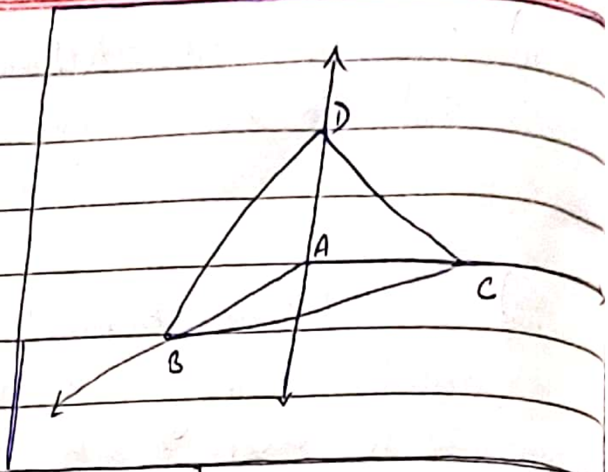
(5) I Translating line to origin



$$T_r = \begin{bmatrix} 1 & 0 & 0 \\ 0 & 1 & 0 \\ 0 & 0 & 1 \\ t_x & t_y & t_z \end{bmatrix}$$

$$T_r = \begin{bmatrix} 1 & 0 & 0 & 0 \\ 0 & 1 & 0 & 0 \\ 0 & 0 & 1 & 0 \\ t_x & t_y & t_z & 1 \end{bmatrix} = \begin{bmatrix} 1 & 0 & 0 & 0 \\ 0 & 1 & 0 & 0 \\ 0 & 0 & 1 & 0 \\ 0 & 1 & 0 & 1 \end{bmatrix} \quad \Big\{ t_x = 0, t_y = -1, t_z = 0$$

II Aligning with +ve Z-axis. $\bar{V} = I + J$

On Comparing with $V = ai + bj + ck$, $a = 1$, $b = 1$, $c = 0$

also $|\bar{v}| = \sqrt{1^2 + 1^2} = \sqrt{2}$

$= \sqrt{a^2 + b^2} = \lambda = \sqrt{2}$

$$A_v = \begin{bmatrix} \lambda/|v| & 0 & a/|v| & 0 \\ -ab/\lambda|v| & c/\lambda & b/|v| & 0 \\ -ac/\lambda|v| & -b/\lambda & c/|v| & 0 \\ 0 & 0 & 0 & 1 \end{bmatrix} = \begin{bmatrix} 1 & 0 & 0 & 0 \\ 0 & 1/\sqrt{2} & 1/\sqrt{2} & 0 \\ 0 & -1/\sqrt{2} & 1/\sqrt{2} & 0 \\ 0 & 1 & 0 & 1 \end{bmatrix}$$

III Rotation of object about Z-axis by an angle of 45°

$$R_z = \begin{bmatrix} \cos\theta & \sin\theta & 0 & 0 \\ -\sin\theta & \cos\theta & 0 & 0 \\ 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 1 \end{bmatrix} = \begin{bmatrix} 1/\sqrt{2} & 1/\sqrt{2} & 0 & 0 \\ -1/\sqrt{2} & 1/\sqrt{2} & 0 & 0 \\ 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 1 \end{bmatrix}$$

IV Now Align Z with V

$$\begin{bmatrix} \lambda/|v| & -ab/\lambda|v| & -ac/\lambda|v| & 0 \\ 0 & c/\lambda & -b/\lambda & 0 \\ a/|v| & b/|v| & c/|v| & 0 \\ 0 & 0 & 0 & 1 \end{bmatrix} = \begin{bmatrix} 1 & 0 & 0 & 0 \\ 0 & 1/\sqrt{2} & -1/\sqrt{2} & 0 \\ 0 & 1/\sqrt{2} & 1/\sqrt{2} & 0 \\ 0 & 0 & 0 & 1 \end{bmatrix}$$

Now Inverse Translation

$$\begin{bmatrix} 1 & 0 & 0 & 0 \\ 0 & 1 & 0 & 0 \\ 0 & 0 & 1 & 0 \\ t_x & t_y & t_z & 1 \end{bmatrix} = \begin{bmatrix} 1 & 0 & 0 & 0 \\ 0 & 1 & 0 & 0 \\ 0 & 0 & 1 & 0 \\ 0 & 1 & 0 & 1 \end{bmatrix}$$

Combine Transformation matrix is given as

$$\begin{bmatrix} 1 & 0 & 0 & 0 \\ 0 & 1 & 0 & 0 \\ 0 & 0 & 1 & 0 \\ 0 & -1 & 0 & 1 \end{bmatrix} \begin{bmatrix} 1 & 0 & 0 & 0 \\ 0 & 1/\sqrt{2} & 1/\sqrt{2} & 0 \\ 0 & -1/\sqrt{2} & 1/\sqrt{2} & 0 \\ 0 & 0 & 0 & 1 \end{bmatrix} \begin{bmatrix} 1/\sqrt{2} & 1/\sqrt{2} & 0 & 0 \\ -1/\sqrt{2} & 1/\sqrt{2} & 0 & 0 \\ 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 1 \end{bmatrix} \begin{bmatrix} 1 & 0 & 0 & 0 \\ 0 & 1/\sqrt{2} & -1/\sqrt{2} & 0 \\ 0 & 1/\sqrt{2} & 1/\sqrt{2} & 0 \\ 0 & 0 & 0 & 1 \end{bmatrix}$$

$$T = \begin{bmatrix} 0.707 & 0.5 & -0.5 & 0 \\ -0.5 & 0.85 & 0.146 & 0 \\ 0.5 & 0.146 & 0.85 & 0 \\ 0.5 & 0.15 & -0.146 & 1 \end{bmatrix}$$

Now we have to find new coordinates $X' = XT$

$$\begin{bmatrix} 1 & 0 & 0 & 0 \\ 0 & 1 & 0 & 0 \\ 0 & 0 & 1 & 0 \\ 0 & 1 & 0 & 1 \end{bmatrix} \begin{bmatrix} 0.707 & 0.5 & -0.5 & 0 \\ -0.5 & 0.85 & 0.146 & 0 \\ 0.5 & 0.146 & 0.85 & 0 \\ 0.5 & 0.15 & -0.146 & 1 \end{bmatrix}$$

$$= \begin{bmatrix} 0.5 & 0.15 & -0.146 & 1 \\ 1.20 & 0.6 & -0.646 & 1 \\ 0 & 1 & 0 & 1 \\ 1 & 0.29 & 0.704 & 1 \end{bmatrix}$$

$A' = (0.5, 0.15, -0.146)$
$B' = (1.207, 0.6, -0.646)$
$C = (0, 1, 0)$
$D' = (1, 0.296, 0.704)$