# SET-D



Name- Ankit , Roll No.- 11706 , Subject - Computer Graphics

Q:-1. A cube has its vertices located at →

A(0, 0, 10)

B(10, 0, 10)

C(10, 10, 10)

D(0, 10, 10)

E(0, 0, 0)

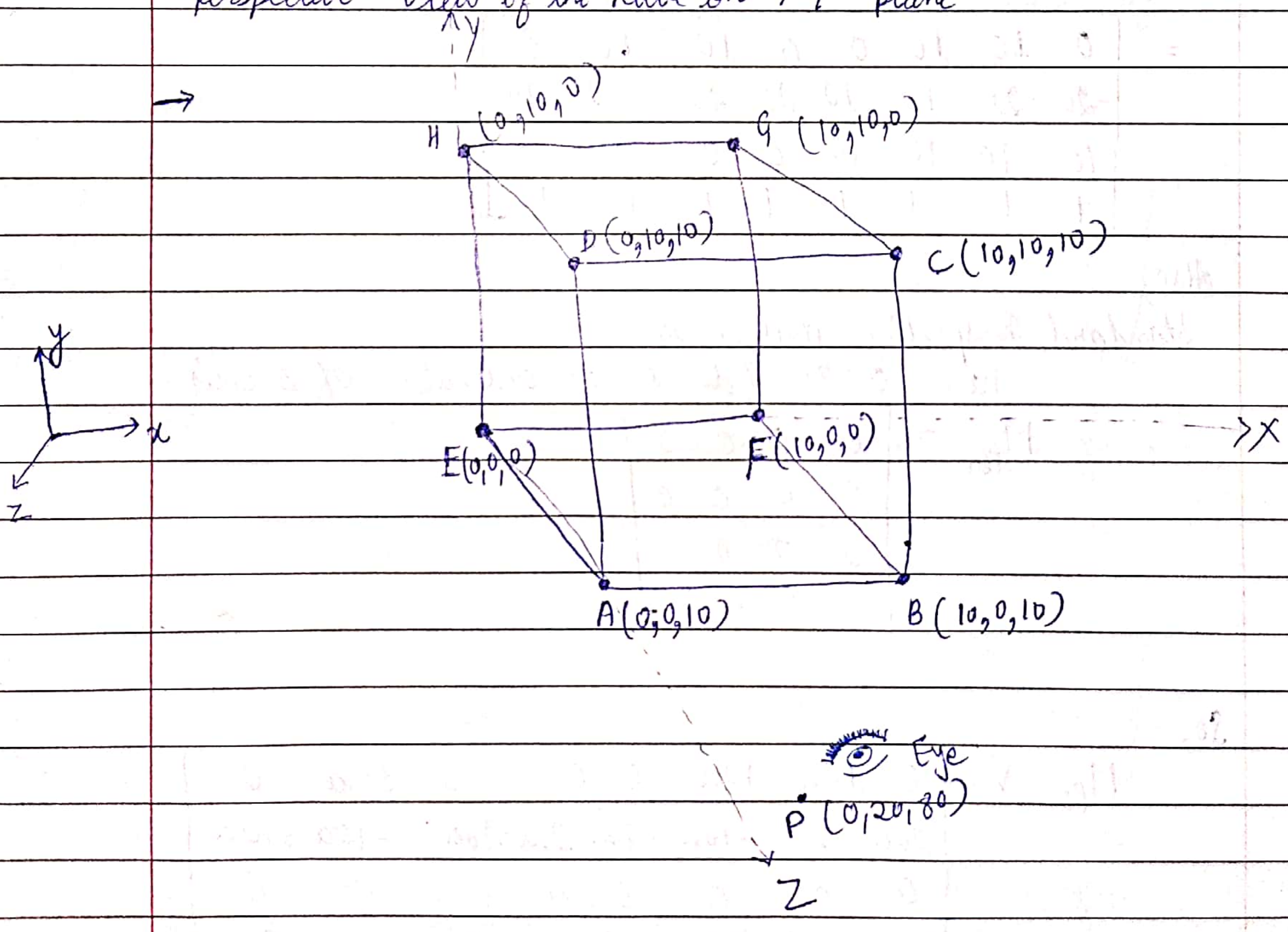
F(10, 0, 0)

G(10, 10, 0)

H(0, 10, 0)

The Y-axis is vertical & Z-axis is oriented towards the viewer. The cube is being viewed from point (0, 20, 80). Calculate the perspective view of the cube on XY- plane.

→



$$V = (A\,B\,C\,D\,E\,F\,G\,H) = \begin{bmatrix} 0 & 10 & 10 & 0 & 0 & 10 & 10 & 0 \\ 0 & 0 & 10 & 10 & 0 & 0 & 10 & 10 \\ 10 & 10 & 10 & 10 & 0 & 0 & 0 & 0 \\ 1 & 1 & 1 & 1 & 1 & 1 & 1 & 1 \end{bmatrix}$$

Translating the co-ordinates about Y-axis, so that projection P is on Z-axis

$$P' = (0, 0, 80).$$

And,

so the change in the matrix of cube due to shift of co-ordinate from Y-axis by 20.

$$= \begin{bmatrix} 0 & 10 & 10 & 0 & 0 & 10 & 10 & 0 \\ -20 & -20 & -10 & -10 & -20 & -20 & -10 & -10 \\ 10 & 10 & 10 & 10 & 0 & 0 & 0 & 0 \\ 1 & 1 & 1 & 1 & 1 & 1 & 1 & 1 \end{bmatrix}$$

Also,

Standard Perspective matrix is →

Here $a = 80$ (due to co-ordinates of Z-axis

$$M_{Per} = \begin{bmatrix} a & 0 & 0 & 0 \\ 0 & a & 0 & 0 \\ 0 & 0 & 0 & 0 \\ 0 & 0 & 1 & a \end{bmatrix}$$

So,

$$M_{Per} \cdot V = \begin{bmatrix} 0 & 10a & 10a & 0 & 0 & 10a & 10a & 0 \\ -20a & -20a & -10a & -10a & -20a & -20a & -10a & -10a \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 10+a & 10+a & 10+a & 10+a & a & a & a & a \end{bmatrix}$$

$$= \begin{bmatrix} 0 & 800 & 800 & 0 & 0 & 800 & 800 & 0 \\ -1600 & -1600 & -800 & -800 & -1600 & -1600 & -800 & -800 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 90 & 90 & 90 & 90 & 80 & 80 & 80 & 80 \end{bmatrix}$$

Take common from the matrix.

$$= \begin{bmatrix} 0 & 80/9 & 80/9 & 0 & 0 & 10 & 10 & 0 \\ -160/9 & -160/9 & -80/9 & -80/9 & -20 & -20 & -10 & -10 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 1 & 1 & 1 & 1 & 1 & 1 & 1 & 1 \end{bmatrix}$$

Again,

transform back to its original position by adding $+20$ in $R_2$.

$$= \begin{bmatrix} 0 & 80/9 & 80/9 & 0 & 0 & 10 & 10 & 0 \\ -20/9 & -20/9 & +100/9 & +100/9 & 0 & 0 & 10 & 10 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 1 & 1 & 1 & 1 & 1 & 1 & 1 & 1 \end{bmatrix}$$

$\therefore$ New Vertices with Perspective View on XY-plane.

$V' = (A' \ B' \ C' \ D' \ E' \ F' \ G' \ H')$

$$= \begin{bmatrix} 0 & 80/9 & 80/9 & 0 & 0 & 10 & 10 & 0 \\ -20/9 & -20/9 & 100/9 & 100/9 & 0 & 0 & 10 & 10 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 1 & 1 & 1 & 1 & 1 & 1 & 1 & 1 \end{bmatrix}$$

Ans.

Q:-2. The reflection along the line X=Y is equivalent to the reflection along the X-axis followed by counter clockwise rotation by θ degree. Find the value of 'θ'.

→ • Reflection along X=Y line

$$\begin{bmatrix} X' \\ Y' \end{bmatrix} = \begin{bmatrix} 0 & 1 \\ 1 & 0 \end{bmatrix} \begin{bmatrix} X \\ Y \end{bmatrix} \quad -(1)$$

• Reflection matrix θ ( counter clockwise ).

$$\begin{bmatrix} X' \\ Y' \end{bmatrix} = \begin{bmatrix} \cos\theta & -\sin\theta \\ \sin\theta & \cos\theta \end{bmatrix} \begin{bmatrix} X \\ Y \end{bmatrix} \quad -(2)$$

• Reflection along X-axis

$$\begin{bmatrix} X' \\ Y' \end{bmatrix} = \begin{bmatrix} 1 & 0 \\ 0 & -1 \end{bmatrix} \begin{bmatrix} X \\ Y \end{bmatrix} \quad -(3)$$

Also; Reflection along X-axis followed by rotation of θ degree counter clockwise.

$$\begin{bmatrix} X' \\ Y' \end{bmatrix} = \begin{bmatrix} \cos\theta & -\sin\theta \\ \sin\theta & \cos\theta \end{bmatrix} \begin{bmatrix} 1 & 0 \\ 0 & -1 \end{bmatrix} \begin{bmatrix} X \\ Y \end{bmatrix} = \begin{bmatrix} \cos\theta & \sin\theta \\ \sin\theta & -\cos\theta \end{bmatrix} \begin{bmatrix} X \\ Y \end{bmatrix} \quad -(4)$$

Equate eq-(1) & (4)

$$\Rightarrow \begin{bmatrix} 0 & 1 \\ 1 & 0 \end{bmatrix} \begin{bmatrix} X \\ Y \end{bmatrix} = \begin{bmatrix} \cos\theta & \sin\theta \\ \sin\theta & -\cos\theta \end{bmatrix} \begin{bmatrix} X \\ Y \end{bmatrix}$$

$\therefore \quad \cos\theta = 0 \quad ; \quad \sin\theta = 1.$

i.e. $\theta = \frac{\pi}{2} \qquad \theta = \frac{\pi}{2}$

Hence,

Value of 'θ' $= \frac{\pi}{2}$

Ans