Step-1

(a)

To find the first column of 3×3 matrix, consider the following vector:

$$\begin{bmatrix}1\\0\\0\end{bmatrix}$$

Project the vector $\begin{bmatrix}1\\0\\0\end{bmatrix}$ onto *x-y* plane, and get the vector $\begin{bmatrix}1\\0\\0\end{bmatrix}$.

Step-2

To find the second and third column of 3×3 matrix, consider the following vectors:

$\begin{bmatrix}0\\1\\0\end{bmatrix}$ And $\begin{bmatrix}0\\0\\1\end{bmatrix}$

Project the vector $\begin{bmatrix}0\\1\\0\end{bmatrix}$ onto *x-y* plane, and get the vector $\begin{bmatrix}0\\1\\0\end{bmatrix}$.

Now, project the vector $\begin{bmatrix}0\\0\\1\end{bmatrix}$ onto *x-y* plane, and get the vector $\begin{bmatrix}0\\0\\0\end{bmatrix}$.

Step-3

Therefore, the matrix transformation by projecting every vector onto the *x-y* plane is given by $\begin{bmatrix}1&0&0\\0&1&0\\0&0&0\end{bmatrix}$.

Step-4

(b)

To find the first column of 3×3 matrix, consider the following vector:

$$\begin{bmatrix}1\\0\\0\end{bmatrix}$$

Reflect the vector $\begin{bmatrix}1\\0\\0\end{bmatrix}$ through the *x-y* plane, we get the vector $\begin{bmatrix}1\\0\\0\end{bmatrix}$.

Step-5

To find the second and third column of 3×3 matrix, consider the following vectors:

$\begin{bmatrix}0\\1\\0\end{bmatrix}$ And $\begin{bmatrix}0\\0\\1\end{bmatrix}$

Reflect the vector $\begin{bmatrix}0\\1\\0\end{bmatrix}$ through the $xy-$ plane, and get the vector $\begin{bmatrix}0\\1\\0\end{bmatrix}$.

Now, reflect the vector $\begin{bmatrix}0\\0\\1\end{bmatrix}$ through the xy-plane, and get the vector $\begin{bmatrix}0\\0\\-1\end{bmatrix}$.

Step-6

Therefore, the matrix of transformation by reflecting every vector though the *x-y* plane is given by $\begin{bmatrix}1&0&0\\0&1&0\\0&0&-1\end{bmatrix}$.

Step-7

(c)

To find the first column of 3×3 matrix, consider the following vector:

$\begin{bmatrix}1\\0\\0\end{bmatrix}$

Rotate the vector $\begin{bmatrix}1\\0\\0\end{bmatrix}$ in the *x*-*y* plane by $90°$, and get the vector $\begin{bmatrix}0\\1\\0\end{bmatrix}$.

To find the second and third column of 3×3 matrix, consider the following vectors:

$\begin{bmatrix}0\\1\\0\end{bmatrix}$ And $\begin{bmatrix}0\\0\\1\end{bmatrix}$

Rotate the vector $\begin{bmatrix}0\\1\\0\end{bmatrix}$ in the *x*-*y* plane by $90°$, and get vector $\begin{bmatrix}-1\\0\\0\end{bmatrix}$.

Rotate the vector $\begin{bmatrix}0\\0\\1\end{bmatrix}$ in the *x*-*y* plane by $90°$, and get the vector $\begin{bmatrix}0\\0\\1\end{bmatrix}$.

Step-8

Therefore, the matrix of transformation by rotating the *x*-*y* plane through $90°$, leaving the *z*-axis alone is given by $\begin{bmatrix}0&-1&0\\1&0&0\\0&0&1\end{bmatrix}$.

Step-9

(d)

To find the first column of 3×3 matrix, consider the following vector:

$\begin{bmatrix}1\\0\\0\end{bmatrix}$

Rotate the vector $\begin{bmatrix}1\\0\\0\end{bmatrix}$ in the *x*-*y* plane by $90°$, and get vector $\begin{bmatrix}0\\1\\0\end{bmatrix}$.

Rotate the vector $\begin{bmatrix}0\\1\\0\end{bmatrix}$ in *x*-*z* plane by $90°$, and get vector $\begin{bmatrix}0\\1\\0\end{bmatrix}$.

Rotate the vector $\begin{bmatrix}0\\1\\0\end{bmatrix}$ in *y*-*z* plane by $90°$, we get vector $\begin{bmatrix}0\\0\\1\end{bmatrix}$.

Step-10

To find the second column of 3×3 matrix, consider the following vectors:

$\begin{bmatrix}0\\1\\0\end{bmatrix}$

Rotate the vector $\begin{bmatrix}0\\1\\0\end{bmatrix}$ in the *x*-*y* plane by $90°$, and get vector $\begin{bmatrix}0\\-1\\0\end{bmatrix}$.

Rotate the vector $\begin{bmatrix}0\\-1\\0\end{bmatrix}$ in *x*-*z* plane by $90°$, and get vector $\begin{bmatrix}0\\0\\-1\end{bmatrix}$.

Rotate the vector $\begin{bmatrix}0\\0\\-1\end{bmatrix}$ in *y*-*z* plane by $90°$, and get vector $\begin{bmatrix}0\\1\\0\end{bmatrix}$.

Step-11

To find the third column of 3×3 matrix, consider the following vector:

$\begin{bmatrix}0\\0\\1\end{bmatrix}$

Rotate the vector $\begin{bmatrix}0\\0\\1\end{bmatrix}$ in the *x*-*y* plane by $90°$, and get vector $\begin{bmatrix}0\\0\\1\end{bmatrix}$.

Rotate the vector $\begin{bmatrix}0\\0\\1\end{bmatrix}$ in *x*-*z* plane by $90°$, and get vector $\begin{bmatrix}-1\\0\\0\end{bmatrix}$.

Rotate the vector $\begin{bmatrix}-1\\0\\0\end{bmatrix}$ in *y*-*z* plane by $90°$, and get vector $\begin{bmatrix}-1\\0\\0\end{bmatrix}$.

Therefore, the matrix transformation by rotating the *x*-*y* plane, then *x*-*z* plane and then *y*-*z* through $90°$, is given by $\begin{bmatrix}0&0&-1\\0&1&0\\1&0&0\end{bmatrix}$.

Step-12

(e)

To find the first column of 3×3 matrix, consider the following vector:

$$\begin{bmatrix}1\\0\\0\end{bmatrix}$$

Step-13

Rotate the vector $\begin{bmatrix}1\\0\\0\end{bmatrix}$ in the *x*-*y* plane by $180°$, and get vector $\begin{bmatrix}-1\\0\\0\end{bmatrix}$.

Rotate the vector $\begin{bmatrix}-1\\0\\0\end{bmatrix}$ in *x*-*z* plane by $180°$, and get vector $\begin{bmatrix}1\\0\\0\end{bmatrix}$.

Rotate the vector $\begin{bmatrix}1\\0\\0\end{bmatrix}$ in *y*-*z* plane by $180°$, and get vector $\begin{bmatrix}1\\0\\0\end{bmatrix}$.

Step-14

To find the second column of 3×3 matrix, consider the following vector:

$$\begin{bmatrix}0\\1\\0\end{bmatrix}$$

Rotate the vector $\begin{bmatrix}0\\1\\0\end{bmatrix}$ in the *x*-*y* plane by $180°$, and get vector $\begin{bmatrix}0\\-1\\0\end{bmatrix}$.

Rotate the vector $\begin{bmatrix}0\\-1\\0\end{bmatrix}$ in *x*-*z* plane by $180°$, and get vector $\begin{bmatrix}0\\-1\\0\end{bmatrix}$.

Rotate the vector $\begin{bmatrix}0\\-1\\0\end{bmatrix}$ in *y*-*z* plane by $180°$, and get vector $\begin{bmatrix}0\\1\\0\end{bmatrix}$.

Step-15

To find the third column of 3×3 matrix, consider the following vector:

$$\begin{bmatrix}0\\0\\1\end{bmatrix}$$

Rotate the vector $\begin{bmatrix}0\\0\\1\end{bmatrix}$ in the *x*-*y* plane by $180°$, and get vector $\begin{bmatrix}0\\0\\1\end{bmatrix}$.

Rotate the vector $\begin{bmatrix}0\\0\\1\end{bmatrix}$ in *x*-*z* plane by $180°$, and get vector $\begin{bmatrix}0\\0\\-1\end{bmatrix}$.

Rotate the vector $\begin{bmatrix}0\\0\\-1\end{bmatrix}$ in *y*-*z* plane by $180°$, and get vector $\begin{bmatrix}0\\0\\1\end{bmatrix}$.

Step-16

Therefore, the matrix of transformation by rotating the *x*-*y* plane, then *x*-*z* plane and then *y*-*z* by $180°$, is given by $\begin{bmatrix} 1 & 0 & 0 \\ 0 & 1 & 0 \\ 0 & 0 & 1 \end{bmatrix}$.