

(Q9)

(a) The rotation on P_{xy} is given as

$$T(x, y, z) = (x \cos \theta - y \sin \theta, x \sin \theta + y \cos \theta, z)$$

Since for any $v = (x, y, 0) \in P_{xy}$, $T(v)$ is still of the form $(x, y, 0)$, $T(P_{xy}) = P_{xy}$.

Similarly, for any $(0, 0, z)$ on the z -axis, rotation gives the same form $(0, 0, z)$, this the line $(0, 0, z)$ is also T -invariant.

(b) Taking T and splitting by parameter, we have

$$x(\cos \theta + \sin \theta + 0) + y(-\sin \theta + \cos \theta + 0) + z(0, 0, 1)$$

which yields the matrix

$$\begin{bmatrix} \cos \theta & -\sin \theta & 0 \\ \sin \theta & \cos \theta & 0 \\ 0 & 0 & 1 \end{bmatrix}$$