

## QUESTION 1

$$i) |X| = \begin{vmatrix} 1 & 2 & 8 \\ 4 & 7 & 6 \\ 9 & 5 & 3 \end{vmatrix}$$

$$\begin{aligned} |X| &= 1 \begin{vmatrix} 7 & 6 \\ 5 & 3 \end{vmatrix} - 2 \begin{vmatrix} 4 & 6 \\ 9 & 3 \end{vmatrix} + 8 \begin{vmatrix} 4 & 7 \\ 9 & 5 \end{vmatrix} \\ &= 1(21 - 30) - 2(12 - 54) + 8(20 - 63) \\ &= 1(-9) - 2(-42) + 8(-43) \\ &= -9 + 84 - 344 \\ &= -269 \end{aligned}$$

$|X| \neq 0$ . Therefore, matrix  $X$  is non-singular

$$ii) |Y| = \begin{vmatrix} 0 & 5 & 0 \\ -3 & -7 & -1 \\ 2 & 1 & 9 \end{vmatrix}$$

$$\begin{aligned} |Y| &= 0 \begin{vmatrix} -7 & -1 \\ 1 & 9 \end{vmatrix} - 5 \begin{vmatrix} -3 & -1 \\ 2 & 9 \end{vmatrix} + 0 \begin{vmatrix} -3 & -7 \\ 2 & 1 \end{vmatrix} \\ &= 0(-63 + 1) - 5(-27 + 2) + 0(-3 + 14) \\ &= 0 - 5(-25) + 0 \\ &= 0 + 125 + 0 \\ &= 125 \end{aligned}$$

$|Y| \neq 0$ . Therefore, matrix  $Y$  is non-singular

iii) RANK OF  $Y$

$$|Y| = \begin{vmatrix} 0 & 5 & 0 \\ -3 & -2 & -1 \\ 2 & 1 & 9 \end{vmatrix}$$

$$|Y| = 0(-63 + 1) - 5(-27 + 2) + 0(-3 + 14)$$

$$\begin{aligned} |Y| &= 0 + 125 - 0 \\ &= 125 \end{aligned}$$

$|Y| \neq 0$ . Hence the Rank of  $Y$  is 3

$$\begin{aligned}
 \text{iv } X+Y &= \begin{pmatrix} 1 & 2 & 8 \\ 4 & 7 & 6 \\ 9 & 5 & 3 \end{pmatrix} + \begin{pmatrix} 0 & 5 & 0 \\ -3 & -7 & -1 \\ 2 & 1 & 9 \end{pmatrix} \\
 &= \begin{pmatrix} 1 & 7 & 8 \\ 1 & 0 & 5 \\ 11 & 6 & 12 \end{pmatrix}
 \end{aligned}$$

$$|X+Y| = \begin{vmatrix} 1 & 7 & 8 \\ 1 & 0 & 5 \\ 11 & 6 & 12 \end{vmatrix}$$

$$\begin{aligned}
 |X+Y| &= 1 \begin{vmatrix} 0 & 5 \\ 6 & 12 \end{vmatrix} - 7 \begin{vmatrix} 1 & 5 \\ 11 & 12 \end{vmatrix} + 8 \begin{vmatrix} 1 & 0 \\ 11 & 6 \end{vmatrix} \\
 &= 1(0-30) - 7(12-55) + 8(6-0) \\
 &= 1(-30) - 7(-43) + 8(6) \\
 &= -30 + 301 + 48 \\
 &= 319
 \end{aligned}$$

$|X+Y| \neq 0$ . Therefore, matrix  $X+Y$  is non-singular

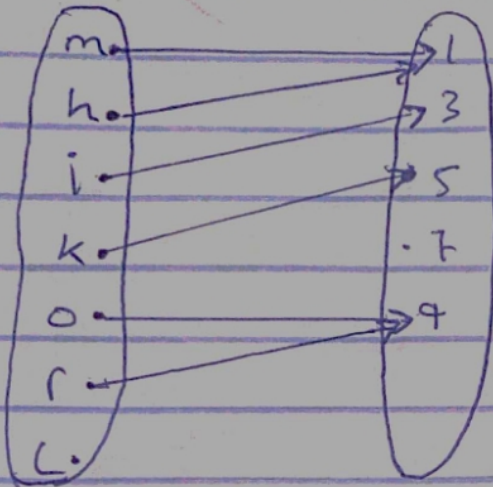
$$\begin{aligned}
 \text{v } SY &= 5 \times \begin{pmatrix} 0 & 5 & 0 \\ -3 & -7 & -1 \\ 2 & 1 & 9 \end{pmatrix} \\
 &= \begin{pmatrix} 0 & 25 & 0 \\ -15 & -35 & -5 \\ 10 & 5 & 45 \end{pmatrix}
 \end{aligned}$$

$$\begin{aligned}
 |SY| &= 0 \begin{vmatrix} -35 & -5 \\ 5 & 45 \end{vmatrix} - 25 \begin{vmatrix} -15 & -5 \\ 10 & 45 \end{vmatrix} + 0 \begin{vmatrix} -15 & -35 \\ 10 & 5 \end{vmatrix} \\
 &= 0(-1575 + 25) - 25(-675 + 50) + 0(-75 + 350) \\
 &= 0 - 25(-625) + 0 \\
 &= 0 + 15,625 + 0 \\
 &= 15,625
 \end{aligned}$$

$|SY| \neq 0$ . Therefore, matrix  $SY$  is non-singular

## QUESTION 2

DOMAIN



$Q \xrightarrow{T} R$

$$T(m) = 1$$

$$T(h) = 3$$

$$T(i) = 5$$

$$T(o) = 9$$

$$T(r) = 9$$