

Q. 15

$$\begin{bmatrix} 2 & -3 & 3 \\ 2 & 2 & 3 \\ 3 & -2 & 2 \end{bmatrix}$$

Soln: Let $A = \begin{bmatrix} 2 & -3 & 3 \\ 2 & 2 & 3 \\ 3 & -2 & 2 \end{bmatrix}$. We know that $I = I_4$

$$\therefore \begin{bmatrix} 2 & -3 & 3 \\ 2 & 2 & 3 \\ 3 & -2 & 2 \end{bmatrix} = \begin{bmatrix} 1 & 0 & 0 \\ 0 & 1 & 0 \\ 0 & 0 & 1 \end{bmatrix} A$$

$$\Rightarrow \begin{bmatrix} 1 & 1 & 4 \\ 2 & 2 & 3 \\ 3 & -2 & 2 \end{bmatrix} = \begin{bmatrix} 1 & 1 & -1 \\ 0 & 1 & 0 \\ 0 & 0 & 1 \end{bmatrix} A \quad [\because R_1 \rightarrow R_1 + R_2 - R_3]$$

$$\Rightarrow \begin{bmatrix} 1 & 1 & 4 \\ 0 & 0 & -5 \\ 0 & -5 & -10 \end{bmatrix} = \begin{bmatrix} 1 & 1 & -1 \\ -2 & -1 & 2 \\ -3 & -3 & 4 \end{bmatrix} A$$

$$[\because R_2 \rightarrow R_2 - 2R_1 \text{ and } R_3 \rightarrow R_3 - 3R_1]$$

$$\Rightarrow \begin{bmatrix} 1 & 1 & 4 \\ 0 & -5 & -10 \\ 0 & 0 & -5 \end{bmatrix} = \begin{bmatrix} 1 & 1 & -1 \\ -3 & -3 & 4 \\ -2 & -1 & 2 \end{bmatrix} A \quad [\because R_1 \leftrightarrow R_3]$$

$$\Rightarrow \begin{bmatrix} 1 & 1 & 4 \\ 0 & 1 & 2 \\ 0 & 0 & 1 \end{bmatrix} = \begin{bmatrix} 1 & 1 & -1 \\ \frac{3}{5} & \frac{3}{5} & \frac{4}{5} \\ \frac{2}{5} & \frac{1}{5} & \frac{2}{5} \end{bmatrix} A$$

$$[\because R_2 \rightarrow -\frac{1}{5}R_2 \text{ and } R_3 \rightarrow -\frac{1}{5}R_3]$$

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 Rest part of Q. 15. Matrix Ex-3.4

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$$\Rightarrow \begin{bmatrix} 1 & 1 & 0 \\ 0 & 1 & 0 \\ 0 & 0 & 1 \end{bmatrix} = \begin{bmatrix} -\frac{3}{5} & \frac{1}{5} & \frac{3}{5} \\ -\frac{1}{5} & \frac{1}{5} & 0 \\ \frac{2}{5} & \frac{1}{5} & -\frac{2}{5} \end{bmatrix} A$$

$$[\because R_2 \rightarrow R_2 - 2R_3 \text{ And } R_1 \rightarrow R_1 - 4R_3]$$

$$\Rightarrow \begin{bmatrix} 1 & 0 & 0 \\ 0 & 1 & 0 \\ 0 & 0 & 1 \end{bmatrix} = \begin{bmatrix} -\frac{2}{5} & 0 & \frac{3}{5} \\ -\frac{1}{5} & \frac{1}{5} & 0 \\ \frac{2}{5} & \frac{1}{5} & -\frac{2}{5} \end{bmatrix} A$$

$$[\because R_1 \rightarrow R_1 - R_2]$$

$$\Rightarrow I_3 = -\frac{1}{5} \begin{bmatrix} 2 & 0 & -3 \\ 1 & -1 & 0 \\ -2 & -1 & 2 \end{bmatrix} A$$

$$\therefore A^{-1} = -\frac{1}{5} \begin{bmatrix} 2 & 0 & -3 \\ 1 & -1 & 0 \\ -2 & -1 & 2 \end{bmatrix} [\because AA^{-1} = I_3]$$

Q. 16 $\begin{bmatrix} 1 & 3 & -2 \\ -3 & 0 & -5 \\ 2 & 5 & 0 \end{bmatrix}$

Soln: Let $A = \begin{bmatrix} 1 & 3 & -2 \\ -3 & 0 & -5 \\ 2 & 5 & 0 \end{bmatrix}$

We know that
 $A = IA$

$$\Rightarrow \begin{bmatrix} 1 & 3 & -2 \\ -3 & 0 & -5 \\ 2 & 5 & 0 \end{bmatrix} = \begin{bmatrix} 1 & 0 & 0 \\ 0 & 1 & 0 \\ 0 & 0 & 1 \end{bmatrix} A$$

$$\Rightarrow \begin{bmatrix} 1 & 3 & -2 \\ 0 & 9 & -11 \\ 0 & -1 & 4 \end{bmatrix} = \begin{bmatrix} 1 & 0 & 0 \\ 3 & 1 & 0 \\ -2 & 0 & 1 \end{bmatrix} A \left[\begin{array}{l} \because R_2 \rightarrow R_2 + 3R_1 \\ \text{and } R_3 \rightarrow R_3 - 2R_1 \end{array} \right]$$

$$\Rightarrow \begin{bmatrix} 1 & 3 & -2 \\ 0 & 1 & -\frac{11}{9} \\ 0 & -1 & 4 \end{bmatrix} = \begin{bmatrix} 1 & 0 & 0 \\ \frac{1}{3} & \frac{1}{9} & 0 \\ -2 & 0 & 1 \end{bmatrix} A \left[\begin{array}{l} \because R_2 \rightarrow \frac{1}{9} R_2 \end{array} \right]$$

$$\Rightarrow \begin{bmatrix} 1 & 3 & -2 \\ 0 & 1 & -\frac{11}{9} \\ 0 & 0 & \frac{25}{9} \end{bmatrix} = \begin{bmatrix} 1 & 0 & 0 \\ \frac{1}{3} & \frac{1}{9} & 0 \\ -\frac{5}{3} & \frac{1}{9} & 1 \end{bmatrix} A \left[\begin{array}{l} \because R_3 \rightarrow R_3 + R_2 \end{array} \right]$$

$$\Rightarrow \begin{bmatrix} 1 & 3 & -2 \\ 0 & 1 & -\frac{11}{9} \\ 0 & 0 & 1 \end{bmatrix} = \begin{bmatrix} 1 & 0 & 0 \\ \frac{1}{3} & \frac{1}{9} & 0 \\ -\frac{3}{5} & \frac{1}{25} & \frac{9}{25} \end{bmatrix} A \left[\begin{array}{l} \because R_3 \rightarrow \left(\frac{9}{25}\right) R_3 \end{array} \right]$$

$$\Rightarrow \begin{bmatrix} 1 & 3 & -2 \\ 0 & 1 & -\frac{11}{9} \\ 0 & 0 & 1 \end{bmatrix} = \begin{bmatrix} -\frac{1}{5} & \frac{2}{25} & \frac{18}{25} \\ -\frac{2}{5} & \frac{4}{25} & \frac{11}{25} \\ -\frac{3}{5} & \frac{1}{25} & \frac{9}{25} \end{bmatrix} A$$

$$\left[\begin{array}{l} \because R_2 \rightarrow R_2 + \left(\frac{11}{9}\right) R_3 \text{ and } R_1 \rightarrow R_1 + 2R_3 \end{array} \right]$$

$$\Rightarrow \begin{bmatrix} 1 & 0 & 0 \\ 0 & 1 & 0 \\ 0 & 0 & 1 \end{bmatrix} = \begin{bmatrix} 1 & -\frac{2}{5} & -\frac{3}{5} \\ -\frac{2}{5} & \frac{4}{25} & \frac{11}{25} \\ -\frac{3}{5} & \frac{1}{25} & \frac{9}{25} \end{bmatrix} A \left[\begin{array}{l} \because R_1 \rightarrow R_1 - 3R_3 \end{array} \right]$$

$$\text{Hence, } A^{-1} = \begin{bmatrix} 1 & -\frac{2}{5} & -\frac{3}{5} \\ -\frac{2}{5} & \frac{4}{25} & \frac{11}{25} \\ -\frac{3}{5} & \frac{1}{25} & \frac{9}{25} \end{bmatrix} = \frac{1}{25} \begin{bmatrix} 25 & -10 & -15 \\ -10 & 4 & 11 \\ -15 & 1 & 9 \end{bmatrix}$$

$$\left[\begin{array}{l} \because AA^{-1} = I \end{array} \right]$$

$$\Rightarrow \begin{bmatrix} 1 & 3 & -2 \\ 0 & 9 & -11 \\ 0 & -1 & 4 \end{bmatrix} = \begin{bmatrix} 1 & 0 & 0 \\ 3 & 1 & 0 \\ -2 & 0 & 1 \end{bmatrix} A \left[\begin{array}{l} \because R_2 \rightarrow R_2 + 3R_1 \\ \text{and } R_3 \rightarrow R_3 - 2R_1 \end{array} \right]$$

$$\Rightarrow \begin{bmatrix} 1 & 3 & -2 \\ 0 & 1 & -\frac{11}{9} \\ 0 & -1 & 4 \end{bmatrix} = \begin{bmatrix} 1 & 0 & 0 \\ \frac{1}{3} & \frac{1}{9} & 0 \\ -2 & 0 & 1 \end{bmatrix} A \left[\begin{array}{l} \because R_2 \rightarrow \frac{1}{9} R_2 \end{array} \right]$$

$$\Rightarrow \begin{bmatrix} 1 & 3 & -2 \\ 0 & 1 & -\frac{11}{9} \\ 0 & 0 & \frac{25}{9} \end{bmatrix} = \begin{bmatrix} 1 & 0 & 0 \\ \frac{1}{3} & \frac{1}{9} & 0 \\ -\frac{5}{3} & \frac{1}{9} & 1 \end{bmatrix} A \left[\begin{array}{l} \because R_3 \rightarrow R_3 + R_2 \end{array} \right]$$

$$\Rightarrow \begin{bmatrix} 1 & 3 & -2 \\ 0 & 1 & -\frac{11}{9} \\ 0 & 0 & 1 \end{bmatrix} = \begin{bmatrix} 1 & 0 & 0 \\ \frac{1}{3} & \frac{1}{9} & 0 \\ -\frac{3}{5} & \frac{1}{25} & \frac{9}{25} \end{bmatrix} A \left[\begin{array}{l} \because R_3 \rightarrow \left(\frac{9}{25}\right) R_3 \end{array} \right]$$

$$\Rightarrow \begin{bmatrix} 1 & 3 & -9 \\ 0 & 1 & -\frac{11}{9} \\ 0 & 0 & 1 \end{bmatrix} = \begin{bmatrix} -\frac{1}{5} & \frac{2}{25} & \frac{18}{25} \\ -\frac{2}{5} & \frac{4}{25} & \frac{11}{25} \\ -\frac{3}{5} & \frac{1}{25} & \frac{9}{25} \end{bmatrix} A$$

$$\left[\begin{array}{l} \because R_2 \rightarrow R_2 + \left(\frac{11}{9}\right) R_3 \text{ and } R_1 \rightarrow R_1 + 2R_3 \end{array} \right]$$

$$\Rightarrow \begin{bmatrix} 1 & 0 & 0 \\ 0 & 1 & 0 \\ 0 & 0 & 1 \end{bmatrix} = \begin{bmatrix} 1 & -\frac{2}{5} & -\frac{3}{5} \\ -\frac{2}{5} & \frac{4}{25} & \frac{11}{25} \\ -\frac{3}{5} & \frac{1}{25} & \frac{9}{25} \end{bmatrix} A \left[\begin{array}{l} \because R_1 \rightarrow R_1 - 3R_3 \end{array} \right]$$

$$\text{Hence, } A^{-1} = \begin{bmatrix} 1 & -\frac{2}{5} & -\frac{3}{5} \\ -\frac{2}{5} & \frac{4}{25} & \frac{11}{25} \\ -\frac{3}{5} & \frac{1}{25} & \frac{9}{25} \end{bmatrix} = \frac{1}{25} \begin{bmatrix} 25 & -10 & -15 \\ -10 & 4 & 11 \\ -15 & 1 & 9 \end{bmatrix}$$

$$\left[\begin{array}{l} \because AA^{-1} = I \end{array} \right]$$