

Q3.

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**Example 7** If  $x = -4$  is a root of  $\Delta = \begin{vmatrix} x & 2 & 3 \\ 1 & x & 1 \\ 3 & 2 & x \end{vmatrix} = 0$ , then find the other two roots.

**Solution** Applying  $R_1 \rightarrow (R_1 + R_2 + R_3)$ , we get

$$\begin{vmatrix} x+4 & x+4 & x+4 \\ 1 & x & 1 \\ 3 & 2 & x \end{vmatrix}.$$

Taking  $(x + 4)$  common from  $R_1$ , we get

$$\Delta = (x+4) \begin{vmatrix} 1 & 1 & 1 \\ 1 & x & 1 \\ 3 & 2 & x \end{vmatrix}$$

Applying  $C_2 \rightarrow C_2 - C_1$ ,  $C_3 \rightarrow C_3 - C_1$ , we get

$$\Delta = (x+4) \begin{vmatrix} 1 & 0 & 0 \\ 1 & x-1 & 0 \\ 3 & -1 & x-3 \end{vmatrix}.$$

Expanding along  $R_1$ ,

$$\Delta = (x + 4) [(x - 1)(x - 3) - 0]. \text{ Thus, } \Delta = 0 \text{ implies}$$

$$x = -4, 1, 3$$

Q4.

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