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Section :- B

Subject :- Differential equation

Quiz :- 1

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①

Q. A yarn merchant sells brands A, B, C of yarn of each is a brand of Pakistan, egyptian and american brand cotton in the ratio of $1:2:1$, $2:1:1$, $2:0:2$ respectively. If one kilogram of A, B, C cost of 40, 50 and 60 rupees, find the cost of a kilogram of cotton of each country.

$1:2:1$, $2:1:1$ $2:0:2$

P	E
A	E

A

P	P
A	E

B

P	P
A	A

C

let x, y, z be the costing of Pakistani, egyptian and american cotton, then according to the given condition

$$\frac{1}{4}x + \frac{2}{4}y + \frac{1}{4}z = 40$$

$$\frac{2}{4}x + \frac{1}{4}y + \frac{1}{4}z = 50$$

$$\frac{2}{4}x + \frac{2}{4}z = 60$$

--- (5)

(2)

$$\left. \begin{aligned} 1x + 2y + 1z &= 160 \\ 2x + 1y + 1z &= 200 \\ 1x + 1z &= 120 \end{aligned} \right\} \text{--- (3)}$$

In Matrix form we can write it as

$$\begin{bmatrix} 1 & 2 & 1 \\ 2 & 1 & 1 \\ 1 & 0 & 1 \end{bmatrix} \begin{bmatrix} x \\ y \\ z \end{bmatrix} = \begin{bmatrix} 160 \\ 200 \\ 120 \end{bmatrix}$$

$$A = \begin{bmatrix} 1 & 2 & 1 \\ 2 & 1 & 1 \\ 1 & 0 & 1 \end{bmatrix}, \underline{x} = \begin{bmatrix} x \\ y \\ z \end{bmatrix}, \underline{b} = \begin{bmatrix} 160 \\ 200 \\ 120 \end{bmatrix}$$

$$\underline{Ax} = \underline{b}$$

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

$$A_1 = \begin{bmatrix} 160 & 2 & 1 \\ 200 & 1 & 1 \\ 120 & 0 & 1 \end{bmatrix}$$

$$A_2 = \begin{bmatrix} 1 & 160 & 1 \\ 2 & 200 & 1 \\ 1 & 120 & 1 \end{bmatrix}$$

$$A_3 = \begin{bmatrix} 1 & 2 & 160 \\ 2 & 1 & 200 \\ 1 & 0 & 120 \end{bmatrix}$$

$$|A| = -2 \quad |A| = \begin{vmatrix} 1 & 2 & 1 \\ 2 & 1 & 1 \\ 1 & 0 & 1 \end{vmatrix} = 1(1 \times 1 - 0 \times 1) - 2(1 \times 1 - 1 \times 1) + 1(2 \times 1 - 1 \times 1)$$

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$$|A_1| = -120 \quad |A| = \begin{bmatrix} 160 & 2 & 1 \\ 200 & 1 & 1 \\ 120 & 0 & 1 \end{bmatrix} = 160(1 \times 1 - 0 \times 1) - 2(200 \times 1 - 120 \times 1) + 1(200 \times 1 - 120 \times 1)$$

$$|A_2| = -40 \quad |A_2| = \begin{bmatrix} 1 & 160 & 1 \\ 2 & 200 & 1 \\ 1 & 120 & 1 \end{bmatrix} = 1(200 \times 1 - 120 \times 1) - 160(2 \times 1 - 1 \times 1) + 1(2 \times 1 - 1 \times 200)$$

$$|A_3| = 120 \quad |A_3| = \begin{bmatrix} 1 & 2 & 160 \\ 2 & 1 & 200 \\ 1 & 1 & 120 \end{bmatrix} = 1(1 \times 120 - 0 \times 200) - 2(2 \times 120 - 1 \times 200) + 160(2 \times 120 - 1 \times 1)$$

$$|A| = -2$$

$$|A_1| = -120 \quad |A_2| = -40$$

$$|A_3| = 120$$

According to Cramer's rule

$$x = \frac{|A_1|}{|A|} = \frac{-120}{-2} = 60$$

$$y = \frac{|A_2|}{|A|} = \frac{-40}{-2} = 20$$

$$z = \frac{|A_3|}{|A|} = \frac{120}{-2} = -60$$

$$(x, y, z) = (60, 20, -60)$$