Date:.....

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Roll No: 2021_SE_04
Subject: LADE
Dicipline: Software-Engineering (SE)

Q1 : Sol:

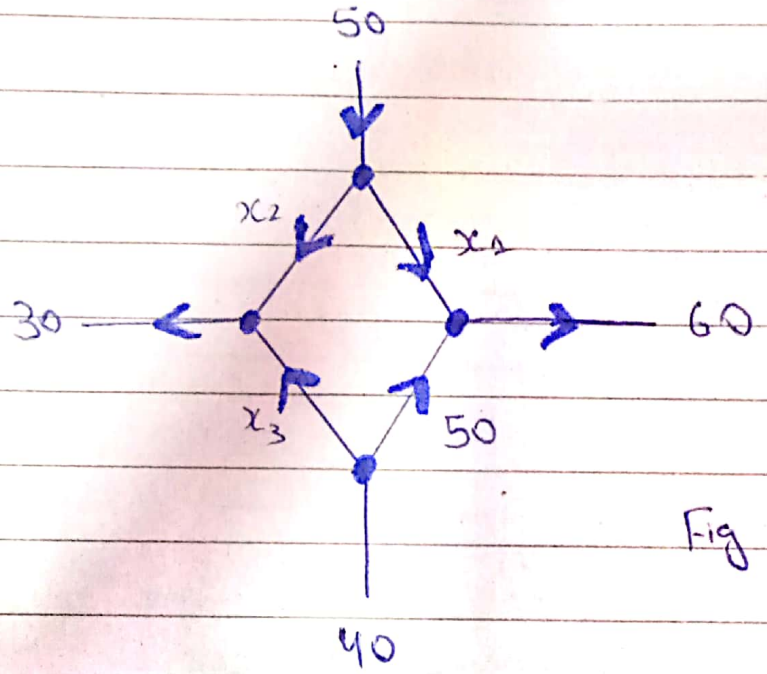

Fig A

Draw Arbitrary Arrows and label them with variables as shown in Fig A

Linear System

$$x_1 + 50 = 60 \quad \text{—(I)}$$
$$x_1 + x_2 = 50 \quad \text{—(II)}$$
$$x_2 + x_3 = 30 \quad \text{—(III)}$$
$$x_3 + 50 = 40 \quad \text{—(IV)}$$

$x_1 = 10$

$x_2 = 40$

$x_3 = -10$

$x_2 = 50 - 10 = 40$; $x_2 + x_3 = 30$

$40 + x_3 = 30$

$x_3 = -10$

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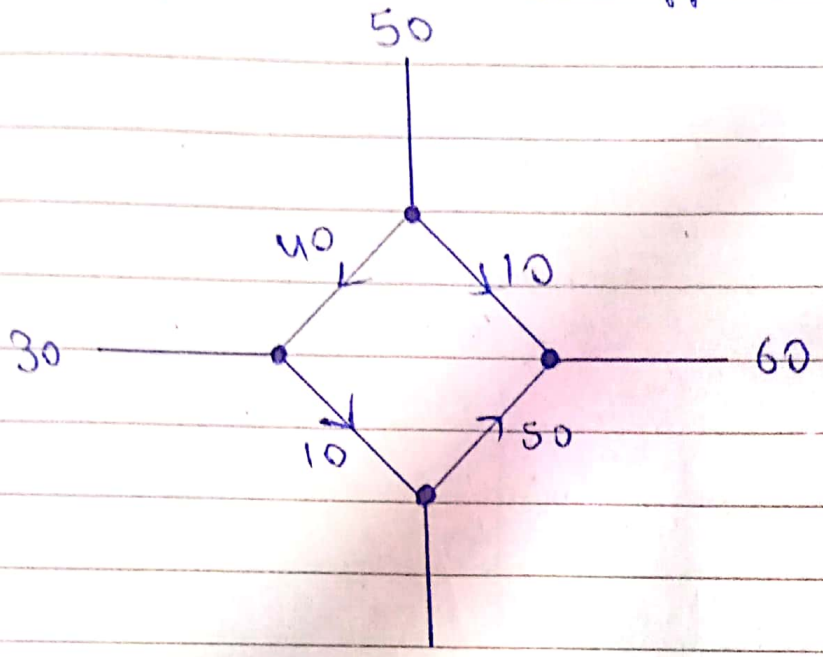
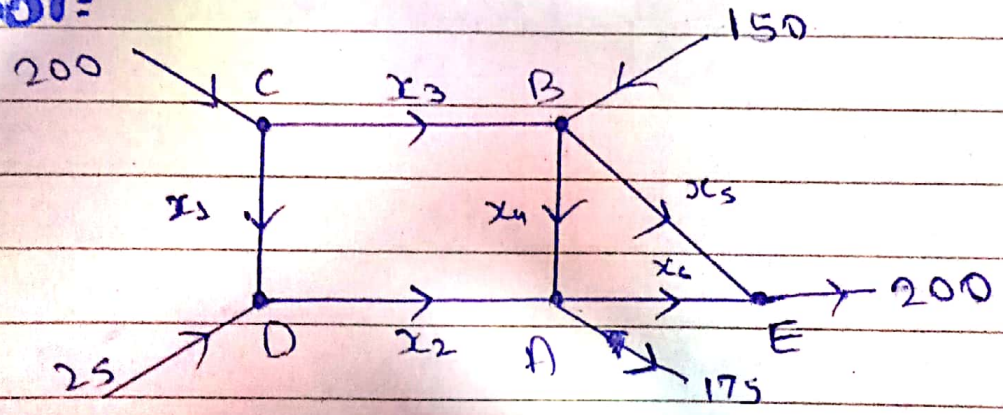
x_3 indicates that the direction in fig A is incorrect. It is reverse (opposite direction as shown in fig A)



Q:2 : Sol:



a) Linear System

$$x_1 + x_3 = 200 \quad -①$$

$$x_1 + 25 = x_2 \quad -②$$

$$x_2 + x_4 = x_6 + 175 \quad -③$$

$$x_5 + x_6 = 200 \quad -④$$

$$x_4 + x_5 = 150 + x_3 \quad -⑤$$

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$$\begin{bmatrix} 1 & 0 & 1 & 0 & 0 & 0 & 200 \\ 1 & -1 & 0 & 0 & 0 & 0 & 25 \\ 0 & 0 & -1 & 1 & 1 & 0 & 150 \\ 0 & 1 & 0 & 1 & 0 & -1 & 175 \\ 0 & 0 & 0 & 0 & 1 & 1 & 200 \end{bmatrix}$$

$R_2 - R_1$, $(-)R_3$

$$\begin{bmatrix} 1 & 0 & 1 & 0 & 0 & 0 & 200 \\ 0 & -1 & -1 & 0 & 0 & 0 & -225 \\ 0 & 0 & 1 & -1 & -1 & 0 & -150 \\ 0 & 1 & 0 & 1 & 0 & -1 & +175 \\ 0 & 0 & 0 & 0 & 1 & 1 & 200 \end{bmatrix}$$

$R_4 + R_2$

$$\begin{bmatrix} 1 & 0 & 1 & 0 & 0 & 0 & 200 \\ 0 & -1 & -1 & 0 & 0 & 0 & -225 \\ 0 & 0 & 1 & -1 & -1 & 0 & -150 \\ 0 & 0 & -1 & 1 & 0 & -1 & +50 \\ 0 & 0 & 0 & 0 & 1 & 1 & 200 \end{bmatrix}$$

$R_4 + R_3$

$$\begin{bmatrix} 1 & 0 & 1 & 0 & 0 & 0 & 200 \\ 0 & -1 & -1 & 0 & 0 & 0 & -225 \\ 0 & 0 & 1 & -1 & -1 & 0 & -150 \\ 0 & 0 & 0 & 0 & -1 & -1 & -200 \\ 0 & 0 & 0 & 0 & 1 & 1 & 200 \end{bmatrix}$$

$R_5 + R_4$, $(-)R_2$, $(-1)R_4$

$$\begin{bmatrix} 1 & 0 & 1 & 0 & 0 & 0 & 200 \\ 0 & +1 & +1 & 0 & 0 & 0 & +225 \\ 0 & 0 & 1 & -1 & -1 & 0 & -150 \\ 0 & 0 & 0 & 0 & -1 & +1 & -200 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 \end{bmatrix}$$

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$x_1 + x_3 = 200$

$x_2 + x_3 = 225$

$x_3 - x_4 - x_5 = -150$

$x_5 + x_6 = 200$

Let $x_5 = u$, $x_4 = t$

$\boxed{x_5 = u}$

$\boxed{x_6 = 200 - u}$

$\boxed{x_4 = t}$

$\boxed{x_3 = -150 + u + t}$

$\boxed{x_2 = 375 + u + t}$

$\boxed{x_1 = 350 + u + t}$

Infinitely Many Solutions.

c) If $x_4 = 50$ $x_6 = 0$ $x_4 = 50 = t$ $\boxed{t = 50}$

→ $\boxed{x_6 = 0}$ $\Rightarrow 0 = 200 - u \Rightarrow \boxed{u = 200}$

→ $\boxed{x_5 = 200}$

→ $\boxed{x_4 = 50}$

$x_3 = -150 + 200 + 50 = 100$

→ $\boxed{x_3 = 100}$

$x_2 = 375 - 200 - 50 = 125$

→ $\boxed{x_2 = 125}$

$x_1 = 350 - 200 - 50 = 100$

→ $\boxed{x_1 = 100}$

Thus if $x_4 = 50$ and $x_6 = 0$ then

$x_1 = 100$, $x_2 = 125$, $x_3 = 100$ and $x_5 = 200$

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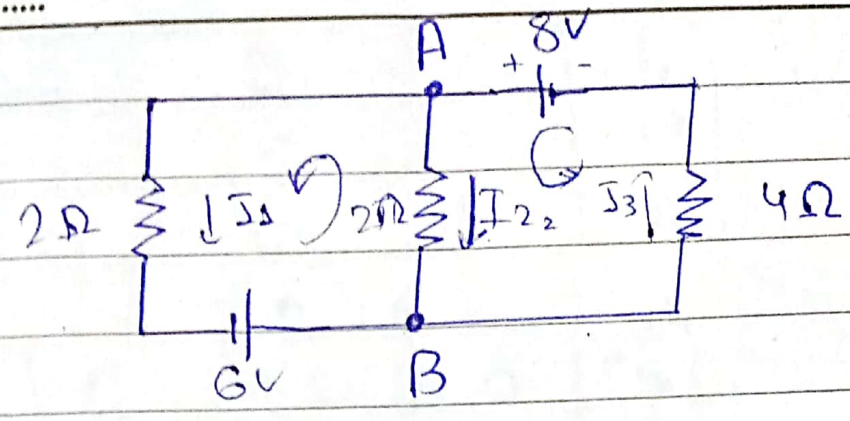
Q5 :



⇒ **Kirchoffs Current Law:**

Node	Current In	Current Out
A	I_3	$I_1 + I_2$
B	I_1, I_2	I_3

As these eqs are same the can be expressedas as ~~Thus they~~

$$I_1 + I_2 - I_3 = 0$$

⇒ **Kirchoffs Voltage Law**

	Voltage Rises	Voltage Drops
Left Inside Loop	$2I_2 + 6$	$2I_1$
Right Inside Loop	8	$2I_2 + 4I_3$
Outside Loop	$6 + 8$	$4I_3 + 2I_1$

$$2I_1 + 4I_3 = 14$$
$$2I_2 + 4I_3 = 8$$
$$-2I_1 + 2I_2 = -6$$

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$$\left[\begin{array}{ccc|c} -2 & 2 & 0 & -6 \\ 2 & 0 & 4 & 14 \\ 0 & 2 & 4 & 8 \end{array}\right]$$

$R_2 + R_1$

$$\left[\begin{array}{ccc|c} 2 & 2 & 0 & -6 \\ 0 & 2 & 4 & 8 \\ 0 & 2 & 4 & 8 \end{array}\right]$$

$R_3 - R_2$

$$\left[\begin{array}{ccc|c} -2 & 2 & 0 & -6 \\ 0 & 2 & 4 & 8 \\ 0 & 0 & 0 & 0 \end{array}\right] \quad -\frac{1}{2}R_2,\ \frac{1}{2}R_2$$

$$\left[\begin{array}{ccc|c} 1 & -1 & 0 & 3 \\ 0 & 1 & 2 & 4 \\ 0 & 0 & 0 & 0 \end{array}\right]$$

$\Rightarrow$ $\boxed{I_1 - I_2 = 3}$ —— (2)

$\Rightarrow$ $\boxed{I_2 + 2I_3 = 4}$ —— (3)

$I_1 + I_2 - I_3 = 0$ from eq (1)

$I_1 + I_2 = I_3$ Put in eq (3)

eq (3) becomes

$I_2 + 2I_1 + 2I_2 = 4$

$3I_2 + 2I_1 = 4$ —— (4)

$I_1 - I_2 = 3$

$\boxed{I_1 = 3 + I_2}$

Put this in eq (2)

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$$3I_2 + 2(3 + I_2) = 4$$

$$3I_2 + 6 + 2I_2 = 4$$

$$3I_2 + 2I_2 = -2$$

$$5I_2 = -2$$

$$\boxed{I_2 = -2/5}$$

For eq (2)

$$I_1 - I_2 = 3$$

$$I_1 + \frac{2}{5} = 3$$

$$\boxed{I_1 = \frac{13}{5}}$$

For eq (3)

$$I_2 + 2I_3 = 4$$

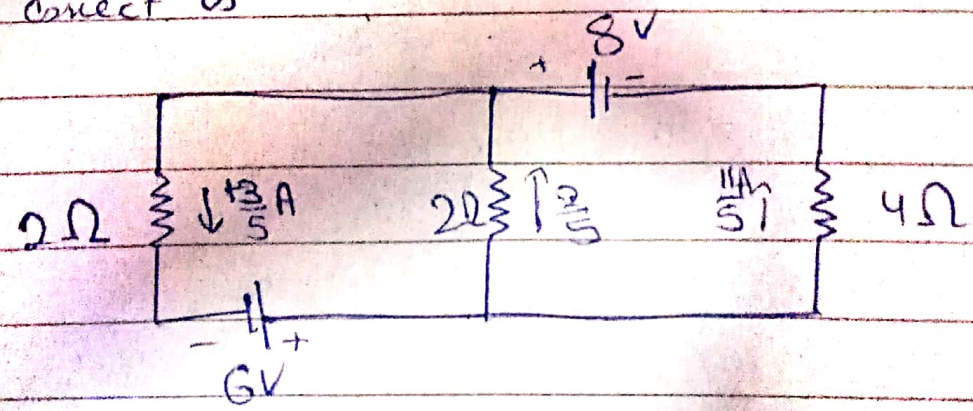
$$2I_3 = 4 - I_2 = 4 + \frac{2}{5} = \frac{22}{5}$$

$$\boxed{I_3 = \frac{11}{5}}$$

$$I_1 = \frac{13}{5}, \quad I_2 = \frac{-2}{5}, \quad I_3 = \frac{11}{5}$$

$I_2 = -\frac{2}{5}$ indicates its direction is opposite as shown.

Thus the correct is



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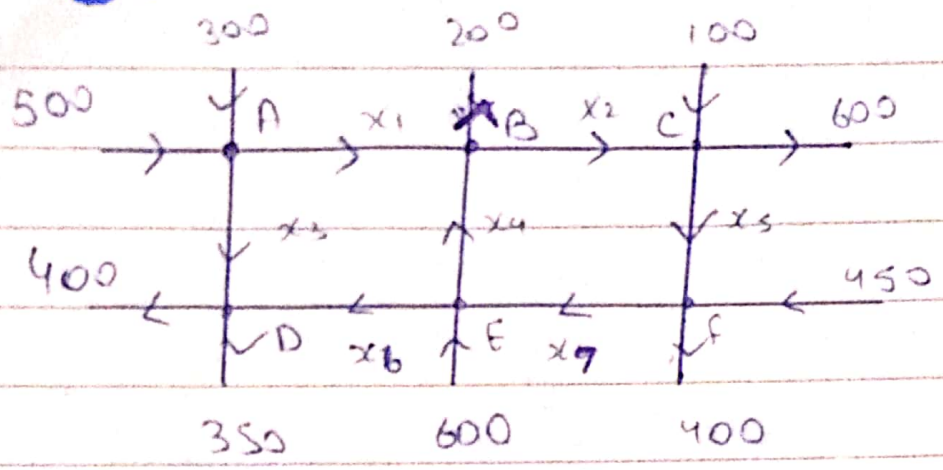
Q4: Sol.



(A) Linear System:

Intersection	Flow In.	Flow Out	
A	$300 + 500$	$x_1 + x_3 \Rightarrow$	$x_1 + x_3 = 800$
B	$x_1 + x_4$	$200 + x_2 \Rightarrow$	$x_1 - x_2 + x_4 = 200$
C	$x_2 + 100$	$x_5 + 600 \Rightarrow$	$x_2 + x_5 = 700$
D	$x_3 + x_6$	$400 + 350 \Rightarrow$	$x_3 + x_6 = 750$
E	$600 + x_7$	$x_4 + x_6 \Rightarrow$	$x_4 + x_6 - x_7 = 600$
F	$x_5 + 450$	$x_7 + 400 \Rightarrow$	$x_5 - x_7 = -50$

$$\left[\begin{array}{ccccccc|c} 1 & 0 & 1 & 0 & 0 & 0 & 0 & 800 \\ 1 & -1 & 0 & 1 & 0 & 0 & 0 & 200 \\ 0 & 1 & 0 & 0 & 1 & 0 & 0 & 700 \\ 0 & 0 & 1 & 0 & 0 & 1 & 0 & 750 \\ 0 & 0 & 0 & 1 & 0 & 1 & -1 & 600 \\ 0 & 0 & 0 & 0 & 1 & 0 & -1 & -50 \end{array}\right]$$

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$R_2 - R_1$

$$\left[\begin{array}{ccccccc|c} 1 & 0 & 1 & 0 & 0 & 0 & 0 & 800 \\ 0 & -1 & -1 & 1 & 0 & 0 & 0 & -600 \\ 0 & 1 & 0 & 0 & 1 & 0 & 0 & 700 \\ 0 & 0 & 1 & 0 & 0 & 1 & 0 & 750 \\ 0 & 0 & 0 & 1 & 0 & 1 & -1 & 600 \\ 0 & 0 & 0 & 0 & 1 & 0 & -1 & -50 \end{array}\right]$$

$R_3 + R_2$

$$\left[\begin{array}{ccccccc|c} 1 & 0 & 1 & 0 & 0 & 0 & 0 & 800 \\ 0 & -1 & -1 & 1 & 0 & 0 & 0 & -600 \\ 0 & 0 & -1 & 1 & 1 & 0 & 0 & 100 \\ 0 & 0 & 1 & 0 & 0 & 1 & 0 & 750 \\ 0 & 0 & 0 & 1 & 0 & 1 & -1 & 600 \\ 0 & 0 & 0 & 0 & 1 & 0 & -1 & -50 \end{array}\right]$$

$R_4 + R_3$

$$\left[\begin{array}{ccccccc|c} 1 & 0 & 1 & 0 & 0 & 0 & 0 & 800 \\ 0 & -1 & -1 & 1 & 0 & 0 & 0 & -600 \\ 0 & 0 & -1 & 1 & 1 & 0 & 0 & 100 \\ 0 & 0 & 0 & 1 & 1 & 1 & 0 & 850 \\ 0 & 0 & 0 & 1 & 0 & 1 & -1 & 600 \\ 0 & 0 & 0 & 0 & 1 & 0 & -1 & -50 \end{array}\right]$$

$R_5 - R_4$

$$\left[\begin{array}{ccccccc|c} 1 & 0 & 1 & 0 & 0 & 0 & 0 & 800 \\ 0 & -1 & -1 & 1 & 0 & 0 & 0 & -600 \\ 0 & 0 & -1 & 1 & 1 & 0 & 0 & 100 \\ 0 & 0 & 0 & 1 & 1 & 1 & 0 & 850 \\ 0 & 0 & 0 & 0 & -1 & 0 & -1 & -250 \\ 0 & 0 & 0 & 0 & 1 & 0 & -1 & -50 \end{array}\right]$$

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$R_6 + R_5$

$$\left[\begin{array}{ccccccc|c} 1 & 0 & 1 & 0 & 0 & 0 & 0 & 800 \\ 0 & -1 & -1 & 1 & 0 & 0 & 0 & -600 \\ 0 & 0 & -1 & 1 & 1 & 0 & 0 & 100 \\ 0 & 0 & 0 & 1 & 1 & 1 & 0 & 850 \\ 0 & 0 & 0 & 0 & -1 & 0 & -1 & -250 \\ 0 & 0 & 0 & 0 & 0 & 0 & -2 & -300 \end{array}\right]$$

$$x_1 + x_3 = 800$$

$$-x_2 - x_3 + x_4 = -600$$

$$-x_3 + x_4 + x_5 = 100$$

$$x_4 + x_5 + x_6 = 850$$

$$-x_5 - x_7 = -250$$

$$-2x_7 = -300$$

$$\boxed{x_7 = 150}$$

$$x_5 + 150 = 250 \qquad \boxed{x_5 = 100}$$

$$-x_3 + 750 - t + x_5 = 100$$

$$-x_3 + 750 - t = 0$$

$$\boxed{750 - t = x_3}$$

$$x_4 + x_5 + x_6 = 850$$

$$x_4 + 100 + x_6 = 850$$

$$x_4 + x_6 = 750$$

Let $x_6 = t$

$$\boxed{x_4 = 750 - t}$$

$$x_1 + 750 - t = 800$$

$$\boxed{x_1 = 50 + t}$$

$$-x_2 - 750 + t + 750 - t = 600$$

$$\boxed{x_2 = 600}$$

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$x_1 = 50 + t$

$x_2 = 600$

$x_3 = 750 - t$

$x_4 = 750 - t$

$x_5 = 100$

$x_6 = t$

$x_7 = 150$

Infinetly Many Sols:

$\Rightarrow x_1 - 50 = x_3 - 750 = x_4 - 750 = x_6$

c)

If A → B road is close $x_1 = 0$

$50 + t = 0$

$t = -50$

$x_1 = 0$

$x_2 = 600$

$x_3 = 800$

$x_4 = 800$

$x_5 = 100$

$x_6 = -50$

$x_7 = 150$

Yes it is possible ad it will look alik this