Q5

Let x, y, z be annual spend on Radio, Mag and TV Respectively. Thus

$$x + y + z = 600{,}000$$
$$x + y = z$$
$$5x = y + z$$

$$x + y + z = 600{,}000 \quad \text{— (I)}$$
$$x + y - z = 0 \quad \text{— (II)}$$
$$5x - y - z = 0 \quad \text{— (III)}$$

Row: No of variable Col: No of eqs

$$\left[\begin{array}{ccc|c} 5 & -1 & -1 & 0 \\ 1 & 1 & -1 & 0 \\ 1 & 1 & 1 & 60000 \end{array}\right]$$

$R_2 \to -\frac{1}{5}R_1,\ R_3 - \frac{1}{5}R_1$

$$\left[\begin{array}{ccc|c} 5 & -1 & -1 & 0 \\ 0 & \frac{6}{5} & -\frac{4}{5} & 0 \\ 0 & \frac{6}{5} & \frac{6}{5} & 600{,}000 \end{array}\right]$$

$R_3 - R_2$

$$\left[\begin{array}{ccc|c} 5 & -1 & -1 & 0 \\ 0 & 6/5 & -4/5 & 0 \\ 0 & 0 & 2 & 600{,}000 \end{array}\right]$$

$\left(\frac{1}{5}\right)R_1, \left(\frac{5}{6}\right)R_2, \left(\frac{1}{2}\right)R_3$

$$\left[\begin{array}{ccc|c} 1 & -1/5 & -1/5 & 0 \\ 0 & 1 & -4/6 & 0 \\ 0 & 0 & 1 & 300,000 \end{array}\right]$$

$R_2 + 4/6 R_3$, $R_1 + \frac{1}{5} R_2$

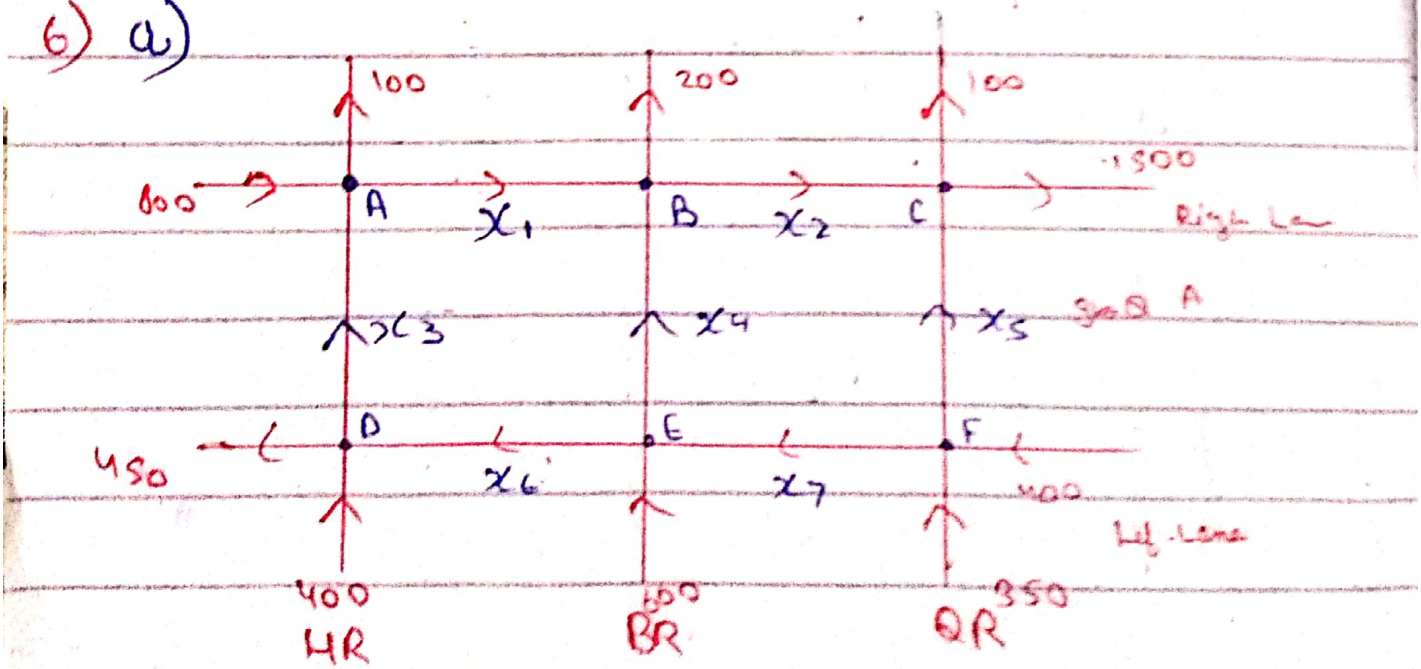
$$\left[\begin{array}{ccc|c} 1 & -1/5 & 0 & 60,000 \\ 0 & 1 & 0 & 200,000 \\ 0 & 0 & 1 & 300,000 \end{array}\right]$$

$R_1 + \frac{1}{5} R_2$

$$\left[\begin{array}{ccc|c} 1 & 0 & 0 & 100,000 \\ 0 & 1 & 0 & 200,000 \\ 0 & 0 & 1 & 300,000 \end{array}\right]$$

$x = 100,000$, $y = 200,000$ $z = 300,000$

6) a)



b) ~~If HR ... HR → BR = 50 → $x_6 = 50$~~

then

Show $x_6 = 50$

c)

If $x_7 = 0$, $x_2 = ?$

a) Linear System (Required Model)

Nod	Flow In	Flow Out	Eq
A	$600 + x_3$	$100 + x_1$	⇒ $x_1 - x_3 = -500$ — ①
B	$x_1 + x_4$	$200 + x_2$	⇒ $x_1 - x_2 + x_4 = 200$ — ②
C	$x_2 + x_5$	1600	⇒ $x_2 + x_5 = 1600$ — ③
D	$400 + x_6$	$x_3 + 450$	⇒ $x_3 + x_6 = -50$ — ④
E	$600 + x_7$	$x_4 + x_6$	⇒ $x_4 + x_6 + x_7 = 600$ — ⑤
F	$350 + 400$	$x_7 + x_5$	⇒ $x_5 + x_7 = 750$ — ⑥

∴ Row = No of Variable   Col = No of Rows

$$\left[\begin{array}{ccccccc|c} 1 & 0 & -1 & 0 & 0 & 0 & 0 & -500 \\ 1 & -1 & 0 & 1 & 0 & 0 & 0 & 200 \\ 0 & 1 & 0 & 0 & 1 & 0 & 0 & 1600 \\ 0 & 0 & 1 & 0 & 0 & -1 & 0 & -50 \\ 0 & 0 & 0 & 1 & 0 & 1 & 1 & 600 \\ 0 & 0 & 0 & 0 & 1 & 0 & 1 & 750 \end{array}\right]$$

b) No he didn't ask for All unknown values so, we don't need to Solve it further (we can but it is useless)

If Prove / Show $x_6 = 50$

From eq (3)

$x_3 + x_6 = 800$

Let $x_6 = 50$

$x_3 + 50 = 850$

$x_3 - x_6 = -50$

If $x_6 = 50$

$x_3 - 50 = -50$

$\boxed{x_3 = 0}$

Thus If $x_3 = 0$ then $x_6 = 50$

That means Left Lane to Hall Road from Beacon Road will be 50 vechile Count if $x_3 = 0$.

c) If $x_7 = 0$, $x_2 = ?$

(Write eqs having x_3 and x_7) $\Rightarrow$ $x_2 + x_5 = 1600$ - (5)

$x_3 + x_7 = 750$ - (6)

From eq (6)

$x_5 + x_7 = 750$

$\boxed{x_5 = 750}$ as $x_7 = 0$

From eq (3)

$x_2 + x_5 = 1600$

$x_2 + 750 = 1600$

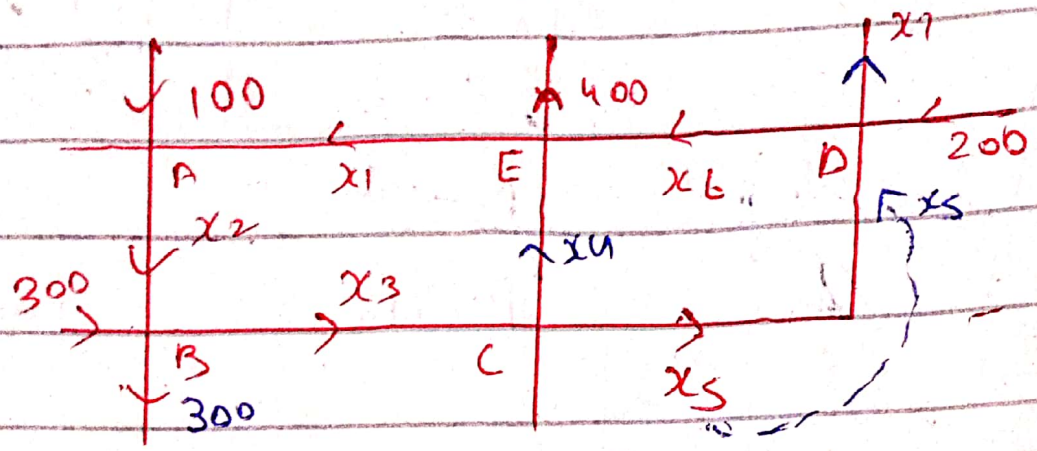
$\boxed{x_2 = 850}$

Q7) a) Linear System

b) $x_1 = 0$, find others

c) $x_1 = 100$, find others

a)



	flow In	flow out	eq
A	$100 + x_1$	x_2	$x_1 - x_2 = -100$
B	$x_2 + 300$	$x_3 + 300$	$x_2 = x_3$
C	$x_3 + 100$	$x_4 + x_5$	$-x_3 + x_4 + x_5 = 100$
D	$x_5 + 200$	$x_6 + x_7$	$-x_5 + x_6 + x_7 = 200$
E	$x_4 + x_6$	$400 + x_1$	$-x_1 + x_4 + x_6 = 400$

$$\begin{bmatrix} 1 & -1 & 0 & 0 & 0 & 0 & 0 & -100 \\ 0 & 1 & -1 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & -1 & 1 & 1 & 0 & 0 & 100 \\ 0 & 0 & 0 & 0 & -1 & 1 & 1 & 200 \\ -1 & 0 & 0 & 1 & 0 & 1 & 0 & 400 \end{bmatrix}$$

$R_5 + R_1$

$$\left[\begin{array}{ccccccc|c} 1 & -1 & 0 & 0 & 0 & 0 & 0 & -100 \\ 0 & 1 & -1 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & -1 & 1 & 1 & 0 & 0 & 100 \\ 0 & 0 & 0 & 0 & -1 & 1 & 1 & 200 \\ 0 & -1 & 0 & 1 & 0 & 1 & 0 & 300 \end{array}\right]$$

$R5+R_2$

$$\left[\begin{array}{ccccccc|c} 1 & -1 & 0 & 0 & 0 & 0 & 0 & -100 \\ 0 & 1 & -1 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & -1 & 1 & 1 & 0 & 0 & 100 \\ 0 & 0 & 0 & 0 & -1 & 1 & 1 & 200 \\ 0 & 0 & -1 & 1 & 0 & 1 & 0 & 300 \end{array}\right]$$

R_5-R_3

$$\left[\begin{array}{ccccccc|c} 1 & -1 & 0 & 0 & 0 & 0 & 0 & -100 \\ 0 & 1 & -1 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & -1 & 1 & 1 & 0 & 0 & 100 \\ 0 & 0 & 0 & 0 & -1 & 1 & 1 & 200 \\ 0 & 0 & 0 & 0 & -1 & 1 & 0 & 300 \end{array}\right]$$

R_5-R_4 $R(-)R_3, (\to)R_4$

$$\left[\begin{array}{ccccccc|c} 1 & -1 & 0 & 0 & 0 & 0 & 0 & -100 \\ 0 & 1 & -1 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & +1 & -1 & -1 & 0 & 0 & -100 \\ 0 & 0 & 0 & 0 & +1 & -1 & -1 & -200 \\ 0 & 0 & 0 & 0 & 0 & 0 & 1 & 0 \end{array}\right]$$

$x_1 - x_2 = -100$

$x_2 - x_3 = 0$

$x_3 - x_4 + x_5 = -100$

$x_5 - x_6 - x_7 = -200$

$x_7 = 0$

let $x_2 = u$

$x_3 = t$

$x_7 = 0$

$x_2 = u$

$x_3 = u$

$x_1 = u - 100$

$x_4 = 100 + u - t$

$x_5 = t$

$x_6 = t - 200$

If $x_1 = 0$ (b)

$x_1 = u - 100$

$0 = -100 + u$

$u = 200$

$x_1 = 0$

$x_2 = 100$

$x_3 = 100$

$x_4 = 200 - t$

$x_5 = t$

$x_6 = t - 200$

$x_7 = 0$

$x_1 = 100$ (c)

$x_1 = -100 + u$

$100 = -100 + u$

$u = 200$

$x_1 = 100$

$x_2 = 200$

$x_3 = 200$

$x_4 = 300 - t$

$x_5 = t$

$x_6 = t - 200$