(215)

USN

CMRIT

Internal Assessment Test III – NOV 2018

Sub:	Network Analysis				Sub Code:	17EC35	Branch:	ECE
Date:	19/11/2018	Duration:	90 min's	Max Marks: 50	Sem / Sec:	3A/3B/3C		OBE

Answer any FIVE FULL Questions

		MARKS	CO	RBT
1	Obtain the laplace transform for the periodic signal given in Fig.1	[10]	CO4	L3

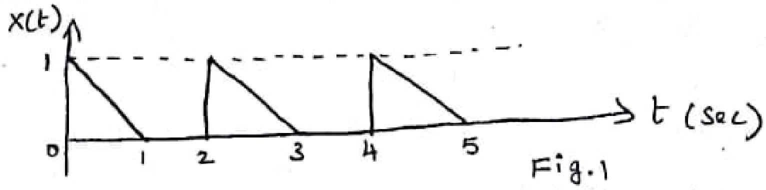

Fig.1

		MARKS	CO	RBT
2	The network shown in Fig.2 was in steady state before t=0. The switch is opened at t=0. Find i(t) for t>0 using laplace transform.	[10]	CO4	L3

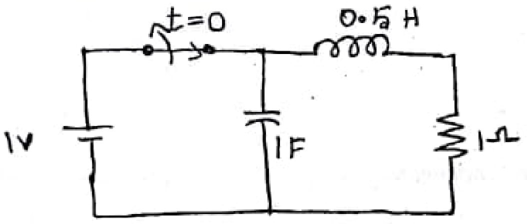

Fig.2

		MARKS	CO	RBT
3	In the circuit shown in Fig.3 switch K is changed from position 1 to 2 at t=0, steady state having been attained in position 1. Find the values of I, first derivative and second derivative of I at t=0⁺	[10]	CO3	L3

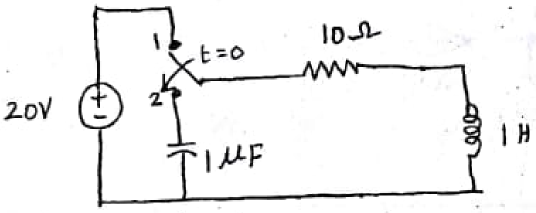

Fig.3

		MARKS	CO	RBT
4	Find the nodal voltages at nodes 1,2,3,4 for the network shown in Fig.4	[10]	CO1	L3

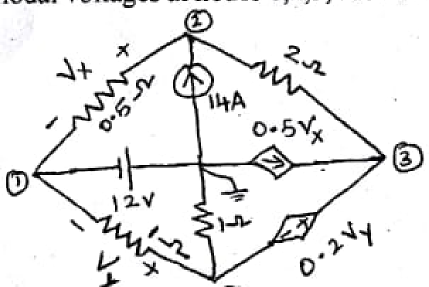

Fig.4

		MARKS	CO	RBT
5	In the circuit shown in Fig.5 determine V_2, which results in zero current through the 4Ω resistor. Use mesh analysis.	[10]	CO1	L3

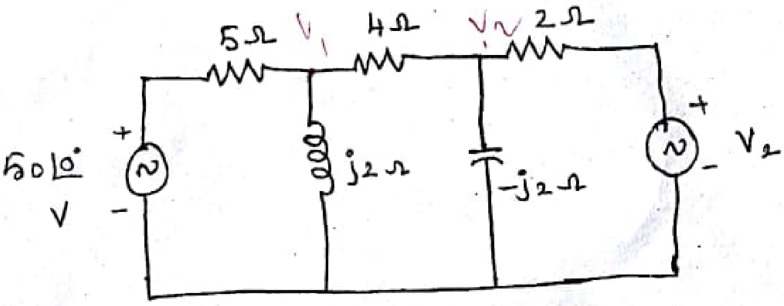

Fig.5

6	For the network shown in Fig.6 find Z-parameters.	[10]	CO6	L3

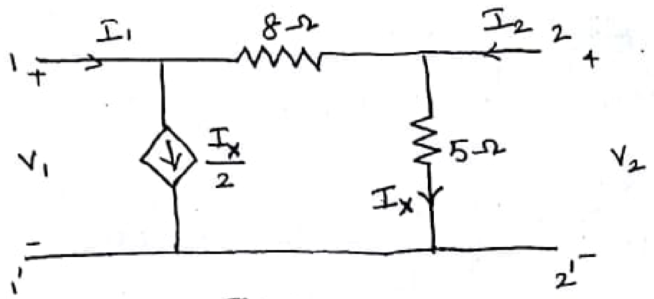

Fig. 6

7	Define 'h' and 'T' parameters. Derive' h' parameters interms of 'T' and 'T' parameters interms of h parameters.	[10]	CO6	L3
8	For the circuit shown in Fig.8, find node voltages V_1,V_2,V_3 using node analysis.	[10]	CO1	L3

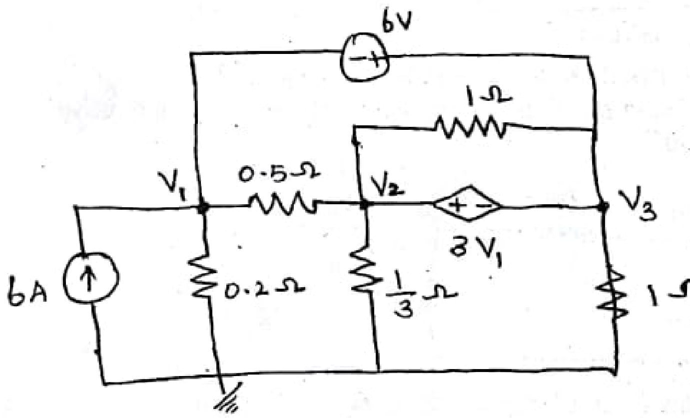

Fig. 8

16/11

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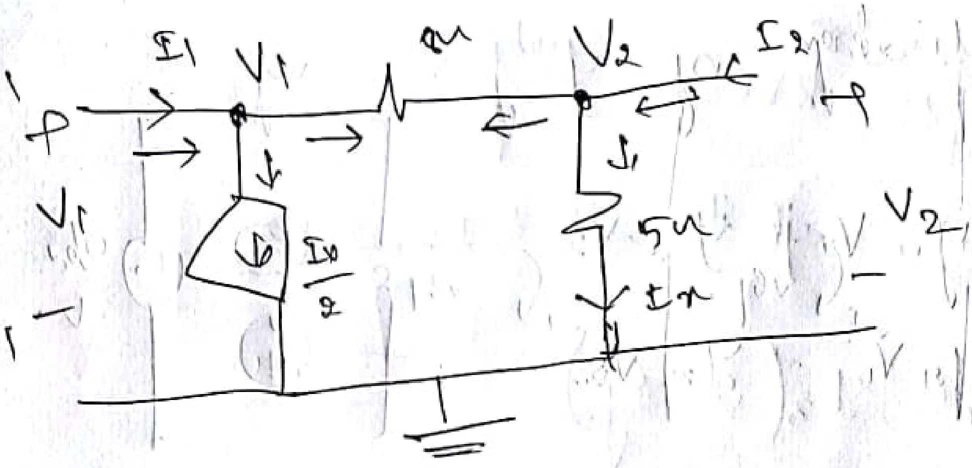

Applying nodal analysis

$$I_1 = \frac{V_1 - V_2}{8} + \frac{I_x}{2}$$

But $I_x = V_2/5$ $\rightarrow \frac{I_x}{2} = \frac{V_2}{5 \times 2} = \frac{V_2}{10}$

$$I_1 = \frac{V_1}{8} - \frac{V_2}{8} + \frac{V_2}{10}$$

$$I_1 = 0.125 V_1 - 0.025 V_2 \quad \text{——— (1)}$$

Also

$$I_2 = \frac{V_2 - V_1}{8} + \frac{V_2}{5}$$

$$I_2 = -0.125 V_1 + 0.325 V_2 \quad \text{——— (2)}$$

By definition of y

$I_1 = y_{11} V_1 + y_{12} V_2$ —— (3)

$I_2 = y_{21} V_1 + y_{22} V_2$ —— (4)

Comparing (1), (2), (3) & (4)

$$y = \begin{bmatrix} y_{11} & y_{12} \\ y_{21} & y_{22} \end{bmatrix} = \begin{bmatrix} 0.125, & -0.025 \\ -0.125, & 0.325 \end{bmatrix} \mho$$

By Relationship b/w z & y

$$z = \begin{bmatrix} z_{11} & z_{12} \\ z_{21} & z_{22} \end{bmatrix} = \begin{bmatrix} \frac{y_{22}}{\Delta y} & -\frac{y_{12}}{\Delta y} \\ -\frac{y_{21}}{\Delta y} & \frac{y_{11}}{\Delta y} \end{bmatrix}$$

where $\Delta y = y_{11} y_{12} - y_{21} y_{22} = 0.037$

$$Z = \begin{bmatrix} z_{11} & z_{12} \\ z_{21} & z_{22} \end{bmatrix} = \begin{bmatrix} 8.67 & 0.67 \\ 3.33 & 3.33 \end{bmatrix} \Omega$$

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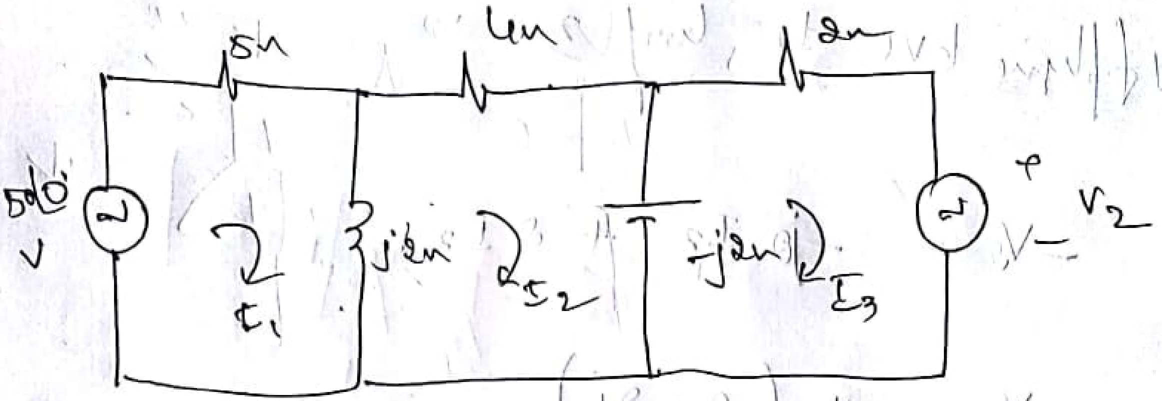


Applying KVL to the loops. I

$$50 \angle 0 = I_1(5+2j) - 0 \qquad [\because I_2 = 0]$$

$$I_1 = 9.28 \angle -21.80^\circ \text{ A}$$

Applying KVL to loop 2

$$0 = [j2 + 4 + (-j2)]\,0 - j2 I_1 - (j2) I_3$$

$$0 = -(j2 I_1) - (j2 I_3)$$

$$-j2 I_3 = -j2 I_1$$

$$\boxed{I_3 = 9.28 \angle -21.80^\circ \text{ A}}$$

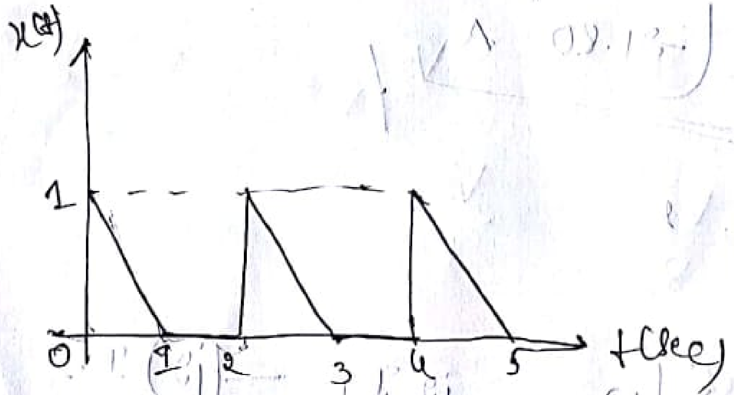
Applying KVL to loop 3

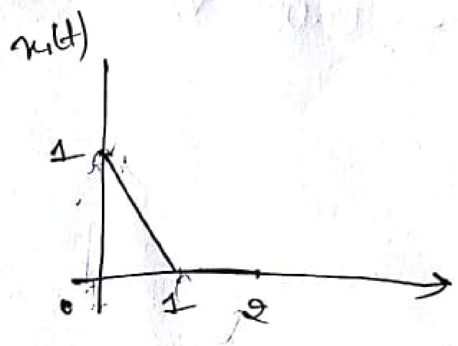
$$-V_2 = -j2 I_3 + 2 I_3$$

$$-V_2 = I_3(2-2j)$$

$$\boxed{V_2 = 26.24 \angle 113.2^\circ \text{ V}}$$

1)

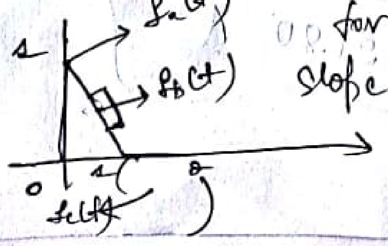




Since it is a periodic function

here $x(s) = \dfrac{x_1(s)}{1-e^{-Ts}}$

where $T = 2$.



for $f_b(t)$ slope $= -1$

$$\therefore x(s) = \frac{x_1(s)}{1-e^{-2s}} \quad \text{(1)}$$

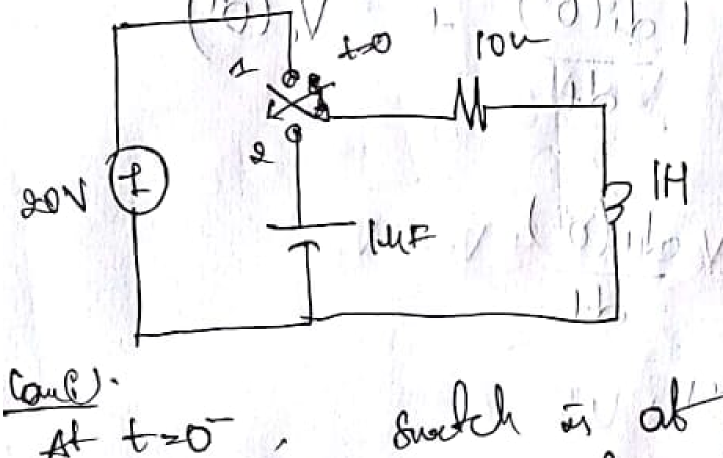
$x_1(t) = u(t) - tu(t) + (t-1)u(t-1)$

using Laplace transform on both sides

$x_1(s) = 1/s - 1/s^2 + \frac{1}{s^2}e^{-s}$

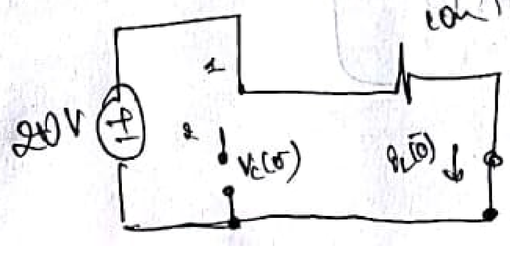
~~$X(s)$~~ substituting in eq^n (1)

$$x(s) = \frac{1/s - 1/s^2 + 1/s^2 \, e^{-s}}{1-e^{-2s}} = \frac{1/s - 1/s^2\left[1-e^{-s}\right]}{1-e^{-2s}}$$



$t=0$, $\frac{di}{dt}$, $\frac{d^2i}{dt^2} = ?$

Case (i):
At $t=0^-$, switch is at position 1. Also it is steady state



Applying KVL

$$\boxed{i_L(0^-) = 20/10 = 2A = i_L(0^+)}$$

Also $V_C(0^-) = 0V = V_C(0^+)$.

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Case (ii) At $t = 0^+$, switch is at position a

Applying KVL for the loop.

$$0 = i(t)R + L\frac{di(t)}{dt} + \frac{1}{C}\int_{-\infty}^{t} i(t)\,dt \quad \text{--- (1)}$$

At $t = 0^+$

$$0 = i(0^+)10 + 1\frac{di(0^+)}{dt} + V_c(0^+)$$

$$0 = 2\times 10 + \frac{di(0^+)}{dt}$$

$$-20 = \frac{di(0^+)}{dt}$$

$$\boxed{\frac{di(0^+)}{dt} = -20\ A/s}$$

(1)

Differentiating eq^n (1) wrt t

$$0 = \frac{di(t)}{dt} R + \frac{L\, d^2 i(t)}{dt^2} + \frac{i(t)}{C}$$

At $t = 0^+$

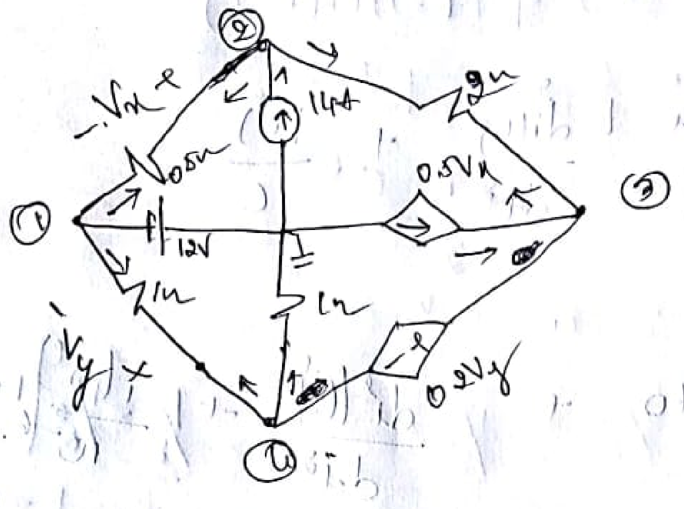
$$0 = \frac{di(0^+)}{dt} 10 + \frac{d^2 i(0^+)}{dt^2} + \frac{i(0^+)}{10^{-6}}$$

$$0 = (-20) \cdot 10 + \frac{d^2 i(0^+)}{dt^2} + 2/10^{-6}$$

$$\frac{d^2 i(0^+)}{dt^2} = 200 - 2 \times 10^{6}$$

$$\boxed{\frac{d^2 i(0^+)}{dt^2} = -1.99 \times 10^{6}\ A/s^2}$$

4)



$\boxed{V_1 = -12\text{ V}}$

Applying nodal analysis at (2).

$$14 = \frac{V_2 - V_1}{0.5} + \frac{V_2 - V_3}{2}$$

$$14 = \frac{2(V_2 + 12)}{1} + \frac{V_2 - V_3}{2}$$

$$28 = 4(V_2 + 12) + V_2 - V_3$$

$$28 = 5V_2 - V_3 + 48$$

$$5V_2 - V_3 = -20 \quad \text{——— (1)}$$

Applying supernode (3) & (4)

$$V_3 - V_4 = 0.2V_y$$

$$V_y = V_4 - V_1$$

$$V_y = V_4 + 12$$

$$V_3 - V_4 = 0.2(V_4 + 12)$$

$$V_3 - V_4 = 0.2V_4 + 2.4$$

$$V_3 - 1.2V_4 = 2.4 \longrightarrow (2)$$

$$0.5V_x = \frac{V_3 - V_2}{2} + \frac{V_4}{1} + \frac{V_4 - V_1}{1}$$

$$V_x = V_2 - V_1$$

$$V_x = V_2 + 12$$

$$0.5(V_2 + 12) = \frac{V_3 - V_2}{2} + \frac{V_4}{1}\times 2 + \frac{V_4 + 12}{1}\times 2$$

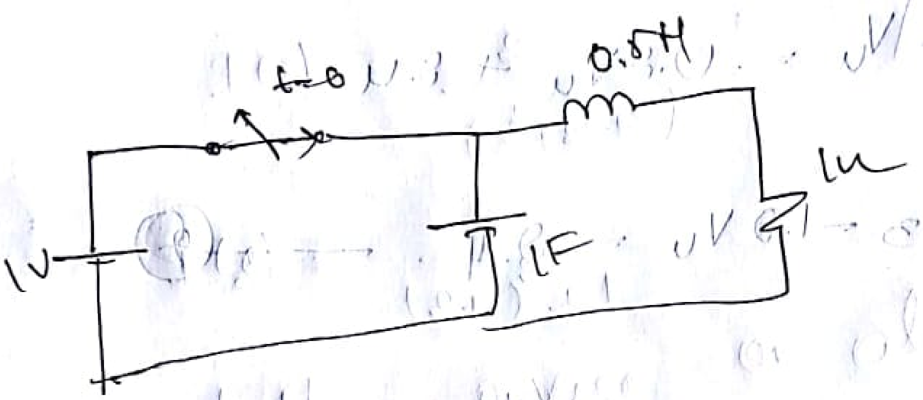
$$\cancel{V_2} + 12 = \cancel{V_3} - \cancel{V_2} + 2\cancel{V_4} + 2V_4 + 24$$

$$V_3 - 2V_2 + 4V_4 = -12 \longrightarrow (3)$$

Solving eqn (1), (2), (3)

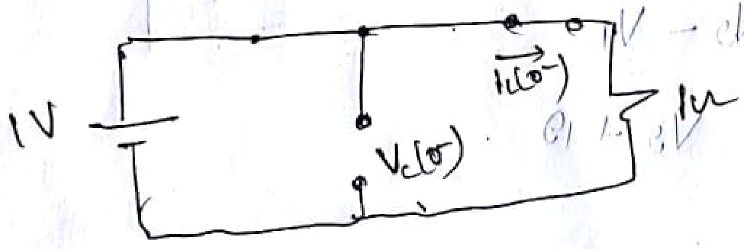
$$\boxed{V_2 = -4.6\ V} \qquad \boxed{V_3 = -3.05\ V}$$

$$\boxed{V_4 = -4.54\ V}$$



$i(0^+) = ?$ using Laplace for

Case (1): At $t = 0^-$, It is steady state, Switch is closed



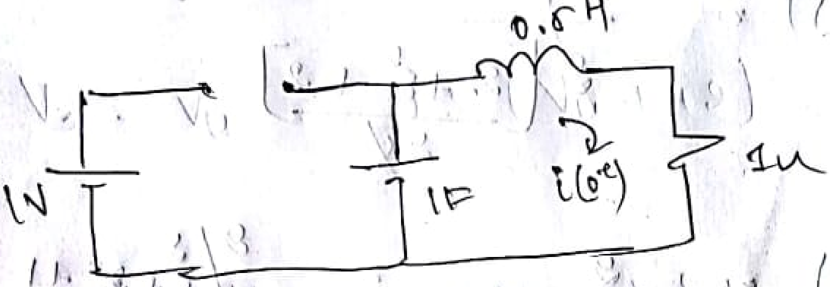
Applying KVL,

$$i(0^-) = i_L(0^-) = 1A = \underline{i_L(0^+)}$$

$$V_c(0^-) = 1V = \underline{V_c(0^+)}$$

Case (ii)

At $t=0^+$, switch is open.



Applying KVL

$$0 = i(t)R + L\frac{di(t)}{dt} + \frac{1}{C}\int_{-\infty}^{t} i(t)\,dt$$

At $(t>0^+)$

$$0 = i(0^+) + 0.5\frac{di(0^+)}{dt}$$

Using Laplace transform on both sides

$$0 = I(s)R + Ls\,I(s) + \frac{1}{Cs}\left[\int_{-\infty}^{0^-} I(s) + \int_{0^-}^{t} 0(t)dt\right]$$

$$0 = I(s) + 0.5s\,I(s) - \frac{1}{s} + \frac{1}{Cs}I(s)$$

$$0 = I(s)\left[1 + 0.5s + 1/s\right] - 1/s$$

$$1/s = \left(1 + s/2 + 1/s\right) I(s)$$

$$I(s) = \frac{1}{s\left(1 + \frac{s}{2} + \frac{1}{s}\right)}$$

$$I(s) = \frac{1}{s\left[\frac{2s + s^2 + 2}{2s}\right]}$$

$$I(s) = \frac{2}{(s^2 + 2s + 2)} = \frac{2}{s^2 + 2s + 1 - 1 + 2}$$

$$I(s) = \frac{2}{(s+1)^2 + 1}$$

using laplace inverse on above eqn

$$\boxed{i(t) = 2 \sin t \, e^{-t}}$$ A

$$i(t) = e^{-t} \cos t + e^{-t} \sin t \;\; A$$

7) h in terms of T :-

By definition of T — we need

$V_1 = AV_2 - BI_2$ — (1) $V_1 = h_{11}I_1 + h_{12}V_2$

$I_1 = CV_2 - DI_2$ — (2) $I_2 = h_{21}I_1 + h_{22}V_2$

from eqn (2)

$I_1 = CV_2 - DI_2$

$DI_2 = CV_2 - I_1$

~~Substituting~~ $\cancel{eq(2)}$

$I_2 = \frac{C}{D}V_2 - \frac{1}{D}I_1$

$$I_2 = -\frac{1}{D}I_1 + \frac{C}{D}V_2 \quad \text{— (5)}$$

from (1)

$V_1 = AV_2 - BI_2$

$V_1 = AV_2 - B\left[-\frac{1}{D}I_1 + \frac{C}{D}V_2\right]$

$V_1 = AV_2 + \frac{B}{D}I_1 - \frac{BC}{D}V_2$

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$$V_1 = \frac{B}{D} I_1 + \left(\frac{AD - BC}{D}\right) V_2 \quad \text{--- (6)}$$

from eq^n (3) (4) (5) & (6)

$$h = \begin{bmatrix} h_{11} & h_{12} \\ h_{21} & h_{22} \end{bmatrix} = \begin{bmatrix} B/D & \Delta T/D \\ -1/D & C/D \end{bmatrix}$$

where $\Delta T = AD - BC$.

T in terms of h

By defination of h, we need

$V_1 = h_{11} I_1 + h_{12} V_2$ --- (1)

$I_2 = h_{21} I_1 + h_{22} V_2$ --- (2)

$V_1 = A V_2 - B I_2$ --- (3)

$I_1 = C V_2 - D I_2$ --- (4)

from (2)

$$I_2 = h_{21} I_1 + h_{22} V_2$$

$$I_1 = \frac{1 I_2}{h_{21}} - \frac{h_{22} V_2}{h_{21}} \quad \text{--- (5)}$$

substituting in eq^n (1)

$$V_1 = h_{11}\left[\frac{I_2}{h_{21}} - \frac{h_{22} V_2}{h_{21}}\right] + h_{12} V_2$$

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$$V_1 = \frac{h_{11} I_2}{h_{21}} - \frac{h_{11} h_{22}}{h_{21}} V_2 + h_{12} V_2$$

$$V_1 = -\left(\frac{\Delta h}{h_{21}}\right) V_2 + \frac{h_{11}}{h_{21}} I_2 \quad (6)$$

from eq^n 3, 4, 5 & (6)

$$T = \begin{bmatrix} A & B \\ C & D \end{bmatrix} = \begin{bmatrix} -\frac{\Delta h}{h_{21}} & -\frac{h_{11}}{h_{21}} \\ -\frac{h_{22}}{h_{21}} & -\frac{1}{h_{21}} \end{bmatrix}$$