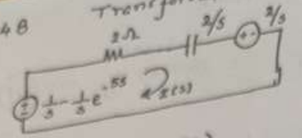
Q.4B Transformed network



$$I(s) = \frac{1/s - \frac{1}{s}e^{-5s} - 2/s}{(2 + 2/s)}$$

$$I(s) = \frac{\frac{1}{s}\left[-1 - e^{-5s}\right]}{2\left(\frac{s+1}{s}\right)}$$

$$I(s) = -\frac{(1 + e^{-5s})}{2(s+1)} \quad \text{— (2M)}$$

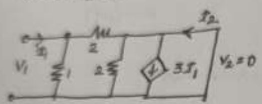
$$i(t) = \mathcal{L}^{-1}\left[I(s)\right] = \mathcal{L}^{-1}\left[-\frac{(1+e^{-5s})}{2}\cdot\frac{1}{s+1}\right] \quad \text{— (1M)}$$

(4C) $\boxed{V(t) = 5r(t-1) - 10r(t-2) + 5r(t-3)}$ —— (2M)

5A. Y PARAMETER

$$I_1 = Y_{11}V_1 + Y_{12}V_2$$
$$I_2 = Y_{21}V_1 + Y_{22}V_2$$

when $V_2 = 0$



$$V_1(1 + 0.5) - \overset{\to 0}{V_2}(0.5) = I_1$$

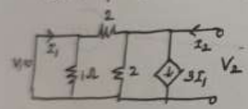
$$V_1(1.5) = I_1 \Rightarrow \boxed{Y_{11} = I_1/V_1 = 1.5\,℧} \text{ — (1M)}$$

$$\overset{\to 0}{V_2}(0.5 + 0.5) - V_1(0.5) = I_2 - 3I_1$$

$$-V_1(0.5) + 3(1.5V_1) = I_2$$

$$4V_1 = I_2 \Rightarrow \boxed{Y_{21} = \frac{I_2}{V_1} = 4\,℧}$$

when $V_1 = 0$



$$\overset{\to 0}{V_1}(1.5) - V_2(0.5) = I_1$$

$$\Rightarrow \boxed{Y_{12} = \frac{I_1}{V_2} = -0.5\,℧}$$

$$V_2(1) - \overset{\to 0}{V_1}(0.5) = I_2 - 3I_1$$

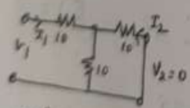
$$V_2 + 3(-0.5V_2) = I_2$$

$$\Longrightarrow \boxed{\frac{I_2}{V_2} = Y_{22} = -0.5\,℧}$$

H PARAMETERS

(5B)

$$V_1 = h_{11}I_1 + h_{12}V_2$$
$$I_2 = h_{21}I_1 + h_{22}V_2$$



$$\left.\begin{array}{l}\boxed{h_{11} = 15\,\Omega} = \frac{V_1}{I_1} \\ \boxed{h_{21} = -2} = I_2/I_1\end{array}\right\} 1.5M$$

$$V_2 = I_2(20) \Rightarrow \boxed{h_{22} = \frac{I_2}{V_2} = \left(\frac{1}{20}\,℧\right)}$$

$$V_1 = 10I_2$$
$$V_2 = 20I_2$$

$$\boxed{h_{12} = \frac{V_1}{V_2} = 0.5} \text{ — (0.5M)}$$

(5C)

→ (2M)

ICE 2101

1A.
1B.
1C.
2A.
2B.
2C.
3A.
3B.
3C.
4A.
4B.
4C.
5A.
5B.
5C.

$R = 5\Omega \quad L = 10\,mH \quad C = 10\,\mu F$

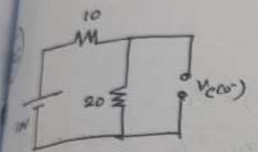
$f_r = \cancel{\frac{1}{2\pi}\sqrt{\frac{L}{C}}}\ \frac{1}{2\pi\sqrt{LC}} = \frac{1}{2\pi\sqrt{10\times10^{-3}\times10\times10^{-6}}} = \cancel{5.0329\,Hz}\ 503.29\,Hz$ — (1M)

$Q = \frac{X_L}{R} = \frac{2\pi f_r \cdot L}{R} = \frac{2\pi\times5.0329\times10\times10^{-3}}{5} = \boxed{6.322}\ \cancel{0.06324}5$ — 0.5M

$\text{Bandwidth} = \frac{f_2-f_1}{2} = \frac{R}{2\pi L} = \left(\frac{5}{2\pi\times10\times10^{-3}}\right) = \boxed{79.58\,Hz}$ — 0.5M

$I = I_{max}$ at Resonance $= \frac{50}{5} = 10A$

$P_{max} = (10)^2\times5 = 500W$ } — (01M)



$V_c(0^-) = \left(\frac{10}{30}\right)\times20 = 6.667V = V_c(0^+)$ — (1M)

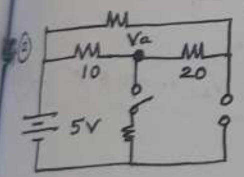
When switch is opened and again S.S is reached

$V_c(\infty) = 0$

$\therefore V_c(t) = V_c(\infty) - [V_c(\infty) - V_c(0)]\,e^{-t/RC}$

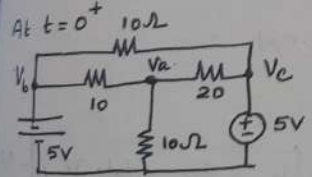
$= 0 - [0 - 6.667]\,e^{-t/20\times2\times10^{-6}}$

$\boxed{V_c(t) = 6.667\,e^{-25000t}}$ — (2M)



Since no current flows

$\boxed{V_a(0^-) = 5V}$ — (2M)



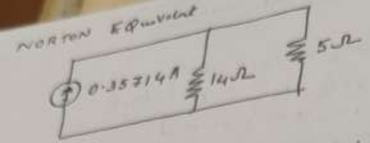
$V_b = 5 \quad V_c = 5V$

$V_a\left(\frac{1}{10}+\frac{1}{10}+\frac{1}{20}\right) - 5\left(\frac{1}{10}\right) - \left(\frac{5}{20}\right) = 0$

$V_a(0.25) = 0.75$

$\boxed{V_a(0^+) = 3V}$ — (3M)

NORTON Equivalent

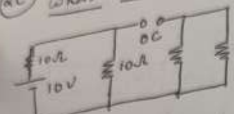


$I_{5\Omega} = 0.35714 \times \frac{14}{19}$

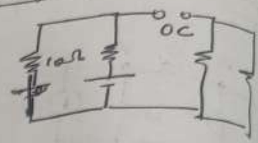
$= 0.263\,A$

$P = (0.263)^2 \times 5 = \boxed{0.?}$ — (1M)

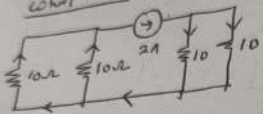
(2C) When 10V Acts alone and 2V Source acts alone



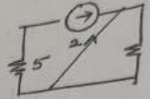
$\boxed{I_{100\Omega} = 0}$ — (1M)

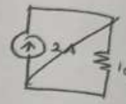


When 2A source acts alone



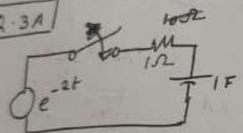
$\boxed{I_{R_1} = 1A}$ — (1M)





$\boxed{I_{RL} = \cancel{2}\ 1A}$

Q.3A



$$Ri + \frac{1}{C}\int i\,dt = e^{-2t}$$

$$i + \int i\,dt = e^{-2t}$$

$$\frac{di}{dt} + i = -2e^{-2t}$$

$$(D+1)\,i = -2e^{-2t}$$ — (2M)

This is in the form $\frac{di}{dt} + Pi = Q$

$$i = e^{-Pt}\int Qe^{Pt}\,dt + Ke^{-Pt}$$

(PI) + (CF)

$$i = e^{-t}\int -2e^{-2t}(e^{t})\,dt + Ke^{-t}$$

$$= -2e^{-t}\int e^{-t}\,dt + Ke^{-t} = 2e^{-2t} + Ke^{-t}$$

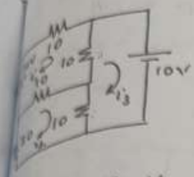
At $t=0$ $i=0$

$$0 = 2(1) + K(1) \Rightarrow K = -2$$

$$i = \boxed{2e^{-2t} - 2e^{-t}}$$

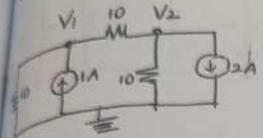
(PI + Comp.F) — (1M)

ECA: [ICE 2101] Scheme of Valuation

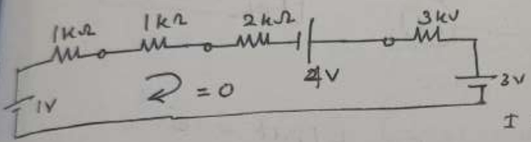


$$30i_1' - 10i_2' - 10i_3' = 10$$
$$-10i_1' + 40i_2' - 10i_3' = 0$$
$$-10i_1' - 10i_2' + 20i_3' = -10$$
— (3M)

$\boxed{i_1' = 0.1538}$ $\boxed{i_2' = -0.0769A}$ $\boxed{i_3' = -0.4615A}$ — (02)M



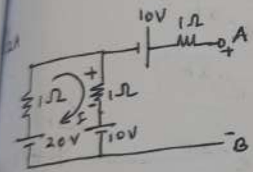
$$V_1\left(\tfrac{1}{10}+\tfrac{1}{10}\right) - V_2\left(\tfrac{1}{10}\right) = 1$$
$$0.2V_1 - 0.1V_2 = 1 \Rightarrow \boxed{2V_1 - V_2 = 10}$$ — (1M)
$$V_2\left(\tfrac{1}{10}+\tfrac{1}{10}\right) - V_1\left(\tfrac{1}{10}\right) = -2$$
$$-0.1V_1 + 0.2V_2 = -2$$
$$\boxed{-V_1 + 2V_2 = -20}$$ — (1M)
$$\boxed{V_1 = 0} \quad \boxed{V_2 = -10V}$$ — (1M)



net $V = 1 + 4 - 3 = 2V$ — (1M)

$I = \frac{2}{7000} = 28.53\,mA$ — (1M)

0.29



To find V_{AB}

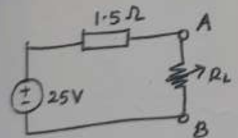
$I = \frac{20-10}{2} = 5A$

$-V_{AB} + 10 + 5(1) + 10 = 0$

$\Rightarrow \boxed{V_{AB} = 25V}$ — (3)M

$Z_{AB} = \frac{1\times1}{1+1} + 1$

$\boxed{Z_{AB} = 1.5\,\Omega}$ $= R_{AB}$

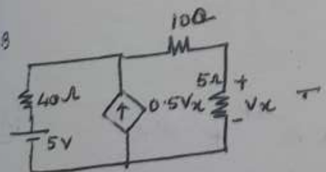


$R_L = R_{source} = R_{AB}$ for $P = P_{max}$

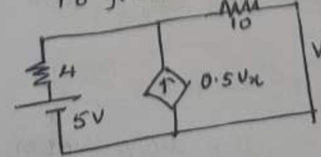
$\therefore R_L = 1.5\,\Omega$ — (1)M

$P_{max} = I^2 R_L = \left(\frac{25}{3}\right)^2 \times 1.5 = \boxed{104.16\,W}$ — (1)M

2B

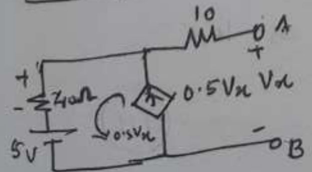


To find $I_N = I_{sc}$



$V_x = 0$ $\quad 0.5V_x = 0$ (1M)

$\boxed{I_N = I_{sc} = \frac{5}{14} = 0.35714}$



$-V_x + 5 + 2V_x = 0 \Rightarrow \boxed{V_{AB} = V_x = -5V}$

$\therefore \boxed{R_N = -14\,\Omega}$ — (1M)

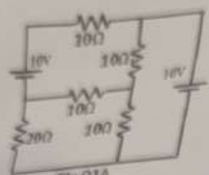


Fig.Q1A

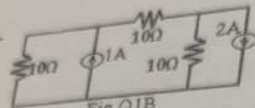


Fig.Q1B

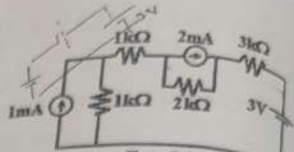


Fig.Q1C

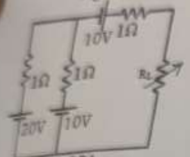


Fig.Q2A

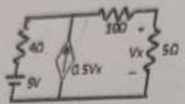


Fig.2B

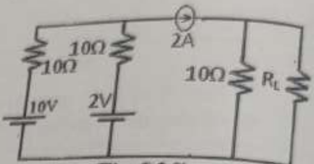


Fig.Q2C

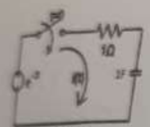


Fig.Q3A

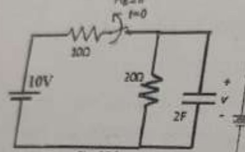


Fig.Q3C

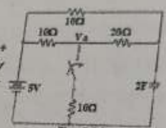


Fig.Q4A

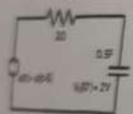


Fig.Q4B

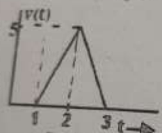


Fig.Q4C

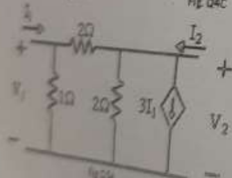


Fig.Q5A

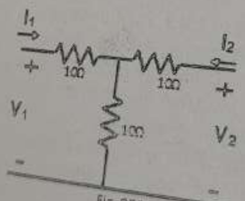


Fig.Q5B

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Reg. No.

MANIPAL INSTITUTE OF TECHNOLOGY
MANIPAL

THIRD SEMESTER B.TECH. (INSTRUMENTATION AND CONTROL ENGG.)

END SEMESTER EXAMINATIONS, DEC - 2017

SUBJECT: ELECTRICAL CIRCUIT ANALYSIS [ICE 2101] - Make-up

Time: 3 Hours MAX. MARKS: 50

Instructions to Candidates:

- Answer **ALL** the questions.
- Missing data may be suitably assumed.

1A.	For the circuit shown in Fig.Q1A, determine the mesh currents.	5
1B.	Calculate all the node voltages for the circuit shown in Fig.Q1B	3
1C.	For the circuit shown in Fig.Q1C calculate the current in 3kΩ resistor	2
2A.	Find R_L to deliver maximum power and the corresponding power in the circuit shown in Fig.Q2A.	5
2B.	Obtain Norton's equivalent circuit for the network shown in Fig.Q2B with respect to 5Ω resistor. Also find power dissipated in 5Ω resistor.	3
2C.	For the network shown in Fig.Q2C, determine the current through R_L = 10Ω resistor using superposition theorem	2
3A.	In the network of the Fig.Q3A the switch is closed at t=0. Obtain expression for current i(t) in complementary and particular solution form.	5
3B.	A resistance of 5Ω, capacitor of 10μF and Inductance of 10mH is connected in series with ac source of 50V. Determine the resonating frequency, quality factor and bandwidth of the circuit. Also determine maximum power dissipated in the circuit.	3
3C.	In the circuit shown in Fig.Q3C, find the expression for V for t≥0, if switch is opened at t = 0 assuming that a steady state having previously been attained.	2
4A.	In the network shown in Fig.Q4A, steady state is reached with switch open. At t=0 switch is closed. Determine the values of Va(0-) and Va(0+).	5
4B.	Use Laplace transform to obtain expression for current in the circuit shown in Fig.Q4B.	3
4C.	Express the waveform shown in Fig. Q4C using basic signals.	2
5A.	For the network shown in Fig.Q5A find Y parameters.	4
5B.	Obtain h parameters for the circuit network shown in Fig.Q5B	4
5C.	Plot $x(t) = u(t) - r(t) + r(t-1)$.	2