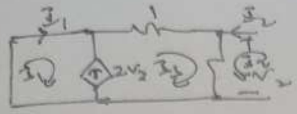
short V_1



$I_3 - I_1 = 2V_2$

$2I_3 + I_2 = 0$

$i_2 + i_3 = V_2$

solving $\quad I_1 = -3V_2 \quad I_2 = 2V_2$

$\therefore \; y_{12} = \frac{I_1}{V_2} = -3 \qquad y_{22} = \frac{I_2}{V_2} = 2$

$$Z = \begin{bmatrix} y_{11} & y_{12} \\ y_{21} & y_{22} \end{bmatrix}^{-1} = \begin{bmatrix} 2/3 & 1 \\ -1/3 & 0 \end{bmatrix}$$

Y-Para $\rightarrow$ 2M

Z-Para - 2M

4M

short V_2, $V_2 = 0$ $\quad$ (A) $\Rightarrow \frac{V_A}{10} + \frac{V_A}{10} + 2I_1 = I_1$

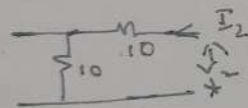
$\Rightarrow V_a = -5I_1$

$V_1 = 2I_1 + V_a = 2I_1 - 5I_1 = -3I_1 \Rightarrow \boxed{\frac{V_1}{I_1} = h_{11} = -3\Omega}$

$\frac{V_A}{10} + 2I_1 = -I_2 \Rightarrow \boxed{\frac{I_2}{I_1} = h_{21} = -\frac{3}{2}}$

1M

Make $I_1 = 0$:



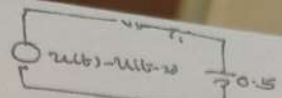
$V_2 = I_2 \times (10+10) \quad \boxed{\frac{I_2}{V_2} = h_{22} = \frac{1}{20} = 0.05\mho}$

$V_1 = I_2 \times 10, = \cancel{V_2/2}$

$\boxed{h_{12} = \frac{V_1}{V_2} = \frac{I_2 \times 10}{I_2(20)} = \frac{1}{2} = 0.5}$

Each $\cdot$ 0.5 mark $\quad$ 1M

4B.



$iR + \frac{1}{C}\int i\,dt =$

$2i + 2\int i\,dt = u(t) - u(t-2)$

Take LT. $2I(s) + 2\frac{I(s)}{s} - \frac{v_c(0)}{s} = \frac{1}{s} - \frac{e^{-2s}}{s}$

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

$\therefore \quad i(t) = -\frac{1}{2} e^{-(t-2)} u(t-2)$

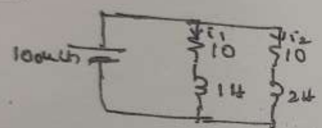
4C

$v(t) = 5r(t-1) - 10r(t-2) + 5r(t-3) + 5r(t-5) - 10r(t-6) + 5r(t-7)$

$\therefore V(s) = \frac{5}{s^2}\left[e^{-s} - 5e^{-2s} + e^{-2s} + e^{-5s} - 5e^{-6s} + e^{-7s}\right]$

NOTE: Mark is given if it is considered as periodic

5A



$i_1 \Rightarrow \quad i_1R_1 + L_1\frac{di_1}{dt} = 100$

$10i_1 + \frac{di_1}{dt} = 100$

$I_1(s) = \frac{100}{s(s+10)}$

$I_1(s) = \frac{A}{s} + \frac{B}{s+10} = \frac{10}{s} - \frac{10}{s+10}$

$\therefore \quad i_1(t) = 10u(t) - 10e^{-t}u(t)$

$\|^{ly}$

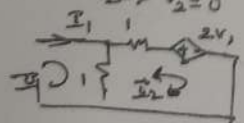
$i_2R_2 + L_2\frac{di_2}{dt} = 100$

$I_2(s) = \cancel{\frac{10}{s}} \cdot \frac{50}{s+5}$

$\Rightarrow \quad i_2(t) = 10(1 - e^{-5t})u(t)$

Q.5B

short $V_2 \Rightarrow V_2 = 0$

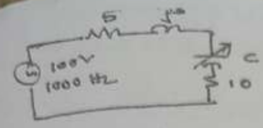


$\Rightarrow \quad I_1 + I_2 = V_1$

$I_1 + 2I_2 = 2V_1 \quad \Rightarrow \quad I_1 = 0$

$I_2 = 1V_1$

$\Rightarrow \quad Y_{11} = \frac{I_1}{V_1} = 0\,\mho, \quad Y_{21} = \frac{I_2}{V_1} = 1$



$X_C = X_L = \frac{1}{2\pi f C}$

$\Rightarrow C = 53\ \mu F$ — (2 M)

$P = I^2 R_L = \left(\frac{100}{5+10}\right)^2 \times 10$

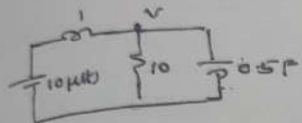
$= 444\ W$ — (1 M)

(3 M)

switch is closed at $t = 5$ sec, Inductor is open at $t = 5$ sec.

$\therefore i(5^+) = 0\ A$ (2 M)

$\boxed{\text{Note: No partial Marks}}$



For $t > 0$

$\frac{1}{L}\int (v-10)\,dt + \frac{v}{10} + 0.5\frac{dv}{dt} = 0$ — (1 M)

apply LT. $\frac{1}{s}\left[V(s) - \frac{10}{s}\right] + \frac{V(s)}{10} + 0.5\, s\, V(s) = 0$ — (1 M)

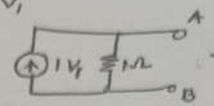
$\Rightarrow V(s) = \frac{20}{s(s^2+0.2s+2)}$ — (1 M)

$V(s) = \frac{A}{s} + \frac{Bs+C}{(s+0.1)^2+(\sqrt{2})^2}$ — (1 M)

$\Rightarrow v(t) = 10u(t) - 10e^{-0.1t}\{\cos\sqrt{2}t + 0.007\sin\sqrt{2}t\}$ — (1 M)

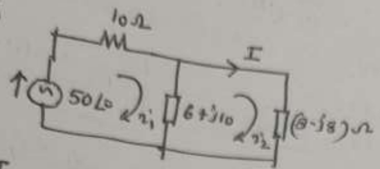
$R_{SC} = \frac{V_{oc}}{I_{sc}} = \frac{V_1}{V_1} = 1\Omega$

$\therefore$ NORTON Equivalent



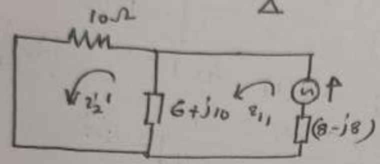
— 1M

2. B



$\Delta = \begin{bmatrix} 16+j10 & -(6+j10) \\ -(6+j10) & 14+j2 \end{bmatrix}$

$I = i_2' = \dfrac{\begin{bmatrix} 16+j10 & 50 \\ -(6+j10) & 0 \end{bmatrix}}{\Delta} = \boxed{2.135 \angle 48^\circ A}$ — 1.5 M



$\Delta = \begin{bmatrix} (14+j2) & -(6+j10) \\ -(6+j10) & (16+j10) \end{bmatrix}$

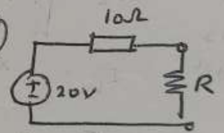
$i_2'' = \dfrac{\begin{bmatrix} 50 & -(6+j10) \\ 0 & (16+j10) \end{bmatrix}}{\Delta} = \boxed{2.135 \angle 48^\circ A}$

$i_2' = i_2''$. Hence Reciprocity theorem verified

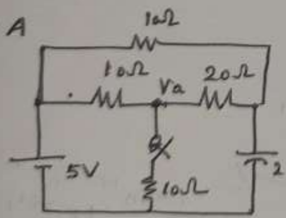
2C

$V_{TH} = 2 \times 10 = 20V$ — 1M

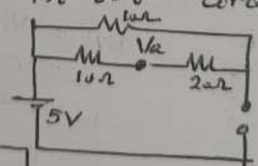
$R_{TH} = 10\Omega$ —— 1M



3. A



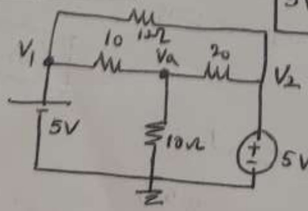
At $t = 0^-$ circuit reaches SS



$\boxed{V_a(0^-) = 5V}$

— 2 M

At $t = 0^+$



$V_1 = V_2 = 5V$

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

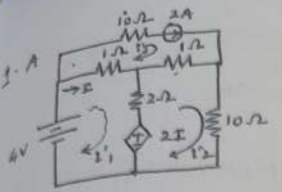
$V_a\left(\frac{5}{20}\right) = \frac{10+5}{20} = \left(\frac{15}{20}\right)$

$V_a = \frac{15}{20} \cdot \frac{20}{5} = 3V$

$\therefore \boxed{V_a(0^+) = 3V}$ — 3 M

ECA · Scheme of VALUATION

1. A



$i_3' = 2A$ — (1M) $\quad I = i_1' - i_3' = (i_1' - 2)$ — (1M)

$3i_1' - 2i_2' - 2 = 4 - 2(i_1' - 2)$

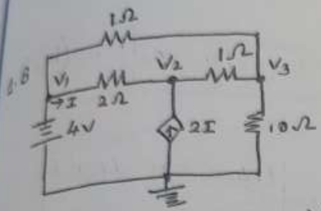
$\boxed{5i_1' - 2i_2' = 10}$ — (1M)

$-2i_1' + 13i_2' - 2 = 2(i_1' - 2) = 2i_1' - 4$

$-4i_1' + 13i_2' = -2$

$\boxed{4i_1' - 13i_2' = 2}$ — (1M) $\quad \boxed{\begin{array}{l} i_1' = 2.210A \\ i_2' = 0.5263A \end{array}}$ — (1M)

1. B



$V_1 = 4V$ — (1/2M) $\quad I = \left(\frac{V_1 - V_2}{2}\right)$

$V_2(1.5) - \left(\frac{4}{2}\right) - V_3 = 2I = 2\cdot\left(\frac{V_1 - V_2}{2}\right) = 4 - V_2$

$\boxed{2.5V_2 - V_3 = 6}$ — (1M)

$V_3(2.1) - V_2(1) - 4(1) = 0$

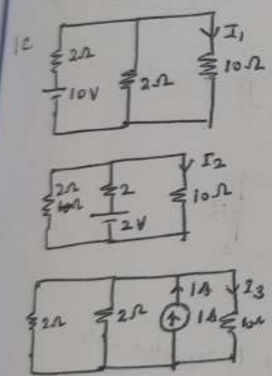
$-V_2 + 2.1V_3 = 4$

$\boxed{V_2 - 2.1V_3 = -4}$ — (1M)

V_2	3.90 V
V_3	3.76 V

(1/2 M) (1/2 M)

1C



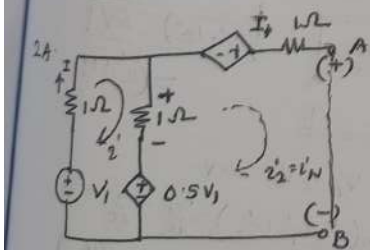
$I_1 = \left[\frac{10}{2 + \frac{2\times 10}{12}}\right] \cdot \frac{2}{12} = \boxed{0.4545A}$ — (1M)

$I_2 = \left[\frac{2}{2 + \frac{2\times 10}{12}}\right] \cdot \frac{2}{12} = \boxed{0.090909A}$ — (1M)

$I_3 = 1 \times \left(\frac{1}{11}\right) = \boxed{0.09090\ A}$ — (1/2)M

$I = I_1 + I_2 + I_3 = \boxed{0.63636}$ — (1/2)M

2A.



$2i' = V_1 - 0.5V_1$

$= 0.5V_1$

$\therefore i_1' = 0.25V_1$ — (A)

$i_1' = I = 0.25V_1$

$-V_{AB} + 0.5V_1 + 0.25V_1 + 0.25V_1 = 0$

$\boxed{V_{AB} = 1V_1 = V_1}$ — (2M)

To find R_{TH} apply short and $I_N = I_{sc} = i_2'$

$2i_1' - i_2' = V_1 - 0.5V_1 = 0.5V_1$

$-2i' + 2i_2' = 0.5V_1 + \cancel{0.25V_1} = \cancel{0.75}V_1 = 0.5V_1 + i_1'$

$-2i' + 2i_2' = 0.5V_1$ $\quad$ Adding $\quad i_2' = 0.5V_1 + 0.5V_1 = 1V_1$

$\therefore I_N = (V_1)$ Amp (2M)

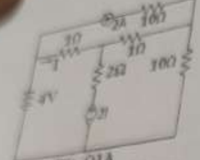


Fig. Q1A

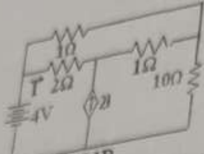


Fig.Q1B

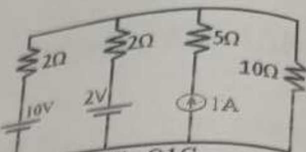


Fig.Q1C

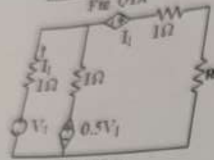


Fig. Q2A

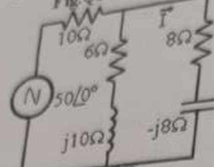


Fig.Q2B

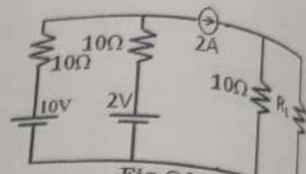


Fig.Q2C

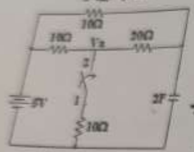


Fig. Q3A

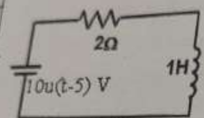


Fig.Q3C

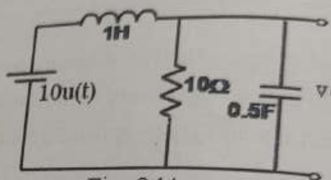


Fig. Q4A

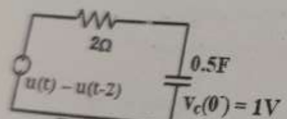


Fig.Q4B

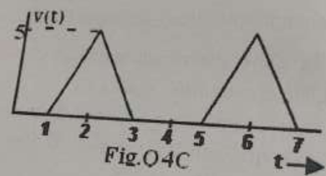


Fig.Q4C

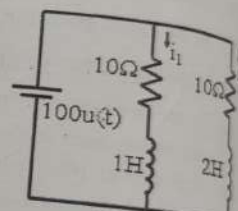


Fig. Q5A

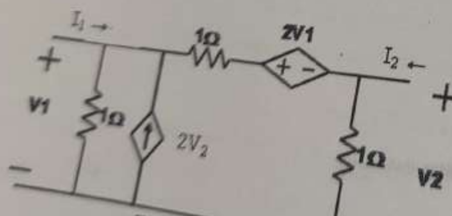


Fig.Q5B

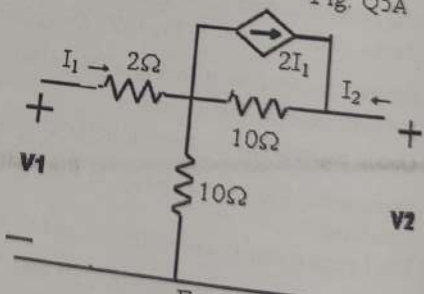


Fig.Q5C

****

Reg. No. | | | | | | | | | | |

MANIPAL INSTITUTE OF TECHNOLOGY
MANIPAL

THIRD SEMESTER B.TECH. (INSTRUMENTATION AND CONTROL ENGG.)
END SEMESTER EXAMINATIONS, NOV/DEC 2016

SUBJECT: ELECTRICAL CIRCUIT ANALYSIS [ICE 2101]

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.	determine the node voltages for the circuit shown in Fig.Q1B	3
1C.	For the circuit shown in Fig.Q1B, find the current in 10Ω resistor using superposition theorem.	2
2A.	Obtain Norton's equivalent for the circuit shown in Fig.Q2A, with respect to R_L.	5
2B.	In the circuit shown in Fig.Q2B, find current I and verify reciprocity theorem.	3
2C.	Obtain Thevinin's equivalent for the circuit shown in Fig.Q2C,with respect to R_L	2
3A.	In the network shown Fig. Q3A, the switch is closed at t=0, a steady state having previously been attained. Determine $v_a(0^-)$ and $v_a(0^+)$.	5
3B.	A source of 100V with source impedance 5+j3 and frequency 1000 Hz is connected to a load of capacitor C in series with 10Ω resistor. At what value of C, power in the 10Ω resistor is maximum? What is the power?	3
3C.	For the circuit shown in Fig.Q3C, find current in the circuit at 5 seconds.	2
4A.	For the circuit shown in Fig. Q4A, obtain expression for current in complementary and particular solution form.	5
4B.	Obtain expression for current in the circuit shown in Fig.Q4B.	3
4C.	Express the waveform shown in Fig. Q4C using basic signals and write the Laplace transform.	2
5A.	Use Laplace transform to find i1 and i2 in the circuit shown in Fig.Q5A	4
5B.	For the network shown in Fig.Q5B find Y parameters. Hence find Z parameters	4
5C.	Find h parameters for the circuit shown in Fig.Q5C	2