CBCS SCHEME

USN

18EC32

Third Semester B.E. Degree Examination, Jan./Feb. 2021
Network Theory

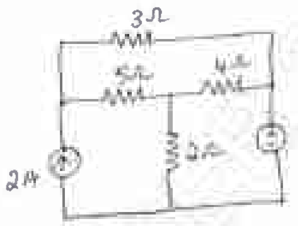
Time: 3 hrs. Max. Marks: 100

Note: Answer any FIVE full questions, choosing ONE full question from each module.

Module-1

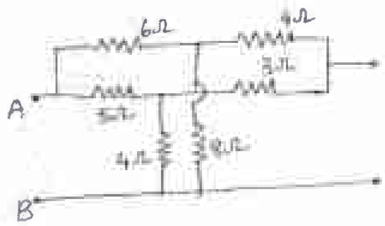
1 a. Using source transformation and source shifting techniques, find voltage across 2Ω resistor as shown in Fig.Q.1(a). **(07 Marks)**

Fig.Q.1(a)



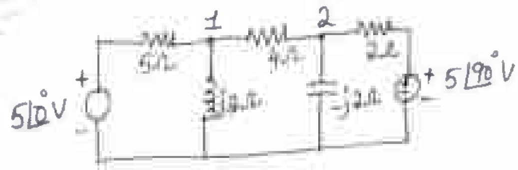
b. For the network shown in Fig.Q.1(b), find the equivalent resistance between A and B using Star-Delta transformation. **(05 Marks)**

Fig.Q.1(b)



c. Determine the node voltages V_1 and V_2 by nodal analysis for the network in Fig.Q.1(c). **(08 Marks)**

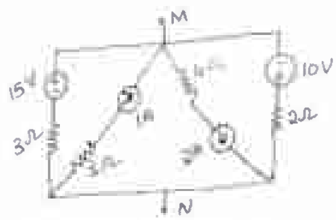
Fig.Q.1(c)



OR

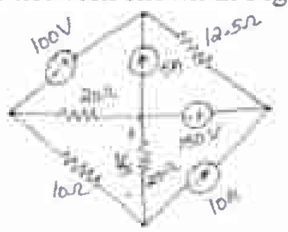
2 a. Find the potential difference between M and N using source transformation, for the network shown in Fig.Q.2(a). **(05 Marks)**

Fig.Q.2(a)



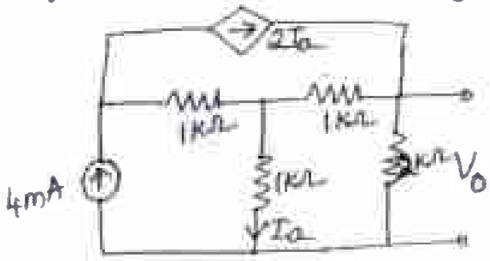
b. Find V_x using nodal analysis for the network shown in Fig.Q.2(b). **(08 Marks)**

Fig.Q.2(b)



c. Determine V_0 using mesh analysis for the network shown in Fig.Q.2(c). **(07 Marks)**

Fig.Q.2(c)

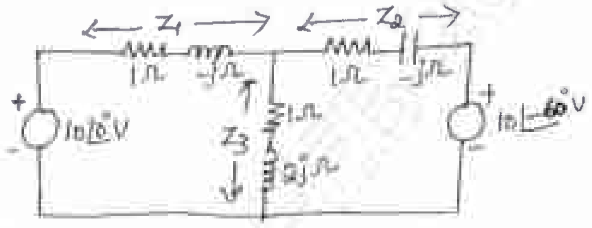


Module-2

3 a. State and prove Millman's theorem. **(06 Marks)**

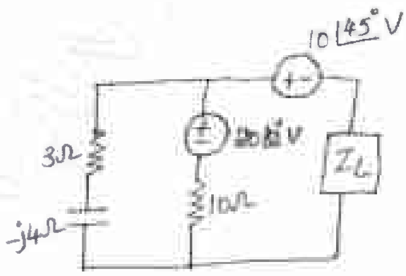
b. Find the current through Z_3 using superposition theorem for the network shown in Fig.Q.3(b). **(10 Marks)**

Fig.Q.3(b)



c. Find the value of Z_L for which maximum power transfer occurs in the network shown in Fig.Q.3(c). **(04 Marks)**

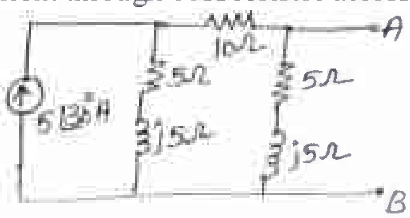
Fig.Q.3(c)



OR

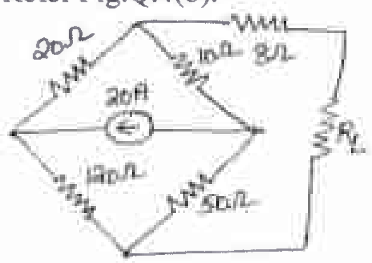
4 a. Obtain Thevenin's and Norton's equivalent circuit at terminals AB for the network shown in Fig.Q.4(a). Hence, find the current through 10Ω resistor across AB. **(12 Marks)**

Fig.Q.4(a)



b. Find the value of R_L for which maximum power is delivered. Also find the maximum power that is delivered to the load R_L. Refer Fig.Q.4(b). **(08 Marks)**

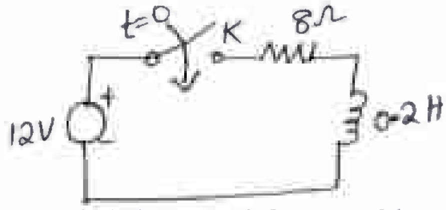
Fig.Q.4(b)



Module-3

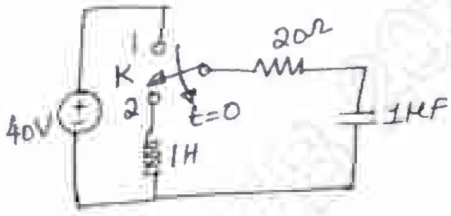
5 a. In the given network Fig.Q.5(a), K is closed at t = 0, with zero current in the inductor. Find the values of i, $\frac{di}{dt}$ and $\frac{d^2i}{dt^2}$ at $t = 0^+$. **(05 Marks)**

Fig.Q.5(a)



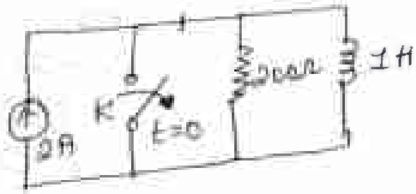
b. In the network Fig.Q.5(b), the switch is moved from position 1 to position 2 at t = 0. The steady-state has been reached before switching. Calculate i, $\frac{di}{dt}$ and $\frac{d^2i}{dt^2}$ at $t = 0^+$. **(07 Marks)**

Fig.Q.5(b)



c. In the network Fig.Q.5(c), the switch K is opened at t = 0. At $t = 0^+$, solve for v, $\frac{dv}{dt}$ and $\frac{d^2v}{dt^2}$. **(08 Marks)**

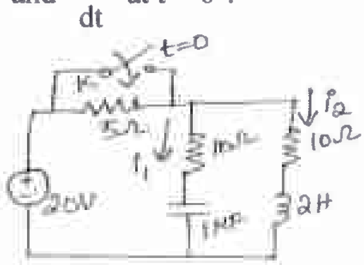
Fig.Q.5(c)



OR

6 a. For the circuit shown in Fig.Q.6(a), steady state is reached with switch K open. The switch is closed at t = 0. Find i_1, i_2, $\frac{di_1}{dt}$ and $\frac{di_2}{dt}$ at $t = 0^+$. **(10 Marks)**

Fig.Q.6(a)



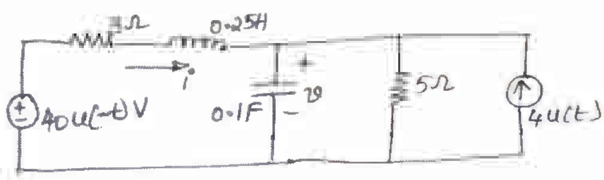
b. For the circuit in Fig.Q.6(b). Find:

i) $v(0^+)$ and $i(0^+)$

ii) $\frac{dv(0^+)}{dt}$ and $\frac{di(0^+)}{dt}$

iii) $v(\infty)$ and $i(\infty)$. **(10 Marks)**

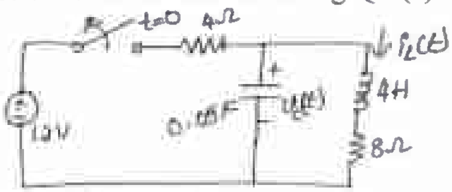
Fig.Q.6(b)



Module-4

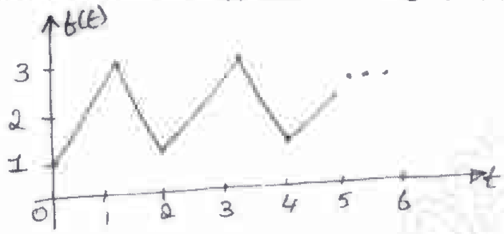
7 a. Determine the current $i_L(t)$ for $t \geq 0$ for the circuit in Fig.Q.7(a). **(10 Marks)**

Fig.Q.7(a)



b. Find the Laplace transform of the function f(t) shown in Fig.Q.7(b). **(10 Marks)**

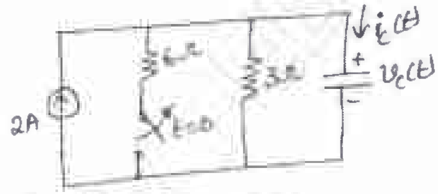
Fig.Q.7(b)



OR

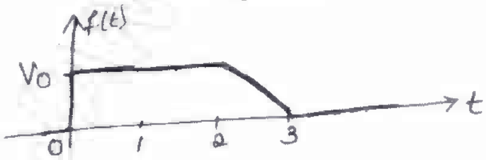
8 a. Determine the voltage $v_c(t)$ and the current $i_c(t)$ for $t \geq 0$ for the circuit shown in Fig.Q.8(a). **(10 Marks)**

Fig.Q.8(a)



b. Find the Laplace transform of f(t) shown in Fig.Q.8(b). **(10 Marks)**

Fig.Q.8(b)

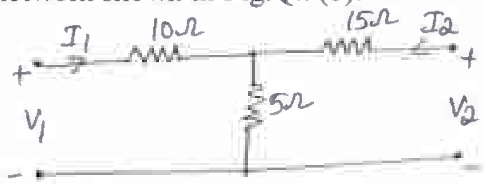


Module-5

9 a. Express Y parameters in terms of h-parameters. **(06 Marks)**

b. Find Z-parameters for the network shown in Fig.Q.9(b). **(06 Marks)**

Fig.Q.9(b)



c. The Z-parameters of a two port network are $z_{11} = 20\Omega$, $z_{22} = 30\Omega$, $z_{12} = z_{21} = 10\Omega$. Find Y and ABCD parameters of the network. **(08 Marks)**

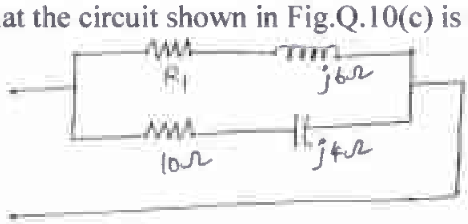
OR

10 a. Prove that the resonant frequency is the geometric mean of the two half power frequencies. **(06 Marks)**

b. A series RLC circuit has $R = 10\Omega$, $L = 0.01H$ and $C = 0.01\mu F$ and it is connected across 10mv supply. Calculate: i) f_0 ii) Q_0 iii) bandwidth iv) f_1 and f_2 v) I_0. **(06 Marks)**

c. Find the value of R_1 such that the circuit shown in Fig.Q.10(c) is resonant. **(08 Marks)**

Fig.Q.10(c)



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Re: Sir, regarding Modification of scheme and solutions (18EC32)

"Mrityunjaya Vithal Latte" <mvlatte@rediffmail.com>

April 22, 2021 3:28 PM

To: boe@vtu.ac.in, "mvlatteBOEVTU" <mvlatte.boe.vtu@gmail.com>

Dear sir,

The scheme of 18EC32 is verified and it is inline with the question paper .
Regards

PROF. MRITYUNJAYA V. LATTE
Principal,
JSS Academy of Technical Education,
Uttarahalli-Kengeri Main Road,Bangalore
Karnataka 560 060

From: <boe@vtu.ac.in>
Sent: Thu, 08 Apr 2021 17:12:35
To: mvlatte@rediffmail.com, mvlatte25@gmail.com
Subject: Sir, regarding Modification of scheme and solutions (18EC32)

" APPROVED "
Registrar (Evaluation)
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Visvesvaraya Technological University
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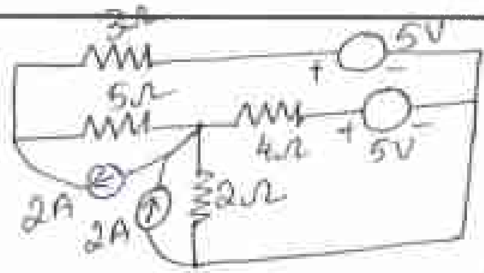
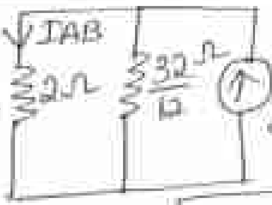
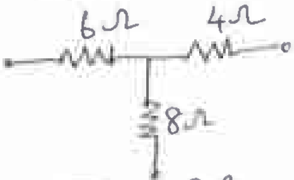
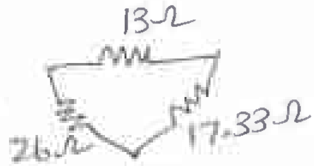
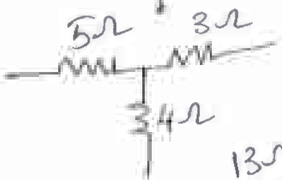
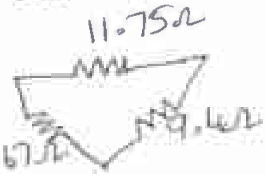
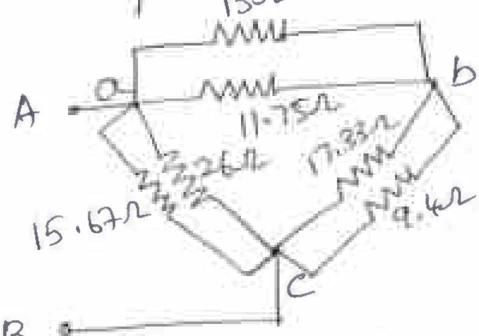
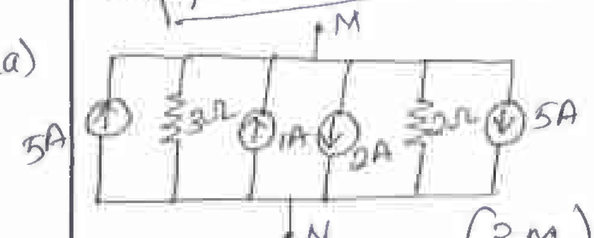
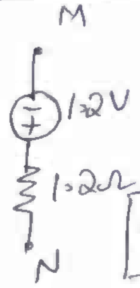
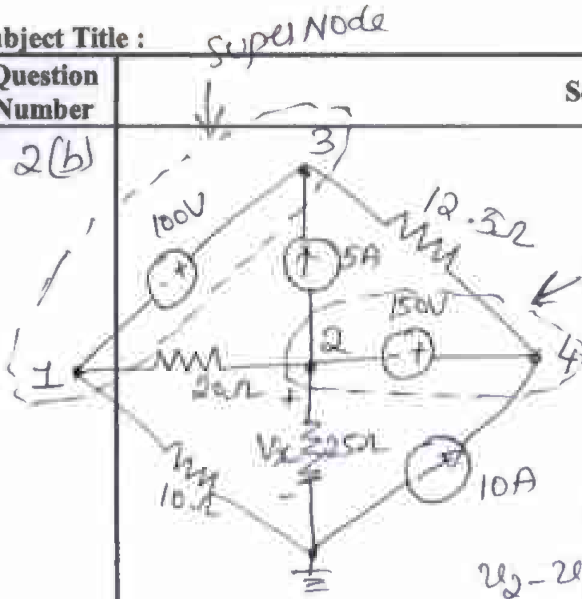
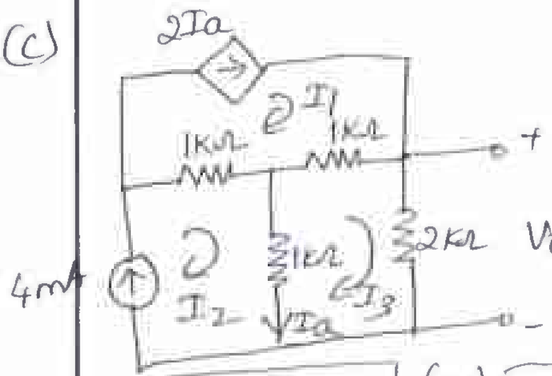
Scheme & Solutions — Signature of Scrutinizer

Subject Title : Network Theory **Subject Code :** 18EC32

Question Number	Solution	Marks Allocated
1(a)	 (3M)  (2M) $I_{AB} = 1.493A$ $V_{2\Omega} = 2\,I_{AB} =$ **2.986V** (2M)	(7M)
1(b)	 ⇒  (2M)   (2M)  **$R_{AB} = 5.441\Omega$** (1M)	(5M)
1(c)	Node1 : $(0.45 - j0.5)V_1 - 0.25V_2 = 1$ → ① – 2M Node2 : $-0.25V_1 + (0.75 + j0.5)V_2 = 2.5\angle 90^\circ$ → ② – 2M ∴ **$V_1 = 2.48\angle 72.1^\circ$ V** **$V_2 = 3.44\angle 26.47^\circ$ V** – 4M	(8M)
2(a)	 (3M) ⇒  (2M) **$V_{MN} = -1.2V$**	(5M)

Subject Title : Subject Code : 18EC32

Question Number	Solution	Marks Allocated
2(b)	 $v_3 - v_1 = 100$ $v_4 - v_2 = 150$ (2M) KCL at 1-3 $\frac{v_1}{10} + \frac{v_1 - v_2}{20} + \frac{v_3 - v_4}{12.5} = 5$ (1M) KCL at 2-4 $\frac{v_2 - v_1}{20} + \frac{v_2}{25} + \frac{v_4 - v_3}{12.5} + 5 = 10$ (1M) ∴ $v_1 = 74.77V$ $v_2 = V_x = 63.06V$ -(4M)	(8M)
2(c)	 $I_2 = 4mA$ $I_1 = 2I_a = 2(I_2 - I_3)$ (2M) KVL to Mesh 3 $10^3(I_3 - I_2) + 10^3(I_3 - I_1) + 2\times10^3 I_3 = 0$ (2M) $I_3 = 2mA$ -(1M) $V_o = 2\times10^3 I_3 = 4V$ -(2M)	(7M)
3(a)	Millman's Theorem: If 'n' voltage sources $V_1, V_2 \cdots V_n$ having internal impedances $Z_1, Z_2 \cdots Z_n$ are in parallel, then these sources may be replaced by a single voltage source of voltage V_M having a series impedance Z_M given by $V_M = \frac{\sum_{K=1}^{n} V_K Y_K}{\sum_{K=1}^{n} Y_K}$ $Z_M = \frac{1}{\sum_{K=1}^{n} Y_K}$ (2M) - proof required (4M)	(6M)
3(b)	Considering only $10\angle 0^\circ V$, current through Z_3 is $-j2.5A$ -(4M) Considering only $10\angle -60^\circ V$, current through Z_3 is $1.247 - j2.17A$ -(4M)	(10M)

∴ Total Current through Z_3 = $4.834\angle -75^\circ A$ -(2M)

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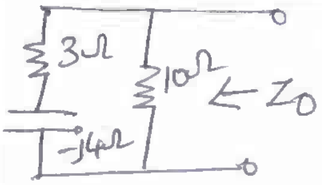
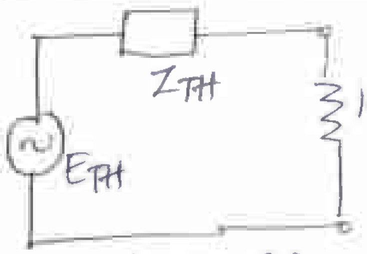
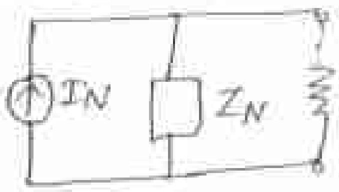
Question Number	Solution	Marks Allocated
3(c)	 (2M) $Z_0 = 7.97 - j2.16\Omega$ –(1M) $Z_L = Z_0^* = 7.97 + j2.16\Omega$ –(1M)	(4M)
4(a)	Thevenin's Eqn Ckt  $E_{TH} = 11.18\angle 93.43^\circ V$ $Z_{TH} = 4 + j3\Omega$ (5M) Norton's Eqn Ckt  $I_N = 2.24\angle 56.56^\circ A$ $Z_N = 4 + 3j\Omega$ –(5M) $I_{10\Omega} = 0.78\angle 81.33^\circ A$ –(2M)	(12M)
4(b)	$V_{TH} = 20V$, $R_L = 41.96\Omega$ } → (6M) $P_{max} = \frac{V_{TH}^2}{4R_L} = 2.383W$ → (2M)	(8M)
5(a)	$i(0^+) = 0$, $Ri + L\frac{di}{dt} = 12$, $\frac{di(0^+)}{dt} = 60A/sec$ (3M) $8\frac{di}{dt} + 0.2\frac{d^2i}{dt^2} = 0$ $\frac{d^2i(0^+)}{dt^2} = -2400A/sec^2$ (2M)	(5M)
5(b)	$i(0^+) = 0$, $Ri + L\frac{di}{dt} + v_c(t) = 0$, $\frac{di(0^+)}{dt} = -40A/sec$ (3M) $v_c(0^+) = 40V$ 2M $R\frac{di}{dt} + L\frac{d^2i}{dt^2} + \frac{i}{C} = 0$, $\frac{d^2i(0^+)}{dt^2} = 800A/sec^2$ (2M)	(7M)
5(c)	$v(0^+) = IR = 400V$ –(2M) $I = \frac{v(t)}{R} + \frac{1}{L}\int_{0^+}^{t} v(\tau)d\tau$ –(4M)	

$$\frac{dv(0^+)}{dt} = -8\times10^4 \, V/sec$$

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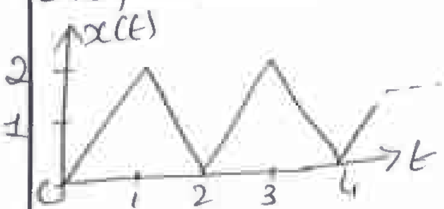
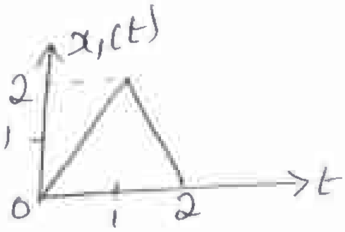
Question Number	Solution	Marks Allocated
	$\frac{1}{R}\frac{d^2v(t)}{dt^2} + \frac{1}{L}\frac{dv(t)}{dt} = 0$, $\frac{d^2v(0^+)}{dt^2} = 16\times10^6 V/sec^2$ -(2M)	(8M)
6(a)	$i_2(0^+) = 1.33A$ $i_1(0^+) = 0.67A$ $v_C(0^+) = 13.3V$ (2M) $10i_1 + \frac{1}{C}\int_{0^+}^{t} i_1(\tau)d\tau = 20$ (4M) $\frac{di_1(0^+)}{dt} = -0.67\times10^5 A/sec$ (4M) $10i_2 + 2\frac{di_2}{dt} = 20$, $\frac{di_2(0^+)}{dt} = 3.35 A/sec$	(10M)
6(b)	$i(0^+) = 5A$, $v(0^+) = 25V$ -(2M) $4 + i = C\frac{dv}{dt} + \frac{v}{5}$, $\frac{dv(0^+)}{dt} = 40V/sec$ -(3M) $3i + 0.25\frac{di}{dt} + v = 0$ $\frac{di(0^+)}{dt} = -160A/sec$ -(3M) $i(\infty) = -2.5A$, $v(\infty) = 7.5V$ -(2M)	(10M)
7(a)	$i_L(0^+) = 1A$ $v_C(0^+) = 8V$ -(2M) $-\frac{8}{s} + \frac{20}{s}I_L(s) + 4sI_L(s) - 4 + 8I_L(s) = 0$ (3M) $I_L(s) = \frac{s+1}{(s+1)^2+2^2} + \frac{1}{2}\left[\frac{2}{(s+1)^2+2^2}\right]$ -(3M) $i_L(t) = \left[e^{-t}\cos 2t + \frac{1}{2}e^{-t}\sin 2t\right]u(t)\ A$. -(2M)	(10M)
7(b)	Let $f(t) = x(t) + u(t)$   (2M)	

10 (a) proof for $\omega_0 = \sqrt{\omega_1 \omega_2}$ is required -(6M)

10 (b) $f_0 = 15{,}915.5 Hz$, $Q_0 = 100$

B.W = 159.155 Hz , $f_1 = 15{,}835.92 Hz$ [1×6 = (6 M)]

$f_2 = 15{,}995.1 Hz$, $I_0 = 1 mA$

10 (c) $Y_1 = \frac{1}{R_1 + j6}$ $Y_2 = \frac{1}{10 - j4}$ (2 M)

$Y = Y_1 + Y_2$, For the circuit to be resonant, the imaginary part of Y must be zero.

(4M) (8M)

$\frac{4}{116} = \frac{6}{R_1^2 + 36}$ $\therefore$ $R_1 = 11.75\Omega$ 2M

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Question Number	Solution	Marks Allocated
7(b) contd.,	$x_1(t) = \begin{cases} 2t, & 0<t<1 \\ 4-2t, & 1<t<2 \end{cases}$ (2M) $X_1(s) = \frac{2}{s^2}(1-e^{-s})^2$ -(2M) $X(s) = \frac{X_1(s)}{1-e^{-sT}} = \frac{2(1-e^{-s})^2}{s^2(1-e^{-2s})}$ $F(s) = X(s) + U(s)$ -(2M) $F(s) = \frac{2(1-e^{-s})^2}{s^2(1-e^{-2s})} + \frac{1}{s}$ - (2M)	(10M)
8(a)	$i_1(0^-) = \frac{4}{3}A$, $v_c(0^+) = 4V$ -(2M) $\frac{V_c(s)}{3} + \frac{s}{2}V_c(s) = 2 + \frac{2}{s}$ $\therefore V_c(s) = \frac{6}{s} - \frac{2}{s+\frac{2}{3}}$ (4M) $v_c(t) = \left[6 - 2e^{-\frac{2}{3}t}\right]u(t)\ V$ -(2M) $I_c(s) = \frac{V_c(s)}{\frac{2}{s}} - 2 = \frac{2/3}{s+\frac{2}{3}}$ (2M) $i_c(t) = \frac{2}{3}e^{-\frac{2}{3}t}u(t)\ A$	(10M)
8(b)	$f(t) = \begin{cases} V_0 & 0<t<2 \\ -V_0t+3V_0, & 2<t<3 \\ 0 & \text{ow} \end{cases}$ (3M) $f(t) = V_0[u(t) - u(t-2)] + [-V_0t + 3V_0][u(t-2) - u(t-3)]$ -(3M) $F(s) = \frac{V_0}{s} - \frac{V_0}{s^2}e^{-2s} + \frac{V_0}{s^2}e^{-3s}$ -(4M)	(10M)
9(a)	$y_{11} = \frac{1}{h_{11}}$, $y_{12} = -\frac{h_{12}}{h_{11}}$, $y_{21} = \frac{h_{21}}{h_{11}}$, $y_{22} = \frac{\Delta h}{h_{11}}$	(6M)
9(b)	$Z_{11} = 15\Omega$, $Z_{21} = 5\Omega$, $Z_{12} = 5\Omega$, $Z_{22} = 20\Omega$	(6M)
9(c)	$y_{11} = 0.06\mho$ $y_{12} = -0.01\mho$ (4M)	$A = 2$ $B = -50\Omega$ (4M)	(8M)

$y_{21} = -0.01\mho$ $C = 0.1\mho$

$y_{22} = 0.04\mho$ $D = 3$