~~Re-modified~~ Re-modified 13/1/2020

CBCS SCHEME

USN | | | | | | | | | | |

18EE32

Third Semester B.E. Degree Examination, Dec.2019/Jan.2020
Electric Circuit Analysis

Time: 3 hrs. Max. Marks: 100

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

Module-1

1 a. Setup nodal equations for the circuit of Fig.Q1(a) and then find the power supplied by 5 – V source.

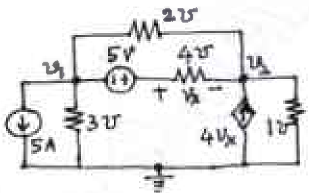

Fig.Q1(a) **(08 Marks)**

b. Making use of source shifting procedure, simplify the circuit of Fig.Q1(b) in such a way that the voltage V_X is determined.

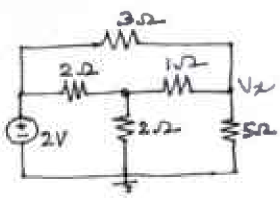

Fig.Q1(b) **(06 Marks)**

c. Use mesh analysis to determine the branch currents in the network indicated in Fig.Q1(c).

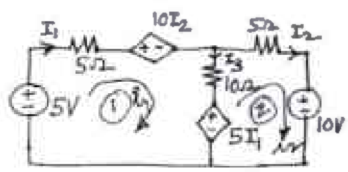

Fig.Q1(c) **(06 Marks)**

OR

2 a. Find 'Req' for the network shown in Fig.Q2(a) across A and B.

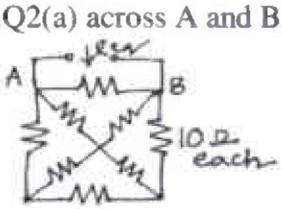

Fig.Q2(a) **(06 Marks)**

b. Draw the exact dual of the network shown in Fig.Q2(b) by writing Kirchhoff's law equations.

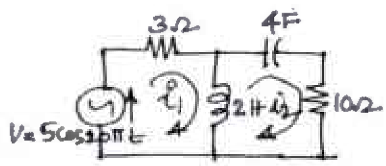

Fig.Q2(b) **(08 Marks)**

c. Reduce the network of Fig.Q2(c) to a form with only one current source across terminals using source transformation (terminals A and B).

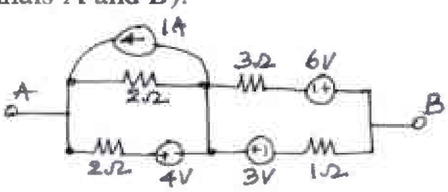

Fig.Q2(c) **(06 Marks)**

Important Note : 1. On completing your answers, compulsorily draw diagonal cross lines on the remaining blank pages.
2. Any revealing of identification, appeal to evaluator and /or equations written eg, 42+8 = 50, will be treated as malpractice.

Module-2

3 a. Find the Thevenin's equivalent circuit at the terminals A and B of the circuit in Fig.Q3(a).

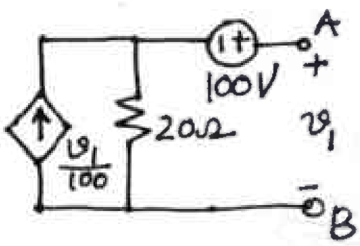

Fig.Q3(a)

(08 Marks)

b. Find the value of R_L in the network shown in Fig.Q3(b) that will absorb a maximum power and specify the value of that power.

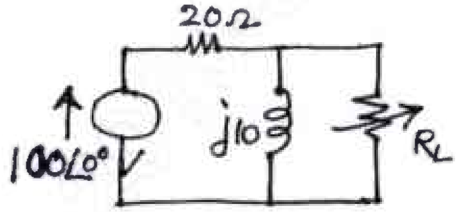

Fig.Q3(b)

(06 Marks)

c. In the network shown in Fig.Q3(c) the voltage source of 5V causes a current I in the 2Ω resistor. Find 'I'. Verify the reciprocity theorem.

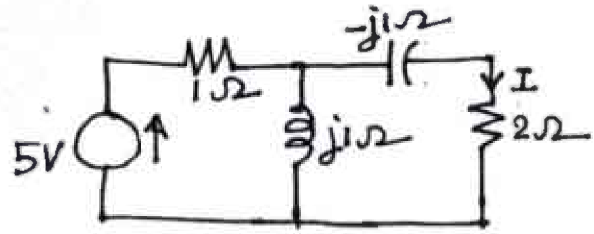

Fig.Q3(c)

(06 Marks)

OR

4 a. In the network shown in Fig.Q4(a) determine the nodal voltage V_2 using superposition theorem.

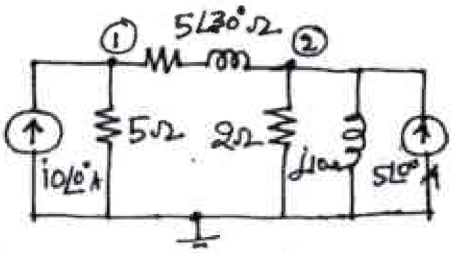

Fig.Q4(a)

(08 Marks)

b. Use Thevenin's theorem to find current in $R_L = 6\Omega$ in Fig.Q4(b).

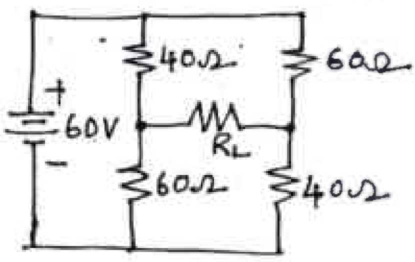

Fig.4(b)

(08 Marks)

c. State and prove Millman's theorem.

(04 Marks)

Module-3

5 a. Derive an expression for resonant frequency 'f_0' for the general parallel resonant circuit show in Fig.Q5(a).

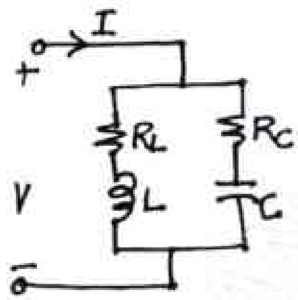

Fig.Q5(a)

(08 Marks)

b. Fig.Q5(b) shows a network with zero capacitor voltage and zero inductor current when the switch 'K' is open. At t = 0 the switch 'K' is closed. Solve for :

i) V_1 and V_2 at $t = 0^+$

ii) $\frac{dv_1}{dt}$ and $\frac{dv_2}{dt}$ and $t = 0^+$

iii) V_1 and V_2 at $t = \infty$

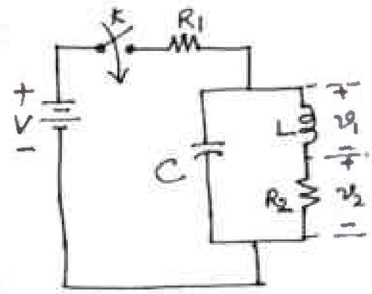

Fig. Q5(b)

(12 Marks)

OR

6 a. Fig.Q6(a) shows a RCL parallel circuit excited by a DC current source. At t = 0, the switch K is opened. Find v(t).

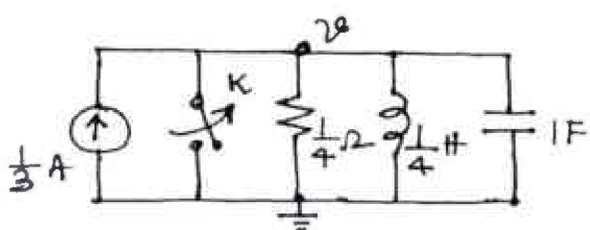

Fig.Q6(a)

(08 Marks)

b. A 400V, 200Hz AC source is connected in series with a capacitor and a coil whose resistance and inductance are 20mΩ and 6mH respectively. If the circuit is in resonance at 200Hz, find :

i) Value of capacitor

ii) V_g A/C the capacitor

iii) Maximum energy stored (instantaneous) in the coil

iv) The half – power frequencies. (08 Marks)

c. What are initial conditions in network? Write the equivalent form of the network elements interms of the initial conditions. (04 Marks)

Module-4

7 a. Find the Lapalce transform of the square wave shown in Fig.Q7(a).

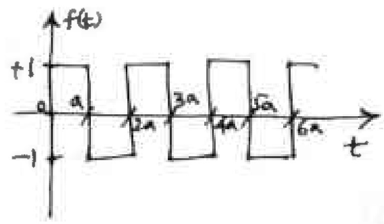

Fig.Q7(a) **(08 Marks)**

b. Fig.Q7(b) shows a series R–L–C circuit excited by a voltage v(t) = 12 sin 5t. The initial current in the circuit is 5A and the initial voltage a/c capacitor is one volt with polarity shown. Find i(t) using Lapalce transformation method.

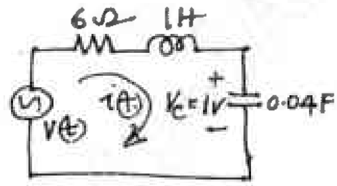

Fig.Q7(b) **(08 Marks)**

c. State and prove the initial–value theorem in the context of Lapalce transformation. **(04 Marks)**

OR

8 a. A rectangular voltage pulse of unit height and duration 'T' is applied to a series R–C combination at t = 0. Determine the voltage across the capacitance 'C' as a function of time. Use Laplace transformation method. **(10 Marks)**

b. Find the Laplace transforms of the two different functions given below and sketch the waveforms. i) sin (wt) u(t t_0) ii) sin w(t – t_0) u(t – t_0). **(10 Marks)**

Module-5

9 a. A symmetrical 3 - ϕ, 100V, 3-wire supply feeds an unbalanced star-connected load with impedances of the load as ZR = $5\angle 0°$ Ω, ZY = $2\angle 90°$ Ω and ZB = $4\angle -90°$ Ω. Find the line currents, voltage across the impedances and the displacement natural voltage. Also calculate the power consumed by the load. Draw the phasor diagram sequence RYB. Take VRY as ref. **(10 Marks)**

b. For the circuit of Fig.9(b) find Z-parameters. Hence calculate transmission (ABCD) parameters. Find whether the network is symmetrical? Reciprocal?

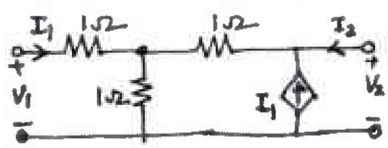

Fig.Q9(b) **(10 Marks)**

OR

10 a. A 3-ϕ delta connected load has Z_{RY} = (100 + j50)Ω, Z_{YB} = (20 – j75)Ω and Z_{BR} = (70.7 + j70.7)Ω and it is connected to balanced 3 - ϕ, 400V supply. Determine the line currents, power consumed by the load. Sketch the phasor diagram. Assume RYB phase sequence and take V_{YB} as the reference phasor. **(10 Marks)**

b. For the circuit shown in Fig.Q10(b) find Y-parameters. Is the network symmetrical? Reciprocal?

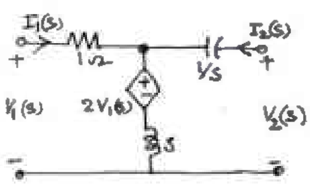

Fig.10(b) **(10 Marks)**

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Modification in Scheme and solutions in subjects Electrical Circuit Analysis

message

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Mon, Jan 13, 2020 at 1:12 PM

Good Morning
The modifications in Scheme and solutions of subjects 18EE32 Electrical Circuit Analysis
Q.no.5b. Full marks may be awarded for steps with wrong solution.
Q.no.6a. Full marks may be awarded for steps with wrong solution.
Q.no.7b. Full marks may be awarded for steps with wrong solution.

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Scheme & Solution

Signature of Scrutinizer

Subject Title: Electric circuit Analysis **Subject Code:** 18EE32

Question Number	Solution	Marks Allocated

Q1 (a)

KCL at node ①: $9v_1 - 6V_2 = -25$

KCL at node ②: $-10v_1 + 11V_2 = 40$

$v_1 = -0.8974\,V$; $V_2 = 2.8205\,V$. (02)

$P_{5V} = 5 \times (V_x \times 4)$ (02)

where $V_x = V_1 + 5 - V_2$

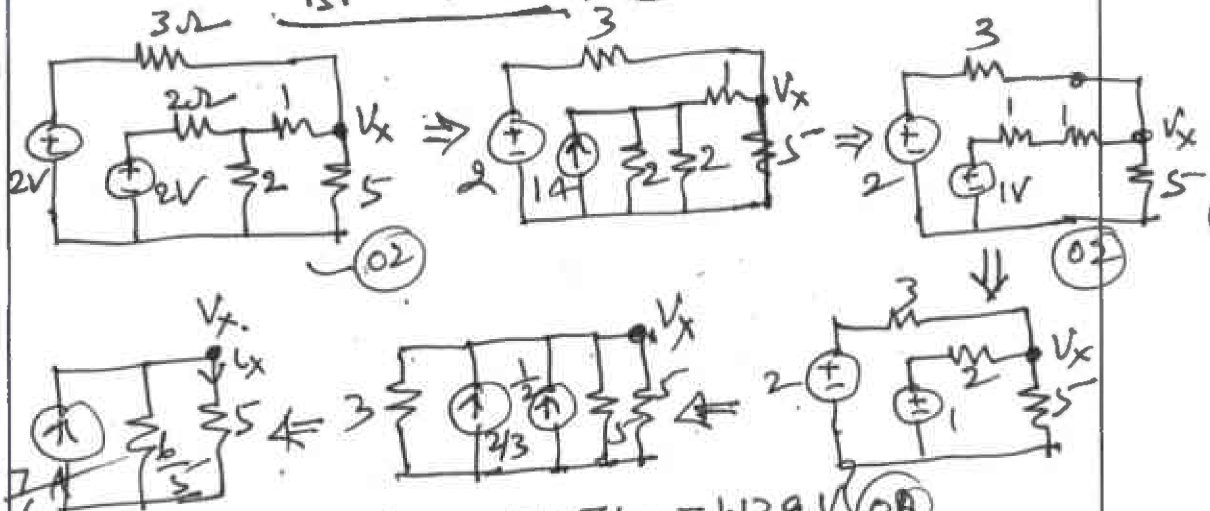
$V_x = 1.2821\,V$ (02)

power supplied $= P_{5V} = 5 \times 4 \times 1.2821$

$P_{5V} = 25.6\,W$ (02)

Marks: 08

(b)



$\therefore V_x = 5i_x = 5 \times 7/31 = 1.129\,V$ (02)

Marks: 06

(c)

Loop ①: $5i_1 + 10I_2 + 10(i_1 - i_2) + 5I_1 - 5 = 0$. since $i_2 = I_2$ & $i_1 = I_1$

$5i_1 + \cancel{10i_2} + 10i_1 \cancel{- 10i_2} + 5i_1 = 5$

$20i_1 = 5 \quad \therefore i_1 = 0.25A$ (02)

Loop ②: $5i_2 + 10 - 5I_1 + 10(i_2 - i_1) = 0$

$5i_2 + 10 - 5i_1 + 10i_2 - 10i_1 = 0$

$-15i_1 + 15i_2 = -10 \quad \therefore i_2 = -0.4167\,A$ (02)

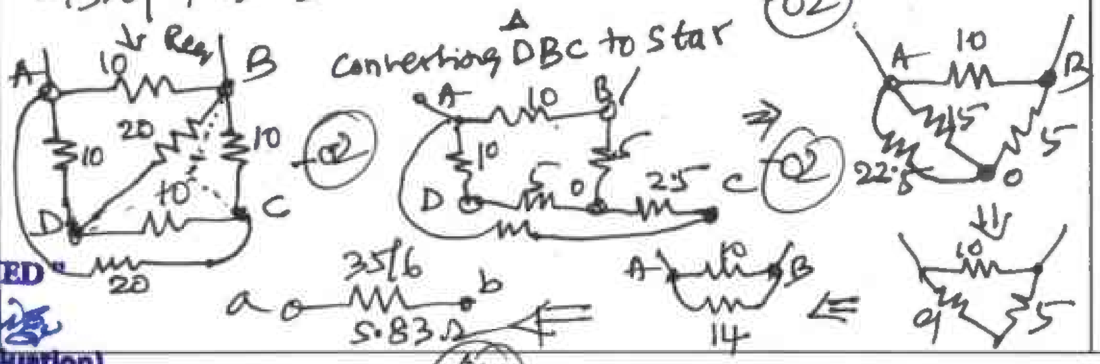
$I_1 = 0.25A$

$I_2 = -0.4167A$ (02)

$I_3 = 0.6667A$

Marks: 06

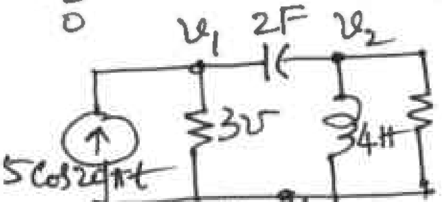
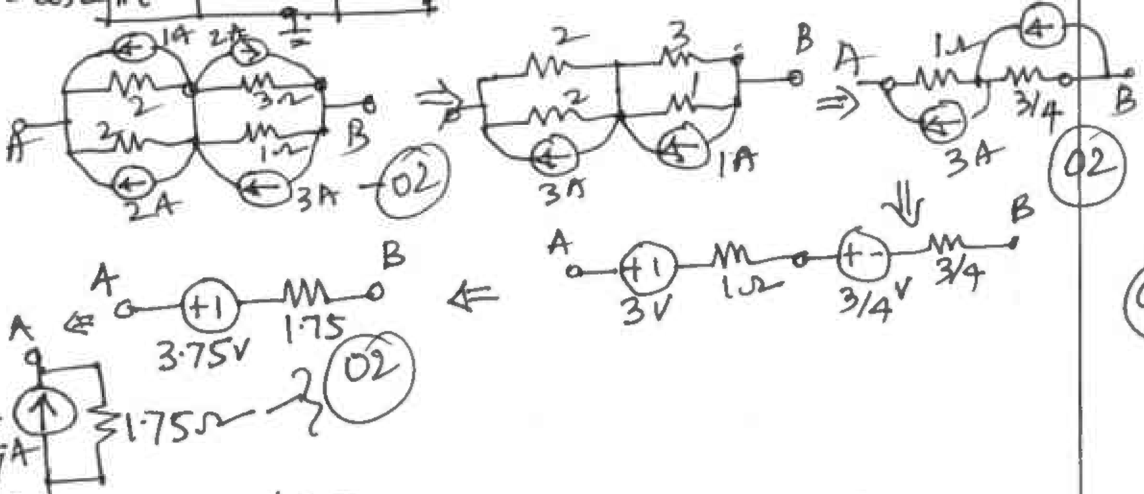
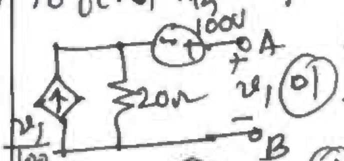
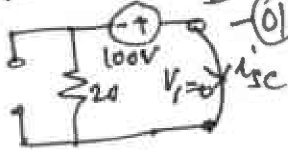
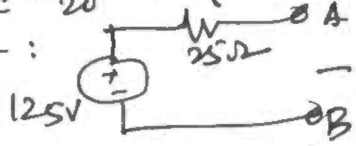
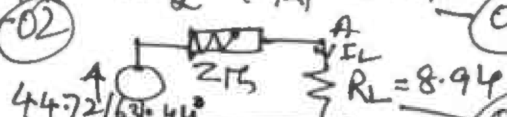
Q2 (a)



(02)

Marks: 06

Subject Title : Subject Code :

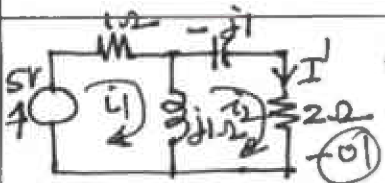
Question Number	Solution	Marks Allocated
Q2(b)	KVL for Loop ①: $3i_1 + 2\frac{d(i_1 - i_2)}{dt} = 5\cos 20\pi t$ — ① KVL for Loop ②: $\frac{1}{4}\int^t i_2\,dt + 10i_2 + 2\frac{d(i_2-i_1)}{dt} = 0$ — ② (02) The exact dual equations of ① & ② are $3v_1 + 2\frac{d(v_1-v_2)}{dt} = 5\cos 20\pi t$ — ③ $\frac{1}{4}\int_0^t v_2\,dt + 10v_2 + 2\frac{d(v_2-v_1)}{dt} = 0$ — ④ (04)  (02)	08
Q2(c)	 (02) (02) (02)	06
Q3(a)	To find V_{th}: open ckt V_{AB} ale AB: Applying KVL eqn $20\left(\frac{V_1}{100}\right) - V_1 + 100 = 0$ ∴ $V_1 = V_{AB} = 125V$ (02)  (01) To find R_{Th}: Short ckt terminals AB & find i_{sc}  (01) ∴ $i_{sc} = \frac{100}{20} = 5A$ (02) ∴ $Z_{Th} = \frac{V_{oc}}{i_{sc}} = \frac{125}{5} = 25\Omega$ (01) The eq. ckt:  (01)	08
3(b)	Thevenin's eq. ckt at the terminals of R_L i.e. Remove the R_L & find the $V_{oc} = V_{Th}$ (01) ∴ $V_{Th} = \frac{100\angle 0^\circ}{20+j10} \times j10 = \frac{100\angle 0 \times 10\angle 90^\circ}{22.36\angle 26.56^\circ} = 44.72\angle 63.44^\circ V$ (01) $Z_{Th} = \frac{20 \times j10}{20+j10} = 8.94\angle 63.44^\circ$ (02). ∴ $R_L = \lvert Z_{Th}\rvert = 8.94\Omega$ (01) $I_L = \frac{V_{Th}}{Z_{Th}+R_L} = 2.94\angle 31.72 A$:  (01)	06

$P_{max} = I_L^2 R_L = 2.94^2 \times 8.94 = 77.27W$ (01)

Subject Title : **Subject Code :**

Question Number	Solution	Marks Allocated

3 (c)



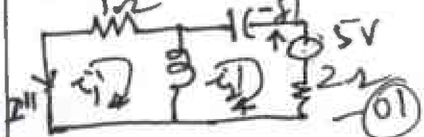
$(1+j1)I_1 - j1 I_2 = 5 \; ; \; -jI_1 + 2I_2 = 0$

$I_2 = \dfrac{j5}{3+j2} = I' (\downarrow)$ — 02

— 01

06

5V source is placed in series with 2Ω



— 01

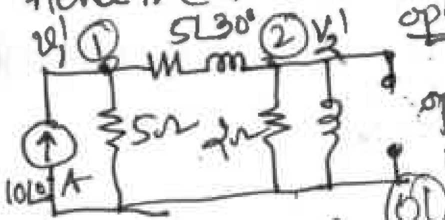
$(1+j1)i_1' - j1 i_2' = 0$.

$-j1 i_1' + 2 i_2' = -5$

$i_1' = \dfrac{-5j}{3+j2} = -I'' = \dfrac{j5}{3+j2} (\downarrow)$ — 02

Hence the theorem.

Q4 (a)



01

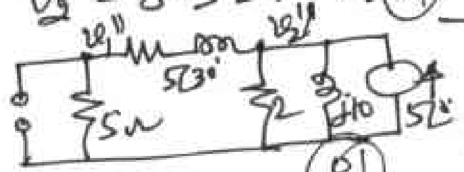
open $5\angle 0°$ A

KCL at (1): $\left(\dfrac{1}{5} + \dfrac{1}{5\angle 30}\right)V_1' - \dfrac{1}{5\angle 30°}V_2' = 10\angle 0°$ — (1)

KCL at (2): $\dfrac{-1}{5\angle 30°}V_1' + \left[\dfrac{1}{5\angle 30°} + \dfrac{1}{2} + \dfrac{1}{j10}\right]V_2' = 0$ — (2) 02

$V_2' = 8.5\angle -3°$ V — 01

open $10\angle 0°$ A source



01

at node (1)

$\left(\dfrac{1}{5} + \dfrac{1}{5\angle 30°}\right)V_1'' - \dfrac{1}{5\angle 30°}V_2'' = 0$ · (3)

at node (2)

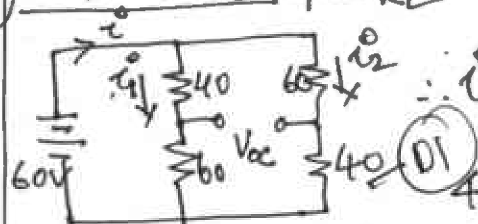
$-\dfrac{1}{5\angle 30°}V_1'' + \left(\dfrac{1}{5\angle 30°} + \dfrac{1}{2} + \dfrac{1}{j10}\right)V_2'' = 5\angle 0°$ · (4) 02

$V_2'' = 8.14\angle 12°$ V (01) By Superposition

$V_2 = V_2' + V_2'' = 16.45\angle 4.35°$

08

Q4 (b) TO find Voc open R_L



— 01

$\therefore i = \dfrac{60}{\dfrac{100 \times 100}{200}} = \dfrac{6}{5}$ A : $i_1 = \dfrac{3}{5}$ A

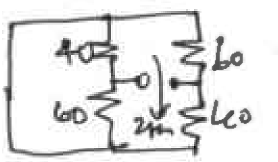
$i_2 = 3/5$ A 02

$40 i_1 + V_{oc} - 60 i_2 = 0$

$V_{oc} = (60-40)i_1 = 20 \times 3/5 = 12V$ 02

01

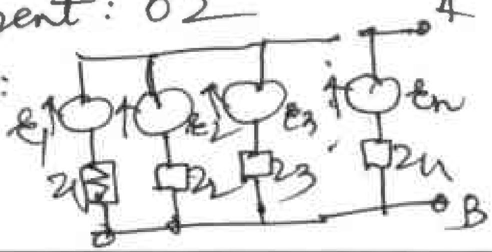
08



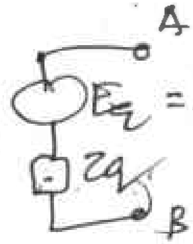
$\Rightarrow \dfrac{(60+40)\times(60+40)}{200} = 48\ \Omega$ — 02

(c) Statement : 02

Proof :



$\Rightarrow$



$E_q = \dfrac{E_1 Y_1 + E_2 Y_2 + \cdots}{Y_1 + Y_2 + \cdots}$ — 02

04

Subject Title : Subject Code :

Question Number	Solution	Marks Allocated

Q5 (a)

$$Y_{in} = \left(\frac{R_L}{R_L^2+X_L^2} + \frac{R_C}{R_C^2+X_C^2}\right) + j\left(\frac{X_C}{R_C^2+X_C^2} - \frac{X_L}{R_L^2+X_L^2}\right) \quad \text{— 04}$$

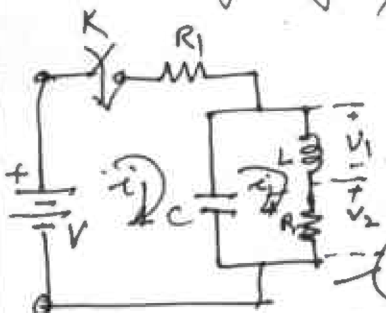
j term is zero at Resonance $\omega = \omega_0$

$$\frac{X_C}{R_C^2+X_C^2} = \frac{X_L}{R_L^2+X_L^2} \quad \text{or} \quad X_C R_L^2 + X_C X_L^2 = X_L R_C^2 + X_L X_C^2$$

$$\omega_0 = \frac{1}{\sqrt{LC}}\sqrt{\frac{L/C - R_L^2}{L/C - R_C^2}} \quad \text{— 04}$$

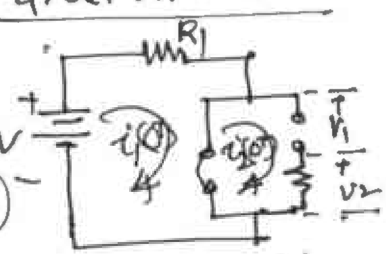
(08)

(b)



— 01

Eq. ckt at $t=0^+$



— 02

for $t \geq 0$ $\quad R_1 i_1 + \frac{1}{C}\int (i_1 - i_2)\,dt = V$ ...(1) ; $L\frac{di_2}{dt} + R_2 i_2 + \frac{1}{C}\int (i_2 - i_1)\,dt = 0$ ...(2) } 02

$i_1(0^+) = \frac{V}{R_1}$; $i_2(0^+) = 0$; $v_1(0^+) = 0$; $v_2(0^+) = 0$ — 02

$\frac{dv_2}{dt}(0^+) = R_2 \frac{di_2}{dt}(0^+) = 0$; $\frac{dv_1}{dt}(0^+) = \frac{V}{R_1 C}$ — 02

At $t = \infty$: $v_1(\infty) = 0$ (01) ; $i_2 = \frac{V}{R_1+R_2}$; $v_2(\infty) = \frac{VR_2}{R_1+R_2}$ } 02

(12)

Q6 (a) KCL eq. for v: $C\frac{dv}{dt} + Gv + \frac{1}{L}\int v\,dt = I$ — 02

$\frac{d^2v}{dt^2} + 4\frac{dv}{dt} + 4v = 0 \;\therefore\; s^2 + 4s + 4 = 0 : s_1 = -2, s_2 = -2$ } 02

$v(t) = K_1 e^{-2t} + K_2 t e^{-2t}$ (02) $v(0^+) = 0$ & $\frac{dv}{dt}(0^+) = \frac{1}{3}$ V/s

$K_1 = 0$ & $K_2 = 1/3$ (01)

$\therefore V(t) = \frac{1}{3} t e^{-2t}$ (01)

(08)

(b) (i) $f_0 = \frac{1}{2\pi\sqrt{LC}}$: $C = \frac{1}{4\pi^2 L f_0^2} = 105.54\,\mu F$ — 02

(ii) $I_0 = V/R = 20{,}000\,A$; $V_C = I_0 X_C = 151\,kV$ — 02

(iii) ~~Maximum~~ instantaneous energy $= W = \frac{1}{2} L I_0$ — 02

$W = \frac{1}{2} \times 0.006 \times (20{,}000\sqrt{2})^2 = 2.4 \times 10^6\,J$

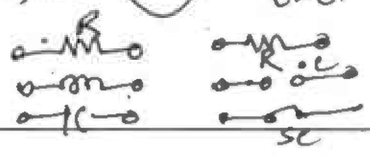
$Q_0 = \frac{\omega_0 L}{R} = 377$; $\Delta f = \frac{f_0}{Q_0} = 0.53\,Hz$

$f_1 = f_0 - \frac{1}{2}\Delta f = 199.74\,Hz$; $f_2 = f_0 + \frac{1}{2}\Delta f = 200.26\,Hz$ } 02

(08)

(c) Definition — 02

Eq. ckt: $t=0^+$



(02)

(04)

Subject Title : **Subject Code :**

Question Number	Solution	Marks Allocated

Q7 (a)

$f_1(t) = u(t) - 2u(t-a) + u(t-2a)$ — 02

$F_1(s) = \frac{1}{s}(1 - 2e^{-as} + e^{-2as}) = \frac{1}{s}(1-e^{-as})^2$ — 02

$T = 2a$. LT of square wave

$F(s) = \frac{1}{1-e^{-Ts}} F_1(s) = \frac{1}{s}\frac{(1-e^{-as})^2}{(1-e^{-2as})} = \frac{1}{s}\frac{(1-e^{-as})}{(1+e^{-as})}$ 02

$F(s) = \frac{1}{s}\tanh\left(\frac{as}{2}\right)$; — 01 — 08

(b) KVL eq. for the ckt $t>0$; $6i + \frac{di}{dt} + \frac{1}{0.04}\int_0^t i\,dt = 12\sin 5t$ — 02

Taking LT. $6I(s) + sI(s) + 25\frac{I(s)}{s} + \frac{1}{s} - 5 = \frac{60}{s^2+25}$ — 02

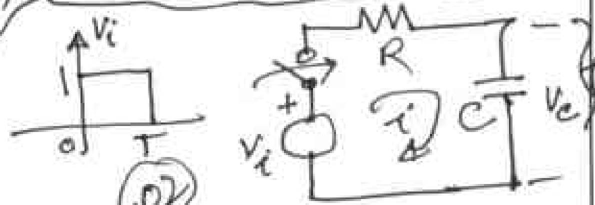
$I(s) = \frac{60s}{(s^2+25)(s^2+6s+25)} + \frac{5s-1}{s^2+6s+25}$ Taking $\mathcal{L}^{-1}$ — 02

$i(t) = 5e^{-3t}\cos 4t - 6.5e^{-3t}\sin 4t + 2\sin 5t$ — 04 — 08

(c) statement — 02

Proof — 02

Q8 (a)



— 01

$RC\frac{dV_c}{dt} + V_c = V_i(t)$ — 02

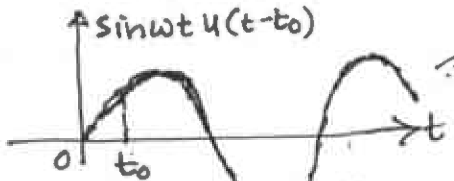
$RC\frac{dv_c}{dt} + V_c = u(t) - u(t-T)$ Taking inverse LT

$RC[sV_c(s) - V_c(0^+)] + V_c(s) = \frac{1}{s}(1 - e^{-Ts})$ since $V_c(0^+) = 0$ — 02

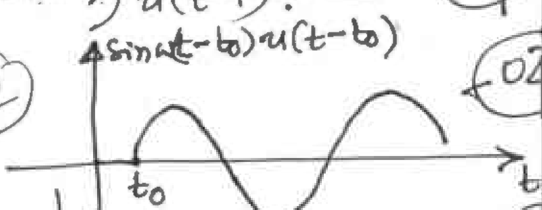
$(RCs+1)V_c(s) = \frac{1}{s}(1-e^{-Ts})$; $V_c(s) = \frac{1-e^{-Ts}}{s(RCs+1)}$ — 01

$V(t) = (1-e^{-t/RC})u(t) - (1-e^{-(t-T)/RC})u(t-T)$ — 02 — 10

(b)



— 02



— 02

$\mathcal{L}[\sin\omega t\, u(t-t_0)] = \int_{t_0}^{\infty}\sin\omega t\, e^{-st}dt$ — 01

$= \frac{1}{2j}\int_{t_0}^{\infty}\left(e^{(-s+j\omega)t} - e^{(-s-j\omega)t}\right)dt$

$= e^{-t_0 s}\left[\frac{\omega\cos\omega t_0 + s\sin\omega t_0}{s^2+\omega^2}\right]$ — 02

$\mathcal{L}[\sin\omega(t-t_0)u(t-t_0)]$ — 01

$= e^{-t_0 s}\mathcal{L}[\sin\omega t]$

$= e^{-t_0 s}\left(\frac{\omega}{s^2+\omega^2}\right)$ — 02 — 10

Subject Title : Subject Code :

Question Number	Solution	Marks Allocated

Q 9 (a)

$V_{Ry} = 100\angle 0^\circ$ ref. $V_{yB} = 100\angle -120^\circ$; $V_{BR} = 100\angle -240 = 100\angle 120$ V

Line currents: $i_R = 27.05\angle -8.7^\circ$ A ; $i_y = 19.7\angle -121.1^\circ$ A

$i_B = 26.69\angle 128.4^\circ$ A. (02)

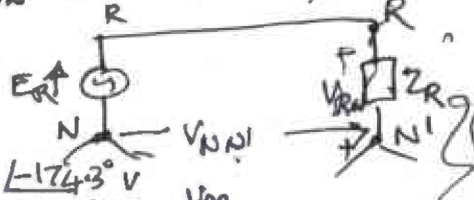
Voltage a/c the impedances (i.e. phase Voltages)

$V_{RN'} = 135.25\angle -8.7^\circ$ V ; $V_{yN'} = 39.38\angle -31^\circ$ V (02)

$V_{BN'} = 106.75\angle 38.4$ V

$V_{NN'} + V_{RN'} = V_{RN} = E_R$ (02)

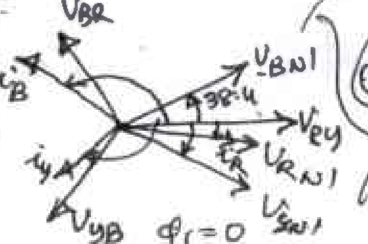
$\therefore V_{NN'} = E_R - V_{RN'} = 84.11\angle -174.3^\circ$ V



$P = V_R I_R \cos\phi_1 + V_y I_y \cos\phi_2 + V_B I_B \cos\phi_3$

$= 135.25 \times 27.05 \times \cos 0^\circ + 0 + 0$

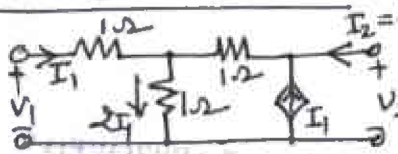
$P = 3.6585$ kW (02)



$\phi_1 = 0$
$\phi_2 = 90^\circ$
$\phi_3 = -90^\circ$ (02)

10

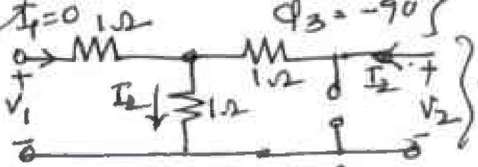
(b)



(02)

$V_1 = 3I_1$; $V_2 = 3I_1$ (01)

$Z_{11} = 3\Omega$; $Z_{21} = 3\Omega$



(02)

$V_1 = I_2$
$V_2 = 2I_2$ (01)

$\therefore Z_{12} = 1\Omega$; $Z_{22} = 2\Omega$

ABCD parameters: $A = \frac{Z_{11}}{Z_{21}} = 3/3 = 1$; $B = \frac{\Delta Z}{Z_{21}} = \frac{3}{3} = 1$

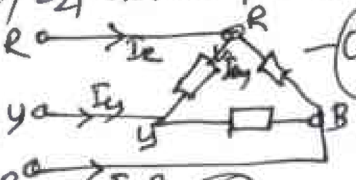
$C = \frac{1}{Z_{21}} = \frac{1}{3}$; $D = \frac{\Delta Z}{Z_{21}} = 3/3 = 1$; $T = \begin{bmatrix} 1 & 1 \\ 1/3 & 2/3 \end{bmatrix}$ (04)

$Z_{11} \neq Z_{22}$ $\therefore$ Not Symmetrical : $Z_{12} \neq Z_{21}$ not Reciprocal.

08

Q10 (a)

$V_{yB} = 400\angle 0^\circ$; $V_{BR} = 400\angle -120^\circ$: $V_{Ry} = 400\angle 120^\circ$



(02)

$I_{Ry} = 3.58\angle 93.4$; $I_{yB} = 5.15\angle 75.1$ (02)

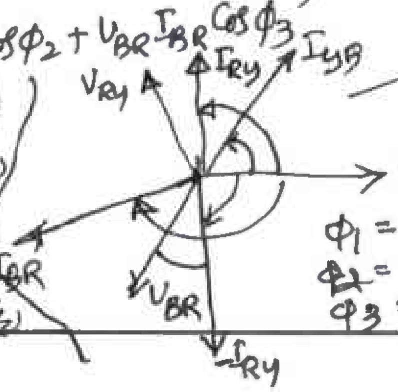
$I_{BR} = 4\angle -165^\circ$.

Line currents: $i_R = 5.88\angle 51.6$ A ; $i_B = 7.95\angle -130.8$ A (02)

$i_y = 2.09\angle 42.4^\circ$ A ;

$P = V_{Ry} I_{Ry} \cos\phi_1 + V_{yB} I_{yB} \cos\phi_2 + V_{BR} I_{BR} \cos\phi_3$

$P = 2941.2$ W : (02)



(02)

$\phi_1 = 333.4$
$\phi_2 = -75.1$
$\phi_3 = -45$

10

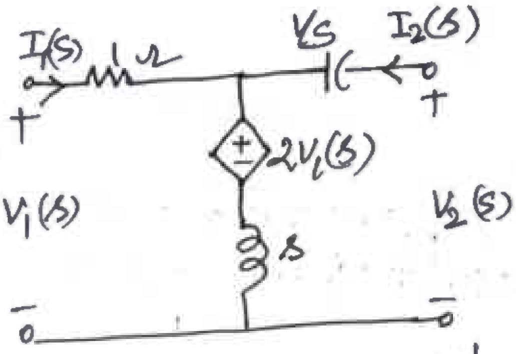
10 (b)

$V_1(s) = -(s+1)I_1(s) - s\,I_2(s)$ — (1)

$V_2(s) - 2V_1(s) = \left(\frac{s^2+1}{s}\right) I_2(s) + sI_1(s)$ — (2)

(02)

PTO



To find y-parameters. $V_2(s) = 0$.

Using in eq (1) & (2)

$$I_1(s) = \frac{-1}{s^2+s+1} V_1(s) \quad \& \quad I_2(s) = \frac{-s}{s^2+s+1} V_1(s)$$

$$y_{11} = \left.\frac{I_1(s)}{V_1(s)}\right|_{V_2=0} = \frac{-1}{s^2+s+1} \; ; \; y_{21} = \left.\frac{I_2(s)}{V_1(s)}\right|_{V_2=0} = \frac{-s}{s^2+s+1} \quad \Bigg\} \; 04$$

Short circuiting input port : $V_1(s) = 0$:

$$I_1(s) = \frac{-s^2}{s^2+s+1} V_2(s) \; : \; I_2(s) = \frac{s(s+1)}{s^2+s+1} V_2(s)$$

$$\left.\frac{I_1(s)}{V_2(s)}\right|_{V_1=0} = y_{12} = \frac{-s^2}{s^2+s+1} \; ; \; \left.\frac{I_2(s)}{V_2(s)}\right|_{V_1=0} = y_{22} = \frac{s(s+1)}{s^2+s+1} \quad \Bigg\} \; 04$$

10

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“ APPROVED ”

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