WINTER-19 EXAMINATION

Subject Name: Electric circuits and network **Subject Code: 22330**

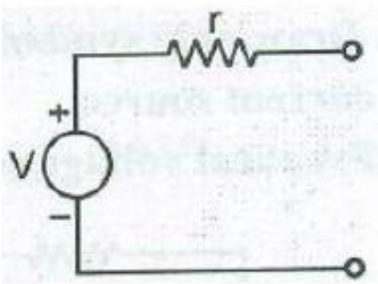
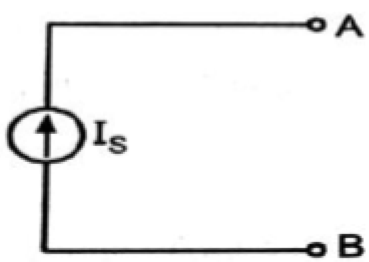
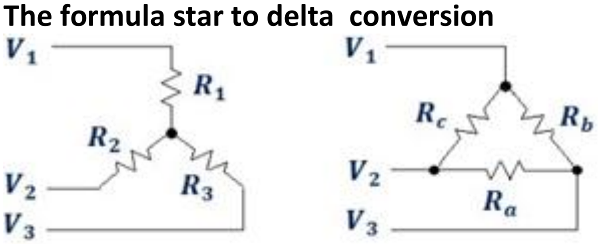
Model Answer

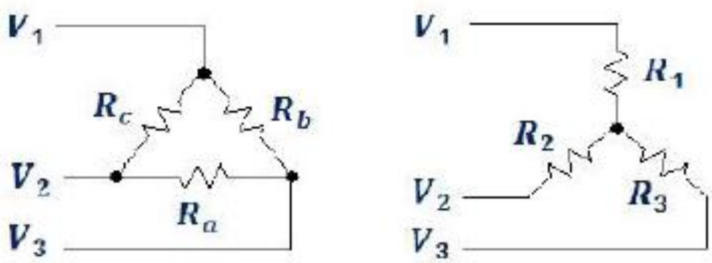
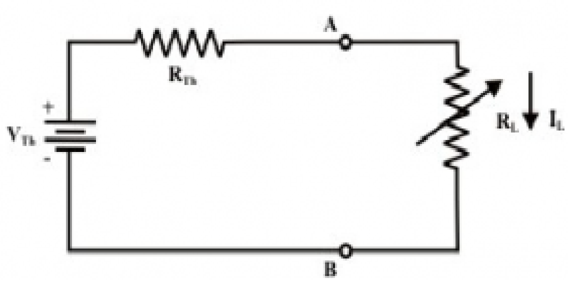
Important Instructions to examiners:

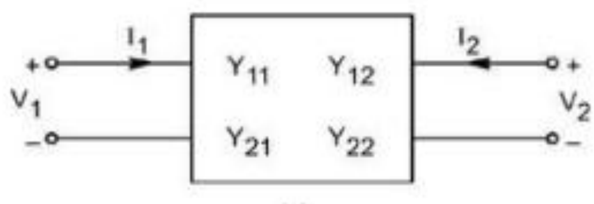
1) The answers should be examined by key words and not as word-to-word as given in themodel answer scheme.
2) The model answer and the answer written by candidate may vary but the examiner may tryto assess the understanding level of the candidate.
3) The language errors such as grammatical, spelling errors should not be given moreImportance (Not applicable for subject English and Communication Skills.
4) While assessing figures, examiner may give credit for principal components indicated in thefigure. The figures drawn by candidate and model answer may vary. The examiner may give credit for anyequivalent figure drawn.
5) Credits may be given step wise for numerical problems. In some cases, the assumed constantvalues may vary and there may be some difference in the candidate's answers and model answer.
6) In case of some questions credit may be given by judgement on part of examiner of relevant answer based on candidate's understanding.
7) For programming language papers, credit may be given to any other program based on equivalent concept.

Q. No.	Sub Q. N.	Answers	Marking Scheme
1	(A)	**Attempt any FIVE of the following:**	**10- Total Marks**
	(a)	**Define:** **(i) Apparent power** **(ii) Real power**	**2M**
	Ans:	**(i) Apparent power** It is the product of rms values of applied voltage and circuit current. Unit: volt-ampere (VA) OR kilo-volt-ampere (kVA) OR Mega-volt-ampere (MVA) S = VI = I^2 Z volt-ampere (VA) **(ii)Real power** The active power is defined as the average power Pavg taken by or consumed by the given circuit. **(OR)**	**1 M for each definition**

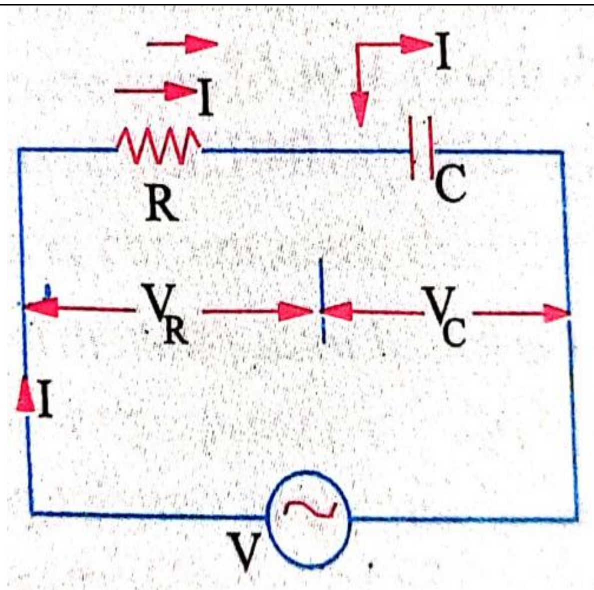
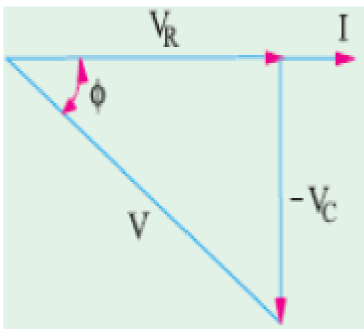
		It is the power which is actually dissipated in the circuit resistance. P =V.I.CosØ Unit: - Watt OR Kilowatt	
	(b)	**Write equation of resultant impedance in R-L circuit.**	**2M**
	Ans:	**The equation of resultant impedance in R-L circuit** $$Z = \sqrt{(R^2 + X_L^2)}$$ Where ,R=Resistance X_L=Inductive Reactance = $2\pi fL\ \Omega$.	**2 M for equation**
	(c)	**State condition for resonance in R-L-C series circuit.**	**2M**
	Ans:	**The condition for resonance in R-L-C series circuit.** i) Inductive Reactance should be equal to capacitive reactance. That is $X_L = X_C$ ii) The power factor of the circuit is Cos ϕ = 1 iii)The voltage and current in the R-L-C series circuit are in phase with each other. iv)Current in the circuit is maximum and given by I =V/R. v)Impedance of the circuit is minimum and given by Z =R.	**2M for any two conditions**
	(d)	**Draw –** **(i) Practical voltage source** **(ii) Ideal current source**	**2M**
	Ans:	**i) Practical voltage source**	**1 M for each diagram**

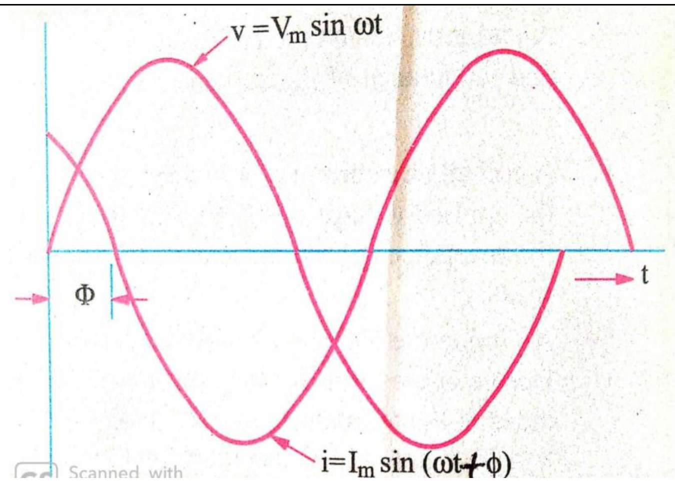
		 **ii) Ideal current source**  Where, I_s = Current Source R_s = internal resistance of source	
	e)	**Write formula for star to delta and delta to star transformation.**	2M
	Ans:	**The formula star to delta conversion**  $R_a = \frac{R_1R_2+R_1R_3+R_2R_3}{R_1}$ $R_b = \frac{R_1R_2+R_1R_3+R_2R_3}{R_2}$ $R_c = \frac{R_1R_2+R_1R_3+R_2R_3}{R_3}$	**1 M for star to delta transformation** **1 M for delta to star transformation**

		The formula for Delta to Star conversion-  $$R_1 = \frac{R_b R_c}{R_a + R_b + R_c}$$ $$R_2 = \frac{R_a R_c}{R_a + R_b + R_c}$$ $$R_3 = \frac{R_a R_b}{R_a + R_b + R_c}$$	
	f)	**State maximum power transfer theorem.**	**2M**
	Ans:	Maximum Power Transfer Theorem states that "Maximum power is transferred from the source to the load when the load resistance is equal to the Thevenin's equivalent resistance of the given circuit as seen from load terminals" .i. e, $R_L = R_{TH}$  	**2M for statement**
	g)	**Write equation of short circuit Y parameters.**	**2M**
	Ans:	**The equation of short circuit Y parameters.**	**1 M for each equation**

		$\begin{bmatrix} I_1 \\ I_2 \end{bmatrix} = \begin{bmatrix} Y_{11} & Y_{12} \\ Y_{21} & Y_{22} \end{bmatrix} \begin{bmatrix} V_1 \\ V_2 \end{bmatrix}$ $I_1 = Y_{11}V_1 + Y_{12}V_2$ .... 1 $I_2 = Y_{21}V_1 + Y_{22}V_2$ .... 2 	

Q. No.	Sub Q. N.	Answers	Marking Scheme
2		**Attempt any THREE of the following:**	**12- Total Marks**
	a)	**For R-C series circuit draw** **(i) Circuit diagram** **(ii) Vector diagram** **(iii) Waveform of voltage and current**	**4M**
	Ans:	**i)Circuit diagram**	**1M- circuit diagram, 1M- vector diagram, 2M- waveforms**

		 **ii)Vector diagram**  **iii)Waveform of voltage and current**	



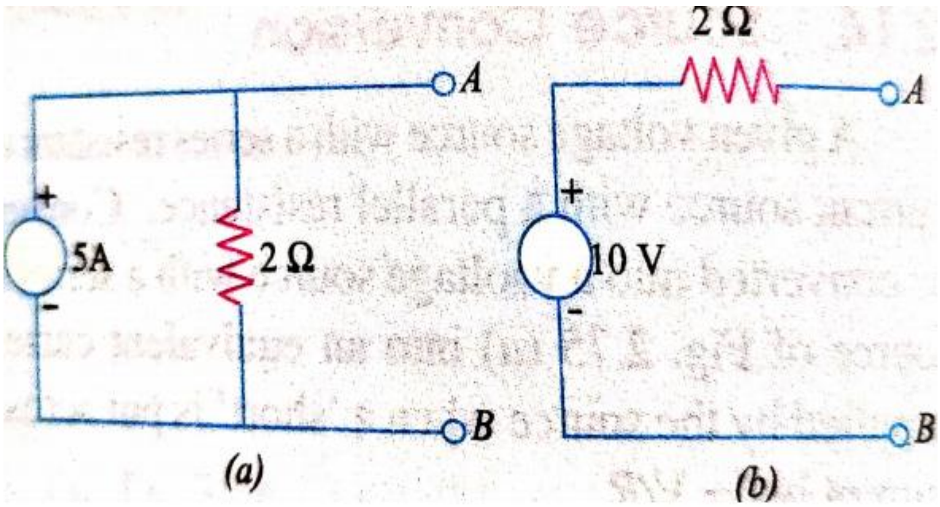
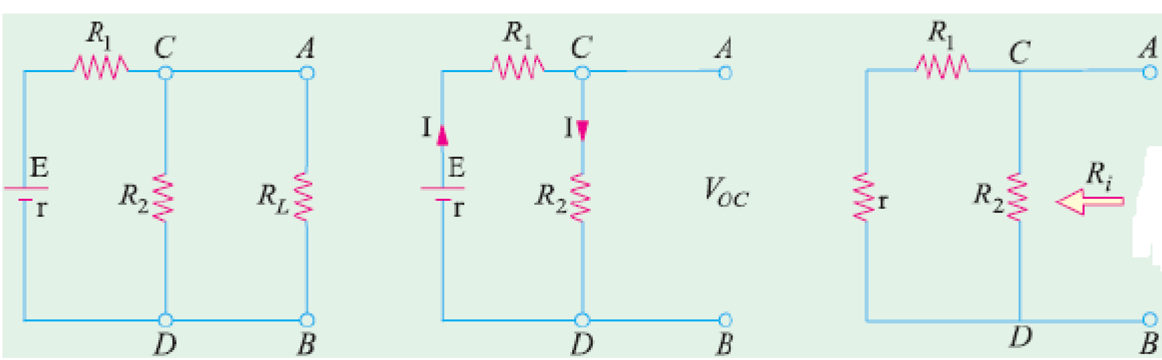
b) Compare series and parallel resonance on the basis of **4M**

(i) Resonating frequency
(ii) Impedance
(iii) Current
(iv) Magnification

Ans: **1M for each point**

S. No.	Parameter	Series Circuit	Parallel Circuit
1	Resonating frequency	$f_r = \frac{1}{2\pi\sqrt{LC}}$	$f_r = \frac{1}{2\pi}\sqrt{\frac{1}{LC} - \frac{R^2}{L^2}}$
2	Impedance	Minimum, Z = R	Maximum, Z = L/CR
3	Current	Maximum, I = V/R	Minimum, I = V/(L/CR)
4	Magnification	Voltage magnification takes place	Current magnification takes place

c) Explain the suitable example to convert a practical current source into equivalent voltage source. **4M**

	Ans:	 The open- circuit voltage across terminals A and B is V_{oc} = drop across R =5x2=10V Hence, voltage source has a voltage of 10V and the same resistance of 2Ω	**2M- circuit diagram, 2M- conversion**
	d)	**Write the steps for finding the current through an element by Thevenin's theorem.**	**4M**
	Ans:	**Steps to find Thevenin's equivalent circuit, taking an example is as follows:**  Fig.(a) fig.(b) fig.(c)	**1M each step**

1. From the given circuit (fig.a),Remove R_L from the terminals A and B and redraw the circuit as shown in Fig.b.

2. Calculate the open-circuit voltage V_{oc} which appears across terminals A and B.
As seen, V_{oc} = drop across R_2 = IR_2 where I is the circuit current when A and B are open.

$$I = \frac{E}{R_1 + R_2 + r} \quad \therefore \; V_{oc} = IR_2 = \frac{ER_2}{R_1 + R_2 + r}$$ [r is the internal resistance of battery]

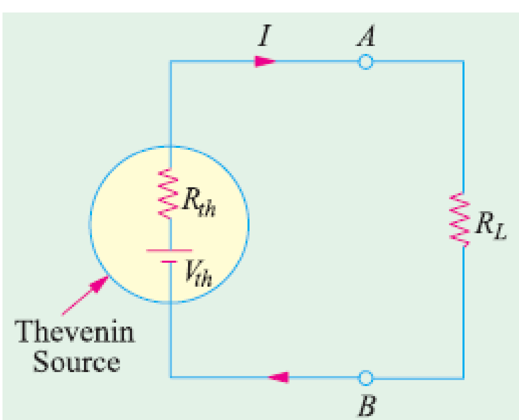
It is also called 'Thevenin voltage' V_{th}.

3.Now, imagine the battery to be removed from the circuit, leaving its internal resistance r behind and redraw the circuit, as shown in Fig.(c). When viewed inwards from terminals A and B, the equivalent resistance is given as,

$$R = R_2 \,||\, (R_1 + r) = \frac{R_2(R_1 + r)}{R_2 + (R_1 + r)}$$

This is called Thevenin's equivalent resistance R_{th}.
4.Connect R_L back across terminals A and B (fig.d)from where it was temporarily removed earlier.
Current flowing through RL is given by

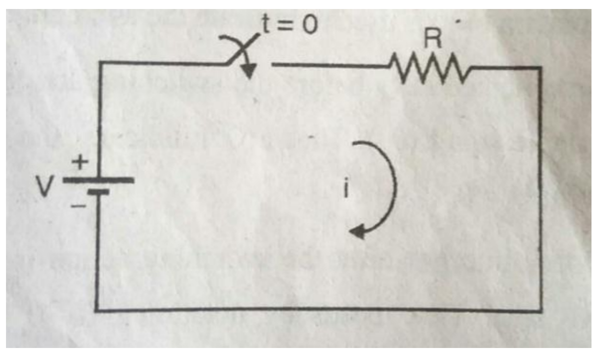
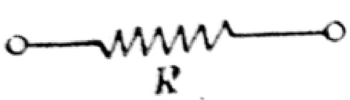
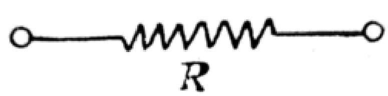
$$I = \frac{V_{th}}{R_{th} + R_L}$$

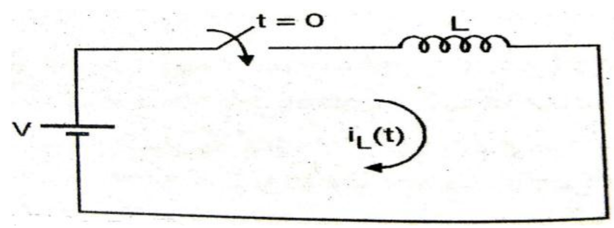


WINTER-19 EXAMINATION

Subject Name: Electric circuits and network **Subject Code:** 22330

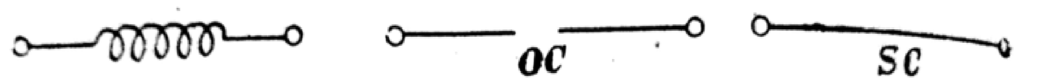
Model Answer

Q. No.	Sub Q. N.	Answers	Marking Scheme
3		**Attempt any THREE of the following :**	**12- Total Marks**
	a)	**Explain the concept of initial and final conditions in switching circuits for elements R and L.**	**4M**
	Ans:	Concept of Initial and final condition in switching circuits for R: Consider a resistor is connected to a voltage source, using a switch as shown in fig below  The switch is closed at time t = 0, so we get V= iR which is time independent equation. Here current changes as per voltage without any time delay. There is no change in the value of resistor R, it remains same for initial condition and final condition.  **Initial condition** **equivalent circuit at t=0+** **equivalent circuit at t= ∞** **Concept of Initial and final condition in switching circuits for L:** Consider a inductor is connected to voltage source as shown in fig below:	**2M for resistance** **2M for inductance**



The property of inductor is to oppose any change in current. So the current through an inductor cannot change instantaneously. There are 2 cases.

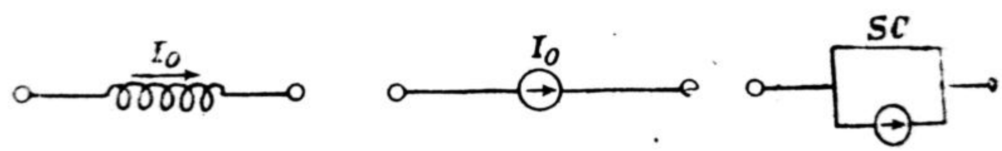
i) If no initial current is passing through inductor, then at t= 0+, it acts as open circuit. The final condition is given by the equation v_L =L di/dt.
At t=∞, it acts as short circuit.



Initial condition **equivalent circuit at t=0+** **equivalent circuit at t= ∞**

ii) If initial current is passing through inductor, then at t= 0+, it acts as constant current source of value I_0.

At t=∞,(final condition),the inductor acts as current source of value I_o in parallel with short circuit.(I_0 is the current in inductor just before switching)



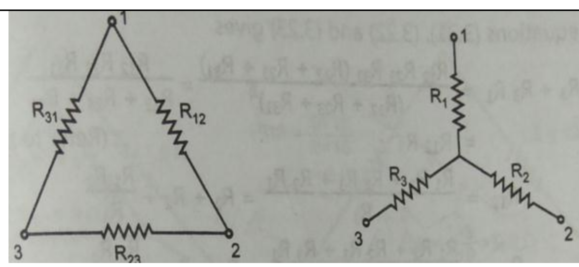
Initial condition **equivalent circuit at t=0+** **equivalent circuit at t= ∞**

b)	**Derive an expression for resonant frequency of series RLC circuit.**	**4M**

WINTER-19 EXAMINATION

Subject Name: Electric circuits and network **Subject Code: 22330**

Model Answer

	Ans:	At resonance frequency in RLC series circuit, we have inductive reactance is equal to capacitive reactance i.e. $X_L = X_C$ As, $X_L = 2\pi f_r L$ and $X_C = 1/2\pi f_r C$, we can write $\therefore \quad 2\pi f_r L = \frac{1}{2\pi f_r C}$ $\therefore \quad f_r^2 = \frac{1}{4\pi^2 LC}$ $\therefore f_r = \frac{1}{2\pi\sqrt{LC}}$ Hz Where fr is the resonant frequency in RLC series circuit.	**4 M**
	c)	**Derive an expression for delta to star transformation.**	**4M**
	Ans:	 Equivalent delta and star network For delta network the resistance between the terminals 1 and 2 consists of R_{12} in parallel with $(R_{23}+R_{31})$Hence ,the resistance between the terminals 1 and 2 is	**1M**

		$$= \frac{R_{12}(R_{23}+R_{31})}{R_{12}+R_{23}+R_{31}}$$ In case of star network the resistance between the terminals 1 and 2 is=R1+R2,so we get $$R_1 + R_2 = \frac{R_{12}(R_{23}+R_{31})}{R_{12}+R_{23}+R_{31}}$$ --i) $$R_2 + R_3 = \frac{R_{23}(R_{31}+R_{12})}{R_{12}+R_{23}+R_{31}}$$ $$R_3 + R_1 = \frac{R_{31}(R_{12}+R_{23})}{R_{12}+R_{23}+R_{31}}$$ ----ii & iii) Subtracting equation(ii) from(i),we get $$R_1 - R_3 = \frac{R_{12}R_{23} + R_{12}R_{31} - R_{23}R_{31} - R_{23}R_{12}}{R_{12}+R_{23}+R_{31}}$$ $$R_1 - R_3 = \frac{R_{12}R_{31} - R_{23}R_{31}}{R_{12}+R_{23}+R_{31}}$$ ----iv)	1M 1M

		Adding equations (iii) and(iv),we have $$2R_1 = \frac{R_{31}R_{12} + R_{31}R_{23} + R_{12}R_{31} - R_{23}R_{31}}{R_{12} + R_{23} + R_{31}}$$ $$R_1 = \frac{R_{31}R_{12}}{R_{12} + R_{23} + R_{31}}$$ $$R_2 = \frac{R_{12}R_{23}}{R_{12} + R_{23} + R_{31}}$$ $$R_3 = \frac{R_{23}R_{31}}{R_{12} + R_{23} + R_{31}}$$	**1M**
	d)	**State super position theorem. Write steps to find current in an element using super position theorem.**	**4M**
	Ans:	Statement of superposition theorem: In any linear network containing two or more sources, the current in any element is equal to algebraic sum of the current caused by individual source acting alone, while the other sources are replaced for the time being by resistances equal to their internal resistances. Steps to find current using superposition theorem: 1. Select any one energy source. 2. Replace all other energy sources i.e. voltage source by short circuit and current source by open circuit. 3. Calculate voltage drop and branch current due to selected energy source. 4. Repeat steps 1,2,3 for each source individually. 5. Add algebraically the voltage drops and branch currents to obtain combined effect of all sources.	**2M – stateme nt** **2M for steps**

WINTER-19 EXAMINATION

Subject Name: Electric circuits and network **Subject Code: 22330**

Model Answer

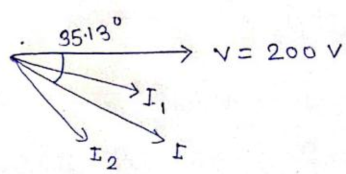
Q. No.	Sub Q. N.	Answers	Marking Scheme
4		**Attempt any THREE of the following :**	**12- Total Marks**
	(a)	**A series combination of resistance 100 ohm and capacitance 50µf is connected in series to a 230 V, 50HZ supply. Calculate** **(i) Capacitive reactance** **(ii) Current** **(iii) Power factor** **(iv) Power consumed**	**4M**
	Ans:	Solution: For RC series circuit	**1M** **1M** **1M**

WINTER-19 EXAMINATION

Subject Name: Electric circuits and network **Subject Code:** 22330

Model Answer

		Given $R=100\,\Omega$, $C=50\,\mu f$, $V=230V$, $f=50Hz$ (i) Capacitive Reactance $X_c = \frac{1}{2\pi fC} = \frac{1}{2\pi \times 50 \times 50 \times 10^{-6}} = 63.66\,\Omega$ (ii) Current $I = \frac{V}{Z} = \frac{V}{\sqrt{R^2+X_c^2}} = \frac{230}{\sqrt{(100)^2+(63.66)^2}}$ $= \frac{230}{118.54} = 1.94\,A$ (iii) Power factor $\cos\phi = \frac{R}{Z} = \frac{100}{118.54} = 0.8435$ leading (iv) Power consumed $P = VI\cos\phi = 230 \times 1.94 \times 0.8435$ $= 376.36\,W$	**1M**
	(b)	**Two unpedauces given by Z1 = 10 + j5 and Z2 = 8 + j9 are joined in parallel and connected across a voltage of V = 200 + j0. Calculate the circuit current and branch currents. Draw the vector diagram.**	**4M**
	Ans:	Solution: Given, Z1=10+j5, Z2=8+j9, V=200+j0	

		Given: $Z_1 = 10 + j5$, $Z_2 = 8 + j9$ and $V = 200 + j0$ To find circuit current first we have to calculate total admittance (a) Total admittance $Y = Y_1 + Y_2 = \frac{1}{Z_1} + \frac{1}{Z_2} = \frac{1}{(10+j5)} + \frac{1}{(8+j9)}$ $= \frac{1}{11.18\angle 26.56^\circ} + \frac{1}{12.04\angle 48.36^\circ}$ $= 0.089\angle -26.56^\circ + 0.083\angle -48.36^\circ$ $= (0.08 - 0.04j) + (0.06 - 0.06j)$ $= 0.14 - 0.1j$ $= 0.17\angle -35.53^\circ$ (b) Circuit current, $I = V \times Y$ $= (200\angle 0^\circ)(0.17\angle 35.53^\circ)$ $= 34\angle -35.53^\circ$ A (c) Branch current $I_1 = V \times Y_1$ $= (200\angle 0^\circ)(0.089\angle -26.56^\circ)$ $= 17.8\angle -26.56^\circ$ A $I_2 = V \times Y_2$ $= (200\angle 0^\circ)(0.083\angle -48.36^\circ)$ $= 16.6\angle -48.36^\circ$ A (d) Vector Diagram  	1M 1M 1M 1M
	(c)	**An a.c series circuit has resistance of 10ohm, inductance of 0.1H and capacitance of 10µf, voltage applied to circuit is 200V. find** **(i) Resonant frequency** **(ii) Current at resonance** **(iii) Power at resonance**	**4M**

	Ans:	Solution: For RLC series circuit Given: $R = 10\Omega$, $L = 0.1 H$, $C = 10 \mu f$, $V = 200 V$ (i) Resonant frequency $f_r = \frac{1}{2\pi\sqrt{LC}} = \frac{1}{2\pi\sqrt{0.1 \times 10 \times 10^{-6}}}$ $= \underline{\underline{159.13\ Hz}}$ (ii) current at resonance, $I = \frac{V}{Z}$ $= \frac{V}{R} = \frac{200}{10} = \underline{\underline{20\ A}}$ (iii) Power at resonance, $P = VI\cos\phi$ $= 200 \times 20 \times 1 = 4000 W$ $= \underline{\underline{4 kW}}$	**2M** **1M** **1M**
	(d)	**Use mesh analysis to calculate ammeter current in Fig No. 1**	**4M**

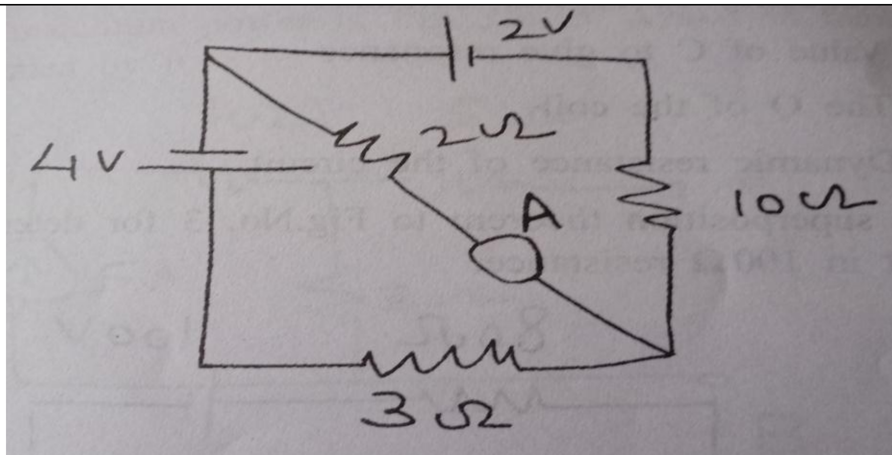
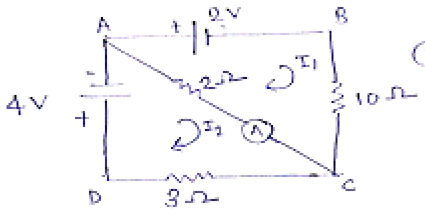


Fig. No. 1

Ans:



ⓐ Applying mesh analysis to loop ABCA, we have

$-2 - 10 I_1 - 2(I_1 - I_2) = 0$

$\therefore -2 - 12 I_1 + 2 I_2 = 0$

$\therefore -6 I_1 + I_2 = 1$ — (I) **1M**

ⓑ Applying mesh analysis to loop ACDB, we have **1M**

$-2(I_2 - I_1) - 3 I_2 - 4 = 0$

$\therefore -5 I_2 + 2 I_1 - 4 = 0$

$\therefore 2 I_1 - 5 I_2 = 4$ — (II)

Multiplying eq^n (II) by 3 we get,

$6 I_1 - 15 I_2 = 12$ — (III) **1/2M**

Adding eq^n (I) + (III) we get

$-14 I_2 = 13$

$\therefore I_2 = -13/14 = -0.92$ A

From eq^n (I) $-6 I_1 + (-0.92) = 1$ **1/2M**

$\therefore -6 I_1 = 1.92$

$\therefore I_1 = -0.32$ A

$\therefore$ Current in ammeter is $I_1 - I_2 = -0.32 - (-0.92)$ **1M**

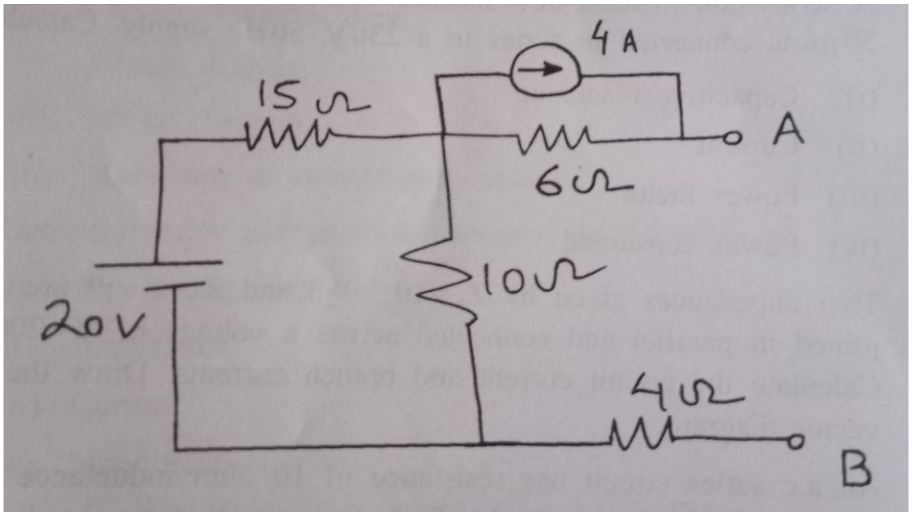
$= -0.32 + 0.92$

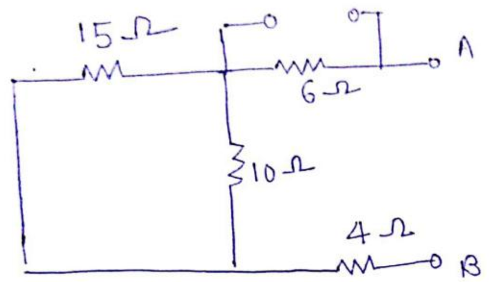
$= \underline{0.6 \text{ A}}$ (c to A)

WINTER-19 EXAMINATION

Subject Name: Electric circuits and network **Subject Code:** 22330

Model Answer

	(e)	**Find the Norton equivalent resistance for the network shown in Fig No. 2**  **Fig. No. 2**	**4M**
	Ans:	Solution: To find Norton's equivalent resistance removing voltage source and current source. Voltage source is replaced by short circuit and current source is replaced by open circuit so, we get circuit as	**Diagram :1M** **R_N calculati n :3M**



Tracing circuit from A & B, we have 15Ω & 10Ω resistor in parallel.

∴ Its equivalent resistance $R_{eq} = \frac{15 \times 10}{15+10} = 6\,\Omega$

Now 6Ω, 6Ω & 4Ω resistor are in series,

∴ we have $R_S = 6+6+4 = 16\,\Omega$

∴ Norton's equivalent resistance $R_N = 16\,\Omega$

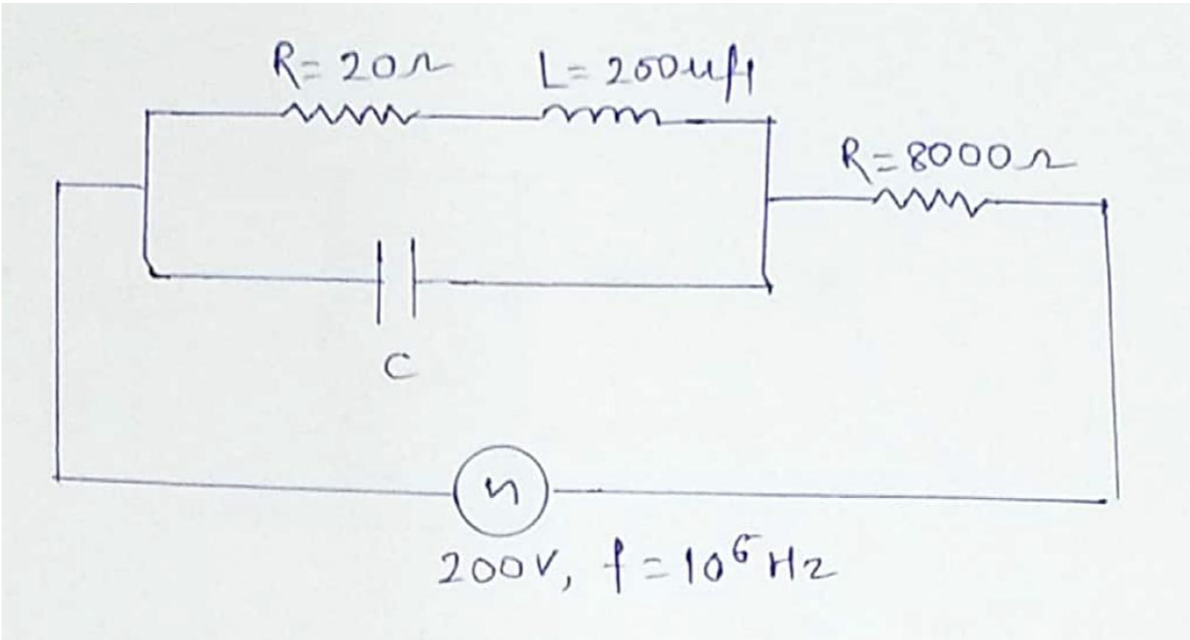
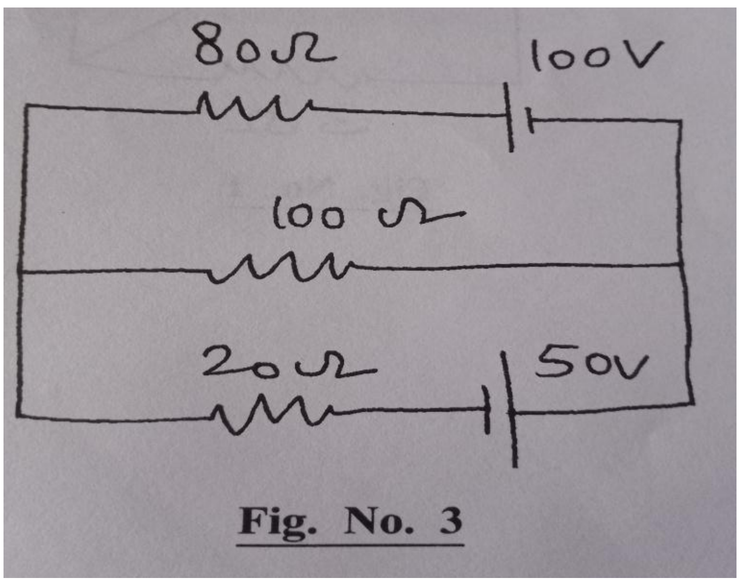
Q. No.	Sub Q. N.	Answers	Marking Scheme
5.		**Attempt any TWO of the following:**	**12- Total Marks**
	a)	**A coil of resistance 20 ohm and inductance of 200µH is in parallel with variable capacitor. This combination is in series with a resistance of 8000 ohm. The voltage of the supply is 200 V and at frequency of 10^6 Hz. Calculate** **(i) Value of C to give resonance** **(ii) The Q of the coil** **(iii) Dynamic resistance of the circuit.**	**6M**

	Ans:	Ans :→ ① Inductive Reactance $X_L = 2\pi f L$ $= 2\times\pi\times10^{6}\times200\times10^{-6}$ $= 1256\,\Omega$ ② Impedance $Z = \sqrt{R^2 + X_L^2}$ $= \sqrt{20^2 + (1256)^2}$ $Z = 1256.16\,\Omega$ ③ $Z_L^2 = L/C$ at parallel Resonance Value of C at Resonance → $C = \frac{L}{Z_L^2} = \frac{200\times10^{-6}}{(1256.16)^2} = 126.6\times10^{-12}\,F$ $= 126.6\,pF$ ④ Q of coil $= \frac{2\pi f_r L}{R}$ $= \frac{2\pi\times10^{6}\times200\times10^{-6}}{20} = 62.8$ ⑤ Dynamic Resistance of coil circuit $Z_r = \frac{L}{CR}$ $Z_r = \frac{200\times10^{-6}}{126.6\times10^{-12}\times20} = 78957\,\Omega$	i)Value of C -2 Marks, ii)Q of coil -2 Marks iii)Dynamic Resistance -2 Marks

WINTER-19 EXAMINATION

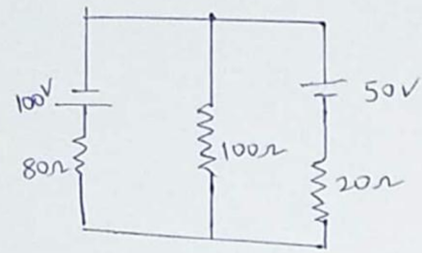
Subject Name: Electric circuits and network Subject Code: 22330

Model Answer

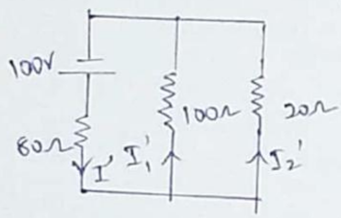
			
	b)	**Apply superposition theorem to Fig No. 3 for determining the current in 100 Ω resistance.** 	**6M**

Ans:

Ans :-



step 1 :- consider only 100V source & short 50V supply



Total Resistance across supply

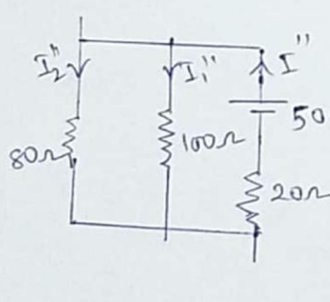
$$= 80 + \frac{100 \times 20}{100 + 20} = 96.66$$

$$I' = \frac{100}{96.66} = 1.034$$

current in 100Ω resistor $= \frac{20}{120} \times 1.034 = 0.172$

$$\boxed{I_1' = 0.172A}$$

Step 2 :- consider only 50V source



Total Resistance across supply

$$= 20 + \frac{80 \times 100}{80 + 100} = 64.44$$

$$I'' = \frac{50}{64.44} = 0.7759$$

current in 100Ω resistor $= \frac{80}{180} \times 0.7759 = 0.3448$

$$I_1'' = 0.3448$$

Therefore current 100Ω resistor

$$I_1 = I_1'' - I_1' = 0.3448 - 0.172 = 0.1728A$$

Step 1 - 2.5 Marks

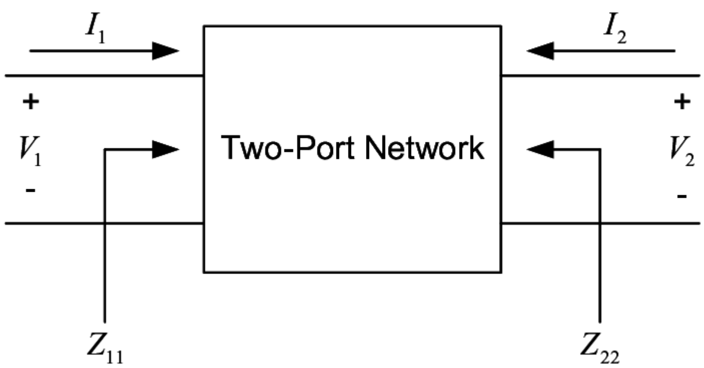
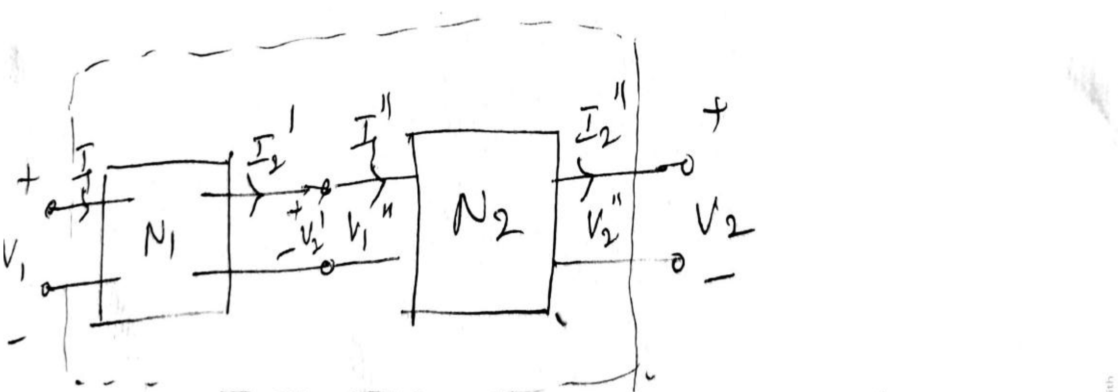
,Step 2- 2.5Marks

Final current 1 Mark

WINTER-19 EXAMINATION

Subject Name: Electric circuits and network **Subject Code:** 22330

Model Answer

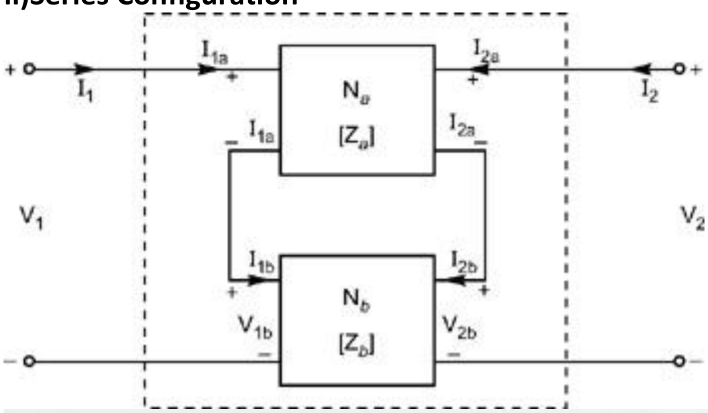
	c)	**Draw the two port network and determine the indicated parameters for the following configuration** **(i) Cascade configuration (ABCD parameter)** **(ii) Series configuration** **(iii) Parallel configuration**	**6M**
	Ans:	 **i)Cascade Configuration**  2 NWs. N_1 and N_2 connected in Cascade	Each configuration : 1M Equation for parameter : 1M

A, B, C, D are the parameters of cascade network, then

$$\begin{bmatrix} A & B \\ C & D \end{bmatrix} = \begin{bmatrix} A_1 & B_1 \\ C_1 & D_1 \end{bmatrix} \begin{bmatrix} A_2 & B_2 \\ C_2 & D_2 \end{bmatrix}$$

For cascade configuration, ABCD parameters has to be multiplied.

ii)Series Configuration



ii) Series configuration (Refer diagram for the same)

$Z_{11} = Z_{11a} + Z_{11b}$

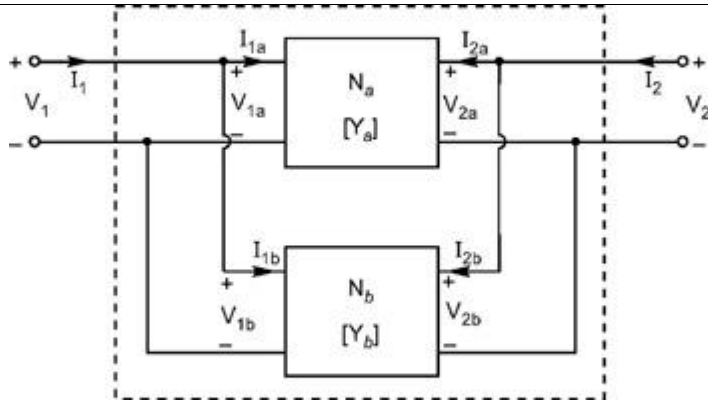
$Z_{12} = Z_{12a} + Z_{12b}$

$Z_{21} = Z_{21a} + Z_{21b}$

$Z_{22} = Z_{22a} + Z_{22b}$

$[Z] = [Z_a] + [Z_b]$

iii)Parallel Configuration



iii) Parallel configuration
(Refer diagram for the same)

$I_1 = (Y_{11a} + Y_{11b})V_1 + (Y_{12a} + Y_{12b})V_2$

$I_2 = (Y_{21a} + Y_{21b})V_1 + (Y_{22a} + Y_{22b})V_2$

that is Y parameters for combined network can be written as

$I_1 = Y_{11}V_1 + Y_{12}V_2$

$I_2 = Y_{21}V_1 + Y_{22}V_2$

where $Y_{11} = Y_{11a} + Y_{11b}$

$Y_{12} = Y_{12a} + Y_{12b}$

$Y_{21} = Y_{21a} + Y_{21b}$

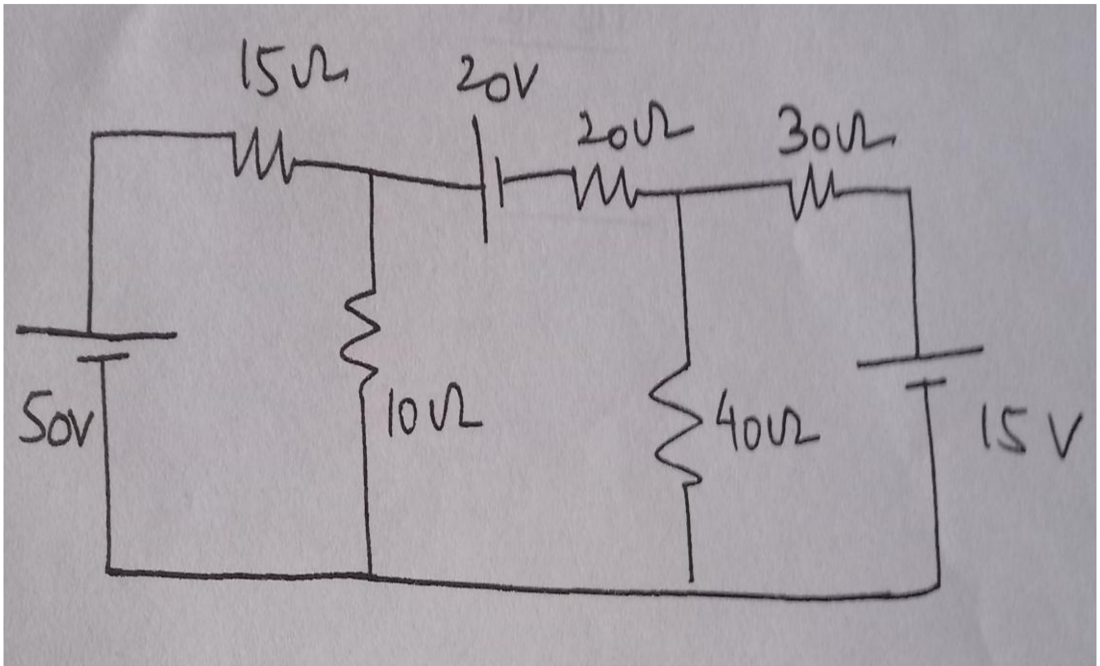
$Y_{22} = Y_{22a} + Y_{22b}$

Q. No.	Sub Q. N.	Answers	Marking Scheme
6.		**Attempt any TWO of the following :**	**12- Total**

WINTER-19 EXAMINATION

Subject Name: Electric circuits and network **Subject Code:** 22330

Model Answer

			Marks
	a)	**Find current in 40 Ω and 10 Ω in Fig no. 4 node voltage analysis method.**  **Fig. No. 4**	6M

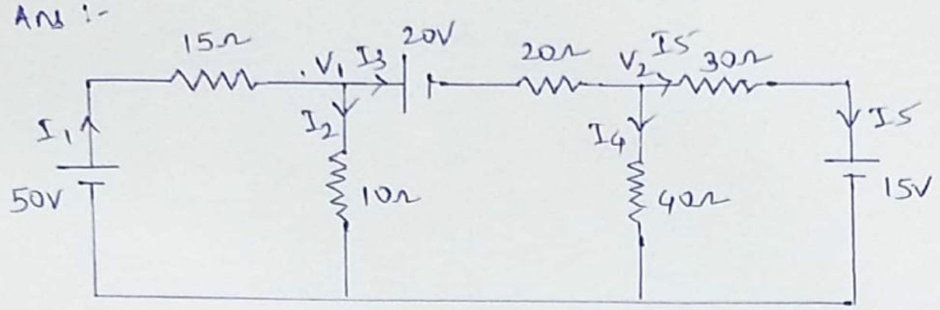
WINTER-19 EXAMINATION

Subject Name: Electric circuits and network **Subject Code:** 22330

Model Answer

Ans:

Ans :-



Applying KCL at nodes V_1 & V_2,

$$I_1 = I_2 + I_3 \rightarrow (1)$$

$$I_3 = I_4 + I_5 \rightarrow (2)$$

for first equation

$$I_1 = I_2 + I_3$$

$$\left(\frac{50-V_1}{15}\right) = \frac{V_1}{10} + \left(\frac{V_1-20-V_2}{20}\right)$$

$$\left(\frac{50-V_1}{15}\right) = \frac{2V_1 + V_1 - 20 - V_2}{20}$$

$$\frac{50-V_1}{15} = \frac{3V_1 - 20 - V_2}{20}$$

$$20(50-V_1) = 15(3V_1 - 20 - V_2)$$

$$1000 - 20V_1 = 45V_1 - 300 - 15V_2$$

$$1300 = 65V_1 - 15V_2 \rightarrow (3)$$

for second equation

$$I_3 = I_4 + I_5$$

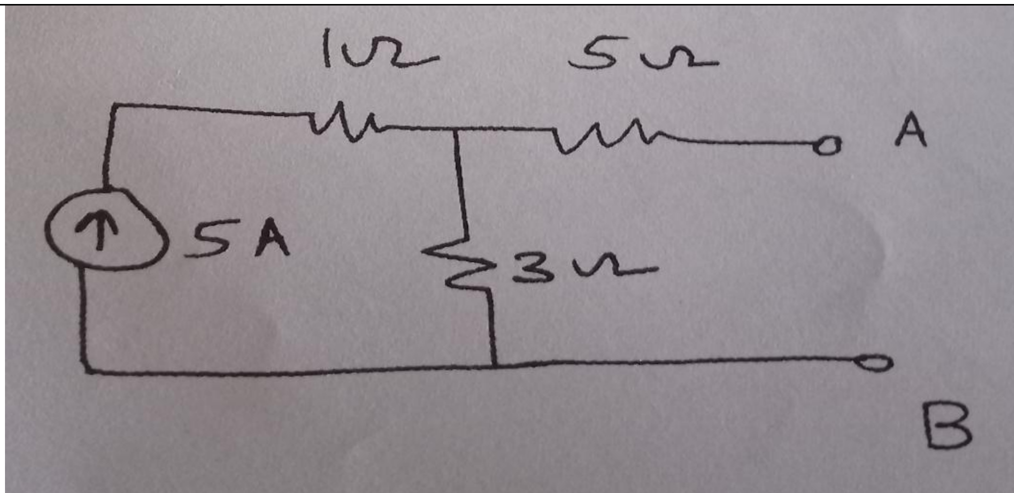
$$\left(\frac{V_1-20-V_2}{20}\right) = \frac{V_2}{40} + \left(\frac{V_2-15}{30}\right)$$

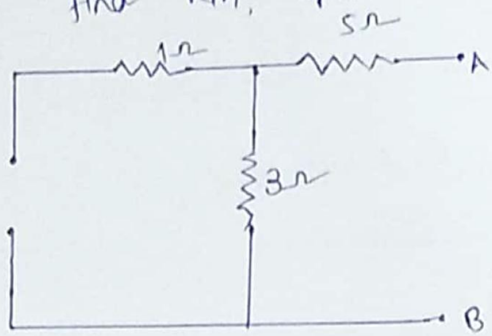
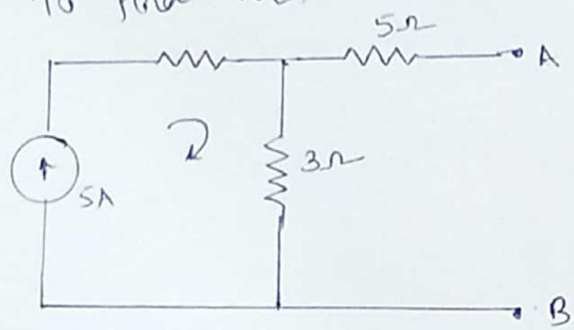
V1 -2 marks,V2 -2 Marks,

I through 40 ohms-1 Mark,

I through 30 ohm -1Mark

		$\frac{V_1 - V_2 - 20}{20} - \frac{V_2}{40} - \frac{V_2 - 15}{30} = 0$ $\frac{6V_1 - 6V_2 - 120 - 3V_2 - 4V_2 + 60}{120} = 0$ $6V_1 - 13V_2 - 60 = 0$ $6V_1 - 13V_2 = 60 \rightarrow (4)$ By solving (3) & (4) we get Multiplying (3) by 13 & (4) by 15, we get $V_1 = 21.19$ $V_2 = 5.17$ $I_4 = \frac{V_2}{40} = \frac{5.17}{40} = 0.13A$ $I_5 = \frac{V_2 - 15}{30} = \frac{5.17 - 15}{30} = -0.327A$	
	b)	**Find the value of resistance to be connected across AB so as to consume maximum power in Fig No. 5. Also find maximum power consumed by it.**	**6M**

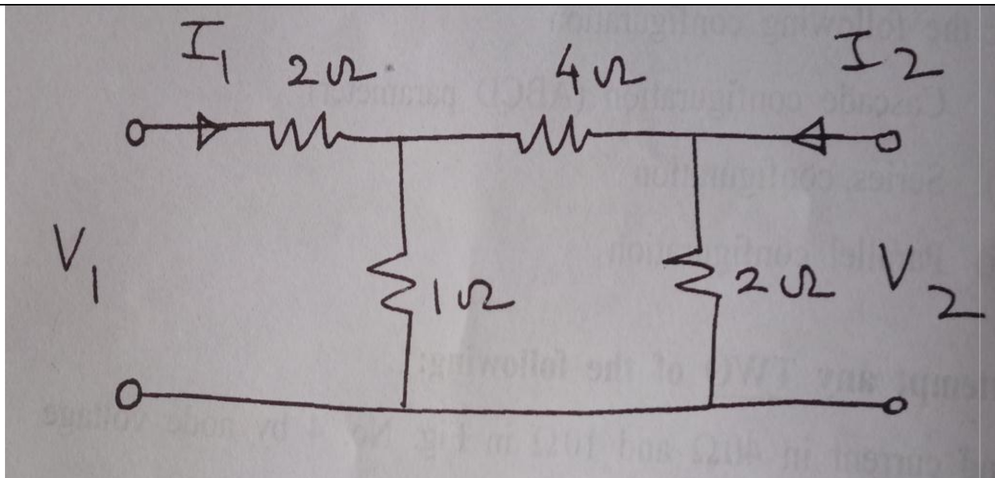
		 Fig. No. 5	

	Ans:	Ans :- Maximum Power will be transferred when $R_{TH} = R_L$, so find out R_{TH} first. ① To find R_{TH}, open 5A source  $R_{TH} = 3+5 = 8\Omega$ $R_L = 8\Omega = R_{TH}$ to transfer maximum power. ② To find Voc.  current through $3\Omega = 5A$ $\therefore V_{oc} = 5\times 3 = 15$ Maximum Power $= \frac{V_{oc}^2}{4R_L} = \frac{15^2}{4\times 8} = 7.03125\ W.$	Rth -2 Marks, Voc - 2Marks, Power - 2Marks
	c)	**Find Z parameters for the network shown in Fig No. 6**	**6M**

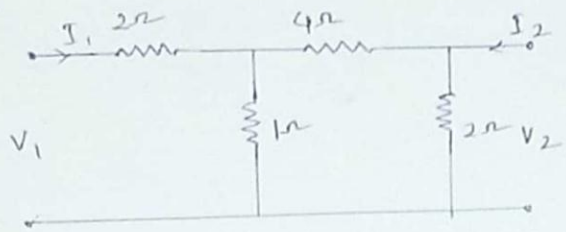
WINTER-19 EXAMINATION

Subject Name: Electric circuits and network **Subject Code: 22330**

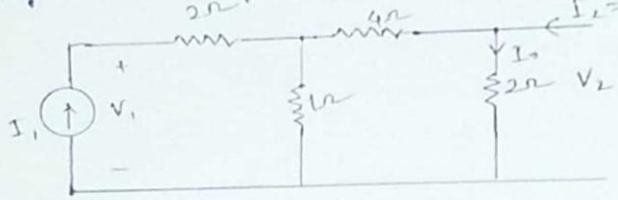
Model Answer

		Fig. No. 6	
	Ans:		Z11-2 Marks, Z12- 1Mark, Z21 - 2Marks, Z22- 1Mark

Ans :-



Step 1 :- To get Z_{11} & Z_{21}, consider the circuit as



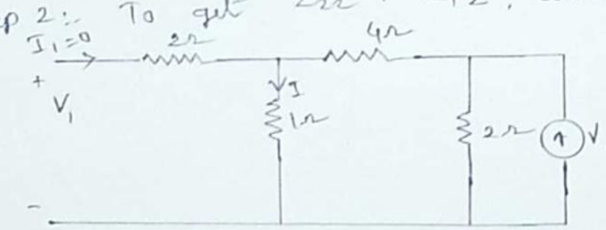
$$Z_{11} = \frac{V_1}{I_1} = 2 + 1 \| (4+2)$$

$$= 2 + \left(\frac{1 \times 6}{1+6}\right) = 2 + \frac{6}{7} = 2.85$$

$$I_a = \frac{1}{2} I_1$$

$$Z_{21} = \frac{V_2}{I_1} = \frac{\frac{2(1)}{7} I_1}{I_1} = \frac{2}{7}\,\Omega = 0.28$$

Step 2 :- To get Z_{22} & Z_{12}, consider the circuit as



$$Z_{22} = \frac{V_2}{I_2} = 2 \| (4+1) = \frac{2 \times 5}{2+5} = \frac{10}{7} = 1.44$$

$$I = \frac{2}{2+5} \times I_2 = \frac{2}{7} I_2 \qquad V_1 = 1 \times I = 1 \times \frac{2}{7} I_2 = \frac{2}{7} I_2$$

$$Z_{12} = \frac{V_1}{I_2} = \frac{2}{7} I_2 \times \frac{1}{I_2} = 2/7 = 0.28$$

		$$Z = \begin{bmatrix} 2.85 & 0.28 \\ 0.28 & 1.44 \end{bmatrix} \Omega$$	