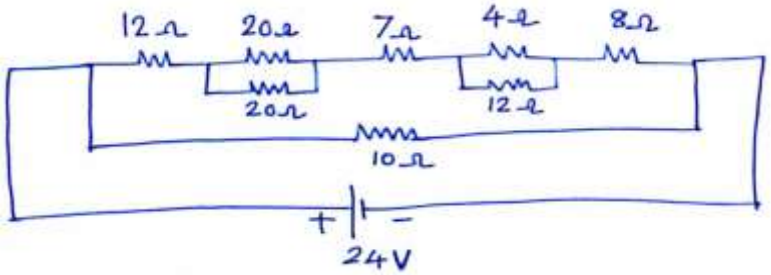
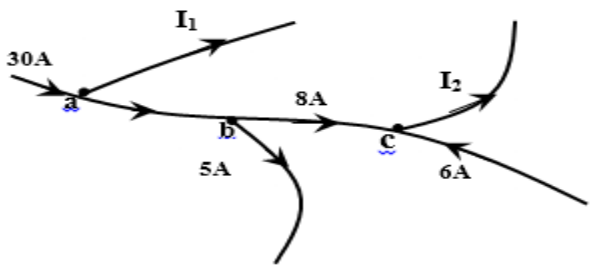
	E.G.S. PILLAY ENGINEERING COLLEGE (An Autonomous Institution, Affiliated to Anna University, Chennai) Nagore Post, Nagapattinam – 611 002, Tamilnadu.	Rev.0 COE/2017/QB

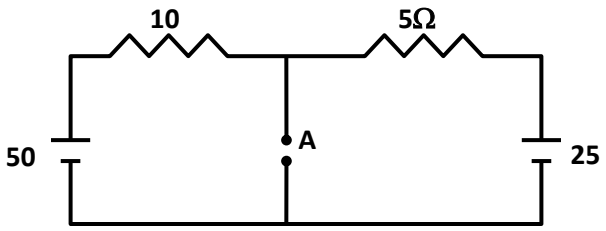
1702EE202 ELECTRIC CIRCUIT ANALYSIS				
Academic Year :	2017-2018	**Question Bank**	Programme	B.E – EEE
Year / Semester :	I / II		Course Coordinator:	Dr.T.SURESH PADMANABHAN

Course Objectives	**Course Outcomes**
1. To know about the basics of electric circuits 2. To impart knowledge on solving circuits using network theorems 3. To introduce the phenomenon of resonance and coupled circuits 4. To determine the transient response of circuits 5. To analyze three phase circuits	On the successful completion of the course, students will be able to CO1: Explain the basic laws, theorems and concepts of DC / AC (1 phase and 3 phase) circuits, Resonant and coupled circuits. CO2: Solve the problems in network topology and to identify the dual of the network. CO3: Solve the problems in resonance circuits, coupled circuits and two port networks. CO4: Analyze the transient behavior of first and second order circuits using Laplace transforms. CO5: Apply Ohms law, Kirchhoff's laws, mesh & nodal methods and network theorems to solve circuit problems. CO6: Analyze three phase 3 wire/ 4wire balanced/ unbalanced star/delta connected loads.

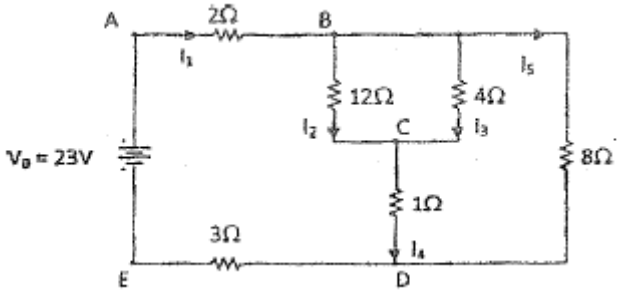
PART – A (2 Mark Questions With Key)

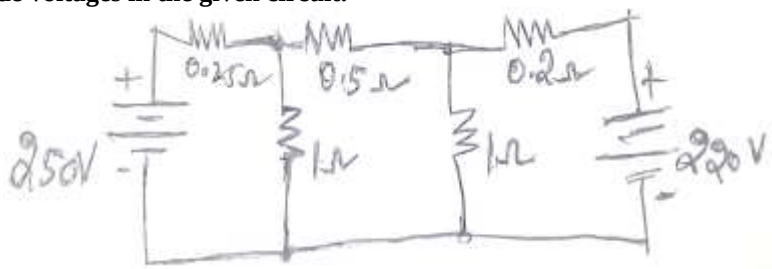
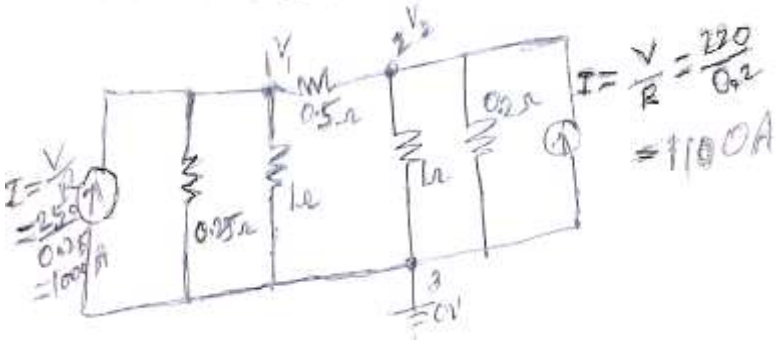
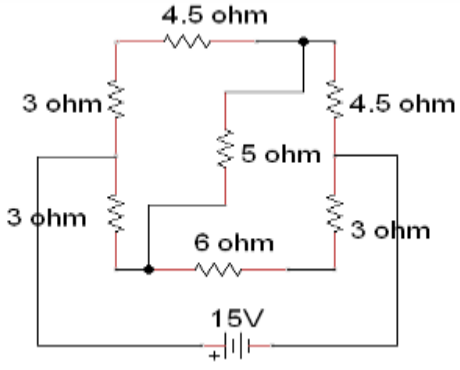
S.No	Questions	Mark	COs	BTL
UNIT I – DC CIRCUITS				
1	**Define Active and passive components**			
	Elements that supply energy to the network are called as active elements/components. E.g.: Voltage or current source, battery, generator	1	1	K1
	Elements that take energy from the sources and either convert it to another form or store it in electric or magnetic field are called passive elements. E.g.: Resistors, inductors, and capacitors.	1		
2	**Differentiate mesh and loop**			
	MESH / LOOP			
	Mesh is a closed path or fundamental loop which cannot be further divides into other loop / Loop is a closed path and may consists of one or many meshes	1	1	K2
	All meshes are loops / But all loops are not meshes	1		
3	**Differentiate circuit and network**			
	CIRCUIT / NETWORK			
	Circuit has active element with closed path / Network may or may not has active element with closed path	1	1	K2
	All circuits are networks / But all networks are not circuits	1		
4	**Define node and principal node**			
	Meeting point of two or more elements is known as node or point or junction.	1	1	K1
	If more than two elements meet at a node then it is called as principal node	1		
5	**Find the total resistance across the battery of the given circuit.**			

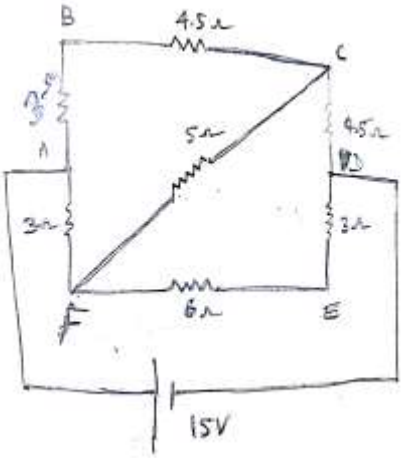
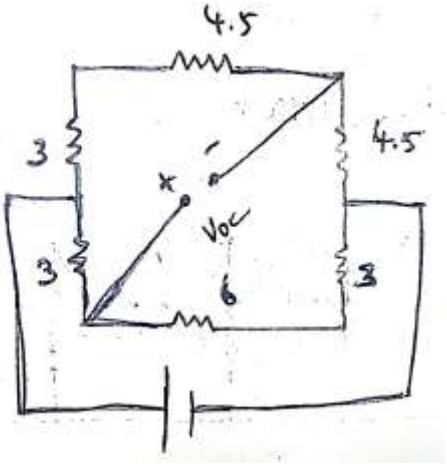
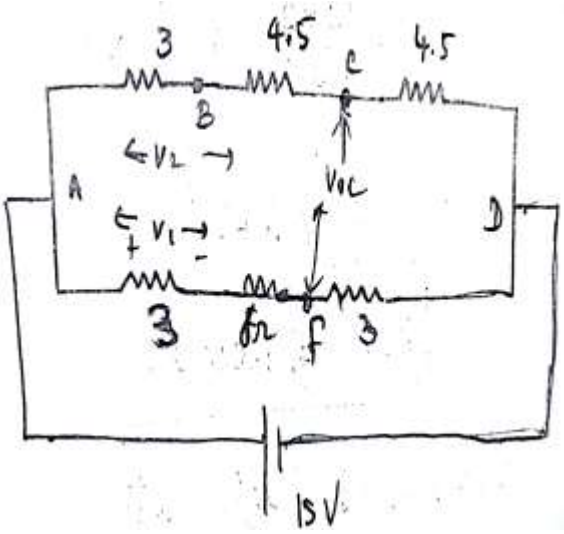
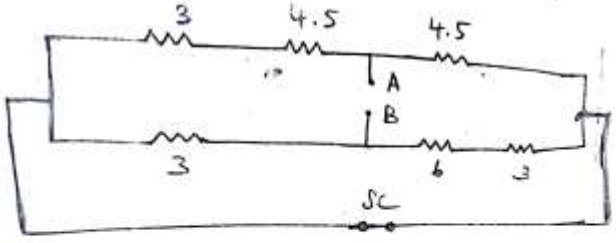
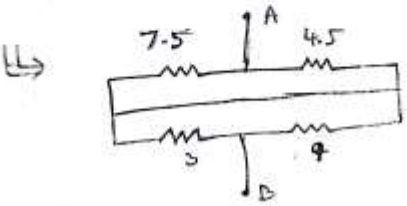
				
	series resistance =12+20 || 20 +7+4 || 12 +8= 40 ohms = 12+10+7+3+8= 40 ohms 40 ohms in parallel with 10 ohms = 8 ohms Total resistance = 8 ohms	1 1	5	K3
6	**State Kirchhoff's laws.**			
	Kirchhoff's current law At a junction, the sum of currents flowing towards the junction is equal to the sum of the currents flowing away from it. **Kirchhoff's voltage law** In a closed circuit, the sum of the potential drops are equal to the sum of the potential rises.	1 1	1	K1
7	**Obtain the currents I_1 and I_2 for the network shown in the figure below** 			
	At node a $5+8+I_1 = 30 \rightarrow I_1=17$ A At node c $I_2= 8+6 = 14$ A	1 1	5	K3
8	**State Thevenin's theorem**			
	Thevenin's theorem states that "Any two terminal linear network having a number of voltage, current sources and resistances can be replaced by a simple equivalent circuit consisting of a single voltage source in series with a resistance, where the value of the voltage source is equal to the open circuit voltage across the two terminals of the network and resistance measured between the terminals with all the energy sources are replaced by their internal resistances.	2	1	K1
9	**State Norton's theorem**			
	Norton's theorem states that "Any two terminal linear network having a number of voltage, current sources and resistances can be replaced by a simple equivalent circuit consisting of a single current source in parallel with a resistance, where the value of the current is the short circuit current between two terminals of the network and the resistance is the equivalent resistance measured between the terminals of the network with all the energy sources replaced by their internal resistance.	2	1	K1
10	**State superposition theorem**			
	Superposition theorem states "In a linear circuit containing more than one source, the current that flows at any point or the voltage that exists between any	2	1	K1

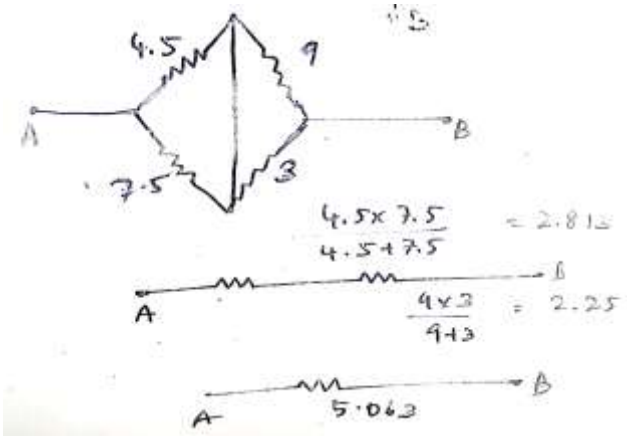
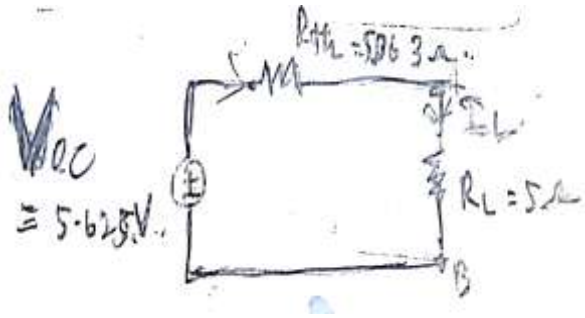
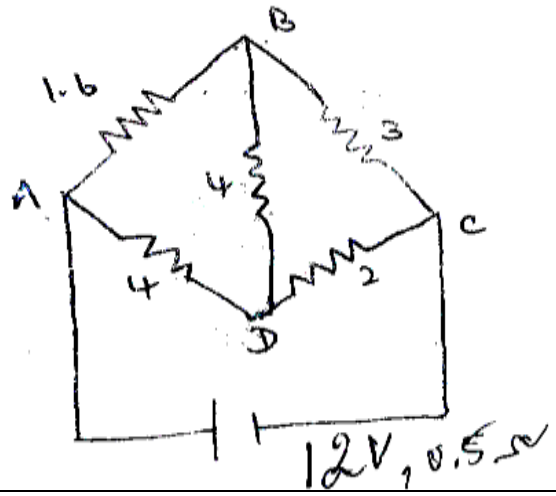
	two points is the algebraic sum of the currents or the voltages that would have been produced by each source taken separately with all other sources removed".			
11	**State reciprocity theorem**			
	Reciprocity theorem states that "In a linear, bilateral network, a voltage source V volts in a branch gives rise to a current I in another branch. If V is applied in the second branch, the current in the first branch will be I. This ratio $\frac{V}{I}$ is called as the transfer impedance or resistance.	2	1	K1
12	**State maximum power transfer theorem**			
	The theorem states "Maximum power will be transferred from a voltage source to a load, when the load resistance is equal to the internal resistance of the source.	2	1	K1
13	**Determine the Thevenin's resistance across 'AB' for the circuit shown below.**  			
	R_{th}= 10 || 5 = (10 x 5) / (10+5) = 3.33 Ω	1 1	5	K3
14	**Give the applications of (i) maximum power transfer theorem and (ii) Thevenin's theorem.**			
	(i) maximum power transfer theorem is used in electronic and communication circuits, impedance matching in power amplifiers, transmission lines, and antenna propagation and in microwave transmission	1	1	K2
	(ii) Thevenin's theorem is used in electronic circuits represented by the controlled sources, it is useful when it is desired to know the effect of the response in the network	1		
15	**What is the expression of load current w.r.to Thevenin's circuit and Norton's circuit?**			
	In Thevenin's equivalent circuit, the load current is expressed as, $I_L = \frac{V_{OC}}{R_{th} + R_L}$ **(ii)** In Norton's equivalent circuit, the load current is expressed as, $I_L = \frac{I_{SC} \times R_{th}}{R_{th} + R_L}$	1 1	5	K2

PART – B (12 Mark Questions with Key)

S.No	Questions (for all problems step marks can be given accordingly)	Mark	COs	BTL
1	**Find branch currents using mesh method** 	12	5	K3
	Using mesh current method,(method of inspection) Three meshes are ABCDEA,BCFB, DCFD The matrices can be formed as			
	$\begin{matrix} 18 & -12 & -1I1 \\ -12 & 16 & -4I2 \\ -1 & -4 & 13I3 \end{matrix} = \begin{matrix} 23 \\ 0 \\ 0 \end{matrix}$	2		
	Determinant value, $\Delta = 1472$	2		
	$\Delta I_1 = 4416$	2		
	$\Delta I_2 = 3680$	2		
	$\Delta I_3 = 1472$			
	$I_1 = 3A$			
	$I_2 = 2.5A$	2		
	$I_3 = 1A$			
	Answers: Current through 2Ω resistor= I_1= 3A Current through 3Ω resistor= I_1= 3A Current through 1Ω resistor= I_1-I_3= 2A Current through 12Ω resistor= I_1-I_2= 0.5A Current through 4Ω resistor= I_2-I_3= 1.5A Current through 8Ω resistor= I_3= 1A	2		

2	**Find the Node voltages in the given circuit.** 	12		
	Convert all voltage sources into equivalent current sources  No. of equations = 3-1=2 The matrices can be formed as $\begin{matrix} \frac{1}{0.25}+\frac{1}{1}+\frac{1}{0.5} & \frac{-1}{0.5} \\ \frac{-1}{0.5} & \frac{1}{0.5}+\frac{1}{1}+\frac{1}{0.2} \end{matrix} \quad \begin{matrix} V1 \\ V2 \end{matrix} = \begin{matrix} 1000 \\ 1100 \end{matrix}$ $\Delta = 52$ $\Delta V_1 = 10200$ $\Delta V_2 = 9700$ V1=196.154 V V1=186.538 V	4 4 4	5	K3
3	**Calculate current through 5Ω resistor using Thevenin's theorem.** 	12	5	K3

	(a) <u>To find Voc:</u>    $V_{oc} = V_2 - V_1 = 5.625$ V **(b) <u>To find R_{th}:</u>**   	4 4		

	R_{th}= 5.063 Ω  (c) **Thevenin's equivalent circuit:**  $I_L = Voc / Rth + R_L = 0.559A$	4		
4	**Find the current in BD arm by using Norton's theorem**  	12	5	K3

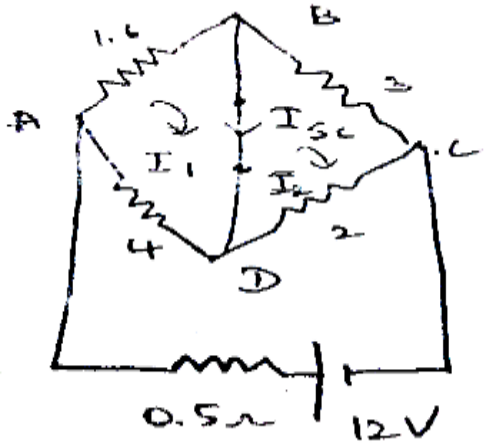
(a) To find I_N :

$Isc=I_N=I_1-I_2$

The matrices can be formed as

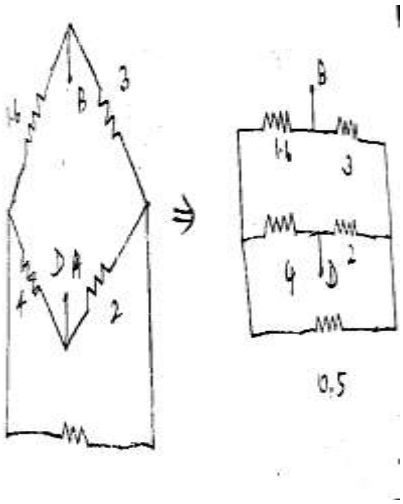
$$\begin{matrix} 5.6 & 0 & -4 & I1 & 0 \\ 0 & 5 & -2 & I2 = & 0 \\ -4 & -2 & 6.5 & I3 & 12 \end{matrix}$$

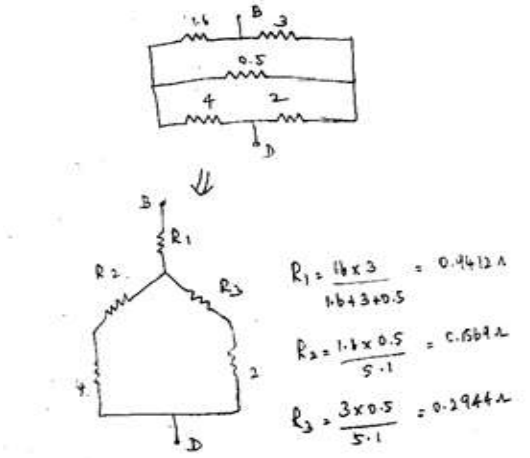
$I_N = 1.33A$



4

(b) To find R_N :



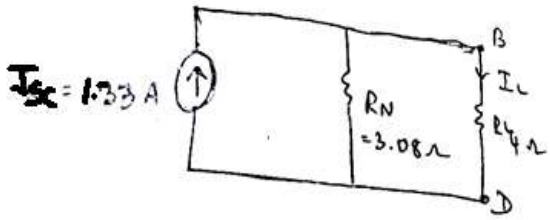


4

$R_N = 3.08\Omega$

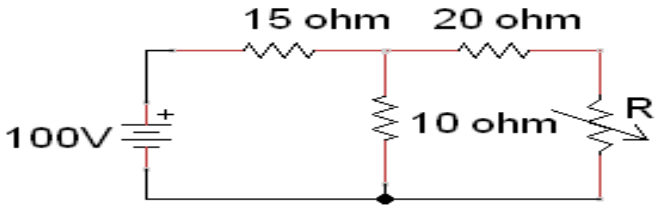
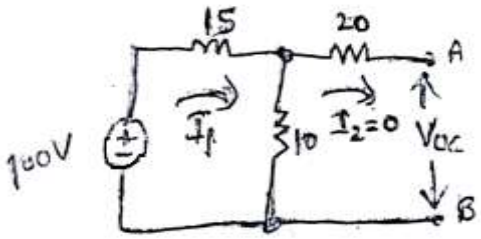
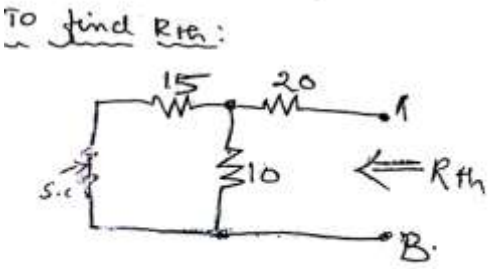
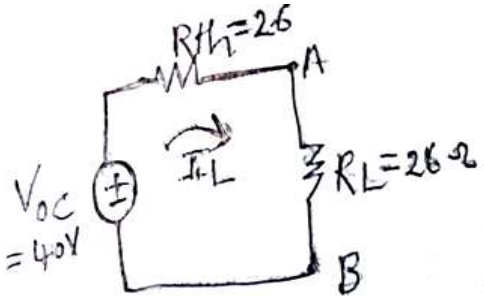
(c) **To find I_L:**

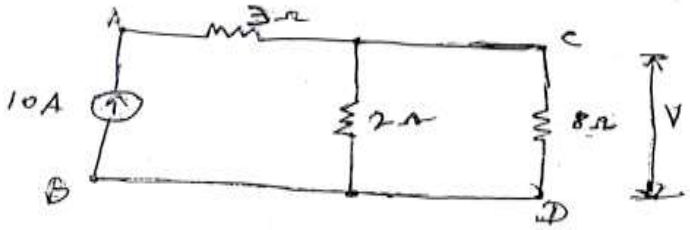
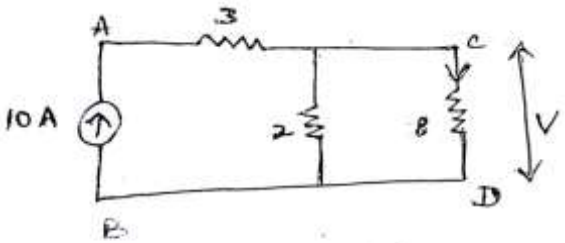
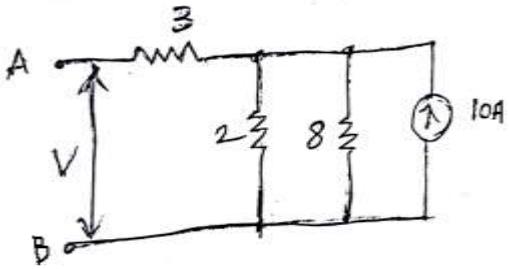
$I_L = 0.577$ A

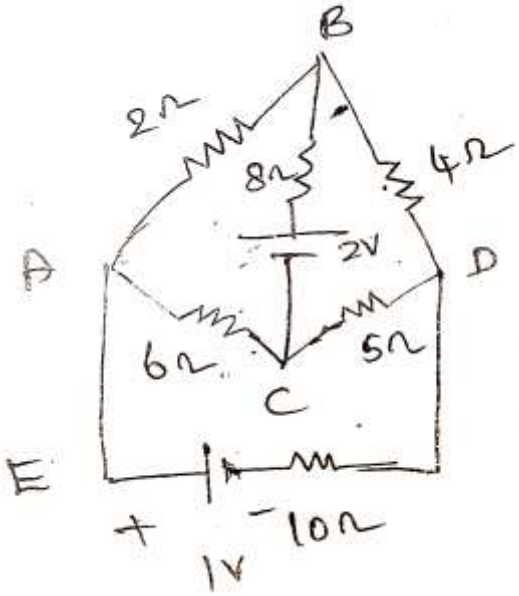


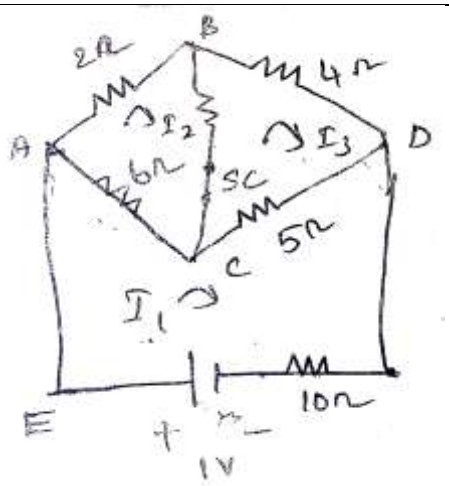
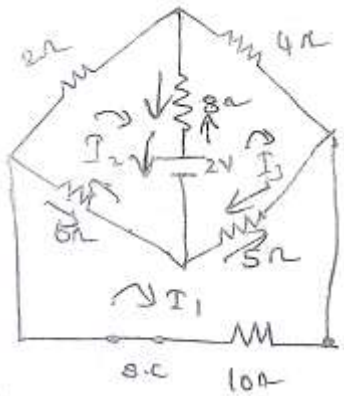
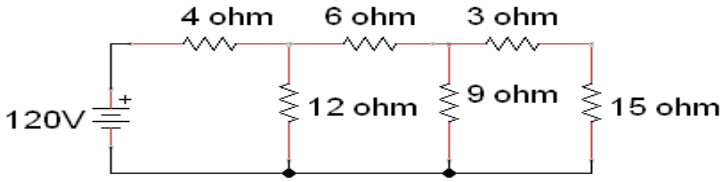
4

$$I_L = I_{sc} \times \frac{R_N}{R_N + R_L}$$

5	**Obtain the value of resistor 'R' for maximum power transferred to it. Also find maximum power.** 	12		
	(i) <u>To find Voc</u>:  $I_1 = \frac{100}{15+10} = 4A$ $Voc = V_{10\Omega} = 4X10 = 40V$	4	5	K3
	(ii) <u>To find Rth:</u>  $R_{th} = \frac{10 \times 15}{10+15} + 20$ $Rth = 10 \| 15 + 20 = 26\Omega$	4		
	(iii) <u>To find R and Pmax:</u> for max. power transfer, R=R_{th} =26 Ω  $I_L = \frac{40}{26+26} = 0.7692A$ Pmax=$I_L^2 \times R_L$ = 15.384 W	4		

6	**Verify reciprocity theorem in the circuit and also infer the transfer resistance** 	12		
	Case(i): $V=V_{CD}=I_{8\Omega}\times 8$ $I_{8\Omega}=2A$ $V=2\times 8=16$ V Transfer resistance= V/I= 1.6Ω 	6	5	K4
	Case(ii): $V=V_{AB}=I_{2\Omega}\times 2$ $I_{2\Omega}=8A$ $V=8\times 2=16$ V Transfer resistance= V/I= 1.6Ω 	6		

PART – C (20 Mark Questions with Key)				
S.No	**Questions**	**Mark**	**COs**	**BTL**
1	**Using superposition theorem, obtain the current through EA in figure** 	20	5	K3

	(a) 1V source alone acting: $\begin{matrix} 21 & -6 & -5 & I1 & 1 \\ -6 & 16 & -8 & I2 = 0 \\ -5 & -8 & 17 & I3 & 0 \end{matrix}$ $\Delta = 2876$ $\Delta I_1' = 208$ $I_1' = 0.0723A$ **(b) 2V source alone acting:** $\begin{matrix} 21 & -6 & -5 & I1 & 0 \\ -6 & 16 & -8 & I2 = -2 \\ -5 & -8 & 17 & I3 & 2 \end{matrix}$ $\Delta = 2876$ $\Delta I1 = -28$ $I_1'' = -9.736$ mA **$I_{EA} = I_1' + I_1'' = 62.564$ mA**	 	6 6		
2	**Obtain the current through 15Ω and power delivered to it using mesh method.** 	20	5	K3
	Mesh method (by using method of inspection) $\begin{matrix} 16 & -12 & 0 & i1 & 120 \\ -12 & 27 & -9 & i2 & = & 0 \\ 0 & -9 & 27 & i3 & 0 \end{matrix}$ Load current= $i3 = i_{15\Omega}$ $\Delta = 6480$ $\Delta i3 = 12960$ $i3 = \Delta i3 / \Delta = 2A$ $P = i3^2 R = 60W$	Figure with mesh currents (4) 4 4 4 2 2		