KINGS
COLLEGE OF ENGINEERING

DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

QUESTION BANK

SUBJECT CODE & NAME : EE 1151 – CIRCUIT THEORY

YEAR / SEM : I / II

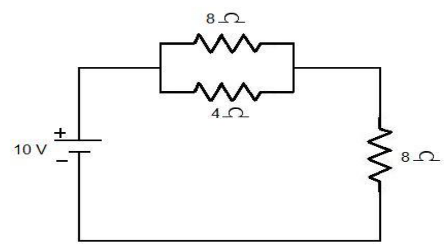
UNIT – I

BASIC CIRCUITS ANALYSIS

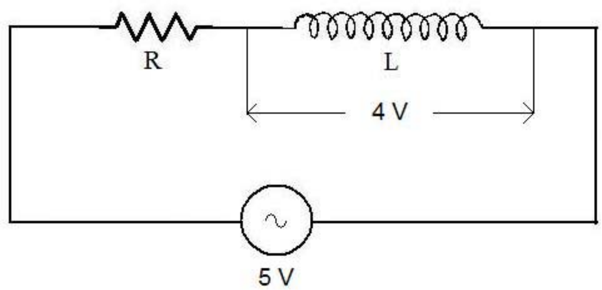
PART – A (2-MARKS)

1. State Ohm's law and its limitations.
2. State Kirchhoff's voltage law.
3. State Kirchhoff's Current law.
4. Name different network elements.
5. What is meant by Electric Circuits?
6. Write Kirchhoff's law mathematically.
7. State two salient points of a series combination of resistance.
8. State two salient points of a parallel combination of resistance.
9. Give two applications of both series and parallel combination.
10. A bulb is as rated 230V, 230W. Find the rated current, resistance of the filament and the energy consumed when it is operated for 10 hours.
11. At a node there are 3 live conductors joining. The currents flowing in two conductors towards the node are 1A and 2A. What is the direction and magnitude of the current in the third conductor?
12. In a closed loop the algebraic sun of the electric motive forces is 10V. What is the voltage drop across resistors in that loop?
13. Define an ideal voltage source.
14. Define an ideal current source.
15. Draw the symbolic representation of the voltage source and current source.
16. Explain how voltage source with a source resistance can be converted into an equivalent current source.
17. Find the equivalent current source for a voltage source of 100 V with series resistance of 2 ohm.

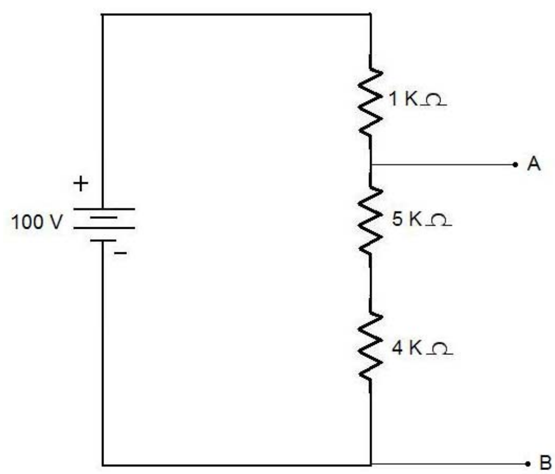
18. Define the dependent source of a circuit.
19. A 10A current source has a source resistance of 100 ohm. What will be the equivalent voltage source?
20. Define the current division rule.
21. Draw the V-I relationship of an ideal voltage source.
22. Find the current in 4 ohm resistor.



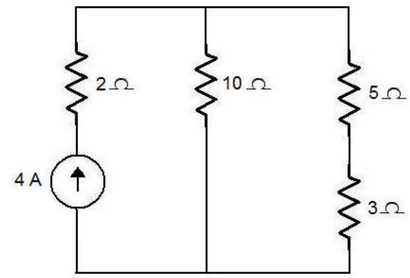
23. Calculate the voltage across resistor R.



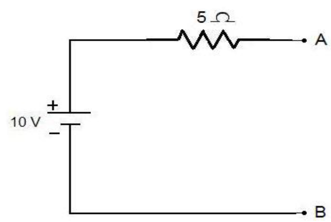
24. Find the voltage between A and B in the circuit given.(Dec 2004, June 2007)



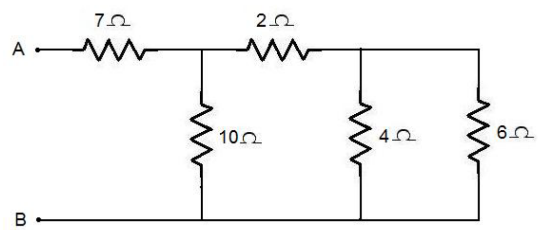
25. Find the current through 10 ohm resistor for the following circuit. (Dec 2004)



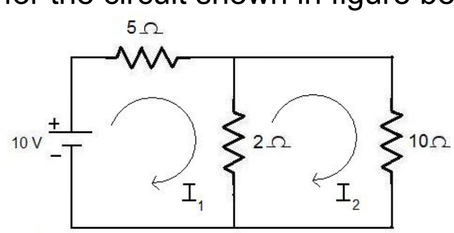
26. What are ideal sources?
27. Give the expressions for star to delta transformation.
28. Define Kirchhoff' laws.
29. Convert the voltage source into a current source for the Circuit given below.



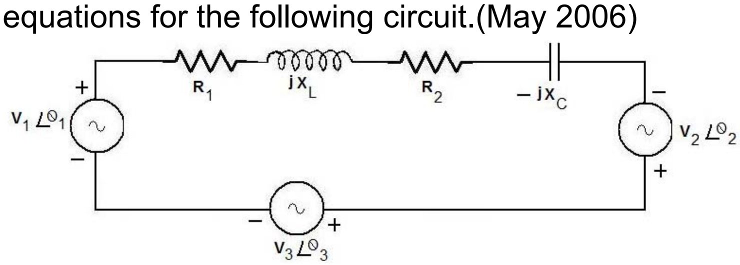
30. Find resistance across AB.



31. Name the four different types of dependent sources in electric circuits.
32. Write the voltage division rule.
33. Define R.M.S value.
34. State the advantages of sinusoidal alternating quantity.
35. What is a phasor?
36. Write the mesh equations for the circuit shown in figure below.(May 2007)

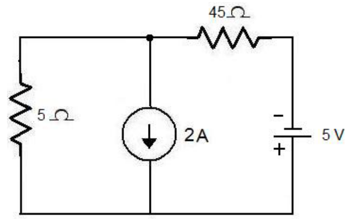


37. Write the mesh equations for the following circuit.(May 2006)



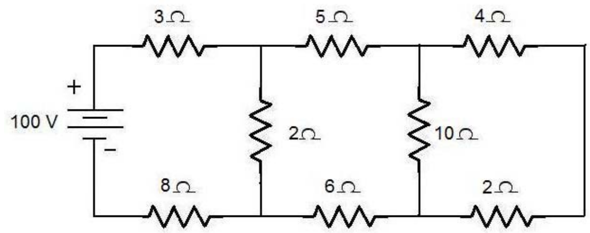
38. Give the algorithm of loop current analysis.

39. Write the node equations at A.

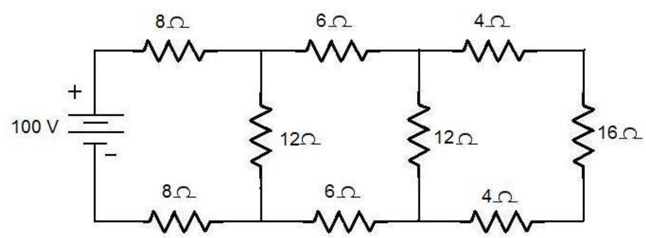


PART – B

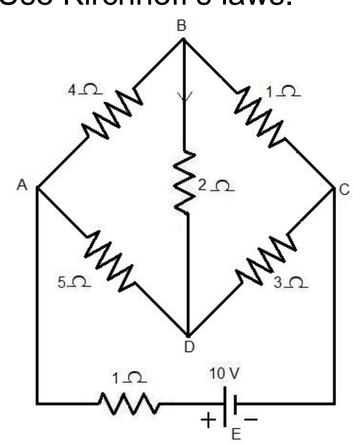
1. Find the current through each branch by network reduction technique. (16)



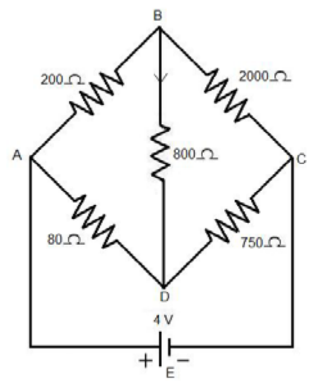
2. Calculate a) the equivalent resistances across the terminals of the supply, b) total current supplied by the source and c) power delivered to 16 ohm resistor in the circuit shown in figure. (16)



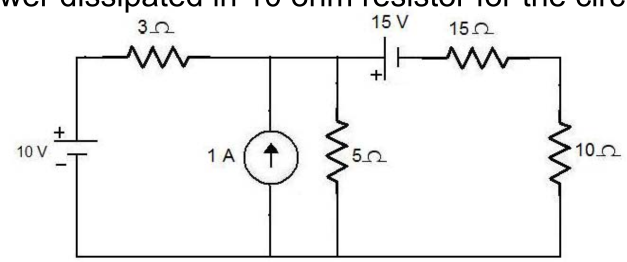
3. In the circuit shown, determine the current through the 2 ohm resistor and the total current delivered by the battery. Use Kirchhoff's laws. (16)



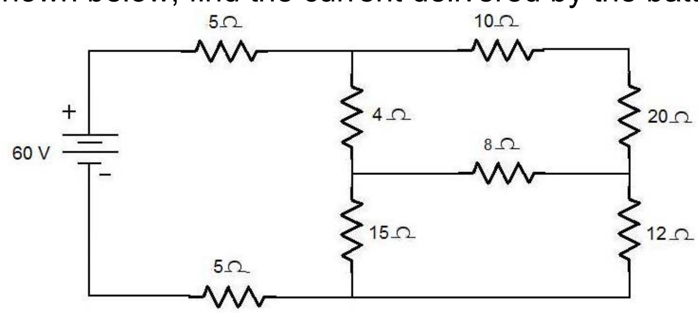
4. (i) Determine the current through 800 ohm resistor in the network shown in figure. (8)



(ii) Find the power dissipated in 10 ohm resistor for the circuit shown in figure. (8)



5. (i) In the network shown below, find the current delivered by the battery. (10)



(ii) Discuss about voltage and current division principles. (6)

6. (i) Explain :

Kirchoff laws. (4)

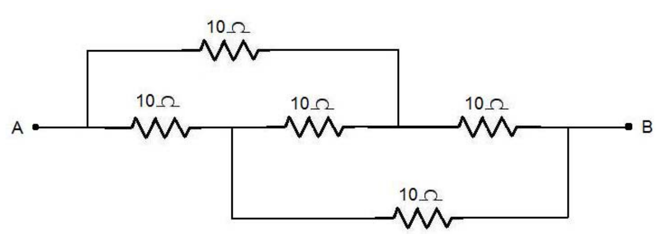
Dependent sources (2)

Source transformations (2)

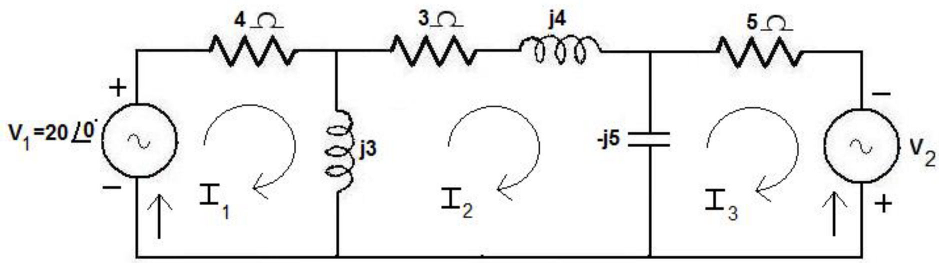
With relevant diagrams.

Voltage division and current division rule (4)

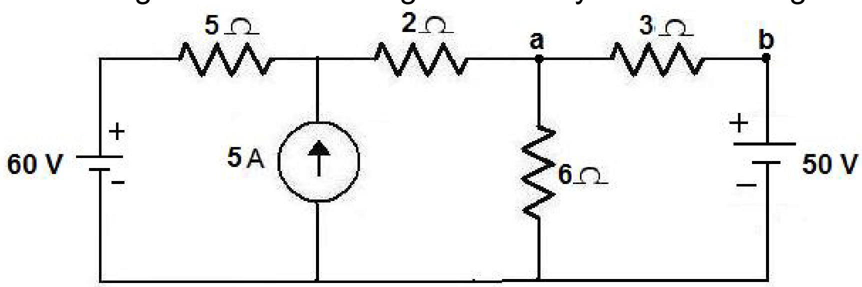
(ii) Calculate the resistance between the terminals A – B. (4)



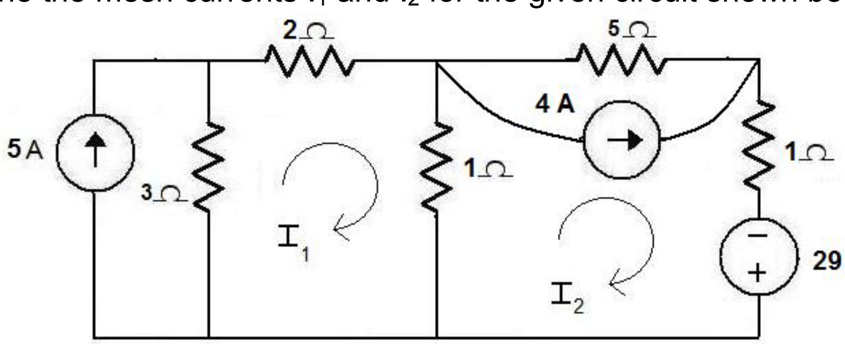
7. i)Determine the value of V_2 such that the current through the impedance (3+j4) ohm is zero. (8)



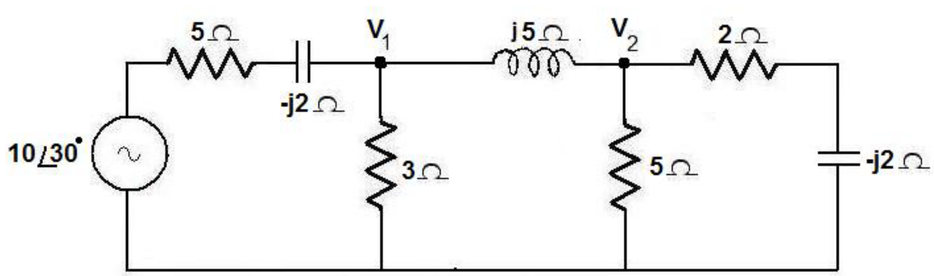
ii) Find the current through branch a-b using mesh analysis shown in figure below. (8)



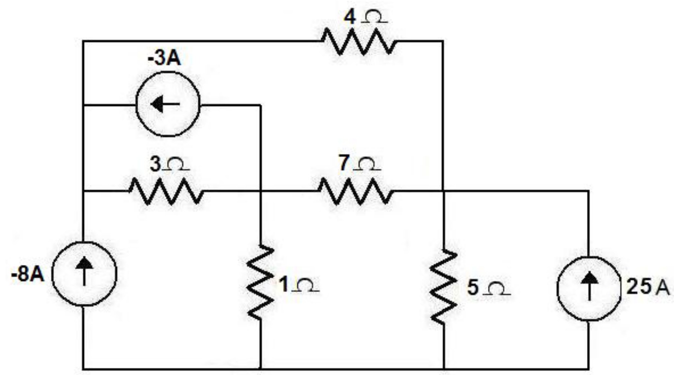
8. Determine the mesh currents I_1 and I_2 for the given circuit shown below (16)



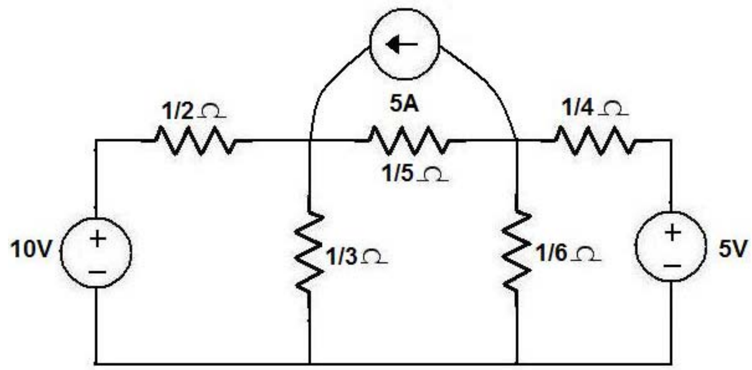
9. Find the node voltages V_1 and V_2 and also the current supplied by the source for the circuit shown below. (16)



10. Find the nodal voltages in the circuit of figure. (16)

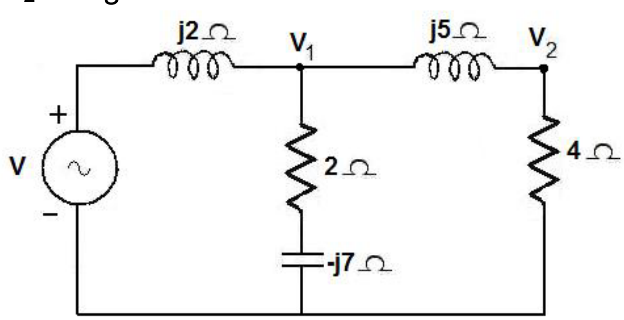


11. i) Using the node voltage analysis, find all the node voltages and currents in 1/3 ohm and 1/5 ohm resistances of figure. (8)

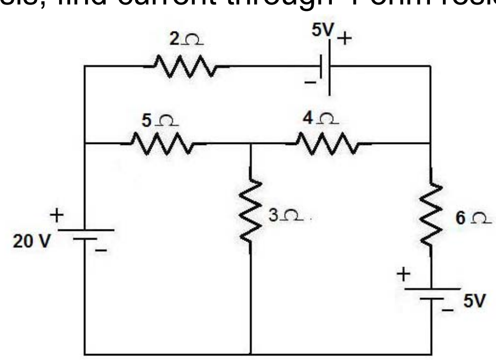


ii) For the mesh-current analysis, explain the rules for constructing mesh impedance matrix and solving the matrix equation [Z]I = V. (8)

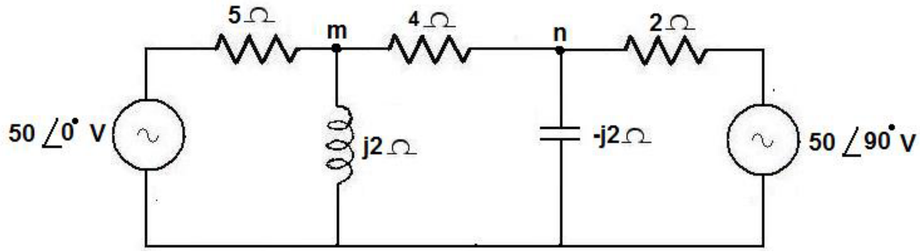
12. Solve for V_1 and V_2 using nodal method. Let V = 100V. (16)



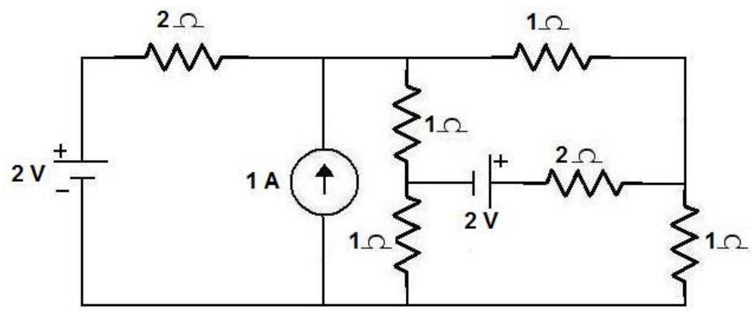
13. Using Mesh analysis, find current through 4 ohm resistor. (16)



14. Use nodal voltage method to find the voltages of nodes 'm' and 'n' and currents through j2 ohm and –j2 ohm reactance in the network shown below. (16)



15. For the circuit shown find the current I flowing through 2 ohm resistance using loop analysis. (16)



UNIT – II

NETWORK REDUCTION AND NETWORK THEOREMS FOR DC AND AC CIRCUITS

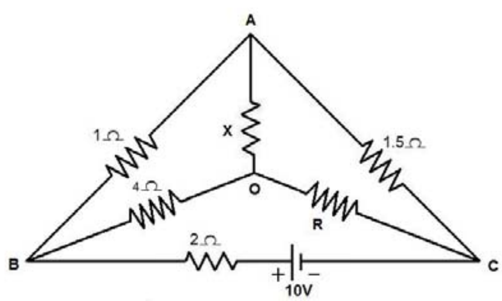
PART – A (2-MARKS)

1. State Superposition theorem.
2. State Thevenin's theorem.
3. State Norton's theorem.
4. State Maximum power transfer theorem.
5. State reciprocity theorem.
6. Write some applications of Maximum power transfer theorem.
7. The power delivered is maximum if the load impedance is equal to the supply circuit impedance – True or False.
8. What is the condition for maximum power transfer.
9. A voltage source has internal impedance (4+j5) ohm. Find the load impedance for maximum power transfer
10. Given that the resistors R_a, R_b and R_c are connected electrically in star. Write the equations for resistors in equivalent delta.

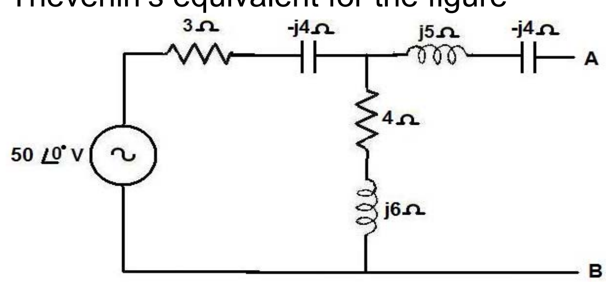
11. Three equal resistors each of R ohms are connected in star. Find the value of resistors in the equivalent delta.
12. Three resistors R_{ab}, R_{bc} and R_{ca} are connected in delta. Write the expression for resistors in equivalent star.
13. Three resistors, each of value R ohms are connected in delta. Find the value of resistors in its equivalent star.
28. Write the expression for converting delta connected resistances into an equivalent star connected resistances.
29. Each of the three arms of a delta connected network has resistance of 3ohm. Find the equivalent star connected network.
14. A Y-connected resistive network consists of 2 ohm in each arm. Draw the equivalent delta-connected network and insert the values
15. Give the expressions for star to delta transformation.

PART – B

1. (i) Find the value of R and the current flowing through it in the circuit shown when the current in the branch OA is zero. (8)

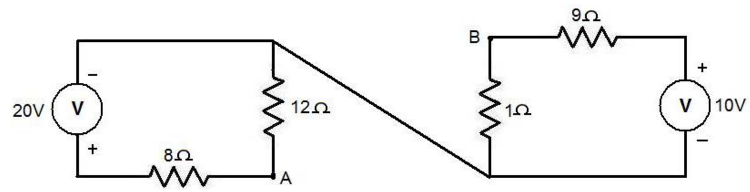


ii) Determine the Thevenin's equivalent for the figure (8)

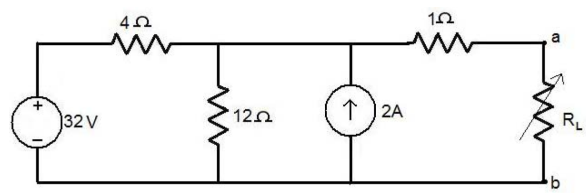


2. Derive expressions for star connected arms in terms of delta connected arms and delta connected arms in terms of star connected arms. (16)

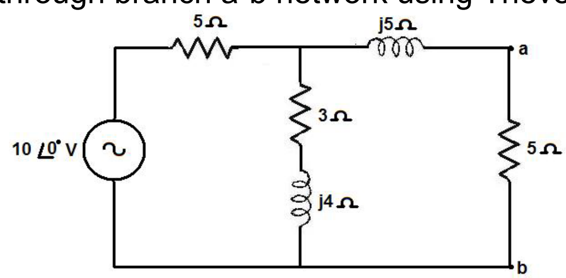
3. Determine Thevenin's equivalent across the terminals AB for the circuit shown in figure below. (16)



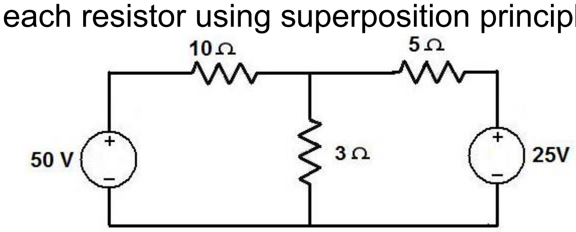
4. Find the Thevenins's equivalent circuit of the circuit shown below, to left of the terminals ab. Then find the current through R_L = 16 ohm and 36 ohm. (16)



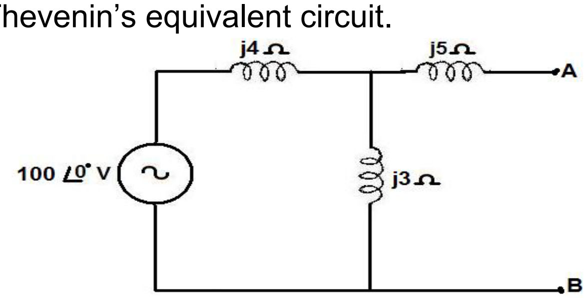
5. i) Find the current through branch a-b network using Thevenin's theorem. (8)



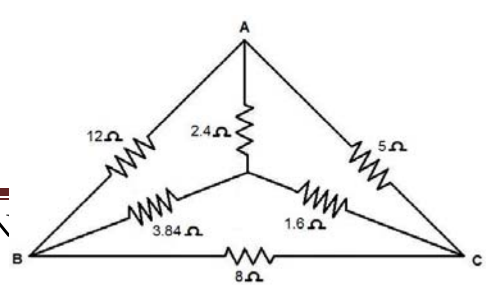
ii) Find the current in each resistor using superposition principle of figure. (8)



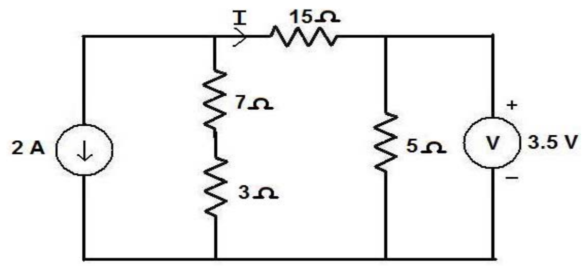
6. i) Determine the Thevenin's equivalent circuit. (8)



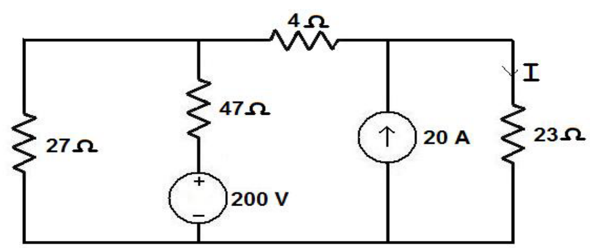
(ii) Determine the equivalent resistance across AB of the circuit shown in the figure below. (8)



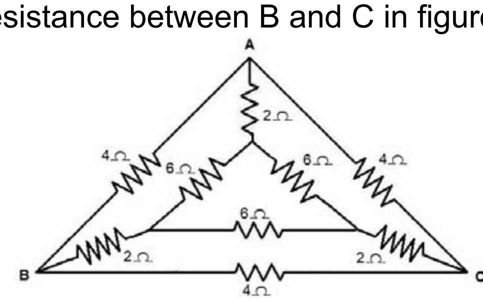
7. For the circuit shown, use superposition theorem to compute current I. (16)



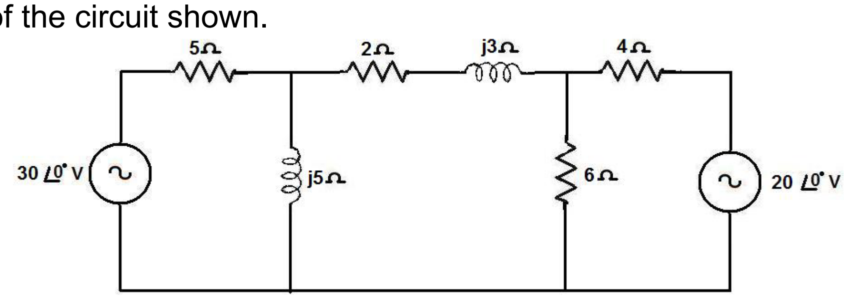
8. (i)Compute the current in 23 ohm resistor using super position theorem for the circuit shown below. (8)



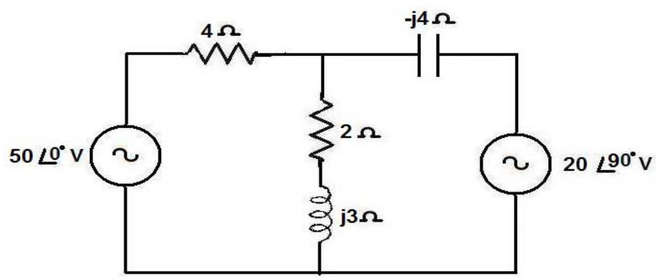
(ii) Find the equivalent resistance between B and C in figure (8)



9. Using superposition theorem calculate current through (2+j3) ohm impedance branch of the circuit shown. (16)

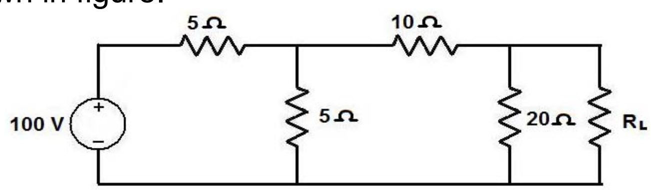


10. i) For the circuit shown, determine the current in (2+j3) ohm by using superposition theorem. (8)



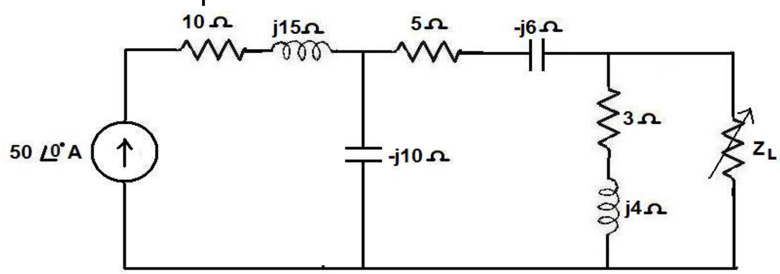
ii) State and prove Norton's theorem. (8)

11.i) Find the value of R_L so that maximum power is delivered to the load resistance shown in figure. (8)

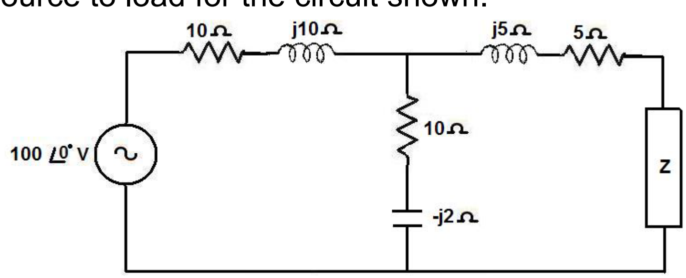


ii) State and prove compensation theorem. (8)

12. Determine the maximum power delivered to the load in the circuit. (16)

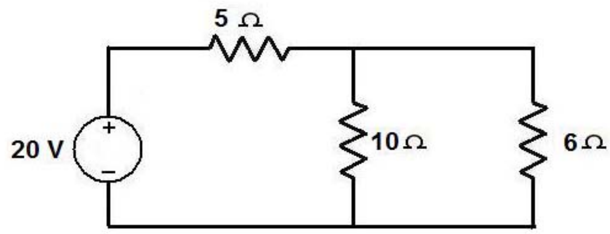


13. Find the value of impedance Z so that maximum power will be transferred from source to load for the circuit shown. (16)



14. i) State and explain maximum power transfer theorem for variable Pure resistive load. (8)

ii) Using Norton's theorem, find current through 6 ohm resistance shown in figure. (8)



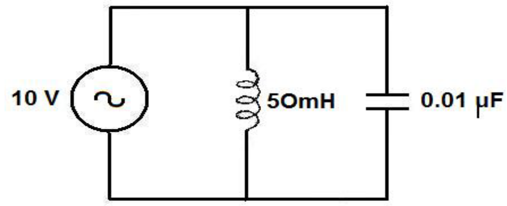
UNIT – III

RESONANCE AND COUPLED CIRCUITS

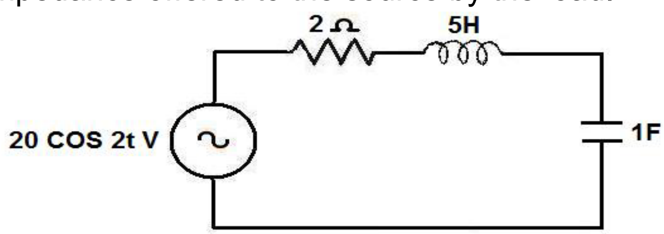
PART – A (2-MARKS)

1. For the purely resistive circuit excited by sinusoidal varying voltage, what are the phase angle and p.f?
2. For the purely inductive circuit supplied by sinusoidal varying voltage, what is the phase relation between current and applied voltage. How are applied voltage and induced emf?
3. For purely capacitive circuit, excited by sinusoidal voltage, find the phase relation between applied voltage and current.
4. How are the following affected by change of frequency?
   a. Resistance b. Inductive reactance c. Capacitive reactance
5. Define quality factor of series resonant circuit.
6. What is the dynamic impedance and what is its expression?
7. Define bandwidth.
8. What are the half power frequencies?
9. What is resonance?
10. What do you understand by series and parallel resonance?
11. A voltage of $v(t) = 100 \sin\omega t$ is applied to a circuit. The current flowing through the circuit is $i(t) = 15 \sin(\omega t-30^\circ)$. Determine the average power delivered to the circuit.
12. Derive resonant frequency for series RLC circuit.

13. Write the expression for resonant frequency and current at resonance of a RLC series circuit.
14. Define Q-factor of a coil.
15. Define bandwidth of a resonant circuit.
16. Find the resonant frequency in the ideal parallel LC circuit shown below



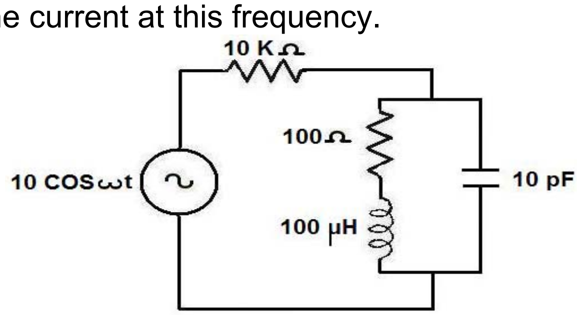
17. Find the impedance offered to the source by the load.



18. State the condition for resonance in RLC series circuit.
19. A resistance 5 ohms, inductance 0.02H and capacitor 5 microfarads are connected in series. Find the resonance frequency and the power factor at resonance.
20. Two capacitances C1 and C2 of values 10μF and 5μF are connected in series. What is the equivalent capacitance of this combination?

PART – B

1. (i) Derive bandwidth for a series RLC circuit as a function of resonant frequency.(16)
2. (i) For the circuit below, find the value of ω so that current and source emf are in phase. Also find the current at this frequency. (8)



(ii) Discuss the characteristics of parallel resonance of a circuit having G,L and C. (8)

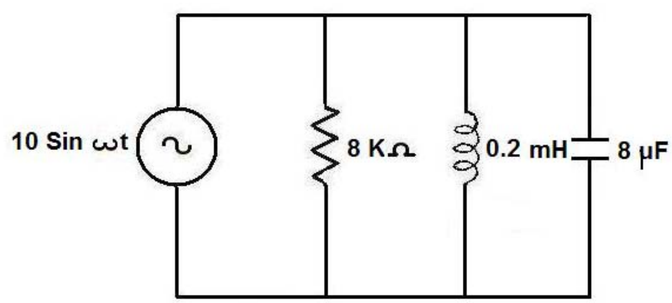
3. (i) A Pure resistor, a pure capacitor and a pure inductor are connected in parallel across a 50Hz supply, find the impedance of the circuit as seen by the supply. Also find the resonant frequency. (8)
(ii) When connected to a 230V, 50Hz single phase supply, a coil takes 10kVA and 8kVAR. For this coil calculate resistance, inductance of coil and power consumed.(8)

4. (i) In an RLC series circuit if ω_1 and ω_2 are two frequencies at which the magnitude of the current is the same and if ω_r is the resonant frequency, prove that $\omega^2_r = \omega_1\omega_2$. (8)
   (ii) A series RLC circuit has Q = 75 and a pass band (between half power frequencies) of 160 Hz. Calculate the resonant frequency and the upper and lower frequencies of the pass band. (8)

5. (i) Explain and derive the relationships for bandwidth and half power frequencies of RLC series circuit. (8)
   (ii) Determine the quality facto of a coil R = 10 ohm, L = 0.1H and C = 10Mf (8)

6. A series RLC circuit has R=20 ohm, L=0.005H and C = 0.2 x 10^{-6} F. It is fed from a 100V variable frequency source. Find i) frequency at which current is maximum ii) impedance at this frequency and iii) voltage across inductance at this frequency. (16)
7. A series RLC circuit consists of R=100 ohm, L = 0.02 H and C = 0.02 microfarad. Calculate frequency of resonance. A variable frequency sinusoidal voltage of constant RMS value of 50V is applied to the circuit. Find the frequency at which voltage across L and C is maximum. Also calculate voltage across L and C is maximum. Also calculate voltages across L and C at frequency of resonance. Find maximum current in the circuit. (16)

8. In the parallel RLC circuit, calculate resonant frequency, bandwidth, Q-factor and power dissipated at half power frequencies. (16)



UNIT – IV

TRANSIENT RESPONSE OF DC AND AC CIRCUITS

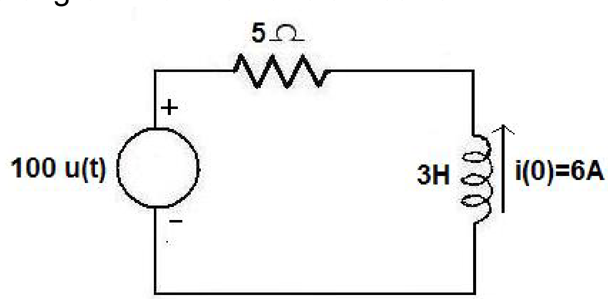
PART – A (2-MARKS)

1. The transients are due to the presence of energy storing elements in the circuit – True or false.
2. What is a step function?
3. What is an initial condition?
4. What is a transient?

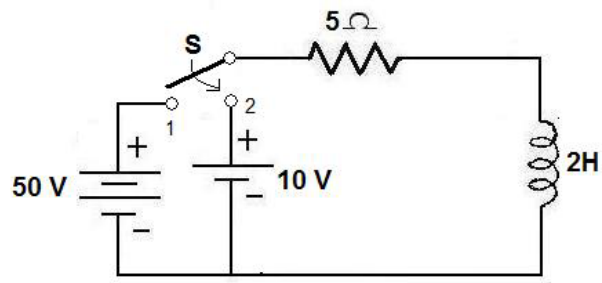
5. What is the steady state value?
6. Write the transient current equation when RL series circuit is connected to a step voltage of volts.
7. A DC voltage of 100 volts is applied to a series RL circuits with R = 25 ohm what will be the current in the circuit in the circuits at twice the time constant?
8. Sketch the current given by I (t) = 5 – 4 $e^{-20\,t}$.
9. Distinguish between free and forced response.
10. Draw the equivalent circuit for inductor and capacitor at t = 0+ when there is no initial energy.
11. Define a time constant of a RL circuit.
12. Draw the equivalent circuits for the inductor and capacitor at t=0+ with presence of initial energy.
13. Distinguish between the steady state and the transient response of an electrical circuit.
14. Define a time constant of a RC circuit.
15. Draw the equivalent circuit at t = 0+ for a capacitor with initial charge of q_{0}.
16. Sketch the response of RC network for a unit step input.
17. What are the periodic inputs?
18. What are critical frequencies? Why are they so called?
19. Draw the transient response of R-L circuits for step input.
20. Define the time constant of a transient response.
21. Find the time constant of RL circuits having R = 10 ohm and L = 0.1 mH.
22. What is meant by critical damping?

PART – B

1. In the circuit of the figure shown below, find the expression for the transient current and the initial rate of growth of the transient current (16)



2. In the circuit shown in figure, switch S is in position 1 for a long time and brought to position 2 at time t=0. Determine the circuit current. (16)

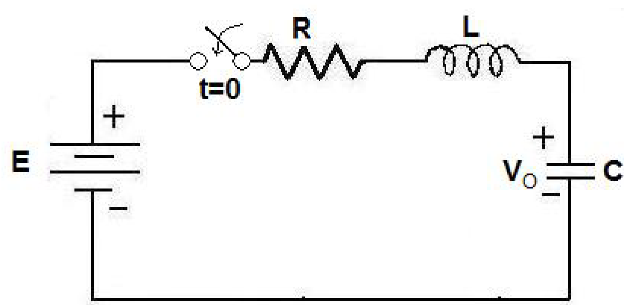


3. A resistance R and 2 microfarad capacitor are connected in series across a 200V direct supply. Across the capacitor is a neon lamp that strikes at 120V. Calculate R to make the lamp strike 5 sec after the switch has been closed. If R = 5Megohm, how long will it take the lamp to strike? (16)

4. A Series RLC circuits has R=50 ohm, L= 0.2H, and C = 50 microfarad. Constant voltage of 100V is impressed upon the circuit at t=0. Find the expression for the transient current assuming initially relaxed conditions. (16)

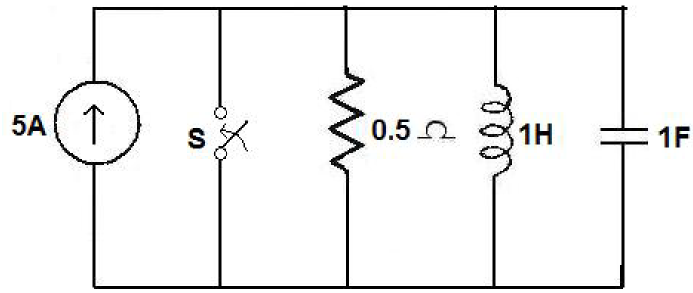
5. A Series RLC circuits with R=300 ohm, L=1H and C=100x10^{-6} F has a constant voltage of 50V applied to it at t= 0. Find the maximum value of current (Assume zero initial conditions) (16)

6. A step voltage V(t) = 100 u(t) is applied to a series RLC circuit with L=10H, R=2ohm and C= 5F. The initial current in the circuit is zero but there is an initial voltage of 50V on the capacitor in a direction which opposes the applied source. Find the expression for the current in the circuit. (16)

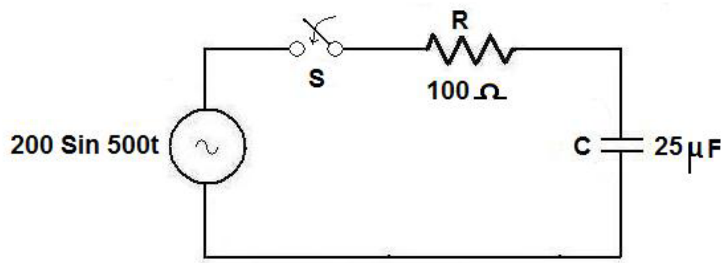


7. For a source free RLC series circuit, the initial voltage across C is 10V and the initial current through L is zero. If L = 20mH, C=0.5 microfarad and R=100 ohm. Evaluate i(t). (16)

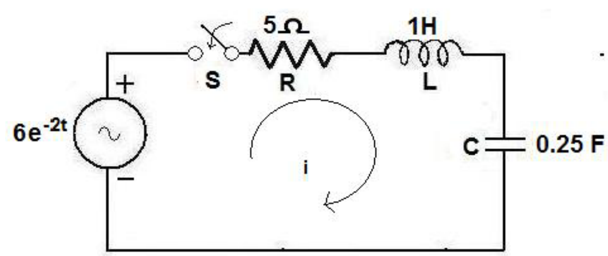
8. For the circuit shown in figure, find the voltage across the resistor 0.5 ohm when the switch, S is opened at t=0. Assume that there is no charge on the capacitor and no current in the inductor before switching. (16)



9. In the circuit shown in figure, find the current i. Assume that initial charge across the capacitor is zero. (16)



10. In the circuit shown in figure, the switch is closed at time t=0. Obtain i(t). Assume zero current through inductor L and zero charge across C before closing the switch. (16)



11. Derive an expression for current response of RLC series circuit transient. (16)

UNIT – V

ANALYSING THREE PHASE CIRCUITS

PART – A (2-MARKS)

1. Give the relation between apparent power, average power and reactive power.
2. What is P.F and what is reactive power?
3. In a three phase circuit, what do you mean by balanced load and unbalanced load?
4. Draw the circuit for two wattmeter method of measurement of three-phase power.
5. Write the relations between phase and line values in a delta and star connected loads.
6. Write the expressions for the power factor in a balanced three phase circuit.

7. Write the expression for total power in a three phase balanced circuit defining each quantity.
8. Write the expression for the wattmeter readings connected to measure the total power in a three phase balanced circuit.
9. Give the three phase power expressions in terms of phase values.
10. Give the relation between V_{ph} and V_L, I_{ph} and I_L for a star circuit.
11. An inductive load consumes 1000W power and draw 10A current when connected to a 25V, 25Hz supply. Determine the resistance and inductance of the load.
12. Write the expressions for calculating real, reactive and apparent power of a three phase system.

PART – B

1. With a neat circuit and phasor diagram explain the three phase power measurement by two wattmeter method. (16)

2. (i) A symmetrical three phase 400V system supplies a balanced delta connected load. The current in each branch circuit is 20A and phase angle 40° (lag) calculate the line current and total power. (8)
(ii) A three phase delta connected load has Z_{ab} = (100+j0) ohms, Z_{bc} = (-j100) ohms and Z_{ca} = (70.7 =j70.7) ohms is connected to a balanced 3 phase 400V supply. Determine the line currents I_a,I_b and I_c. Assume the phase sequence abc. (8)

3. (i) A balanced three phase star connected load with impedance 8+j6 ohm per phase is connected across a symmetrical 400V three phase 50Hz supply. Determine the line current, power factor of the load and total power. (8)
(ii) An alternating current is expressed as i=14.14 sin 314t. Determine rms current, frequency and instantaneous current hen t =0.02ms. (8)

4. (i) A balanced star connected load of 4+j3 ohm per phase is connected to a 400V, 3 phase, 50Hz supply. Find the line current, power factor ,power, reactive volt ampere and total volt ampere. (8)
(ii) A Voltage source 100V with resistance of 10 ohms and inductance 50 mH, a capacitor 50 microfarad are connected in series. Calculate the impedance when the frequency is (i) 50HZ (ii) 500Hz (iii) the power factor at 100Hz. (8)

5. (i) Three impedances $Z_1 = 3\angle 45°$ ohm, $Z_2 = 10\sqrt{2}\angle 45°$ ohm, $Z_3 = 5\angle -90°$ ohm are connected in series. Calculate applied voltage if voltage across $Z_1 = 27\angle -10°$ V. (8)
(ii) A delta connected load as shown in figure is connected across 3 phase 100 volt supply. Determine all line currents. (8)

a.