KINGS
COLLEGE OF ENGINEERING

DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

QUESTION BANK

NAME OF THE SUBJECT: EE 1151 – CIRCUIT THEORY

YEAR / SEM : I / II

UNIT – I

BASIC CIRCUITS ANALYSIS

PART – A (2-MARKS)

1. State Ohm's law.
2. Mention the limitations of Ohm's Law.
3. State Kirchhoff's voltage law.
4. State Kirchhoff's Current law.
5. State two salient points of a series combination of resistance.
6. State two salient points of a parallel combination of resistance.
7. Give two applications of both series and parallel combination.
8. Define an ideal voltage source.
9. Define an ideal current source.
10. Explain how voltage source with a source resistance can be converted into an equivalent current source.
11. Name the four different types of dependent sources in electric circuits.
12. Define R.M.S value.

13. State the advantages of sinusoidal alternating quantity.

14. What is a phasor?

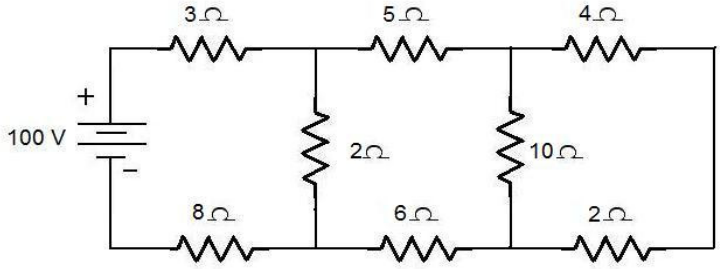
15. What is meant by linear and nonlinear elements?

16. What is meant by active and Passive elements?

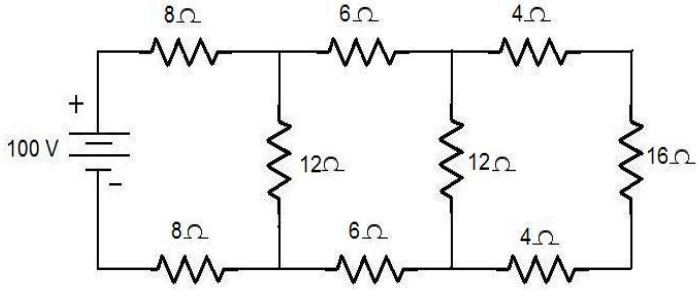
17. What is meant by Unilateral and bi-lateral element?

PART – B

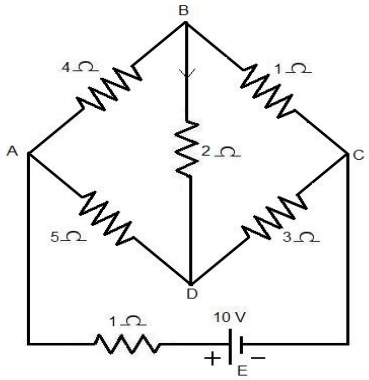
1. Find the current through each branch by network reduction technique. (16)



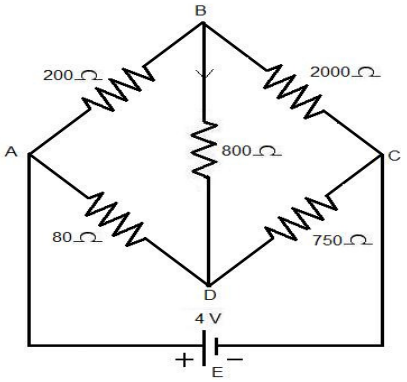
2. Calculate a) the equivalent resistances across the terminals of the supply, b) total current supplied by the source and c) power delivered to 16 ohm resistor in the circuit shown in figure. (16)



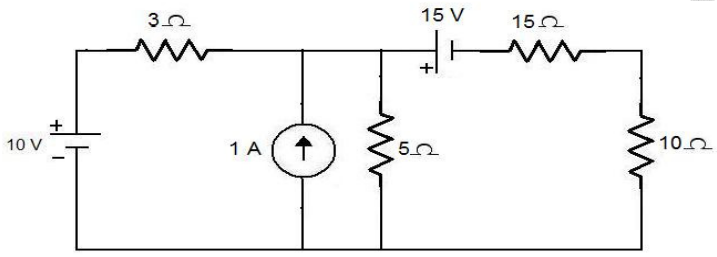
3. In the circuit shown, determine the current through the 2 ohm resistor and the total current delivered by the battery. Use Kirchhoff's laws. (16)



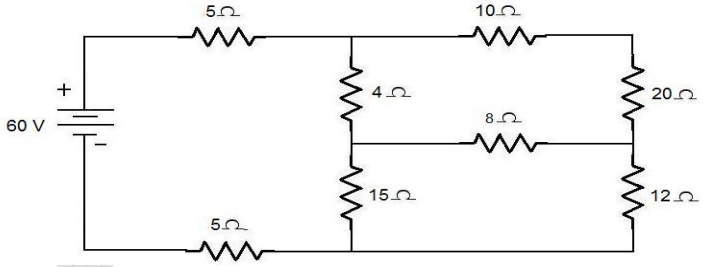
4. (a) Determine the current through 800 ohm resistor in the network shown in figure. (8)



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



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

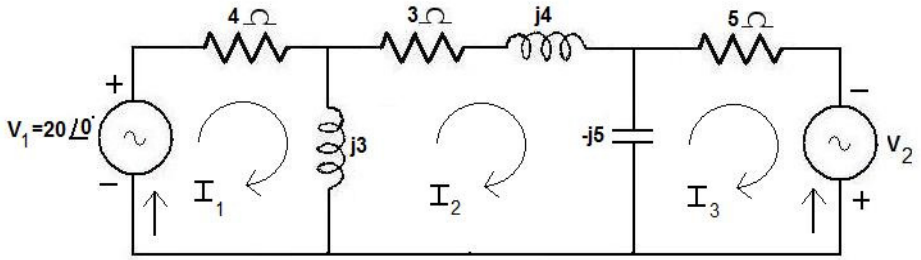


(b) Discuss about voltage and current division principles. (6)

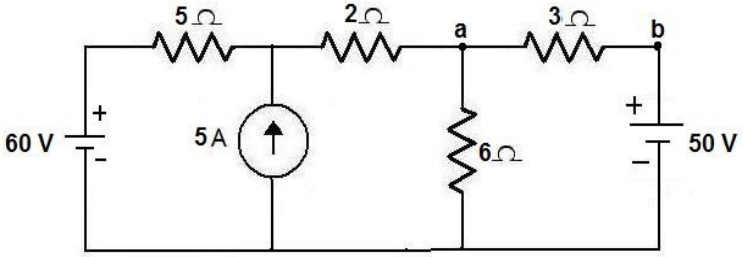
6. Explain with relevant diagrams:

i) Kirchoff laws. (5)
ii) Dependent sources (3)
iii) Source transformations (4)
iv) Voltage division and current division rule (4)

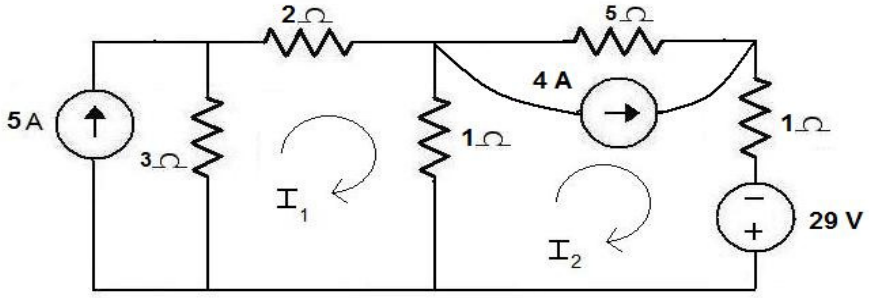
7. (a) Determine the value of V_2 such that the current through the impedance (3+j4) ohm is zero. (8)



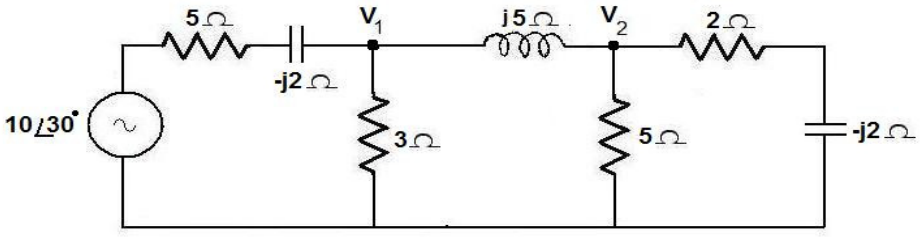
(b) Find the current through branch a-b using mesh analysis shown in figure below. (8)



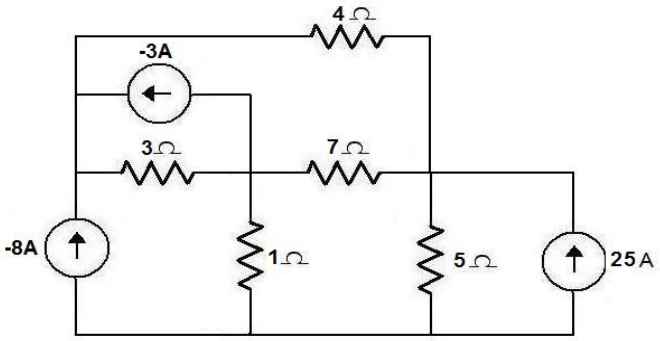
8. Determine the mesh currents I_1 and I_2 for the given circuit shown below (16)



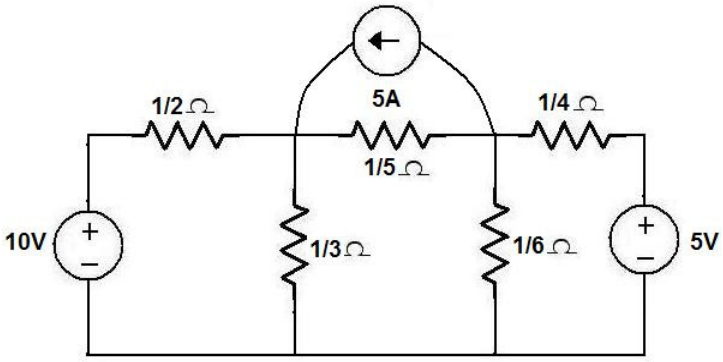
9. Find the node voltages V_1 and V_2 and also the current supplied by the source for the circuit shown below. (16)



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

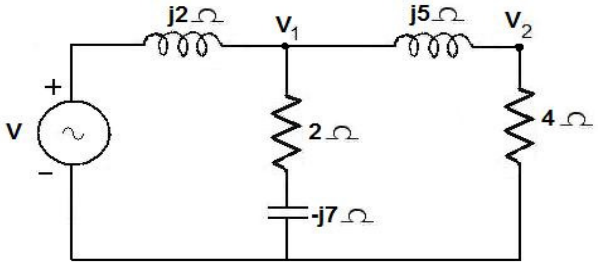


11. (a) Using the node voltage analysis, find all the node voltages and currents in 1/3 ohm and 1/5 ohm resistances of figure. (8)

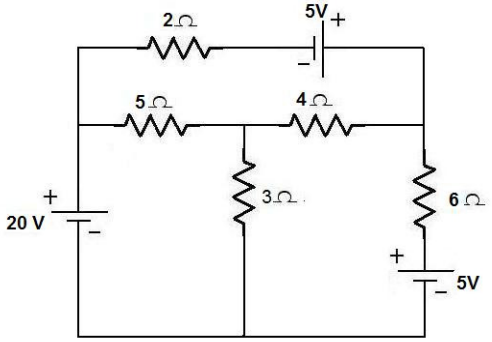


(b) For the mesh-current analysis, explain the rules for constructing mesh impedance matrix and solving the matrix equation [Z]I = V. (8)

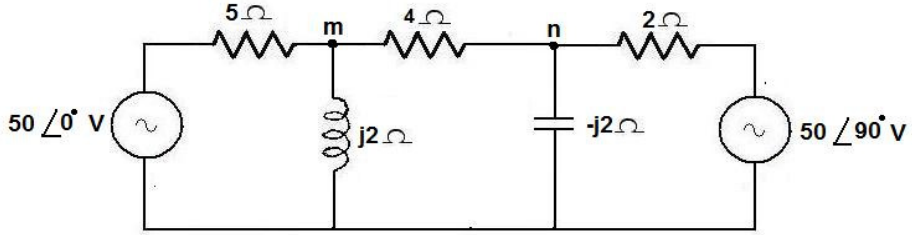
12. Solve for V_1 and V_2 using nodal method. Let V = 100V. (16)



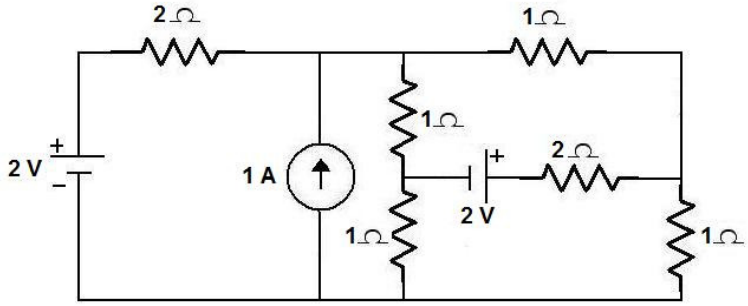
13. Using Mesh analysis, find current through 4 ohm resistor. (16)



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. A voltage source has internal impedance (4+j5) ohm. Find the load impedance for maximum power transfer.

8. Given that the resistors R_a, R_b and R_c are connected electrically in star. Write the equations for resistors in equivalent delta.

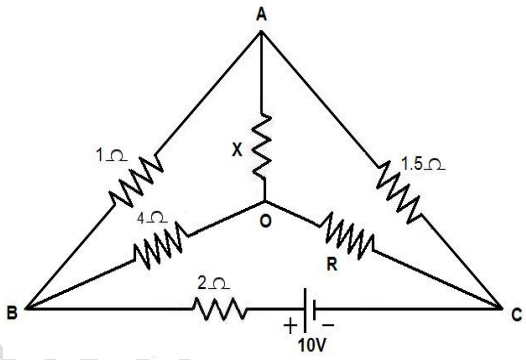
9. Three equal resistors each of R ohms are connected in star. Find the value of resistors in the equivalent delta.

10. Three resistors R_{ab}, R_{bc} and R_{ca} are connected in delta. Write the expression for resistors in equivalent star.

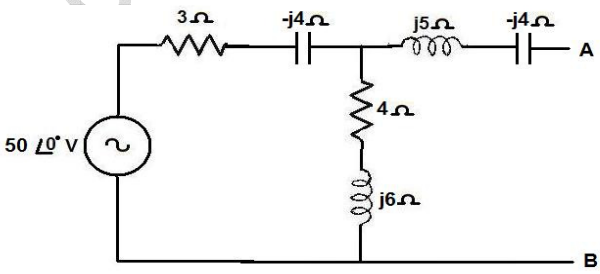
11. Three resistors, each of value R ohms are connected in delta. Find the value of resistors in its equivalent star.

PART – B

1. (a) 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)

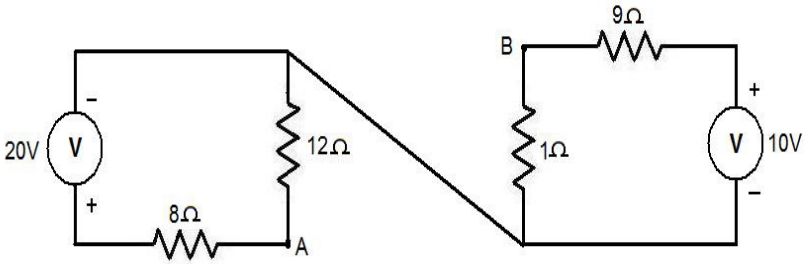


(b) Determine the Thevenin's equivalent for the figure (8)

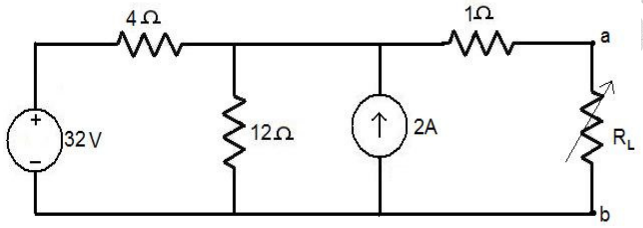


2. Derive expressions for star connected arms in terms of delta connected arms and delta connected arms in terms of star connected arms. (16)

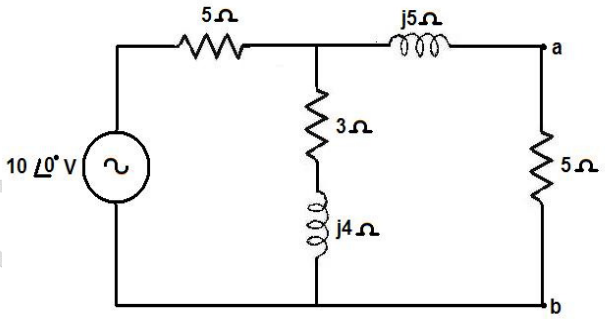
3. Determine Thevenin's equivalent across the terminals AB for the circuit shown in figure below. (16)



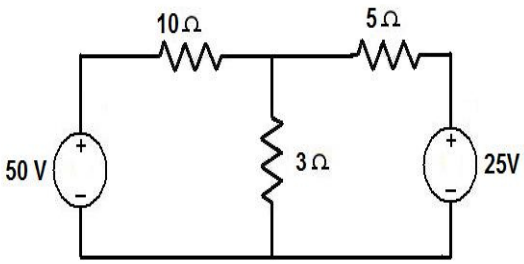
4. Find the Thevenins's equivalent circuit of the circuit shown below, to left of the terminals ab. Then find the current through R_L = 16 ohm and 36 ohm. (16)



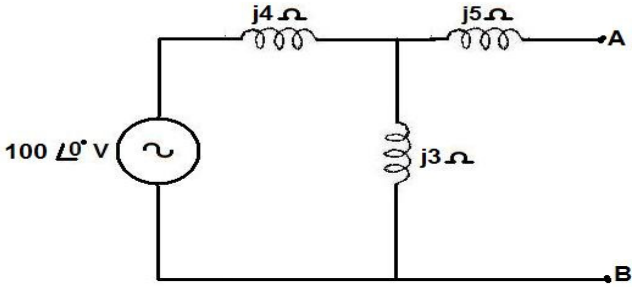
5. (a) Find the current through branch a-b network using Thevenin's theorem. (8)



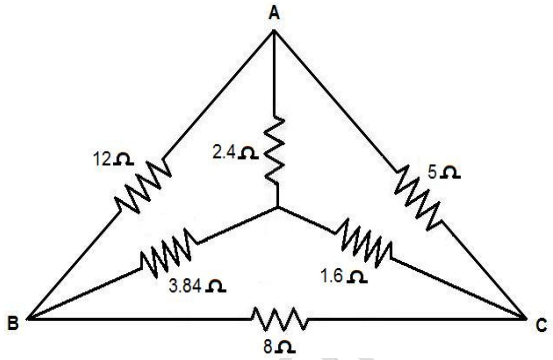
(b) Find the current in each resistor using superposition principle of figure. (8)



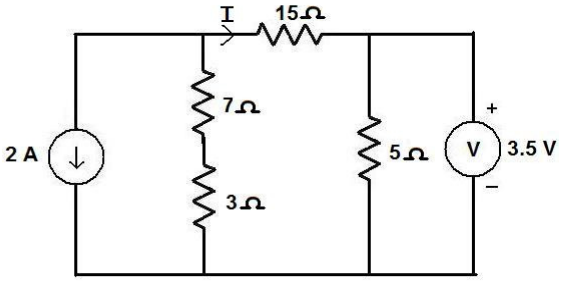
6. (a) Determine the Thevenin's equivalent circuit. (8)



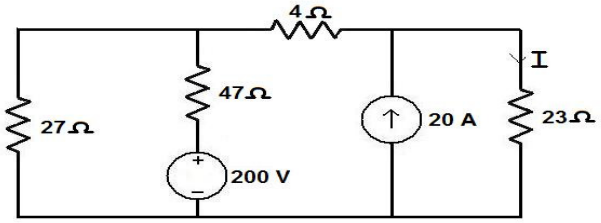
(b) Determine the equivalent resistance across AB of the circuit shown in the figure below. (8)



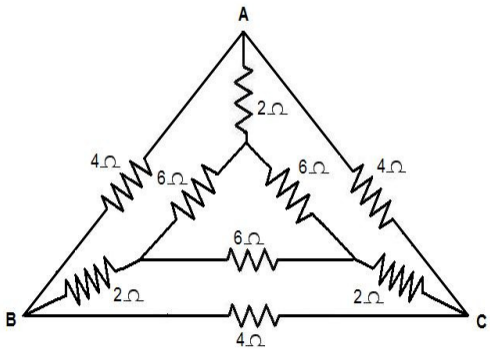
7. For the circuit shown, use superposition theorem to compute current I. (16)



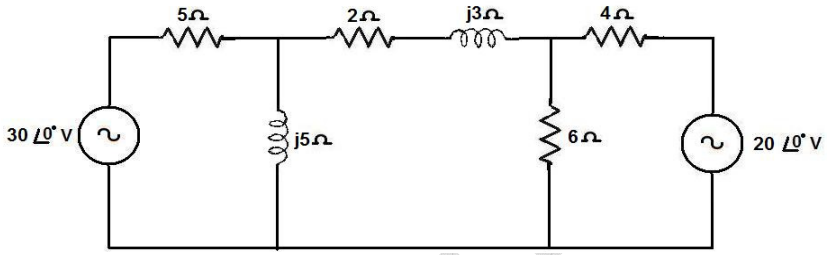
8. (a)Compute the current in 23 ohm resistor using super position theorem for the circuit shown below. (8)



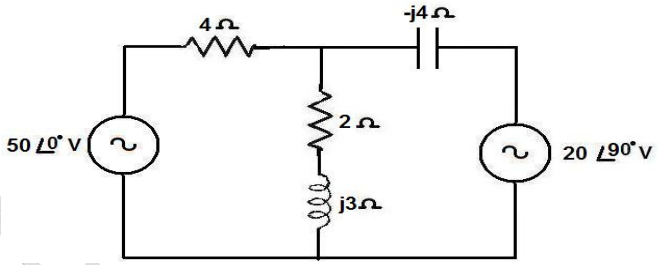
(b) Find the equivalent resistance between B and C in figure (8)



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

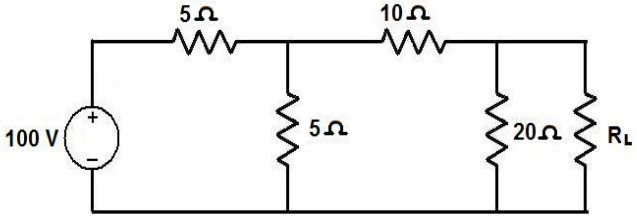


10. (a) For the circuit shown, determine the current in (2+j3) ohm by using superposition theorem. (8)



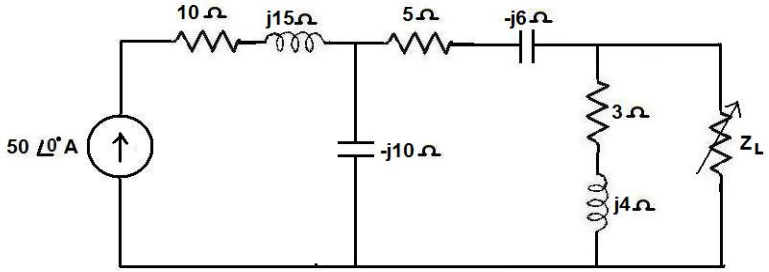
(b) State and prove Norton's theorem. (8)

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

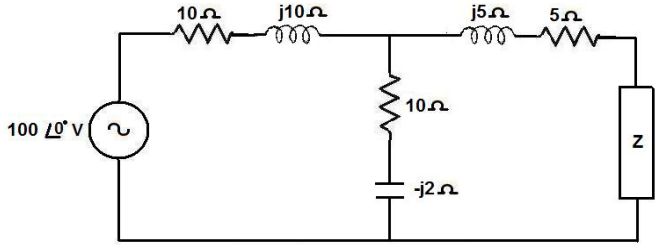


(b) State and explain reciprocity theorem. (8)

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

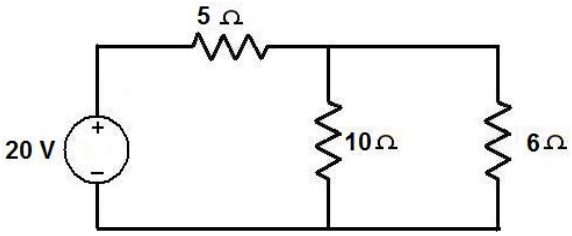


13. Find the value of impedance Z so that maximum power will be transferred from source to load for the circuit shown. (16)



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

(b) 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. Define quality factor.

2. What are half power frequencies?

3. Define selectivity.

4. Write the characteristics of series resonance.

5. What is anti resonance?

6. Write the characteristics of parallel resonance.

7. What is Band width and Selectivity ?

8. Mention the Properties of a series RLC circuit.

9. Mention the Properties of a parallel RLC circuit.

10. What is resonance?

11. What are coupled circuits?

12. What are coupled coils?

13. Define self-inductance.

14. Define mutual inductance.

15. Define coefficient of coupling.

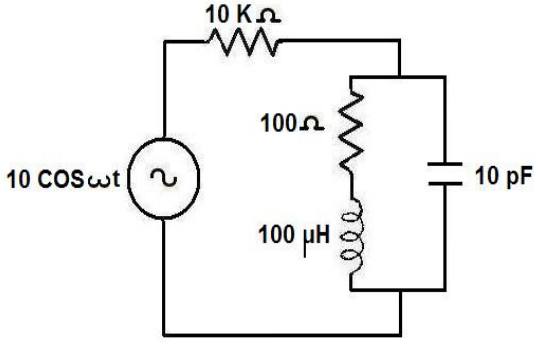
16. What is DOT convention?

17. State dot rule for coupled coils.

PART – B

1. Derive bandwidth for a series RLC circuit as a function of resonant frequency. (16)

2. (a) 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)



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

3. (a) 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)

(b) 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. (a) Explain in detail about Single tuned circuits. (8)

(b) 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)

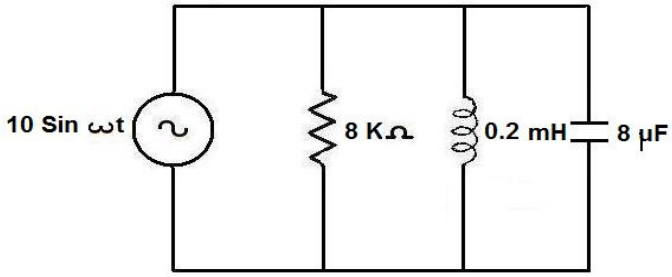
5. (a) Explain and derive the relationships for bandwidth and half power frequencies of RLC series circuit. (8)

(b) Determine the quality factor of a coil R = 10 ohm, L = 0.1H and C = 10μF (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)



9. (a) For the given circuit constants, find (a) Mutual Inductance (b) Find equivalent inductance for all the combination L_1 = 0.02H , L_2 = 0.01H and k = 0.5. (8)

   (b) Calculate the mutual inductance of two coils of self-inductances 100μH and 240μH, which are connected in series to yield a total inductance of 146μH. (4)

   (c) Two perfectly coupled coils each of 1H self-inductance are connected in parallel so as to aid each other. Calculate the effective inductance. (4)

10. Three similar coils are wound on a long common core in such a way that the voltage of mutual inductance between each set of coils is positive. The self-inductance of each coil is 0.2H. The effective inductance of the first two in series is 0.6H and of all the three in series is 1H. When the terminals of the first coil are interchanged, the effective inductance of the three coils in series becomes 0.5 H. Determine the co-efficient of coupling between each set of coils. (16)

11. What is mutual inductance? Derive an expression for the mutual inductance between two magnetically coupled coils having self-inductances L_1 and L_2 respectively. (16)

12. A coil of inductance 100μH and of self-inductance 5pF is magnetically coupled to another coil of inductance 200μH and of self-inductance 10pF. The co-efficient of coupling between the coil is 0.1.Calculate the effective mutual inductance between them at 1 MHz. (16)

UNIT – IV

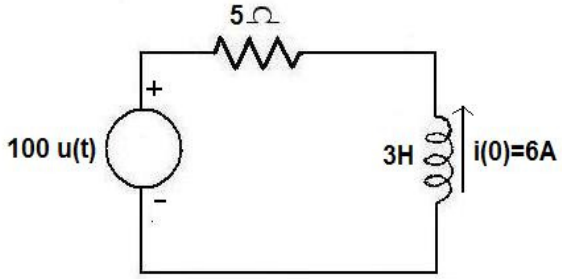
TRANSIENT RESPONSE OF DC AND AC CIRCUITS

PART – A (2-MARKS)

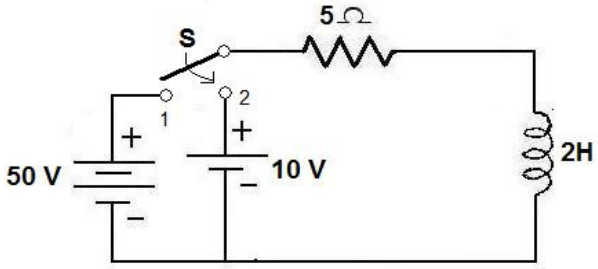
1. What is transient?
2. Why transients occur in electric circuits?
3. What is free and forced response?
4. What is complementary function?
5. What is particular solution?
6. Define time constant of RL circuit.
7. Define time constant of RC circuit.
8. What is damping ratio?
9. What is critical damping.?
10. What is critical resistance?
11. What is natural and damped frequency?
12. What is an initial condition?
13. What is the steady state value?
14. What are critical frequencies? Why they are so called?
15. Distinguish between steady state and transient response.

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)

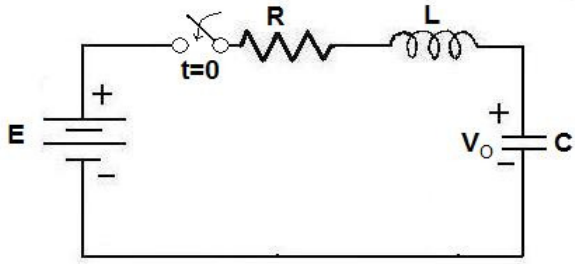
5. A Series RLC circuits with R=300 ohm, L=1H and C=100x10^{-6} F has a constant voltage of 50V applied to it at t= 0. Find the maximum value of current (Assume zero initial conditions) (16)

6. 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)

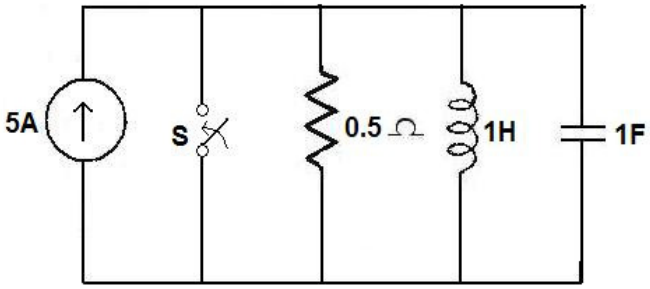
7. Derive an expression for current response of RLC series circuit transient. (16)

8. Derive an expression for current response of RL and RC series circuit transients.(16)

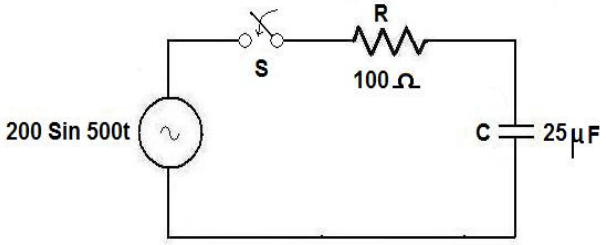
9. A step voltage V(t) = 100 u(t) is applied to a series RLC circuit with L=10H, R=2ohm and C= 5F. The initial current in the circuit is zero but there is an initial voltage of 50V on the capacitor in a direction which opposes the applied source. Find the expression for the current in the circuit. (16)



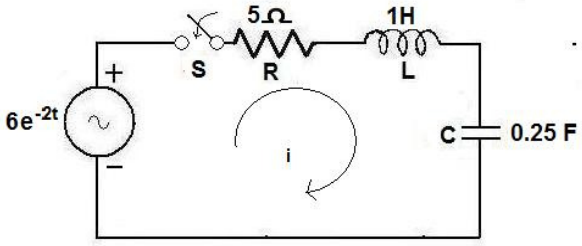
10. For the circuit shown in figure, find the voltage across the resistor 0.5 ohm when the switch, S is opened at t=0. Assume that there is no charge on the capacitor and no current in the inductor before switching. (16)



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



12. 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)



UNIT – V

ANALYSING THREE PHASE CIRCUITS

PART – A (2-MARKS)

1. What is balanced voltage?

2. What are balanced impedance?

3. What is phase sequence?

4. Write the relation between the line and phase value of voltage and current in a balanced star connected load.

5. Write the relation between the line and phase voltage of voltage current in a balanced delta connected load.

6. What is neutral shift voltage?

7. Write the relation between the power factor and wattmeter readings in two-wattmeter method of power measurement.

8. In three phase circuit, what do you mean by balanced load?

9. When is a three phase supply system called balanced supply system?

10. List any two advantages of 3-phase system over 1-phase system.

PART – B

1. With a neat circuit and phasor diagram explain the three phase power measurement by two wattmeter method and also derive the expression for Power Factor. (16)

2. (a) 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)

   (b) 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. (a) 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)

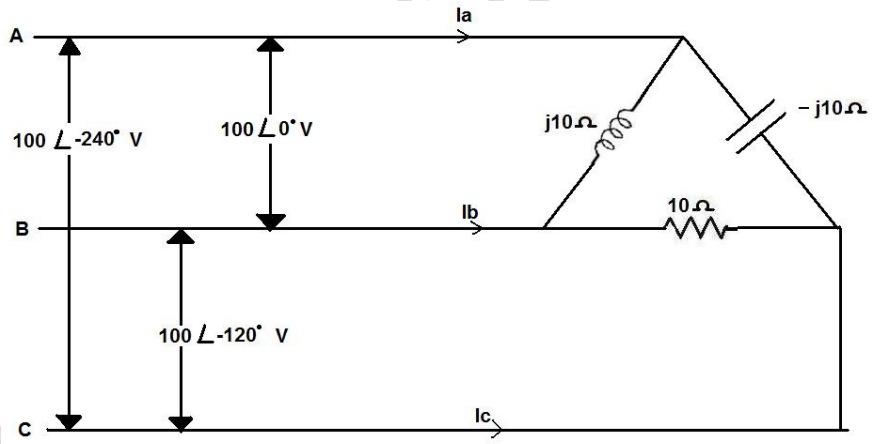
   (b) An alternating current is expressed as i=14.14 sin 314t. Determine rms current, frequency and instantaneous current when t =0.02ms. (8)

4. (a) 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)

   (b) 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. (a) 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)

   (b) A delta connected load as shown in figure is connected across 3 phase 100 volt supply. Determine all line currents. (8)



6. Three load impedances are connected in star to a three-phase supply with a line voltage of 208V. The phase sequence is ABC. Given $Z_A = 10\angle 0° \Omega$, $Z_B = 15\angle 0° \Omega$ and $Z_C = 10\angle -30° \Omega$. Calculate the three line currents I_A, I_B and I_C and the voltage across the load impedances. (16)

7. Three identical coils each having a resistance of 20 Ω and a reactance of 20 Ω are connected in i) Star ii) Delta across 440 V, 3 phase supply. Calculate for each case, line current and reading in each of the wattmeters connected to measure power. (16)

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