EC 3251 – CIRCUIT ANALYSIS

UNIT 1

Part - A

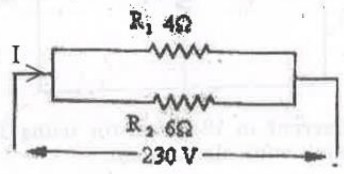
- **State Kirchoff's current law**
- State current division rule and voltage division rule
- Distinguish between mesh and loop of a circuit
- Define charge and electric current
- What are the limitations of Ohms law
- State kirchoff's Laws

PART A - PROBLEMS

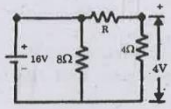
- Estimate the resultant resistance produced by the parallel connection of two resistors of 10 ohm and 30 ohm.
- Estimate the equivalent resistance of circuit with three resistors connected in series having a resistance value of 3 ohms.
- Calculate the average power absorbed by impedance Z=(30-j70)ohm, when voltage of 100 Vs = 100 Angle 0°
- The resistance of two wires is 25 ohm when connected in series and 6 ohm when connected in parallel. Calculate the resistance of each wire
- A stove element draws 15A when connected to a 120V line. How long does it take to consume 30KJ.
- The equivalent resistance of four resistors joined in parallel is 30 ohms. The current flowing through them are 0.5A,0.4A,0.6A and 0.1A. Find the value of each resistor.

State Kirchoff's current law.

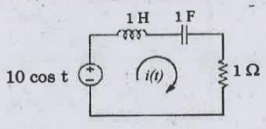
Find the current flowing through the circuit shown below.



1. Find 'R' in the circuit shown below.



2. Determine the current i(t) for the given circuit



PART-B & C

1. Find 'R' in the circuit shown in Figure. 1

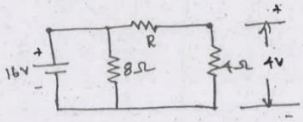


Figure. 1

(ii) Find the equivalent capacitance C between terminals A and B of fig. 11(b) (ii). (4)

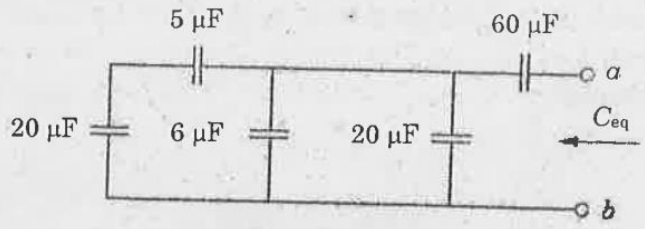


Fig. 11 (b) (ii)

11. (a) (i) Calculate the node voltages of given circuit in fig. 11(a) (i). (8)

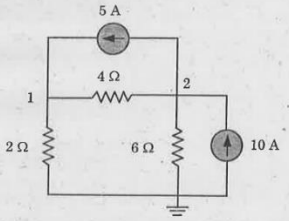


Fig. 11 (a) (i)

(ii) Determine current I_0 for the given circuit in Fig. 11(a) (ii) when $v_s = 12$ V. (8)

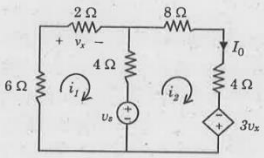


Fig. 11 (a) (ii)

Or

(b) (i) Using mesh analysis for the given fig. 11(b) (i), find the current I_2 and drop across 1Ω resistor. (12)

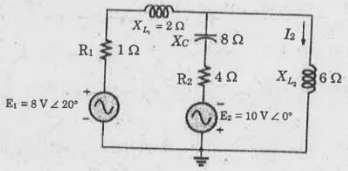
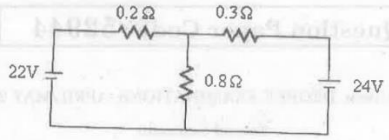
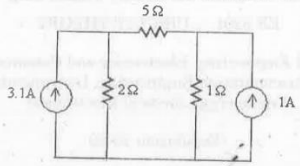


Fig. 11 (b) (i)

11. (a) (i) Calculate the branch currents and also calculate voltage across 0.8Ω. Use Kirchofis law. (8)

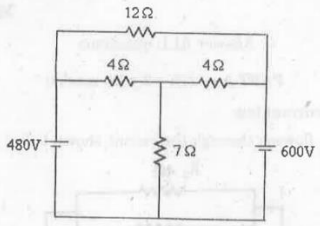


(ii) Determine the node voltage for the given circuit. (8)



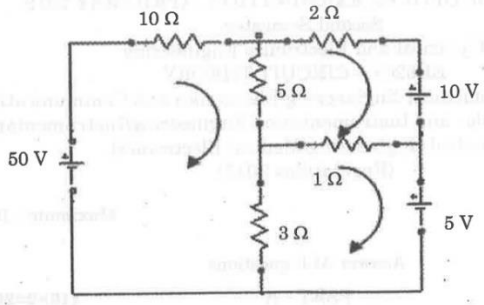
Or

(b) Write the mesh equations for the circuit shown in figure and solve for the current in 12Ω resistor. (16)



PART – B (5×13=65 Marks)

11. a) Using mesh analysis, determine the current through 1 Ohm resistor for the given circuit. (13)



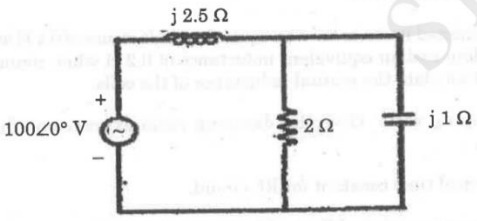
(OR)

b) For the circuit shown below :

a) Determine the currents in all the branches.

b) Calculate the power and power factor of the source.

c) Show the power delivered by the source is equal to the power consumed by the 2Ω resistor. (13)



(b) (i) Determine v_x and i_x in the given fig 1.1 (b) (i). (10)

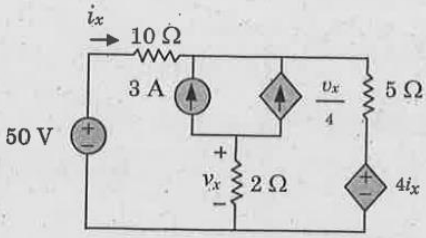
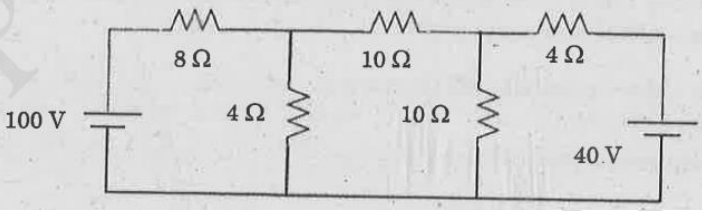


Fig 11 (b) (i).

(ii) Write the mesh equation and nodal equation for the network in fig. 11(b) (ii) by inspection method. (6)



11. (a) (i) Determine the potential difference between points A and B given in fig. 11 (a) (i) (8)

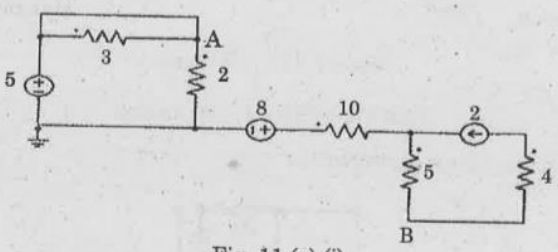


Fig. 11 (a) (i)

(ii) Using Mesh analysis, find the current I_o n the circuit shown fig. 11 (a) (ii). (8)

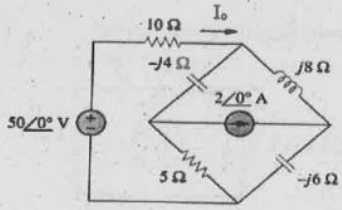


Fig. 11 (a) (ii)

11. (a) (i) Determine the current I_L in the circuit shown in Fig. 11 (a) (i). **(8)**

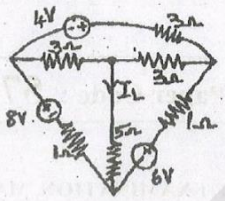


Fig. 11 (a) (i)

(ii) Calculate the voltage across A and B in the circuit shown in Fig. 11 (a) (ii). **(8)**

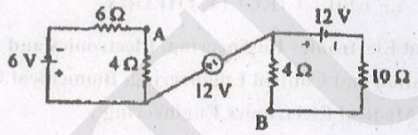


Fig. 11 (a) (ii)

OR

(b) (i) Three loads A, B, C are connected in parallel to a 240 V source. Load A takes 9.6 kW, load B takes 60 A, and load C has a resistance of 4.8 Ω. Calculate R_A and R_B, the total current, total power and equivalent resistance. **(8)**

(ii) For the circuit shown in Fig. 11 (b) (ii), determine the total current and power factor. **(8)**

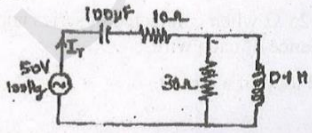


Fig. 11 (b) (ii)

b) i) Determine the current in the 10Ω resistor in the circuit shown in Fig. 11 (b) (i) and find the voltage across terminal AB. **(7)**

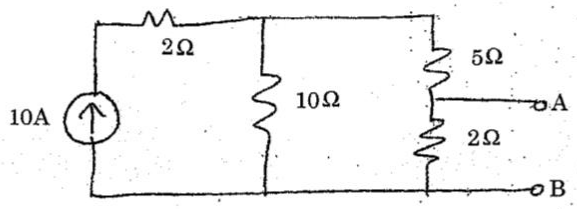


Fig. 11 (b) (i)

ii) Find the voltage between A and B of the circuit shown below in Fig. 11 (b) (ii) by mesh analysis. **(6)**

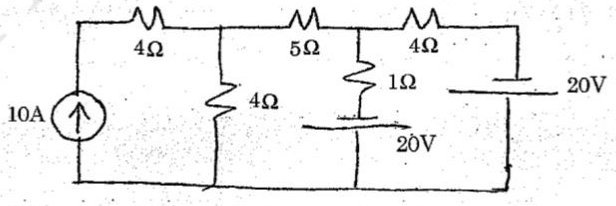


Fig. 11 (b) (ii)

11. (a) (i) Calculate the node voltages of given circuit in fig. 11(a) (i). (8)

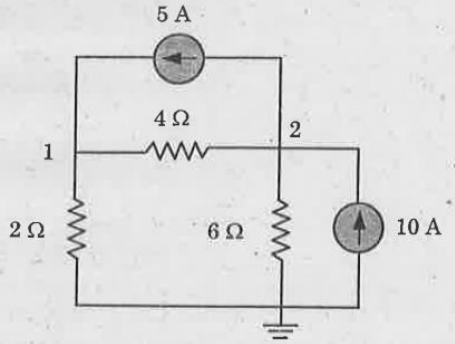


Fig. 11 (a) (i)

(ii) Determine current I_0 for the given circuit in Fig. 11(a) (ii) when $v_s = 12$ V. (8)

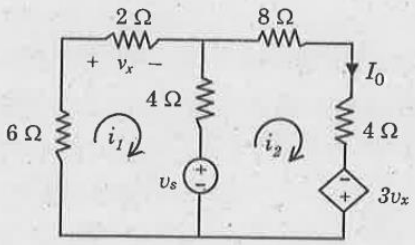


Fig. 11 (a) (ii)

Or

(b) (i) Using mesh analysis for the given fig. 11(b) (i), find the current I_2 and drop across 1Ω resistor. (12)

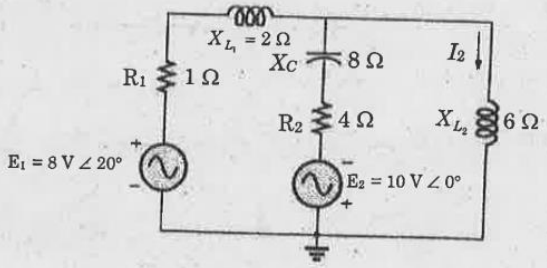


Fig. 11 (b) (i)

11. (a) Use resistance and source combinations to determine the current i in the Fig 1. And the power delivered by the 80-V source.

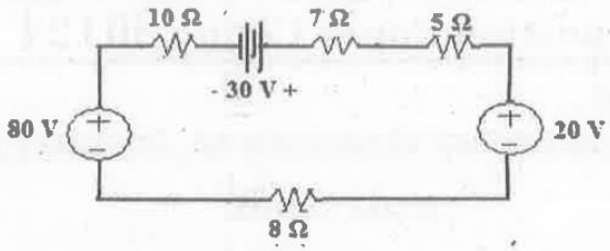


Fig. 1

Or

(b) (i) Find the magnitude of total current (I_T) and also find out current and voltage drop across the resistors as shown in the Fig. 2. Assume $R_1 = 100\,\Omega$, $R_2 = 20\ \Omega$ and $V = 50V$.

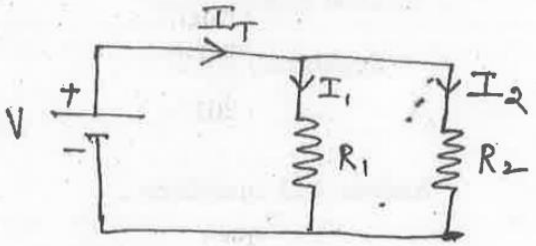


Fig. 2

(ii) Find the voltage across the three resistances shown in the Fig. 3.

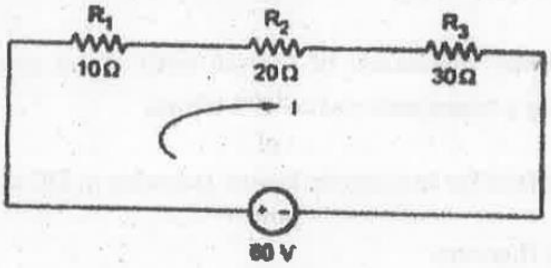


Fig. 3

11. a) Apply mesh analysis to the circuit shown in Fig. Q. 11. a) and find voltage across the dependent source.

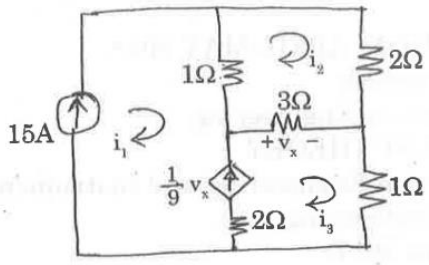


Fig. Q. 11. a)

(OR)

b) Apply nodal analysis to the circuit shown in Fig. Q. 11. b) i) and find :

i) The voltage at each node of the circuit. **(8)**

ii) State and explain Kirchoff's laws. **(8)**

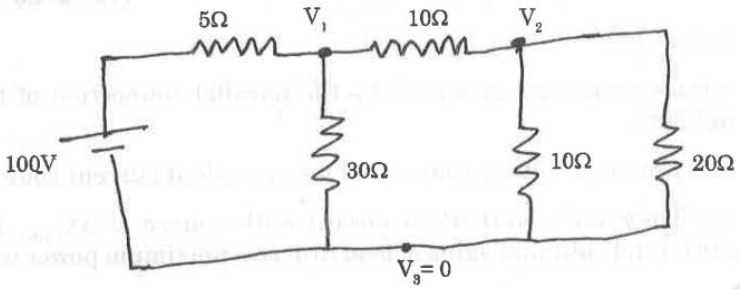


Fig. Q. 11. b) i)

Bullet Institute

UNIT 2

Part - A

- Draw the circuit of a practical voltage source and its equivalent current source.
- **What is the condition for maximum power transfer in DC Circuits**
- State Thevenin's Theoram
- Define Millman Theoram
- **What is the purpose of reciprocity theorem**
- What is meant by mesh and super mesh
- Write the condition to transfer maximum power from source to load in any AC Circuit.
- State superposition theorem

PART A – PROBLEMS

- Let the network has thevenis's equivalent circuit with source of $5V_{rms}$ and impedance of 50-j30 ohm. Find optimum value of load to derive the maximum power from the network.
- A star connected load of 5 ohm each is to be converted in to an equivalent delta connected load. Find the resistance be used.
- **A load is connected to a network of the terminals to which load is connected, R_{th}=10 ohms and V_{th} =40V. Calculate the maximum power supplied to the load.**
- The 2 resistance of 4 ohm and 6 ohm are connected in parallel. If the total current is 2A.Find the current through each resistor.

3. Determine the value of current I_0 of the given figure. 3

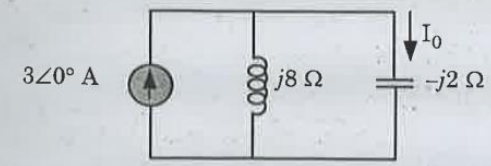


Fig. 3

PART-B & C

12. a) State superposition theorem and apply to the circuit shown in Fig. 12. a) to find the voltage across –j20Ω capacitor.

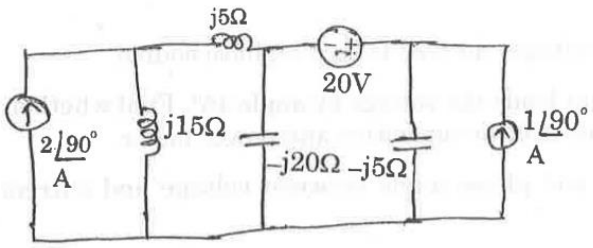


Fig. 12. a)

b) Determine Thevenin's and Norton's equivalent circuit of the network shown in Fig. Q. 12. b).

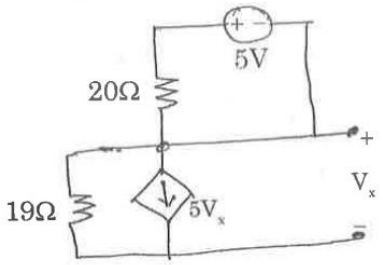


Fig. Q. 12. b).

Fig. 3

12. (a) (i) Specify the procedure to solve any given circuit using thevenin theorem.

(ii) Find the Thevenin's Equivalent circuit for the network faced by the 1 KΩ resistor in Fig 4.

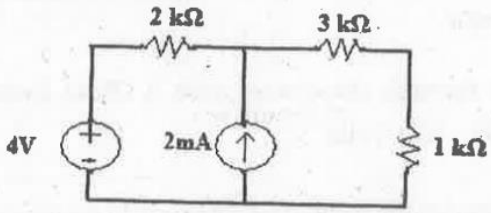


Fig. 4

Or

(b) (i) Specify the procedure to solve any given circuit using Norton theorem.

(ii) Find the Norton Equivalent circuit for the network faced by the 1 KΩ resistor in Fig 5.

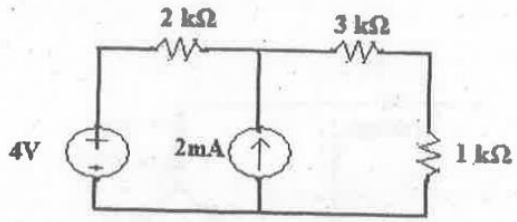


Fig. 5

12. a) Determine the Thevenin equivalent circuit across terminal AB shown in Fig. 12 (a) **(13)**

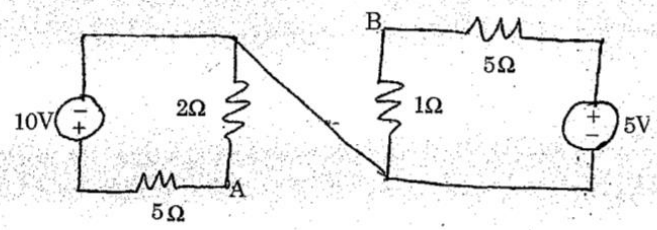


Fig. 12 (a)

b) Determine the Norton equivalent circuit across terminals A and B as shown in Fig. 12 (b). **(13)**

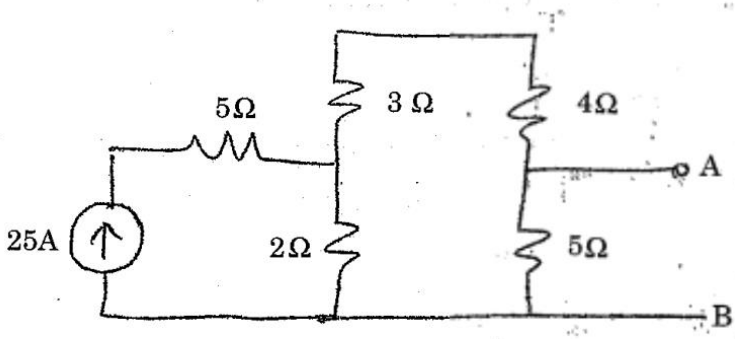


Fig. 12 (b)

(a) Find the voltage across 5 Ω resistor for the circuit shown in Fig. 12 (a) using source transformation technique and verify the results using mesh analysis. **(16)**

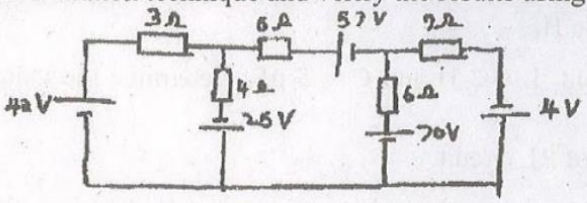


Fig. 12 (a)

OR

(b) Obtain the Norton's model and find the maximum power that can be transferred to the 100 Ω load resistance, in the circuit shown in Fig. 12 (b) . **(16)**

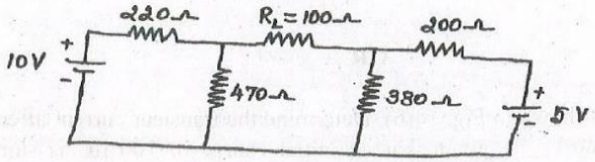


Fig. 12 (b)

12. (a) (i) Apply source transformation technique to determine current i_o in Fig. 12 (a) (i). (8)

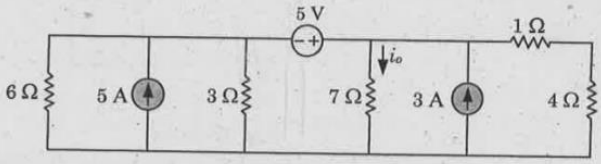


Fig. 12 (a) (i)

(ii) Find the power delivered by the 20V source using superposition theorem. (8)

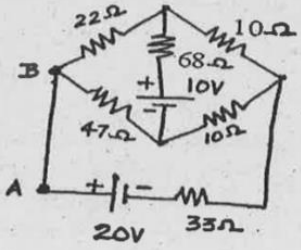


Fig. 12 (a) (ii)

Or

(b) Apply Norton theorem to determine current I_o for the given circuit in Fig. 12 (b). (16)

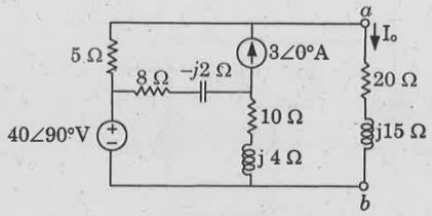


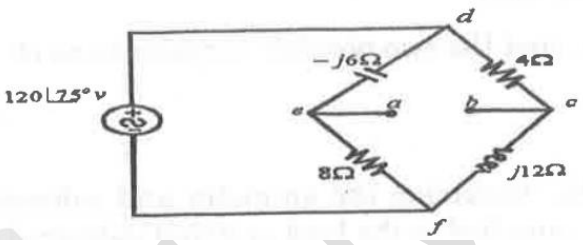
Fig. 12 (b)

12 / 25

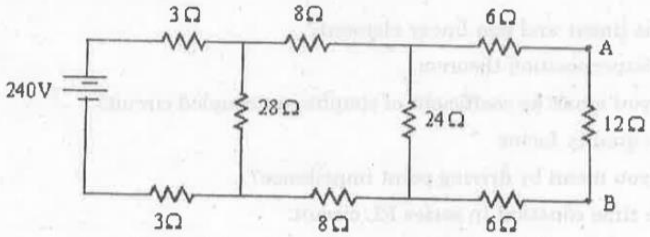
12. a) Derive the expressions to transfer resistance in star connected netw Delta connected network.

(OR)

b) Obtain the Thevenin's equivalent circuit at terminals a-b for the figur below :



12. (a) Determine the current in 12Ω resistor using Thevenin's theorem. Also draw the Thevenin's equivalent circuit. (16)



(b) For the circuit, find the value R_L for maximum power delivered to it. Calculate also the maximum load power. (16)

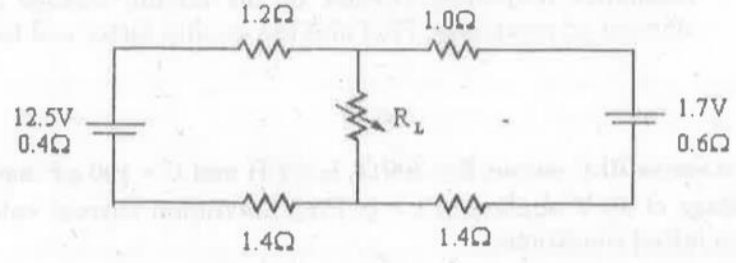


Fig. 11 (b) (ii)

12. (a) (i) Obtain the equivalent resistance R_{ab} of the circuit given in Fig. 12 (a) (i) and calculate the total current i. (8)

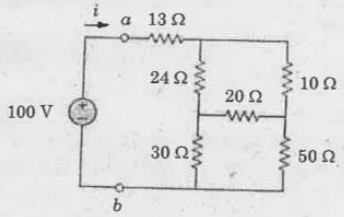


Figure 12 (a) (i)

(ii) Find the value of R_L in fig. 12 (a) (ii) for maximum power to R_L and calculate the maximum power. (8)

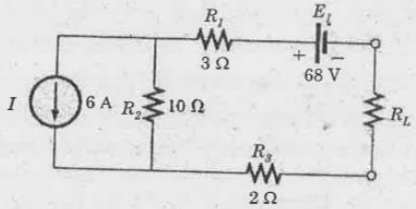


Figure 12 (a) (ii)

Or

(b) Apply superposition theorem to determine current i through 3Ω resistor for the given circuit in fig. 12(b). (16)

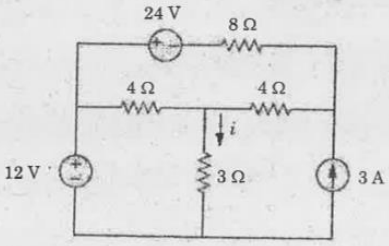


Figure 12 (b)

Figure 11 (b)

12. (a) (i) Apply source transformation technique to determine current i_0 in Figure 12.(a) (i). (9)

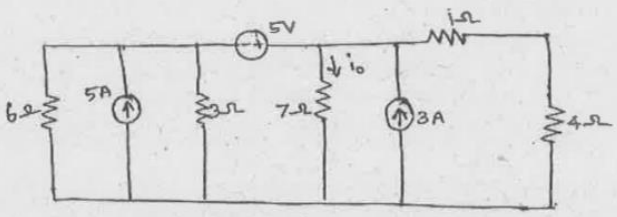


Figure. 12 (a) (i)

(ii) In the circuit of Figure 12. (a) (ii), six resistors are connected to form delta and a star. Find the effective resistance between A and B. (7)

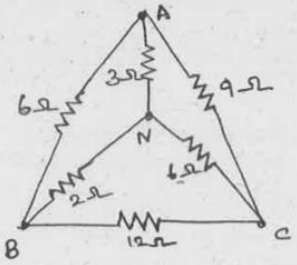


Figure 12 (a) (ii)

UNIT 3

Part - A

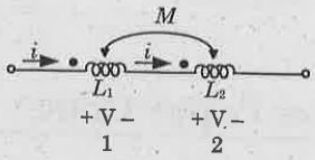
- Define time constant and write the time constant of a series of RC circuit
- Write down the time constant of R-L and R-C circuit.
- How does an inductor act at t=0 and t=∞
- **Define co-efficient of coupling**
- Write Dot convention rule
- Draw the frequency response characteristic of a parallel resonant circuit
- Determine the equivalent inductance of the circuit comprising two inductors in series opposing mode
- Define self inductance and mutual inductance of a coil

Part – A Problem

- Let a RL circuit has 50 ohm and 1mH elements and free of source but the inductor has initial current of 1mA at time t=0s. Find the voltage across the resistor at time t=∞
- A DC voltage is applied to a series of RL circuit by closing a switch. The voltage across L is 100 volts at t=0 and drops to 13.5 volts at t=0.02sec. If L=0.1H, find the R
- Two Coils are connected in series have an equivalent inductance of 0.4H. when connected in service aiding and an equivalent inductance of 0.2H. when connected in series opposition. Calculate the mutual inductance of the coils.

Define self inductance and mutual inductance of a coil.

6. Given the circuit, what is the equivalent inductance of the system shown below.



7. Define time constant for RL circuit. Draw the transient current characteristics

5. **The RC series circuit shown in Figure 5 below has an initial charge $Q_0 = 2 \times 10^{-3}$ coloumb. Find the transient current if the switch is closed at t = 0.**

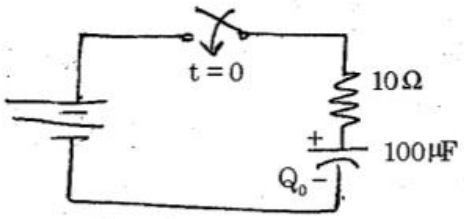


Figure 5

PART-B & C

Fig. Q. 12. b).

13. a) Consider a source free parallel RLC circuit and evaluate the voltage response of the circuit on different damping conditions.

(OR)

b) Consider a series RC circuit has been energized by a DC source of V_0 Volts over infinite duration. Suddenly at time t=0s, the DC source potential increased to V_1 Volts. If so, find the voltage across the capacitor for all values of time 't'.

Fig. Q. 12. b).

13. a) Consider a source free parallel RLC circuit and evaluate the voltage response of the circuit on different damping conditions.

(OR)

b) Consider a series RC circuit has been energized by a DC source of V_0 Volts over infinite duration. Suddenly at time t=0s, the DC source potential increased to V_1 Volts. If so, find the voltage across the capacitor for all values of time 't'.

13. (a) For the series resonant circuit of Fig. 13 (a), find I, V_R, V_L, and V_C at resonance. Also, if resonant frequency is 5000Hz, determine bandwidth, Q factor, half power frequencies, and power dissipated in the circuit at resonance and at the half power frequencies. Derive the expression for resonant frequency. (16)

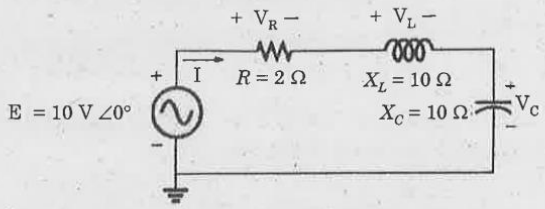


Fig. 13 (a)

Or

(b) (i) Obtain the conductively coupled equivalent circuit for the given circuit in Fig. 13 (b) (i) and Find the voltage drop across 12 Ω resistor. (8)

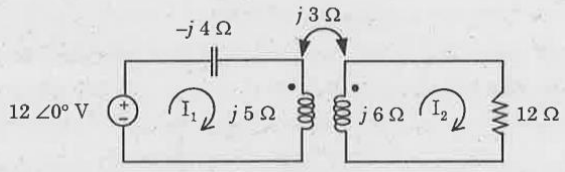


Fig. 13 (b) (i)

(ii) The number of turns in two coupled coils are 500 turns and 1500 turns respectively. When 5 A current flows in coil 1, the total flux in this coil is 0.6×10^{-3} wb and the flux linking in second coil is 0.3×10^{-3} wb. Determine L_1, L_2, M and K. (8)

13. a) Derive the relation between coefficient of coupling, the self inductance and mutual inductance. **(13)**

(OR)

b) A series RLC circuits consist of R = 1000 Ohm, L = 100 mH & C = 10×10^{-12}F, the applied voltage is 100 V. Calculate :

i) the resonant frequency of the circuit.

ii) the Q-factor of the circuit at resonant frequency.

iii) at what angular velocities do the half power points occur ?

iv) compute the band width of the circuit.

v) the value of frequency at which maximum voltage occurs across inductor

vi) the value of frequency at which maximum voltage occurs across capacitor. **(13**

13. (a) (i) Derive the expression for resonant frequency and bandwidth for a series RLC resonant circuit. (8)

(ii) In the parallel *RLC* circuit of Fig. 13 (a) (ii), let $R = 8k\Omega$, $L = 0.2, mH$ and $C = 8\,\mu F$.. Calculate ω_0, Q, half power frequencies and *BW*. (8)

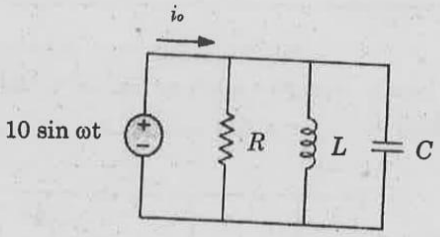


Fig. 13 (a) (ii)

Or

(b) (i) Find the voltage drop across 12Ω resistor for the given circuit in Fig. 13 (b) (i). Also, draw the conductively coupled equivalent circuit. (8)

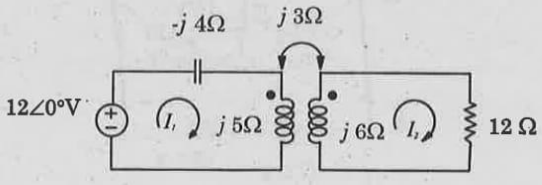


Fig. 13 (b) (i)

13. (a) Determine the resonant frequency, bandwidth and quality factor of the coil for the series resonant circuit considering R = 10 Ω, L = 0.1H and C = 10 μF. Derive the formula used for bandwidth. **(16)**

OR

(b) (i) Derive the expression for equivalent inductance of the parallel resonant circuit as shown in Fig. 13 (b) (i). **(8)**

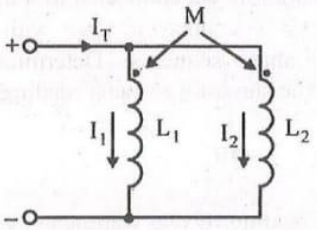


Fig. 13 (b) (i)

(ii) Write the mesh equations and obtain the conductively coupled equivalent circuit for the magnetically coupled circuit shown in Fig. 13 (b) (ii). **(8)**

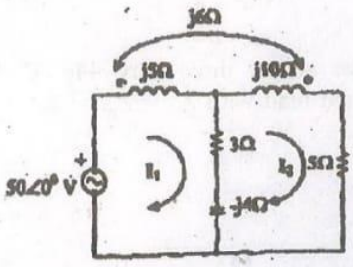


Fig. 13 (b) (ii)

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(ii) The number of turns in two Coupled coils are 500 turns and 1500 turns respectively When 5 A current flows in coil, the total flux in this coil is 0.6×10^{-3} wb and the flux linking in second coil is 0.3×10^{-3} wb. Determine L_1, L_2 M and K. **(8)**

13. a) In a circuit shown in figure 13 (a), the switch is closed on position 1 at t = 0 and after 1 time constant is moved to position 2. Find the currents before and after moving to position 2. Assume no initial charge across the capacitor. **(13)**

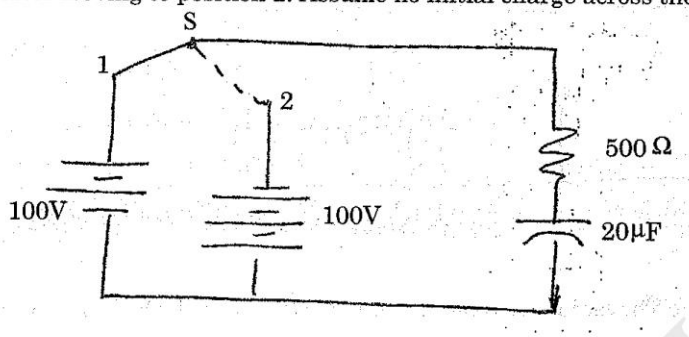

Fig. 13 (a)

(OR)

b) A series RLC circuit with R = 1000 ohms, L = 0.1 H and C= 100 μF has a DC voltage of 200 V applied to it at t = 0 through a switch. Assume initially relaxed circuit conditions

i) Find the expression for the transient current. **(7)**

ii) For what value of capacitance the circuit will be critically damped. **(6)**

Fig. 5

13. (a) Derive the expressions for a current in a source free RC circuit.

Or

(b) Derive the expressions for a current in a source free RL circuit.

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(b) (i) Find the power delivered by the 20 V source using superposition theorem for the given circuit in Figure 12 (b) (i). (9)

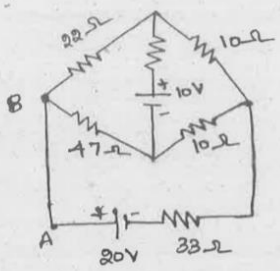

Figure 12 (b) (i)

(ii) Determine the thevenin's equivalent across AB for the given circuit in Figure 12 (b) (ii). (7)

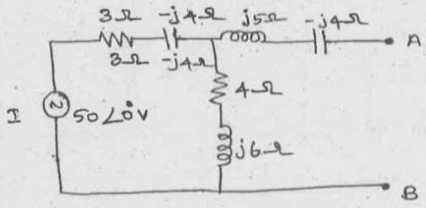

Figure 12 (b) (ii)

Bullet Nature

UNIT 4

Part - A

- Draw the phasor diagram of voltages derived from a 3 phase source
- Define quality factor
- Define co-efficient mutual coupling
- Compare series resonance and parallel resonance
- **Define time constant of RL circuit and draw the transient current characteristics**
- when a two port network is said to be reciprocal
- Define damping ratio. Give the damping ratio expressions for RLC series circuit
- What is meant by driving point impedence
- What are the parameters commonly used in the analysis of two port network
- Determine the laplace transform of unit step function u(t) and sinusoidal function sin(ωt)

Part – A Problem

- In a series RLC Circuit, L=2H and C=5μF. Determine the value of R to give critical damping
- In a reactive circuit, the current leads the voltage by angle of 45°. Find whether the resultant reactive is either inductive or capacitive and power factor
- Find the current through the circuit with 5 ohms resistor across a voltage source of 10 cos(50t-50°)Volts.
- A RLC circuit R=10 ohms and L=2H. What value of capacitance will make the circuit critically damped

PART-B & C

14. a) Discuss the method of measuring power in a three-phase system with balanced and unbalanced load conditions.

(OR)

b) Consider a series RLC circuit is energized by a sinusoidal signal source (assume amplitude of A_m and frequency of ω).

i) What would be the instantaneous and average power delivered by source. **(7)**

ii) What would be the instantaneous and average power dissipated by elements R, L and C. **(6)**

14. (a) (i) Derive the expressions of the phasor relationship for Inductor.

(ii) Find the current flowing through a circuit with a voltage of $8\cos(100t - 50°)$ at a frequency $\omega = 100$ rad/s across a 4 H inductor.

Or

(b) Explicate in detail about the three phase balanced circuits.

---

14. a) i) A symmetrical 3 phase 440 V system supplies balanced delta connected load. The branch current is $10\angle 30°$ lagging. Find

1) Line current
2) Total active power
3) Total reactive power and draw phasor diagram. **(7)**

ii) Calculate the total power input and readings of two wattmeters connected to measure power in three phase balanced load. Reactive power input is 15 kVAR and load power factor is 0.8. **(6)**

(OR)

b) A three phase delta connected load has $Z_{ab} = 100 + j0, Z_{ab} = -j100,$ $Z_{ab} = 70.7 + j70.7$. Compute the line and phase currents if it is connected in

i) abc sequence **(7)**

ii) acb sequence. **(6)**

---

14. (a) A sinusoidal voltage of 10 sin 100 is connected in series with a switch and R = 10 Ω & L = 0.1H. If the switch is closed at t=0, determine the transient current i(t). **(16)**

OR

(b) In the circuit shown in Fig. 14(b). Determine the transient current after switch is closed at time t = 0, given that an initial charge of 100 μC is stored in the capacitor. Derive the necessary equations. **(16)**

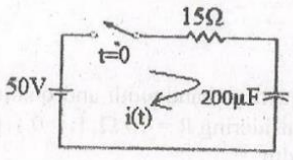

Fig. 14(b)

14. (a) A series RL circuit with $R = 10\,\Omega$ and L = 0.1 H is supplied by an input Voltage v(t) 10 sin 100t Volts applied at t = 0 as shown in fig. 14 (a). Determine the current i, voltage across inductor. Derive the necessary expression and plot the respective curves. (16)

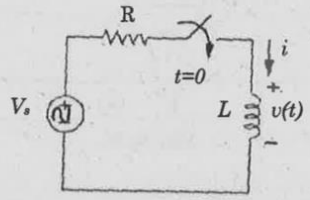

Fig. 14 (a)

Or

(b) Determine the impedance (Z) parameter and draw the T- equivalent circuit for the given two port network in Fig. 14 (b). Also, derive the transmission line (ABCD) parameters from Z parameter. (16)

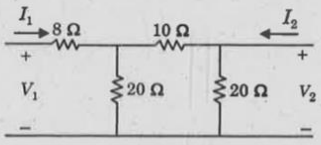

Fig. 14 (b)

vi) the value of frequency at which maximum voltage occurs across capacitor. **(13)**

14. a) Step by step, derive the transient current for series RLC circuit with step input. **(13)**

(OR)

b) Develop an expression for transient current, voltages and the energy stored in capacitor of a RC transient circuit excited by a DC source. **(13)**

15. a) Show that three phase power can be measured by using two wattmeters. With

---

14. (a) (i) A series RL circuit with R = 100 Ω and L = 20 H has a DC voltage of 200 volts applied through a switch at t = 0. Find

(1) The equation for the current and voltage across different elements.

(2) The current at t = 0.5 Sec.

(3) The current at 1 sec.

(4) The time at which voltage across resistor and inductor is equal. (8)

(ii) In a series RLC circuit R = 10Ω. L = 10 mH, C = 1 μF has an applied voltage of 200 V at resonance frequency. Calculate the resonance frequency. current in the circuit, voltage across each element at resonance. Find also the quality factor and band width. (8)

Or

(b) In a series RLC circuit R = 300Ω, L = 1 H and C = 100 μF has a constant voltage of 50 V applied at t = 0. Find maximum current value. Assume

14. (a) A series R_L circuit with R = 50 Ω and L = 30 H has a constant voltage V = 50 volts applied at t = 0 as shown in fig. 14 (a). Determine the current i, voltage across inductor. Derive the necessary expression and plot the respective curves. (16)

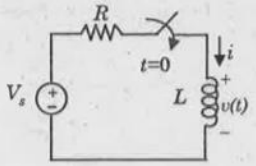

Fig. 14 (a)

(b) (i) Determine the impedance (Z) parameter of the given two port network in Fig. 14(b) (i). (8)

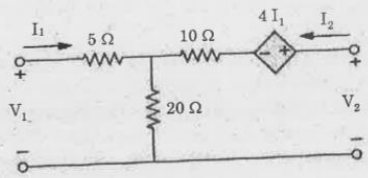

Fig. 14 (b) (i)

(ii) Find the hybrid (h) parameter of the two port network in Fig. 14 (b)(ii). (8)

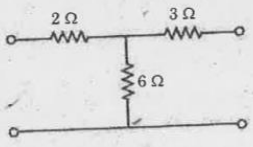

Fig. 14 (b) (ii)

14. (a) A series RL circuit with R = 10 Ω and L = 0.1 H is supplied by an input voltage V(t) = 10 sin 100t volts applied at t = 0 as shown in Figure.14 (a). Determine the current I, Voltage across inductor. Derive the necessary expression and plot the respective curves. (16)

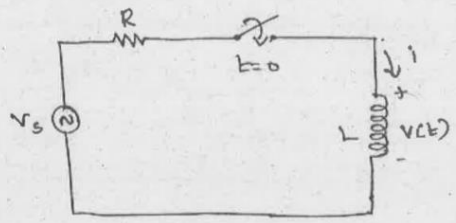

Figure 14 (a)

Or

(b) Find the h-Parameters for the network shown in Figure. 14. (b) (16)

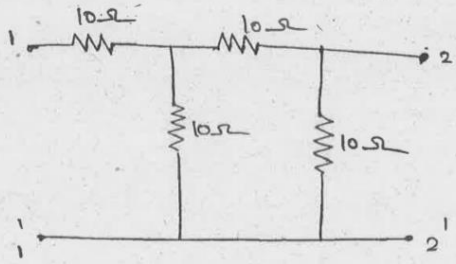

Figure. 14. (b)

UNIT 5

Part – A

- Comment on the impedence and phase angle between voltage and current at resonance
- Mention the expression for resonant frequency in series resonance
- Define co-efficient of coupling
- **What is the relationship between line current and line voltage in a star and delta connected circuit**
- List out the advantages of three phase system over single phase system
- Draw the phasor diagram of line currents and line voltage of a balanced delta connected load
- Distinguish between unbalanced supply and unbalanced load
- Define apparent power and power factor
- Compare balanced system with un balanced system
- Phase sequence of 3 phase system
- Write the distortion power factor equation of the three phase circuits

Part – A PROBLEM

- If circuit resonates at 1MHz and produces -3dB bandwidth of 100kHz then, find the quality factor of the circuit
- A line to line voltage applied to star connected primary of a transformer is 220V(balanced). If the line current drawn from the primary side is 20A, find the phase voltage and phase current
- A three phase 400V is given to balanced star connected load of impedence 8+6j ohm. Calculate the line current
- A star connected load has 6+8j ohm impedance per phase. Determine the line current if it is connected to 400V, three phase and 50Hz supply
- The power input to a 2000V, 50Hz, 3 Phase motar is measured by two watt meters which indicate 300KW and 100KW respectively. Calculate power factor.

PART-B & C

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15. a) Consider the circuit shown in Fig. 15. a). Find the voltage across 1Ω resistor at resonance.

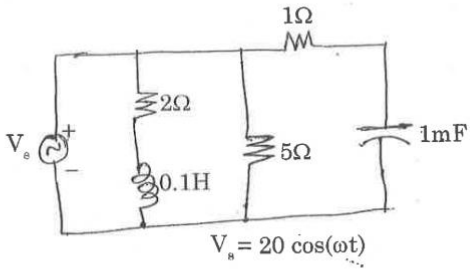

Fig. 15. a)

(OR)

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b) Consider the circuit shown in Fig. 15. b). Find the voltage across 3Ω resistor.

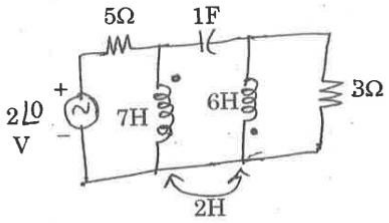


Fig. 15. b)

15. (a) Derive the expression to obtain the frequency of parallel resonance.

Or

(b) Elucidate the dot convention procedure to obtain the mutual inductance with relevant circuit diagrams.

15. a) i) A coil having an inductance of 100 mH is magnetically coupled to another coil having an inductance of 900 mH. The coefficient of coupling between the coils is 0.45. Calculate the equivalent inductance of the two coils connected by

- Series aiding,
- Parallel aiding,
- Series opposing, and
- Parallel opposing **(7)**

ii) A series circuit consisting of an 12Ω resistor 84.4 μF capacitor and a variable inductor connected to a 100 V 50 Hz supply. For the resonance condition determine the current through the inductor and voltage drop across it. Find Q and Bandwidth. **(6)**

b) Calculate the currents I_1 and I_2 in the circuit shown in Fig. 15 (b). (13)

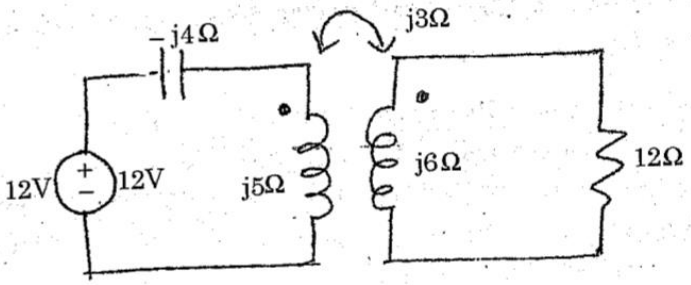


Fig. 15 (b)

15. (a) Obtain the readings of two wattmeters connected to a three phase, 3 wire, 120V system feeding a balanced Δ connected load with a load impedance of $12\angle 30°\ \Omega$. Assume RYB phase sequence. Determine the phase power and compare the total power to the sum of wattmeter readings. (16)

OR

(b) (i) If W_1 & W_2 are the reading of two wattmeters which measures power in the three phase balanced system and if $W_1 / W_2 = a$, show that the power factor of the circuit is given by (8)

$$\cos\phi = \frac{a+1}{\sqrt[2]{a^2 - a + 1}}$$

(ii) A symmetrical,three phase, three wire 440 V ABC system feeds a balanced Y-connected load with $Z_A = Z_B = Z_C = 10\angle 30°\ \Omega$ obtain the line currents. (8)

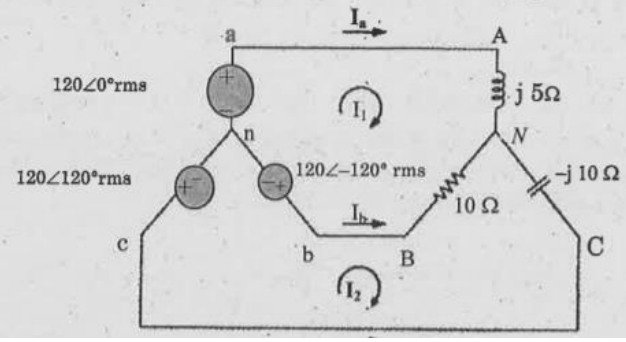
Fig. 14 (b)

15. (a) (i) A balanced Δ-connected load having an impedance $20 - j15\Omega$ is connected to a Δ-connected, positive sequence supply $V_{ab} = 330\angle 0° V$. Calculate the phase currents of the load and the line currents. (8)

(ii) The input power to a 3ϕ load is 10kw at 0.8 pf. Two wattmeters are connected to measure power, find the individual readings of the wattmeters. (8)

Or

(b) For the unbalanced circuit in Fig. 15 (b), determine the line currents and voltage across each load impedance Draw the phasor diagram. (16)



15. a) Show that three phase power can be measured by using two wattmeters. With necessary phasor diagrams, derive an expression for power factor. **(13)**

(OR)

b) An unbalanced four wire star connected load has a balanced supply voltage of 400 V. The load imp are $Z_R = (4 + j8)\ \Omega$, $Z_Y = (3 + j4)\ \Omega$ & $Z_B = (15 + j10)\Omega$. Calculate the line currents, neutral currents and total power ? And also draw the phasor diagram of the same. **(13)**

15. (a) (i) A symmetrical three phase, three wire 440 V supply is connected to a star connected load. The impedances in each branch are $Z_R = (2 + j3)\Omega, Z_Y = (1 - j2)\Omega$ and $Z_B = (2 + j4)\Omega$. Find its equivalent delta connected load. The phase sequence is RYB. (8)

(ii) A three phase balanced delta connected load of $(4 + j8)\ \Omega$ is connected across a 400 V, three phase balanced supply. Determine the phase currents and line currents. Assume the phase sequence to be RYB. Also calculate the power drawn by the load. (8)

Or

(b) Show that the total power in a three phase. three wire system using the two wattmeter method of measurement is given by the sum of the wattmeter readings. Draw a connection diagram and phasor diagram for the two-wattmeter method for a balanced load. Also derive the expression for the power factor of a three phase system using only the wattmeter readings. (16)

15. (a) (i) For the Δ-Δ system shown in fig. 15 (a) (i), find the phase angles θ_2 and θ_3 for the specified phase sequence. Also, find the phase current and line current in each phase of the load. (8)

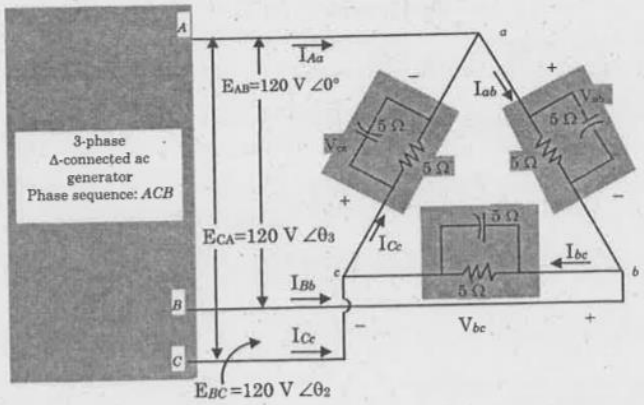


Fig. 15 (a) (i)

(ii) A 3 phase 400V supply is given to balanced star connected load of impedance (8 + 6j) ohms in each branch. Determine line current, power factor and total power. (8)

Or

(b) The two wattmeter produces wattmeter readings P_1 = 1560W and P_2 = 2100W when connected to a delta connected load. If the line voltage is 220V, calculate (i) the per phase average power (ii) total reactive power, (iii) power factor and (iv) the phase impedance. Is the impedance inductive or Capacitive? Justify. (16)

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15. (a) Discuss in detail the three phase 3-wire circuits with star connected balanced loads. (16)

Or

(b) For the balanced circuit in Figure 15 (b), determine the line currents and voltage across each load impedance. Draw the phasor diagram. (16)

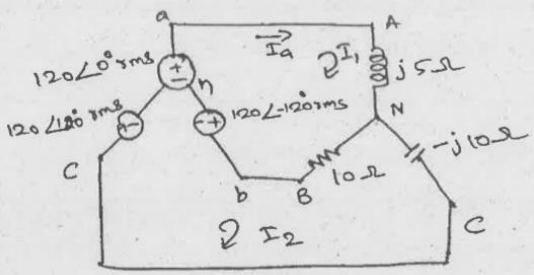

Figure 15 (b)