EE 2151 CIRCUIT THEORY

TWO MARK QUESTION AND ANSWERS

UNIT: 1 BASICS OF CIRCUIT ANALYSIS

1. What are the classification of circuit elements?

The classification of circuit elements are

i) Active elements
ii) Passive elements.
iii) Lumped and distributed elements
iv) Bilateral and unilateral elements
v) Linear and non linear elements

2. What are active elements and passive elements?

The elements which can deliver energy are called **active elements**. These are voltage and current sources.

The elements which consume energy either by absorbing or storing are called **passive elements**. These are resistor, inductors and capacitors.

3. What are lumped and distributed elements?

Physically separate elements such as resistors, capacitors and inductors are called **lumped elements**.

A **distributed element** is one which is not separable for electrical purposes.

A transmission line has distributed resistance, capacitance and inductance along its length.

4. What are bilateral and unilateral elements?

In bilateral element, the voltage-current relation is the same for current flowing in either direction.

E.g: resistor, inductor and capacitor.

In a unilateral element, it has different relations between voltage and current for two possible directions of currents E.g: vacuum tube, silicon diode.

5. What are linear and non-linear elements?

An element is said to be linear, if it satisfies the linear current voltage relationship that is the relation between V and I is linear.

The elements which do not satisfy the Linear voltage-Current relationship is called as non-linear elements.

6. What are dependent and independent sources?

The electrical energy supplied by an dependent source depends on another source of electrical energy.

The electrical energy supplied by an independent source does not depend on another electrical source. They convert energy in some form to electrical energy.

7. State Kirchoff's current law?

Krichoff's current law states that "the algebraic sum of the currents meeting at a junction is equal to zero",

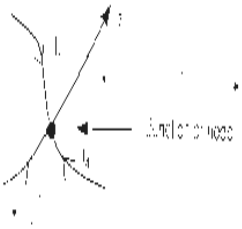


Fig. : $I_1 + I_2 - I_3 + I_4 = 0$.

8. State Kirchoff's voltage law?

Krichoff's voltage law states "The algebraic sum of electromotive forces plus the algebraic sum of voltages across the impedances, in any closed electrical circuit is equal to zero".

Σ emf + Σ IZ = 0.

9. State Ohm's law?

Ohm's law states the ratio between the potential difference across two terminals of a conductor and the current through it remains constant, when the physical conditions of the conductor remain unchanged.

V = IR.

10. Define series and parallel connection?

If the resistors are connected end to end, the combination is said to be series.

If one end of all the resistors is joined to a common point and the other ends are joined to another common point, the combination is said to be parallel combination between two common points.

11. What are the advantages of parallel circuits?

The advantages of parallel connections are

1) The electrical appliances of different power ratings may be rated for the same voltage.
2) In case a break (open) occurs in any of the branch circuit it will not affect the other branch circuits.

12. Define ideal voltage source?

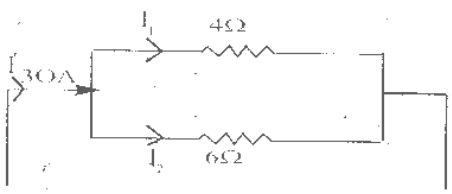
For ideal voltage source, source impedance is zero, such voltage source gives a constant voltage V irrespective of current drawn from it.

13. Define an ideal current source?

For an ideal current source, source impedance is infinite, such an ideal current source gives a constant current irrespective of voltage across it.

14.Two resistor of 4Q and 6Q are connected in parallel. If the total currerit is 30A. Find the current through each resistor.

Ans:



$$R_1 = 4\Omega, R_2 = 6\Omega, I = 30A$$

$$I_1 = \frac{IR_2}{R_1 + R_2}$$

$$I_1 = 30 \times \frac{6}{6+4} = 18A$$

W.K.T. $I = I_1 + I_2$

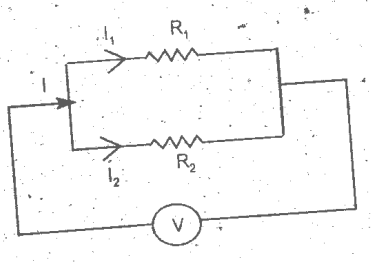
$30 = 18 + I_2$

$I_2 = 12A.$

,,,

15.Write the current division formula when only two resistance is connected in parallel?

Ans:



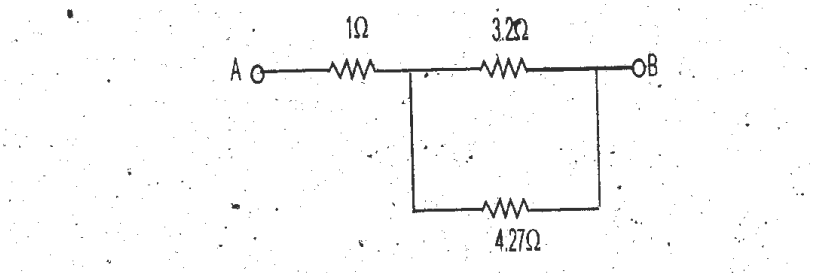
$$I_1 = \frac{IR_2}{R_1 + R_2}$$

$$I_2 = \frac{IR_1}{R_1 + R_2}$$

16. Comparison of series and parallel circuits.

Series Circuit	Parallel Circuit
1. The current is same through all the elements.	The current is divided, inversely proportional to resistance.
2. The voltage is distributed.	The voltage is same across each element.
3. There is only one path for flow of current.	There are more than one path for the flow of current.
4. The total resistance is greater than the greatest	Total resistance is lesser than the smallest of the

17.In the figure determine the equivalent resistance.

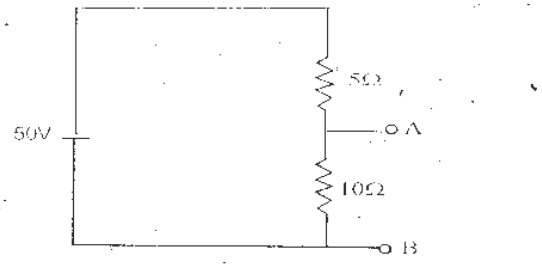


Ans: $\frac{3.2 \times 4.277}{3.2 + 4.277} = 1.83\Omega$

$R_{req} = 1 + 1.83$

$= 2.83\Omega.$

18. What is the voltage across the 10Ω resistor?



Ans: Voltage across 10Ω, $V_{10} = 50 \times \frac{10}{5+10} = \frac{500}{15} = 33.3V$

20.What is an independent voltage source?

An independent voltage source is an ideal source characterized by a terminal voltage which is completely independent of the current through it.

21.What is an independent current source?

An independent current source is an ideal source in which the current through the element is completely independent of the voltage across it.

22.What are called dependent sources?

The sources in which voltage or current is dependent of the voltage or current existing at some other location in the circuit are called dependent sources. They are also known as controlled sources.

23.What is a node?

A node is a point in a network in which two or more elements have a common

24. What is a super node?

The region surrounding a voltage source which connects the two nodes directly is called super node.

25. What is principle node?

The meeting point of three or more elements is called principle node.

26. What is a closed path?

A closed path is a path, which starts at a node and travels through some part of the circuit and arrives to the same node without crossing a node more than once.

27. What is a node, a junction and a branch?

A node of a network is an equipotential surface at which two or more circuit elements are joined.

A junction is that point in a network where three or more circuit elements are joined.

A branch is that part of a network which lies between two junction points.

28. What is the difference between a loop and a mesh?

A loop is any closed path of a network. A mesh is the most elementary form of a loop and can not be further divided into other loops.

29. State voltage division rule.

Voltage across a resistor in a series circuit is equal to the total voltage across the series elements multiplied by the value of that resistor divided by the total resistance of the series elements.

30. State current division rule.

The current in any branch is equal to the ratio of the opposite parallel branch resistance to the total resistance value, multiplied by the total current in the circuit.

31. Define mesh.

A mesh is defined as a loop which does not contain any other loops within it.

32. What is a planar circuit?

A circuit is said to be planar, if it can be drawn on a plane surface without crossovers.

33. What is a non-planar circuit?

A circuit is said to be non-planar, if it cannot be drawn on a plane surface without a crossovers.

34. Define super mesh.

The loop existing, around a current source which is common to the two loops is called super mesh.

35. What are the advantages of sinusoids?

The advantages of sinusoids are :

1. The machines and appliances working on sine wave voltage and currents have better performance characteristics than with other wave shapes.
2. The rate of change of a sinusoidal quantity is small and hence does not induce large harmful EMFs in the associated circuits.
3. The derivatives and integrals of a sinusoid are also sinusoids.
4. The addition and multiplication of two sinusoids result in a sinusoid.

36. Define average value.

The average value of an alternating quantity is defined as that value which is obtained by averaging all the instantaneous values over a period of half cycle.

37. Define instantaneous value.

The value of an alternating quantity at a particular instant is known as instantaneous value. For example e_1 and e_2 are the instantaneous value of an alternating emf at instants t_1 and t_2 respectively.

38. Define cycle of an alternating quantity.

Each repetition of a set of positive and negative instantaneous values of the alternating quantity is called a cycle.

39. Define time period of an alternating quantity.

The time taken by an alternating quantity to complete its one cycle is known as its time period denoted by T. after every T seconds, the cycle of an alternating quantity repeats.

40. Define frequency of an alternating quantity.

The number of cycles completed by an alternating quantity per second is known as its frequency. It is denoted by f and is measured in cycles/second which is known as Hertz, denoted as Hz.

$$f = 1/T \text{ Hz}$$

41. Define peak value of an alternating quantity.

The maximum value attained by an alternating quantity during positive or negative half cycle is called its peak value. It is denoted as E_m or I_m.

Thus E_m is called peak value of the voltage while I_m is called peak value of the current.

42. Define RMS value or effective value of an alternating quantity.

The Root Mean Square (RMS) value or effective value is defined as the steady current (D.C) which, when flowing through a given circuit for a given time, produces the same amount of heat as produced by the alternating current, which when flowing through the same circuit for the same time.

43. Define peak factor.

The peak factor of any waveform is defined as the ratio of the peak value of the wave to the rms value of the wave.

Peak factor = maximum value / rms value

Peak factor = V_m / V_{rms}

44. Define form factor.

Form factor is defined as the ratio of rms value to the average value of the wave.

Form factor = rms value / average value

For a sinusoidal wave, form factor =

= 1.11

45. Define impedance and admittance.

The ratio of phasor voltage V to phasor current I is called impedance, Z.

Impedance (Z) = V / I

The reciprocal of impedance is called admittance, Y.

Admittance (Y) = 1 / Z (s) where $s = 1\Omega^{-1}$ = 1 mho

46. **What are the different types of dependent or controlled sources?**

The different types of dependent or controlled sources are

(i) Voltage controlled voltage source (VCVS)

(ii)Current controlled voltage source (CCVS)

(iii) Voltage controlled current source (VCCS)

(iv) Current controlled current source(CCCS)

UNIT 2 : NETWORK REUDCTION AND NETWORK THEOREMS FOR DC AND AC CIRCUITS

1. **State Thevenin's theorem.**
   Thevenin's theorem states that any two terminal linear network having a number of voltage sources, current sources and resistances can be replaced by a simple equivalent circuit consisting of a single voltage source in series with a resistance.

2. **State Norton's theorem.**
   Norton's theorem states that any two terminal linear network with current sources, voltage sources and resistances can be replaced by an equivalent circuit consisting of a current source in parallel with a resistance.

3. **State superposition theorem.**
   Superposition theorem states that in any linear network containing two or more sources, the response in any element is equal to the algebraic sum of the responses caused by individual sources acting alone, while the other sources are non operative.

4. **State maximum power transfer theorem.**
   The maximum power transfer theorem states that maximum power is delivered from a source to a load when the load resistance is equal to the source resistance.
   $$R_S = R_L$$

5. **State compensation theorem.**
   The compensation theorem states that any element in the linear, bilateral network, may be replaced by a voltage source of magnitude equal to the current passing through the element multiplied by the value of the element, provided currents and voltages in other parts of the circuit remain unaltered.

6. **State Reciprocity theorem.**
   Reciprocity theorem states that if an input is applied to a circuit, the ratio of response (output) in any element to the input is constant, even when the position of input and output are interchanged.

7. **List the applications of Thevenin's theorem.**
   The applications of Thevenin's theorem are :
   1. It is applied to all linear circuits, including electronic circuits represented by the controlled sources.
   2. This theorem is useful when it is desired to know the effect of the response in network or varying part of the network.

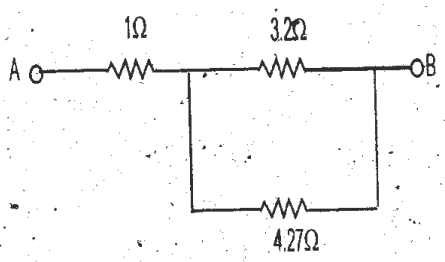
8. Where and why maximum power transfer theorem is applied?

Maximum power transfer theorem is used in systems where maximum power is transfer is needed. For example, in communication circuits power involved is sufficiently small. In some situations to match source impedance with load impedance.

9.Explain the purpose of Star-delta transformation?

The transformation of a given set of resistance in star to delta or vice versa proves extremely useful in. circuit analysis and the apparent complexity of a given circuit can sometime be very much reduced.

10.In the figure determine the equivalent resistance by using star delta transformation

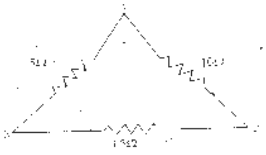


Ans: $\frac{3.2\times4.277}{3.2+4.277}=1.83\Omega$

$R_{req}=1+1.83$

$=2.83\Omega.$

11.Convert given delta into equivalent star.

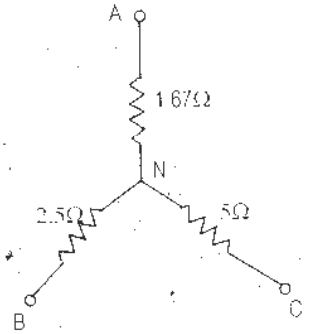


Ans: The equivalent star is given by

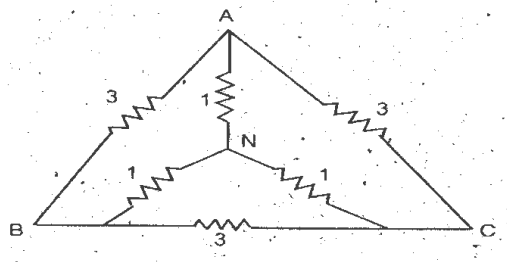
$R_1=\frac{10\times5}{5+10+15}=1.67\Omega$

$R_2=\frac{15\times10}{5+10+15}=5\Omega$

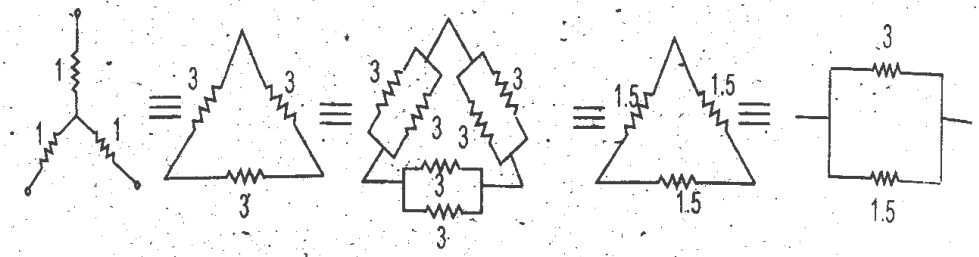
$R_3=\frac{5\times15}{5+10+15}=2.5\Omega$



11.For the network shown find the equivalent resistance between terminals B and C



Ans:



The resistance between B and C is

$$R_{BC} = \frac{3 \times 1.5}{3 + 1.5} = 1\Omega.$$

12. **What is Star and. Delta connection?**

One end of each resistance is connected at a point called star point and the other, three terminals are connected to A, B, C. This is called **star connection**.

When three resistances are connected end to end to form delta shape it is called **delta connection.**

13. What is the condition for maximum power transfer in DC and AC circuits?

Condition for maximum power transfer for DC circuit $P_{max} = V^2_{th} / 4 R_L$

Condition for maximum power transfer for AC circuit $P_{max} = V^2_{th} / 4 Z_L$

Where $Z_L = Z_{th}^*$

14. Superposition theorem is applicable only to …….. networks.

Answer: Linear.

15…….**theorem is useful when the current in a one branch of a network is to be determined for different values of the branch resistance.**

Answer:Thevenin's

16. **Find the thevenins equivalent for the circuit shown in fig.**

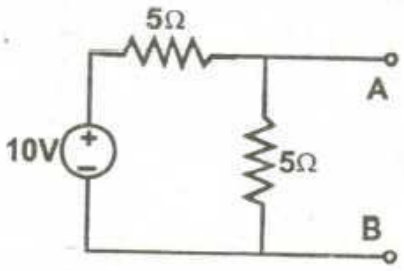
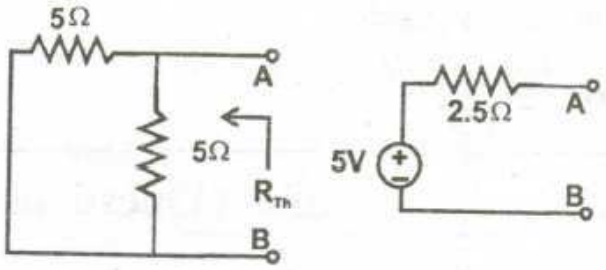


Fig. 2.367

Solution

$$R_{\text{Th}} = 5||5$$
$$= 2.5\Omega$$
$$V_{\text{Th}} = \frac{10}{(5+5)}(5V) = 5\text{ V}$$



17. Find the value of R_L for maximum power transfer.

To find R_L maximum power transfer we have to find R_{Th}

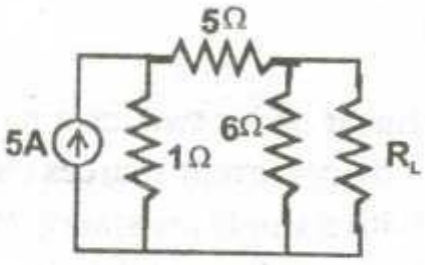


Fig.2.370

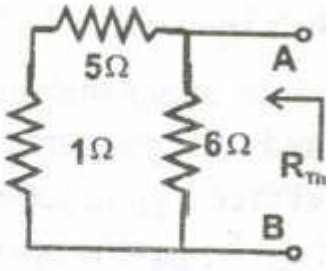
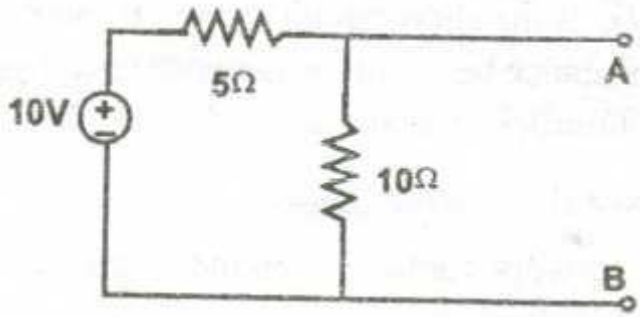


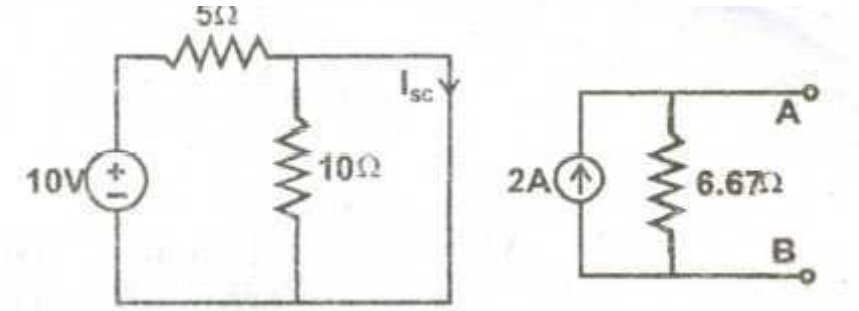
Fig.2.371

$$R_{\text{Th}} = 6||6 = 3\Omega$$

Therefore $R_L = 3\Omega$

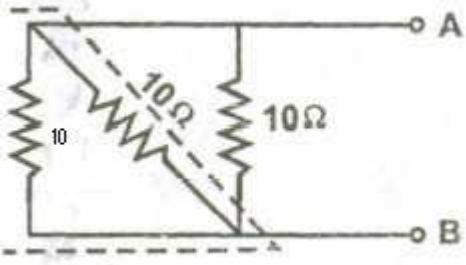
18.Find the Nortons equivalent of the circuit shown in fig.

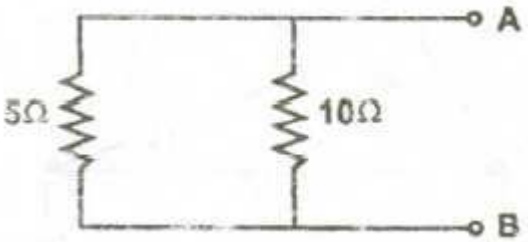




To find I_{sc} short AB , I_{sc} = 10 /5 =2A , R_{th} = (5x10)/(5+10)= 6.67ohms

19.The resistance between AB terminal is equal to ……..





R_{eq} = (10 x10)/(10+10) =5 ohms

R_{AB} = (5X10)/(5+10) = 3.33 ohms

20. The resistance between the terminal AB is 30ohms, the value of R is…….

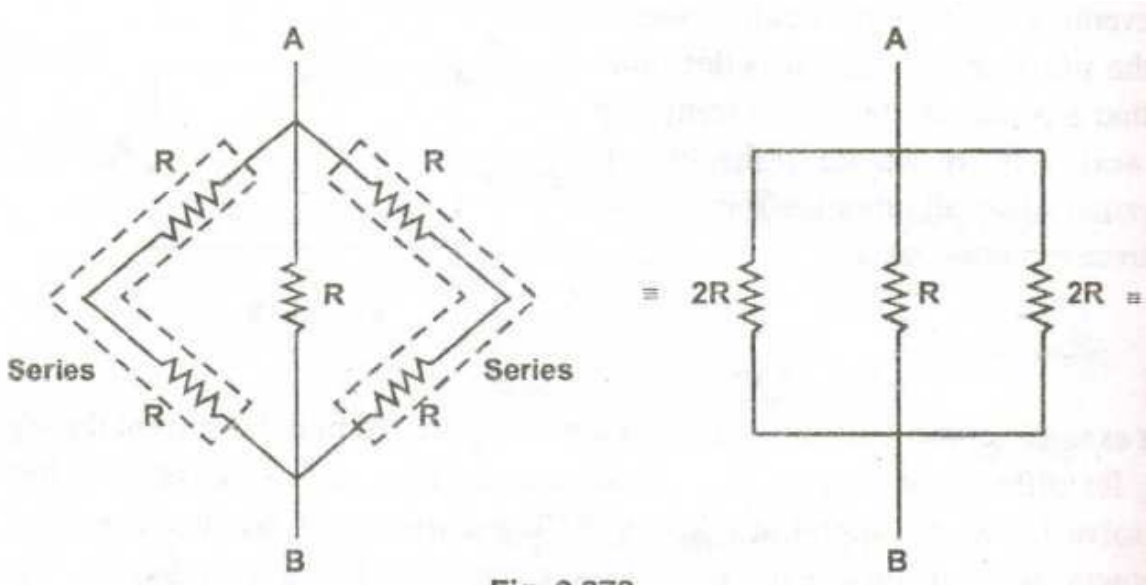


Fig. 2.378

$$\frac{1}{R_{eq}} = \frac{1}{2R} + \frac{1}{R} + \frac{1}{2R} = \frac{4}{2R} = \frac{2}{R}$$

$$\frac{1}{30} = \frac{2}{R} \qquad (\because \ R_{eq} = 30\Omega)$$

$$\boxed{R = 60\Omega}$$

21.Find the resistance between the points A and B for the circuit shown in fig.

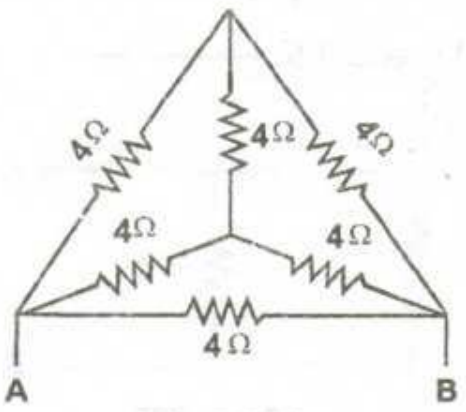


Fig.2.379

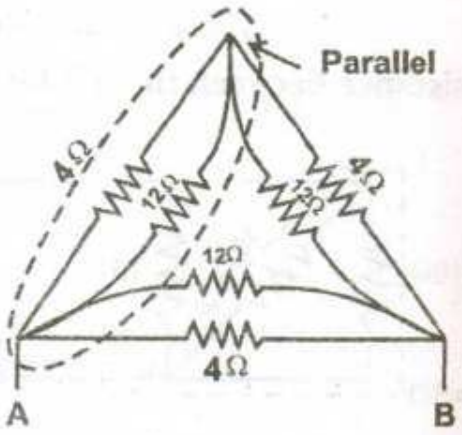


Fig.2.380

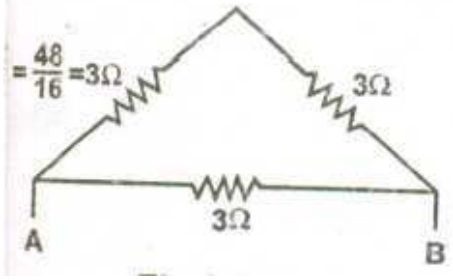
$$\frac{4 \times 12}{4+12} = \frac{48}{16} = 3$$

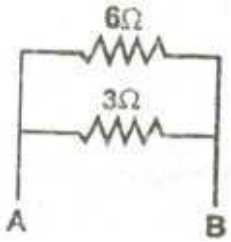
$$R_{AB} = R_A + R_B + \frac{R_A R_B}{R_C}$$

$$R_A = R_B = R_C = R$$

$$R_{AB} = 3R$$

$$= 3 \times 4 = 12$$





$$\equiv \frac{6 \times 3}{6+3} = \frac{18}{9} = 2\Omega$$

UNIT 3 : RESONANCE AND COUPLED CIRCUITS

1. What is the resonance?

In RLC -series, circuit the inductive and capacitive reactance have opposite signs. Hence when the reactances are varied there is a possibility that the inductive reactance may cancel the capacitive reactance and the circuit may behave as a purely resistive circuit. This condition is called resonance.

2. What is the resonant frequency?

The frequency at which the resonant condition occurs is known as the resonant frequency.

3. Write the expression for resonant frequency and current at resonance of a RLC series circuit? ,

Ans: Angular resonant frequency, $\omega_r = \frac{1}{\sqrt{LC}}$

Resonant frequency, $f_r = \frac{1}{2\pi\sqrt{LC}}$

Current at resonance, $I_r = \frac{V}{R}$

4. What is anti-resonance?

In RLC parallel circuit, the current is minimum at resonance whereas in series resonance the current-is maximum. Therefore the parallel resonance is called anti-resonance.

5. Write the characteristics of parallel resonance?

At resonance, admittance is minimum and equal to conductance, therefore current is minimum.

Below resonant frequency the circuit behaves as inductive circuit and above resonant frequency the circuit behaves as capacitive circuit.

At resonance the magnitude of current through inductance and capacitance will be Q times the current supplied by the source, but they are in phase opposition.

6. What are half power frequencies?

In-RLC circuits, the frequencies at which the power is half the -maximum/minimum power are called half power- frequencies.

7. 'Define Quality factor

The Quality factor is. defined as the ratio of maximum energy stored to the energy dissipated in one period.

Quality factor Q = 2Π X(maximum energy stored/energy dissipated in one period)

8. Find the resonant frequency in the ideal parallel LC circuit with L = 40mH and C-0.01 μF.

Ans: Resonant frequency, $f_r = \frac{1}{2\pi\sqrt{LC}}$

$$= \frac{1}{2\pi\sqrt{40\times10^{-3}\times0.01\times10^{-6}}}$$

$$= 7958\text{Hz.}$$

9. Define selectivity.

The selectivity is defined as the ratio of bandwidth and resonant frequency.

$$\text{Selectivity} = \frac{\beta}{\omega_r} \text{ or } \frac{1}{Q_r}$$

10. Determine the quality factor of a RLC series circuit with R = 10Ω, C=100μF and L=0.01mH.

Ans: Quality factor at resonance, $Q_r = \frac{1}{R}\sqrt{\frac{L}{C}} = \frac{1}{10}\sqrt{\frac{0.01}{100\times10^{-6}}}$

$$= 1$$

11. What is the tuned circuit?

In a coupled circuit, when capacitors are added to primary and secondary of coupled coils to resonate the coils to achieve maximum power transfer condition then the coupled circuit is called tuned coupled circuit.

12. What is single tuned and double tuned circuit?

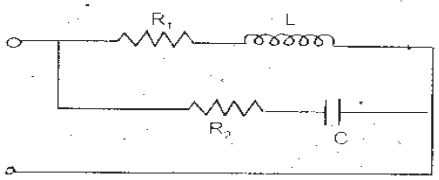
In a coupled circuit when a capacitor is added to secondary coil to resonate the secondary, the coupled circuit is called single tuned coupled circuit. In a coupled circuit when capacitors are added both to primary and secondary coils to resonate the primary and secondary, the coupled circuit is called double tuned coupled circuit.

13.Write the expression far resonant frequency for the RLC network shown: when Rj =R_2 = R and L=CR^2.

Ans: Resonant frequency,

$$f_r = \frac{1}{2\pi\sqrt{LC}}\sqrt{\frac{L-CR_1^2}{L-CR_2^2}}$$

when $L = CR^2$ the circuit will resonate at all frequencies.



14. What is dynamic resistance? Write the expression for dynamic resistance of RL circuit parallel with C.

The resistance of the RLC parallel circuit at resonance is called dynamic resistance. ,

For RL circuit parallel with C, the dynamic resistance is given by,

$$R_{dynamic} = \frac{L}{RC}$$

15.Define co-efficient of coupling.

The amount of coupling between to inductively coupled coils is expressed in terms of the coefficient of coupling, which is defined as

$$K = M / \sqrt{L_1 L_2}$$

16.**Write the expression for equivalent inductance of series connected magnetically coupled coils.**

For cumulative coupling effective inductance $L = L_1 + L_2 + 2M$

For differential coupling effective inductance $L = L_1 + L_2 - 2M$

17.What is the maximum possible mutual inductance of two inductively coupled coils with self inductances L_1 =25Mh, L_2 = 100Mh?

Maximum mutual inductance $M = \sqrt{L_1 L_2}$

$= \sqrt{25 \times 10^{-3} \times 100 \times 10^{-3}}$

$= 50m$

18.Define bandwidth.

The bandwidth is defined as the frequency difference between upper and lower cut off frequency.

Bandwidth $= f_2 - f_1$

where

f_1- lower cut-off frequency

f_2-upper cut-off frequency

19.What is ideal transformer?

An ideal transformer is a unity coupled lossless transformer in which the primary and secondary coils have infinite self inductance.

20.Write the condition for resonance in series RLC circuit.

1.A network is in resonance when the voltage and current at the network input terminals are in phase.

2.If inductive reactance of a network equals capacitive reactance then the network is said to be resonance.

21. Define half power frequencies.

The frequencies at which the power is half the maximum power are called half power frequencies.

Lower half power frequency $f_1 = f_r - R / 4 \pi L$

Upper half power frequency $f_1 = f_r + R / 4 \pi L$

22.Give the expression for quality factor of series RLC circuits.

The expression for quality factor of series RLC circuits is given by

$$Q = (1 / R) \sqrt{L/C}$$

23.Give the expression for quality factor of parallel RLC circuits.

The expression for quality factor of parallel RLC circuits is given by

$$Q = R * \sqrt{C/L}$$

24. Define duality.

Two electrical network which are governed by the same type of equations are called duality.

25. State the dot rule for coupled circuits.

1. If both currents enter dotted ends of coupled coils or if both currents enter undotted ends, then the signs on the M- terms will be same as the signs on the L-terms
2. If one current enters a dotted end and the other an un dotted end, the sign on the M-terms will be opposite to the signs on the L –terms.

26. Define coupled circuit. Give the examples of coupled circuits.

The coupled circuits refer to circuits involving elements with magnetic coupling. If the flux produced by an element of a circuit links other elements of the same circuit or nearby circuit, then the elements are said to have magnetic coupling.

Examples : 1.Transistor 2. Transformer

27. What is perfect coupling?

Co-efficient of coupling is equal to one, that type of coupling is known as perfect coupling.

28.A series RLC circuit has R = 50Ω; L=100μH; and C = 300ρF; v=20V.What is the current at resonance?

The current at resonance will be $I = V / R = 20 / 50 = 0.4A$

29.How the RLC series circuit behaves for the frequencies above and below resonant frequencies?

For frequencies below resonant frequency the capacitive reactance is more than the inductive reactance. Therefore the equivalent reactance is equal to capacitive and the circuit behaves like a RC circuit. For the frequencies above resonant frequency the inductive reactance is more than the capacitive reactance and the circuit behaves like a RL series circuit.

30.A series resonant circuit is capacitive at f=100Hz. The circuit will be inductive somewhere at

Answer: f is greater than 100Hz

UNIT 4: TRANSIENT RESPONSE FOR DC&AC CIRCUITS

1. Define transient response.

The transient response is defined as the response or output of a circuit from the instant of switching to attainment of steady state.

2, What is natural response?

The response of a circuit due to stored energy alone without external source is called natural response or source-free response.

3. What is the forced response?

The response of a circuit due to -ah external source is called forced response

4. How the RL circuit behaves for the step input?

At $t = 0^+$, the current through inductance is zero and so it behave as open circuit, At $t=\infty$, the voltage across inductance is zero and so it. -behave as short circuit.

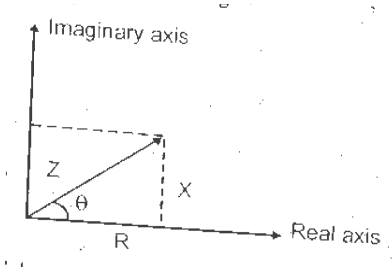
5. Define the time constant of RL circuit

The time constant of RL circuit is defined as the time taken by the current through the inductance to reach steady value if initial rate of rise is maintained.

8. What is an impedance triangle?

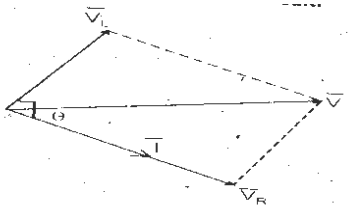
Real axis

The right-angled triangle formed by the resistance (R), reactance (X) and the impedance (Z) is called an impedance triangle.



9.Draw the phasor diagram of RL circuit.

The phasor diagram of RL circuit is



$\bar{V}$ → Reference phasor

$\bar{I}$ → lags $\bar{V}$ by an angle ϕ

$\bar{V}_R$ → In phase with $\bar{I}$

$\bar{V}_L$ → Leads $\bar{I}$ by an angle 90°

11. Define the apparent power.

The apparent power, is defined as the product of magnitude of voltage and magnitude of current.

12. What is power factor and reactive factor?

The power factor is defined as, the cosine of the phase difference between voltage and current.

(i.e) Power factor = cosΦ

The reactive factor of the circuit is defined as the sine of the phase angle.

(i.e) Reactive factor = sinΦ

13. What is the conductance and susceptance?

The inverse of resistance is called as the conductance.

G=(1/R)

The inverse of reactance is called as the susceptance.

B=(1/X)

14. Define the admittance.

The admittance, is the reciprocal of impedance. It is a complex quantity and denoted by Y. The real part of admittance is conductance and the imaginary part of admittance is susceptance. .

15. How the RC circuit behaves for the step input?

At $t = 0^+$, the voltage across capacitance is zero and so it behave as short circuit. At $t = \infty$ the current through the capacitance is zero and so it behave as open circuit.

16. Define the time constant of RC circuit.

The time constant of RC circuit is defined as the time taken by the voltage across the capacitance to reach steady value if initial rate of rise is maintained.

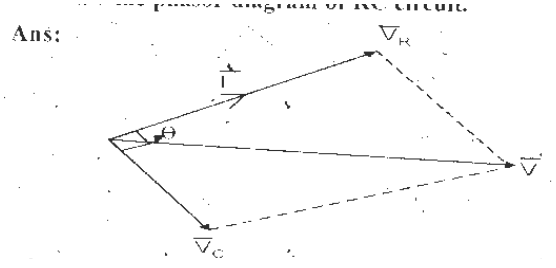
17. Write the expression for the impedance of the RC circuit in rectangular and polar form?

Impedance in rectangular form Z= R+jX Impedance in polar form, Z = |Z| $\angle -\S$

Here the current leads the applied voltage.

18. Draw the phasor diagram of RC circuit. '

Ans:



19. What is damping ratio? . . ..

The ratio of resistance- of the circuit and resistance for critical damping is called clamping ratio.

20. What is critical damping?

The critical damping is the condition of the circuit at which the oscillations in the response are just eliminated. This is possible by increasing the value of resistance in the circuit.

21. What is critical 'resistance?

The critical resistance is the value of the resistance of the circuit to achieve critical damping.

22. Write the expression for critical resistance and damping ratio of RLC/series circuit?

The expression for critical resistance and damping ratio of RLC/series circuit is

. .

Ans: Critical resistance, $R_C = 2\sqrt{\frac{L}{C}}$

Damping ratio, $G = \frac{R}{R_C} = R/2\sqrt{\frac{C}{L}}$

23. What is the voltage triangle for a RLC series circuit?

A right angled triangle with sides V_R,V_L and V in which V is the hypotenuse is called voltage triangle.

24. Write the expression for the impedance of RLC circuit?

The expression for the impedance Z of the RLC circuit is given by

$$\bar{Z} = R + jX_L - jX_C = R + j(X_L - X_C) = R \pm jX$$

25. What are the methods of solving AC parallel circuit?

The methods of sloving AC parallel circuits can be solved by:

*Admittance method.
* Symbolic method
* Vector method.

26. Define dual networks.

Two networks are called dual networks if the mesh equations of one have the same form as the nodal equations of the other. The property of duality is a mutual property.

27.State the dual elements for inductance and mesh current.

Dual of inductance is capacitance.
Dual of mesh current is node voltage.

28. State the dual elements for resistance and capacitance.

Dual of resistance is conductance

29. Distinguish between steady state and transient state.

A circuit having constant sources is said to be in steady state if the currents and the voltages do not vary with time.

In a circuit containing energy storage elements, with change in excitation, the voltage and current change from one state to other state. The behaviour of the voltage or current when it is changed from one state to other is called transient state.

30. What is free and forced response.

When a circuit contains storage elements which are independent of the sources, the response depends upon the nature of the circuit. This response is called natural or free response.

The storage elements deliver the energy to the resistances. So, the response changes with time, gets saturated after some time. It is referred to as the transient response.

When we consider sources acting on a circuit, the response depends on the nature of such sources. This response is called forced response.

31. Find the laplace transform of $x(t) = u(t) + \delta(t)$

$L(x(t)) = L[\mathbf{u(t)}] + \mathbf{L[\delta(t)]}$

$= 1/s + 1 = (1+s)/s$

32. Write the integra-differential equation of an RLC series circuit with supply voltage E.

The integra-differential equation of an RLC series circuit with supply voltage E is given by

$$E = Ri + L\, di/dt + 1/C \int idt$$

33.In one time-constant, a capacitor discharges ……..percent of its initial charge.

Answer:63.2%

34.The power factor of the pure inductive circuit is …….

Answer: Zero.

35.Find the laplace transform of the following signals?

(i) $\delta(t)$ (ii) $u(t)$ (iii)$e^{-at}\, u(t)$

(i) $L[\mathbf{\delta(t)] = 1}$

(ii) $L[\mathbf{u(t)\ ]=1/s}$

(iii) $L[\mathbf{e^{-at}\, u(t)]=1/s+a}$

UNIT 5: THREE PHASE CIRCUIT ANALYSIS

1. What is phase sequence?

Phase sequence of a polyphase system in the order in which the different phase quantities reach their maximum values.

2. What are the methods of connections of three phase windings?

The methods of connections of three phase windings are

(i) Independent connection.

(ii) Star connection.

(iii) Delta connection.

3. What is line current and Phase current?

The current flowing in the line is called the line current.
The current flowing in the phase is called the phase current.

4. What is line voltage and phase voltage?

The voltage between any two lines is called line voltage.
The voltage between any line and the neutral point is called the phase voltage

5. Give the line and phase values in star connection.

The relation between line voltage and phase voltage in a star connection is

$$E_L = \sqrt{3}\, E_{ph}$$

The relation between line current and phase current in a star connection is

$$I_L = I_{ph}$$

6. Give the line and phase values in delta connection.

The relation between line voltage and phase voltage in a delta connection is

$$E_L = E_{ph}$$

The relation between line current and phase current in a delta connection is

$$I_L = \sqrt{3}\ I_{ph}$$

7. Write few methods available for measuring power in a 3- phase load.

The few methods available for measuring power in a 3- phase load are

(i) One wattmeter method

(ii) Two wattmeter method

(iii) Three wattmeter method

8. List the methods used for power measurement with single wattmeter.

The methods used for power measurement with single wattmeter are

(i) Potential lead shift method.

(ii) T-method.

(iii) Artificial neutral method.

(iv) Current transformer method.

9. List the methods used for un balanced star connected load.

The methods used for un balanced star connected load are

(i) Equivalent delta method.

(ii) Mesh method.

(iii) Neutral voltage displacement method.

10. Write the expression for power factor in a balanced three phase circuit.

The expression for power factor in a balanced three phase circuit is given by

Power factor = $\cos [\tan^{-1}(\sqrt{3} (w_2-w_1)/ (w_1+ w_2)]$

11. What are the advantages of three phase system?

(i) The generation and transmission of electrical power are more efficient.

(ii) The power transmission in a three phase circuit is constant rather than pulsating as in a single phase circuit.

(iii) Three phase motors start and run much better than single phase motors.

12. What is the power factor when two wattmeter readings are equal in a two wattmeter method of power measurement?

Power factor =1

13. Write expression for total power in a three phase system.

$P_T = \sqrt{3}\ V_L I_L \cos\Phi$

14. Write the expression for calculating real, reactive and apparent power of a three phase system.

i) Real power $P = \sqrt{3}\, V_L I_L \cos\Phi$
ii) Reactive power $Q = \sqrt{3}\, V_L I_L \sin\Phi$
iii) Apparent power $S = \sqrt{3}\, V_L I_L$

15. How are the wattmeter readings equal in two wattmeter method at UPF? Establish the condition mathematically.

$W_1 = E_L I_L \cos(30^\circ - \Phi^\circ)$

$W_2 = E_L I_L \cos(30^\circ + \Phi^\circ)$

Since $\Phi = 0$ at Unity power factor, $W1 = W_2$

16. **In a 3-phase circuit, what do you mean by balanced load?**
When the loads in all the phases are identical it is called balanced load.

17. When is a 3-phase supply system called balanced supply system?
When all the 3-phase voltages are equal in magnitude and displaced by 120° in space, the supply system is called 3-phase balanced system.

18. **In two wattmeter method of 3-phase power measurement, one of the meters gave reading after reversal of its current coil connection. What do you infer from this?**
The power factor is definitely less than 0.5.

19. **In two wattmeter method, what do you infer about the power factor when one wattmeter shows zero reading?**
The power factor is definitely 0.5.

20. What will be the readings of the two wattmeter used for measurement of power in a three – phase circuit at unity P.F?
$W_1 = (\sqrt{3}/2)\, E_L I_L$

$W_2 = (\sqrt{3}/2)\, E_L I_L$

i.e., Both wattmeter readings are equal to each other and each will read half the total power.

21. Compare balanced and unbalanced network.

Let the three – phase circuit consist of loads Z_1, Z_2 and Z_3 . If all the loads are equal in magnitude and phase angle and connected to a balanced supply system, it is called a balanced network.

If all the loads are different, it is called unbalanced network, even when the supply system is balanced.

e.g., for balanced load $Z_1 = Z_2 = Z_3$

for unbalanced load $Z_1 \neq Z_2 \neq Z_3$

22. **How can a wattmeter be used to measure reactive power?**

In case of balanced three phase circuit, the reactive power can be determined by using one wattmeter. The current coil of the wattmeter is connected in one line and its pressure coil is connected across the other two lines.

Let the reading of wattmeter be W_r.
Then the total reactive power = $\sqrt{3}\ W_r$

23. A three phase balanced star connected load has 400V line to line voltage and 10 amperes line current. Determine the line to neutral voltage and phase current.

Phase voltage = line voltage / $\sqrt{3}$ = 400 / $\sqrt{3}$ =231 volts
Phase current = line current = 10 amperes

********** ALL THE BEST**********