UNIT I
BASIC CIRCUITS ANALYSIS

1. **What are Active elements and Passive elements?**

   The elements which can deliver energy are called **Active elements**.

   Example: Voltage and current sources

   The elements which can consume energy either by absorbing or storing are called

   Passive elements.

   Example: Resistor, inductor and capacitors.

2. **What are Linear and non linear elements?**

   In Linear element, the element which satisfies the current-voltage relationship is called Linear. **Example:** Resistor.

   In Non linear element, the element which does not satisfy the current-voltage relationship is called non Linear. **Example:** Diode, Transistor.

3. **State Kirchoff's current law?**

   Kirchoff's current law states that in a node, sum of entering current is equal of sum of leaving current. (Or)

   The algebraic sum of the current meeting at a junction is equal to zero. $\sum I = 0$.

4. **State Kirchoff's voltage law?**

   Kirchoff's voltage law states that "The algebraic sum of the voltages around any closed path is zero". $\sum v = 0$.

5. **State Ohm's law?**

   The current flowing through the electric circuit is directly proportional to the potential difference across the circuit and inversely proportional to the resistance of the circuit, provided by the temperature remains constant.

   $V = IR$.

6. **Comparison of series and parallel connection?**

Series circuit	Parallel circuit
The current is same through all the elements	The current is divided, inversely proportional to resistance.
The voltage is distributed.	The voltage is same across each element.
There is only one path for flow of current	There are more than one path for flow of current

7. **State voltage division rule and Current 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 series elements. $\mathbf{V_1 = R_1 V / R_1 + R_2}$

   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.

   $$\mathbf{I_1 = R_2 I / R_1 + R_2}$$

8. **What is average value and R.M.S value**

The average value of the sine wave is the total area under the half cycle curve divided by the distance of the curve.

Average value = Area under one complete cycle Period

The R.M.S value may be determined by taking the means of the squares of the instantaneous value of current over one complete cycle.

R.M.S = (Area under hatched line)² /√Period

9. **Calculate the current and resistance of a 100 W, 200V electric bulb.**

Power, P = 100W, Voltage, V = 200V , Power p = VI

Current I = P/V = 100/200 = 0.5A, Resistance R = V /I = 200/0.5 = 400 Ω.

10. **Three resistances of values 2Ω,3Ω connected and in series 5 Ω across are 20 V ,D.C supply .Calculate (a) equivalent resistance of the circuit (b) the total current of the circuit (c) the voltage drop across each resistor and (d) the power dissipated in each resistor.**

Total resistance R = R1 + R 2+ R3. = 2 +3+5 = 10Ω

Voltage = 20V, Total current I = V/R = 20/10 = 2A.

Voltage drop across 2Ω resistor V1 = I R1 = 2× 2 = 4 volts.

Voltage drop across 3Ωresistor V 2 = IR2 = 2 × 3 = 6 volts.

Voltage drop across 5Ωresistor V3 = I R3 = 2 ×5 = 10 volts.

Power dissipated in 2Ωresistor is P1 = I2 R1 = 22 × 2 = 8 watts.

Power dissipated in 3 resistor is P2 = I2 R2. = 22 × 3 = 12 watts.

Power dissipated in 5 resistor is P3 = I2 R3 = 22 × 5 = 20 watts.

11. **A lamp can work on a 50 volt mains taking 2 amps. What value of the resistance must be connected in series with it so that it can be operated from 200 volt mains giving the same power.**

Lamp voltage, V = 50V, Current, I = 2 amps.

Resistance of the lamp = V/I = 50/25 = 25 Ω

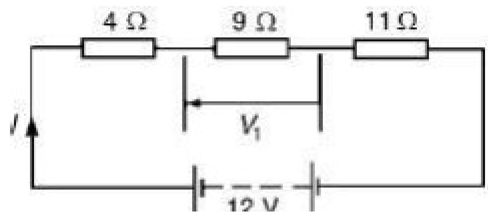
Resistance connected in series with lamp = r.

Supply voltage = 200 volt. Circuit current I = 2A

Total resistance Rt= V/I = 200/2 = 100Ω

Rt = R + r 100 = 25 + r r = 75Ω

12. **A 12V battery is connected in a circuit having three series-connected resistors having resistances of 4 Ω, 9 Ωand 11 Ω. Determine the current flowing through, and the p.d. across the 9 Ωresistor. Find also the power dissipated in the 11 Ωresistor**



Total resistance R=4 + 9 + 11=24 Ω

Current I = V/ R = 12/24 =0.5A, which is the current in the 9 Ωresistor. P.d. across the 9_ resistor, V1 = I × 9 = 0.5 × 9 = 4.5V

Power dissipated in the 11 Ωresistor,

P = I2R=0.52(11) = 0.25(11) = 2.75W

UNIT II

NETWORK REDUCTION AND NETWORK THEOREMS FOR DC AND AC CIRCUITS

1. **State Thevenin's theorem?**

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

2. **State Norton's theorem?**

   The Norton's theorem states that any two terminal linear networks with voltage sources, current sources and resistances can be replaced by a simple equivalent circuit consisting of a current source in a parallel with a resistance.

3. **State Norton's theorem?**

   The Norton's 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 source acting alone, while sources are non operative.

4. **State Maximum power transfer theorem?**

   The Maximum power transfer states that maximum power delivered from source to load, when load resistance is equal to the source resistance.

   $$R_S = R_L$$

5. **State Compensation theorem?**

   The Compensation theorem States that any element in linear network ,bilateral network may be replaced by a voltage source of magnitude equal to a current passing through the element multiplied by the value of the element, provided current and voltages in other parts of the remain unaltered.

6. **State reciprocity theorem?**

   It states that in a linear, bilateral single source circuit the ratio of excitation to the response is constant when the position of excitation and response are interchanged.

7. **State Millman's theorem?**

   It states that if a number of voltage sources with internal impedance are in parallel then they can be combined to give a voltage source with an equivalent emf and internal impedance.

8. **Write some applications of maximum power transfer theorem.**

   Power amplifiers

   Communication system

   Microwave transmission

9. **Write some applications of Thevenin's theorem.**

   It is applied to all linear circuits including electronic circuits represented by the controlled source.

   This theorem is useful when t is desired to know the effect of the response in network or varying part of the network.

10. **State Tellegen's Theorem.**

It states that the summation of all the product of branch voltage and its current of a circuit is zero.

11. **What is the Load current in a Norton's circuit?**

The load current in a Norton's circuit is given by

IL= (ISC.RTH) / (RTH+RL)

12. **What is the load current in Thevenin's circuit?**

The load current in a Thevenin's circuit is given by

$I_L = V_{OC} / (R_{TH}+R_L)$

13. **What is the maximum power in a circuit?**

The maximum power is given by

Max power: $V_{OC}^2 / 4 R_{TH}$

14. **What is the limitation of superposition theorem?**

This theorem is valid only for linear systems. This theorem can be applied for calculating the current through or voltage across in particular element. But this superposition theorem is not applicable for calculation of the power.

15. **What are the limitations of maximum power transfer theorem?**

The maximum efficiency can be obtained by using this theorem is only 50%. It is because of 50% of the power is unnecessarily wasted in Rth.

Therefore this theorem only applicable for communication circuits and not for power circuits where efficiency is greater importance rather than power delivered.

16. **Explain the purpose of star delta transformation.**

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

17. **What is Star and Delta Connection?**

`One end of each resistance is connected at a point is called Star point and 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 is called delta connection.

UNIT III

TRANSIENT RESPONSE FOR DC CIRCUITS

1. **What is transient state?**

   If a network contains energy storage elements, with change in excitation, the current and voltage change from one state to other state the behavior of the voltage or current when it is changed from one state to another state is called transient state.

2. **What is transient time?**

   The time taken for the circuit to change from one steady state to another steady state is called transient time.

3. **What is transient response?**

   The storage elements deliver their energy to the resistances; hence the response changes with time, get saturated after sometime, and are referred to the transient response.

4. **Define time constant of RLC circuit.**

   The time taken to reach 63.2% of final value in a RL circuit is called the time constant of RL circuit.

   Time constant=L / R

5. **Define time constant of RC circuit**.

   The time to taken to reach 36.8% of initial current in an RC circuit is called the time constant of RC circuit.

   Time constant = RC

6. **What is meant by natural frequency?**

   If the damping is made zero then the response oscillates with natural frequency without any opposition, such a frequency is called natural frequency of oscillations.

7. **Define damping ratio.**

   It is the ratio of actual resistance in the circuit to the critical resistance.

8. **Write down the condition, for the response of RLC series circuit to be under damped for step input.**

   The condition for the response of RLC series circuit to be under damped step input is $(R/2L)^2 > (1/LC)$

9. **Write down the condition for the response of RLC series circuit to be over damped for step input.**

   The condition for the response of RLC series circuit to be over damped for step input is,

   $(R/2L)^2 > (1/LC)$

10. **Write down the few applications of RL, RC, RLC circuits.**

    Coupling circuits
    Phase shift circuits
    Filters
    Resonant circuits
    AC bridge circuits and Transformers

11. **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.

12. **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.

13. **What is forced response?**

The response of the circuit due to the external source is called forced response.

14. **Define apparent power.**

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

15. **What is power factor and reactive power?**

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

In reactive power, the reactive power of the circuit is defined as the sine of the phase angle.

16. **Define Dual network.**

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 mutual property.

17. **Define the admittance.**

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

18. **What is conductance and susceptance?**

The inverse of resistance is called as the conductance. G = (I / R)

The inverse of reactance is called as the susceptance. B = (I / X)

19. **What are the methods of solving AC parallel circuits?**

Admittance method.

Symbolic method.

Vector method.

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.

UNIT IV
RESONANCE AND COUPLED CIRCUITS

1. **What is meant by Resonance?**
   An A.C circuit is said to be resonance if it behaves as a purely resistive circuit. The total current drawn by the circuit is then in phase with the applied voltage, and the power factor will then unity. Thus at resonance the equivalent complex impedance of the circuit has no j component.
2. **What is resonant frequency?**
   The frequency at which resonance occurs is called resonant frequency.
   At resonant frequency XL=XC.
3. **Define series resonance.**
   A resonance occurs in RLC series circuit called series resonance. Under resonance condition, the input current is in phase with applied voltage.
4. **Define Quality factor.**
   The quality factor is defined as the ratio of maximum energy stored to the energy dissipated in one period.
5. **What are half power frequencies?**
   In RLC circuits the frequencies at which the power is half the max/min power are called half power frequencies.
6. **Write the characteristics of series resonance.**
   At resonance impedance in min and equal to resistance therefore current is max. Before resonant frequency the circuit behaves as capacitive circuit and above resonant frequency the circuit will behave as inductive circuit.
   At resonance the magnitude of voltage across the inductance and capacitance will be Q times the supply voltage but they are in phase opposition.
7. **Define selectivity.**
   It is defined as the ratio of bandwidth and resonant frequency.
8. **What is anti resonance?**
   In RLC parallel circuit the current is min at resonance whereas in series resonance the current is max. Therefore the parallel resonance is called anti resonance.
9. **Write the characteristics of parallel resonance.**
   At resonance admittance in min and equal to conductance therefore the current is min.
   Below resonant frequency the circuits behave 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.
10. **What is Bandwidth and selectivity?**
    The frequency band within the limits of lower and upper half frequency is called bandwidth. **BW=f_2-f_1**
    Selectivity is the ratio of f_r to the bandwidth **Selectivity= f_r / (f_2-f_1)**

11. **What are coupled circuits?**

It refers to circuit involving elements with magnetic coupling. If the flux produced by an element of a circuit links other elements of the same circuit then the elements are said to be magnetic coupling.

12. **State the properties of a series RLC circuit.**

The applied voltage and the resulting current are in phase, when also means than the P.F of RLC circuit is unity.

The net reactance is zero at resonance and the impedance does not have the resistive part only.

The current in the circuit is max: and is V/R amperes.

At resonance the circuit has got minimum impedance and max: current

Frequency of resonance is given by fr=1/(2π√LC).

13. **State the properties of a parallel RLC circuit.**

PF is unity

Current at resonance is (V/(L/RC)) and is in phase with the applied voltage.

The value of current at resonance is minimum.

Net impedance at resonance is max: & is equal to L/RC.

The admittance is min: and the net susceptance is zero at resonance.

14. **Define self inductance.**

When permeability is constant the self inductance of a coil is defined as the ratio of flux linkage and current.

15. **Define mutual inductance.**

When permeability is constant the mutual inductance between two coupled coils is defined as the ratio of flux linkage in one coil due to common flux and current through another coil.

16. **Define coefficient of coupling.**

In coupled coils the coefficient of coupling is defined as the reaction of the total flux produced by one coil linking another coil.

17. **What is DOT convention?**

The sign of mutual induced emf depends on the winding sense and the current through the coil. The winding sense is decided by the manufacturer and to inform the user about the winding sense a dot is placed at one end of each coil. When current enter at dotted end in one coil then the mutual induced emf in the other coil is positive at dot end.

18. **State dot rule for coupled circuit.**

It states that in coupled coils current entering at the dotted terminal of one coil induce an emf in second coil which is +ve at dotted terminal of second coil.

Current entering at the undotted terminal of one coil induce an emf in second coil which is (+ve) at un dotted terminal of second coil.

19. **Define coefficient of coupling.**

The amount of coupling between to inductively coupled coils is expressed in terms of the coefficient of coupling. **K=M/√L1L2**

UNIT V

THREE PHASE CIRCUITS

1. **Define line current and phase current.**
   The current flowing through the line is called line current.
   The current flowing through the phase is called phase current.
2. **Define line and phase voltage?**
   The voltage between two lines is called the line voltage
   The voltage between any line and the neutral point is called phase voltage.
3. **Give the line and phase values in star connection?**
   The relation between line and phase voltage in star connection is $E_L=\sqrt{3}E_{ph}$
   The relation between line current and phase current in a star connection is $I_L=I_{ph}$
4. **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 delta connection is $I_L=\sqrt{3}I_{ph}$
5. **Write few methods available for measuring in 3-phase load**.
   One wattmeter method.
   Two wattmeter method.
   Three wattmeter method.
6. **List the methods used for power measurement with single wattmeter**.
   Potential lead shift method.
   T- Method.
   Artificial neutral method.
   Current transformer method.
7. **List the methods for unbalanced star connected load.**
   Equivalents delta method.
   Mesh method.
   Neutral voltage displacement method.
8. **Write the methods of connections of 3 phase windings?**
   Independent connection.
   Star connection.
   Delta connection.
9. **What are the advantages of three phase system?**
   The generation and transmission are electrical power are more efficient.
   The power transmission in a three phase circuit is constant rather than pulsating as in a single phase circuit.
   Three phase motors start and run much better than single phase circuits.
10. **in a three phase circuit, what do you mean by balanced load?**
    When the loads in all the phases are identical. It is called balanced load.

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

12. **Write the expression for total power in a three phase system?**

$P_T = \sqrt{3} V_L I_L COSØ$

13. **Write the expression for calculating real, reactive and apparent power in a three phase system?**

Real power **P** = $\sqrt{3} V_L I_L COSØ$.

Reactive power **Q** = $\sqrt{3} V_L I_L SINØ$.

Apparent power **S** = $\sqrt{3} V_L I_{L.}$

14. **When is the three phase supply system called balanced supply system?**

When all the three phase voltages are equal in magnitude and displaced by 120° in space, the supply system is called three phase balanced system.

15. **A three phase balanced star connected load has 400v line to line voltage and 10A line current. Determine the line to neutral voltage and phase current?**

Phase voltage = line voltage / √3
= 400 / √3
=231V
Phase current = Line current
= 10A.

16. **Compare balanced and unbalanced networks?**

Let the three phase circuit consist of loads Z_1, Z_2 and $Z_{3.}$ If all the nodes are equal magnitude and phase angle connected to a balanced supply system. It is called balanced network.

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

Example: for balanced load $Z_1 = Z_2 = Z_3$

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

17. **How can 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 wattmeter is connected in one line and its pressure coil connected across the other two lines.

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

18. **What will be the reading of two wattmeter used for measurement of power in a three phase circuit at unity P.F?**

19. $W_1 = (\sqrt{3}/2) E_L I_{L.}$ $W_2 = (\sqrt{3}/2) E_L I_{L.}$

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