



CMS COLLEGE OF ENGINEERING AND TECHNOLOGY COIMBATORE-641 032

DEPARTMENT OF EEE

Subject: ELECTRIC CIRCUITS AND ELECTRON DEVICES

UNIT-1 CIRCUIT ANALYSIS TECHNIQUES

1. Define Electric Current.

Electric current is defined as rate of flow of electric charge.

$$I = \frac{dq}{dt} \text{ amperes}$$

Where q is the charge in coulombs.

The unit of current is the ampere which is the current that flow when 1 coulomb of charge is transferred in one second.

2. Define Electrical potential or Voltage.

Electric al potential is measured between two points. Its unit is volt.

If the work done in moving a charge of one coulomb between any two points is 1 joule, then the potential of one point with reference to the second point is 1 volt.

$$E = \frac{dW}{dQ}$$

Where W is the work done in Joules.

3. What is meant by resistance?

The resistance of a circuit is the property by which it opposes the flow of current. It is measured in Ohms, which is responsible for energy dissipation.

4. Define Electrical power.

The rate at which work is done is power and its unit is joule per second or watt. When one coulomb of electric charge is moved through a potential difference of one volt in one second, the rate of work is one joule per second or one watt. Hence power in electric circuits is obtained as a product of the voltage*(E) and current (I).

$$P = E.I \text{ Watts}$$

5. What is meant by Electric energy?

Energy is the total amount of work done and hence is the product of power and time.

$$W=Pt \text{ joules}$$

6. What are the classifications of circuit elements?

The elements of the circuit can be classified into two types namely

- Active elements
Voltage and current source.
- Passive elements
Resistor, inductor, capacitor

7. What are active elements and passive elements?

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

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

8. What are lumped and distributed elements?

Physically separate elements such as resistors, capacitors and inductor 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.

9. What are bilateral and unilateral elements?

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

Eg: resistor, inductor and capacitor.

In a unilateral element, it has different relations between voltage and current for two possible directions of current.

Eg: vacuum tube, silicon diode.

10. What are linear and non-linear elements?

An element is said to be linear, if it satisfies the linear current voltage relationship 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.

11. What are independent sources?

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

12. What are dependent sources?

A dependent voltage and current source is one which depends on some other quantity in the circuit which may be either a voltage or a current.

There are four types of dependent sources

Voltage dependent voltage source
Voltage dependent current source
Current dependent voltage source
Current dependent current source

13. What are the ideal sources of Electrical energy?

- Ideal voltage source
- Ideal current source

14. What is an ideal voltage source and ideal current source?

Ideal voltage source

Voltage source is a source which delivers energy with specified terminal voltage, which is independent of the current supplied by the source. Such a voltage source which maintains constant specified voltage for all currents supplied by the source is called an ideal voltage source. For ideal voltage source the internal impedance is zero.

Ideal current source

Current source is a source which delivers energy with specified current, which is independent of the voltage at its terminal. Such a current source which maintains constant specified current for all voltages is called an ideal voltage source.

15. State Kirchoff's current law?

It states that "the algebraic sum of the currents meeting at a junction is equal to zero".

16. State Kirchoff's voltage law?

"The algebraic sum of electromotive forces plus the algebraic sum of voltages across the impedances, in any closed electrical circuit is equal to zero".

i.e., $\text{Emf} + IZ=0$

17. State Ohm's law?

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.

$V=IR$

18. Mention the disadvantages of Ohm's law

Ohm's law does not apply to all non-metallic conductors.

It also does not apply to non-linear devices such as zener diode, vacuum tubes etc.

Ohm's law is true for metal conductors at constant temperature. If the temperature changes, the law is not applicable.

19. 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.

20. What are the advantages of parallel circuits?

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

21. State Thevenin's theorem?

Any linear active network with output terminals A and B can be replaced by a single voltage source ($V_{th} = V_{OC}$) in series with a single impedance ($Z_{TH} = Z_i$).
 V_{th} - Thevenin's voltage. It is the voltage between the terminals A and B on open circuit condition.
 Z_{th} is called thevenin's impedance.

22. State superposition theorem?

In a linear circuit containing more than one source, the current that flows at any point or the voltage that exists between any two points is the algebraic sum of the currents or the voltages that would have been produced by each source taken separately with all other sources removed.

23. What is the limitation of superposition theorem?

Superposition 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 theorem is not applicable for calculation of power.

24. State Norton's theorem.

Any two terminal network containing linear, passive and active elements may be replaced by an equivalent current source I_N parallel with a resistance R_{TH} where I_N is the current flowing through a short circuit placed across the terminals AB and R_{TH} is the equivalent resistance of the network as seen from the terminals with all independent sources replaced by their internal resistors.

Where

I_N short circuit current at AB

R_{TH} Thevenin's Resistance

25. State maximum power transfer theorem.

In d.c circuits, maximum power is transferred from a source to the load when the load resistance is made equal to the resistance of the network as viewed from the load terminals with load removed and all the sources replaced by their internal resistances.

26. Write some applications of maximum power transfer theorem.

Power amplifiers

Communication systems
Microwave transmission.

27. What is duality?

Two electrical networks which are governed by the same types of equations are called dual networks or duality is said to exist between them.

28. 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.

29. What is sign conversion?

a) In a closed path if we go from positive marked terminal to negative marked terminal, the voltage must be taken as positive. This is called potential rise.

b) In a closed path, if we go from negative marked to positive marked terminal the voltage must be taken as negative. This is called potential drop.

30. 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.