Date:

Q. Write note on Resistors?

- **Resistor:**

A resistor is an electrical component with a known specified value of resistance. It is probably the most common component in all kinds of electronic equipments ranging from a small radio to a colour television receiver.

- **Types:**

Resistors are mainly of two types.

1- wire wound resistors
2- Carbon resistors
a) carbon composition resistors.
b) carbon film resistors
c) cermet film resistors
d) metal film resistors.

1- **wire wound resistors:**
They are constructed from a long wire (usually nickel-chromium wire) wound on a ceremic core. The length of the wire used and its resistivity determine the resistance of the unit.
These are available in power rating from 5W to several hundred watts and resitance values from 1Ω to 100K.

2- **Carbon resistors:**

a- **Carbon-Composition type:**
They are made of finaly-divided carbon mixed with a powdered

insulating material in suitable proportion
often the resistance element is a simple
rod of pressed carbon granules and
enclosed in a plastic case. The two ends
are joined to metal caps
Such resistors are available in power ratings
of 1/10, 1/8, 1/4, 1/2, 1, 2 watt and in
resistance values from 1Ω to 20MΩ.

Carbon film resistors:

They consist of a high grade ceramic core
(substrate) on which is deposited a thin
resistive film of carbon. They are cheap in price.

cermet film resistors:

They consist of a thin carbon coating fixed
onto a solid ceramic substrate. very often they
are made in small square with leads to
fit into a printed circuit board (PCB).

metal film resistors:-

They consist of a thin metal coating
deposited on a cylindrical insulating support
They give high resistance values due to
thinness of the film. However such resistors
are free of troublesome effects.

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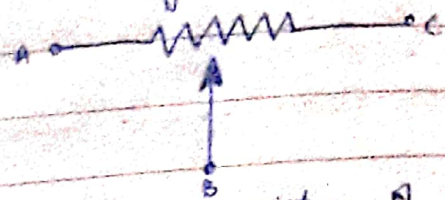
Q. write note on variable resistors?

- Variable resistors:

These are the resistors whose resistance can be changed b/w zero and a certain maximum value. They can be wire wound or carbon type

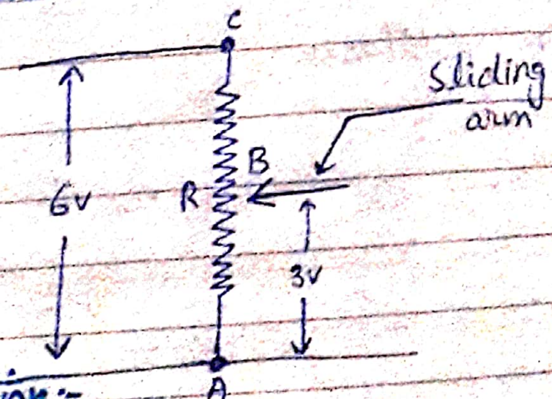


Carbon variable resistors of power rating 1/2 W to 2W and resistance of 1kΩ to 5MΩ are commonly available.

- Potentiometers and Rheostats:-

These are variable resistors either of carbon or wire-wound type often used for controlling voltage and current in a circuit

a) Potentiometers:



- Construction:-

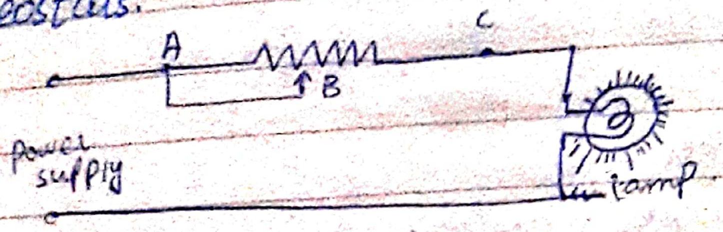
They generaly have carbon composition resistance element and are connected across a voltage source. They have three terminals the centerone is connected to the variable arm which is used for varying voltage division in the circuit

STAR NOTES

Working:
By moving the variable arm B over the fixed resistor R b/w points A and C, any part of the input voltage can be tapped off. B happens to be at the middle value of R, output voltage is half of the input voltage.

Uses:
Most variable resistors used in radios are potentiometers for controling volume or tone. These work as potential divider, volume control resistors and Tone control resistors.

Rheostats:



Construction:-
The resistance of element of rheostats is made of high resistance wire. It has two terminals and is connected in series with a circuit for adjusting the amount of current flowing through it

Working:
These are commonly used to control relatively high currents. Rheostat can be connected into a lamp circuit for controling its current. As seen, only resistance

BC is connected into the circuit

Use:

If we connect a battery to the both terminals as a potential divider we can use this resistor as fixed resistor, variable resistor and a potential divider also.

Q: write a note on Inductors?

- **Inductors:**

  Inductors are basic components commonly used in electronic circuits. It is nothing else but a coil wound on a core or former of some suitable material.

  symbol use for inductor is;

- **Types:**

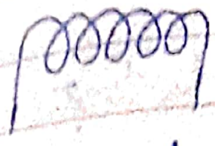
a) **Air-core inductor:**

It consist of number of turns of wire wound on a former made of ordinary cardboard. Since their is nothing but air inside of the coil, an air core has least value of inductance for a given number of turns and core length.

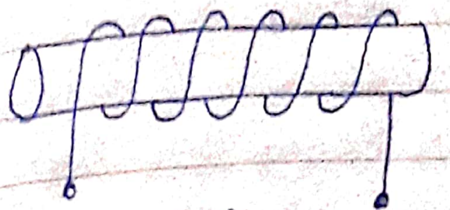
air core inductor

STAR NOTES

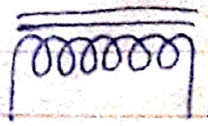
In air core coils there are no loss even at high frequencies. but their inductance are limited to low values in μH or mH range.

symbol: 

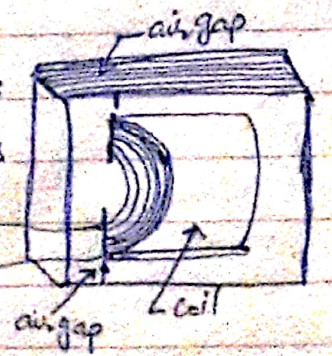
Iron core inductor:-



it is that inductor in which a coil of wire is wound over a solid or laminated iron core. putting iron inside an inductor has the effect of increasing its inductance. in order to avoid eddy loss iron core is laminated. The iron core has been found to work more efficiently particularly at low frequency. In Iron core, coil losses are minimal at low frequency. They Possess comparatively much larger inductance as compared to air core coils.

symbol: 

c) Ferrite-core Inductors:



In this case, coil of wire is wound on a solid core made of highly ferromagnetic substance. A ferrite core has minimum eddy current loss

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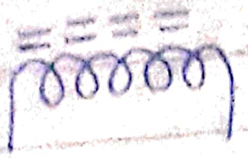
and hysteresis losses even at very high frequencies

Symbol:



- **Inductance of an inductor:**

whenever current through an inductor change (ie, increase or decrease), a counter emf is induced in it which tends to oppose this change. This property of coil due to which it oppose any change of current through it is called inductance(L)
Its unit is Henry(H)

Inductance of a coil is given by

$$L = \frac{\mu_0 \mu_r A N^2}{l} \text{ henrys.}$$

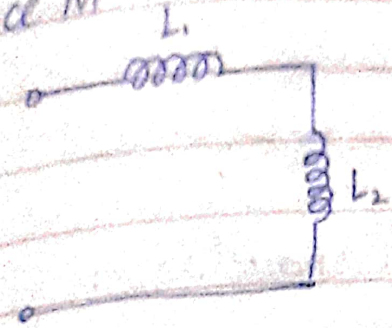
L varies

1. directly as relative permeability ($\mu_0 \mu_r$) of core material.
2. directly as core cross sectional area (A)
3. directly as sq. of numbers of turns (N^2) of coil
4. Inversly as core length.

Write series combination of inductors with or without M?

Inductors in series without M:

we will assume that different coils are connected in series have no mutual inductance M.



Here

$$L = L_1 + L_2$$

In general

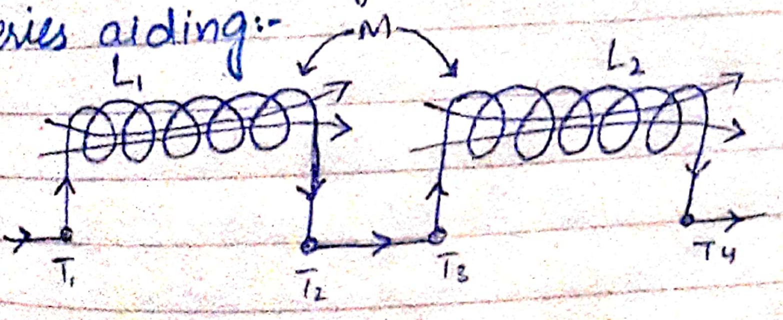
$$L = L_1 + L_2 + L_3 + \cdots$$

Series combination with M:

In this case, value of total inductance depend upon:

1) amount of mutual inductance present
2) whether combination is series aiding or series opposing.

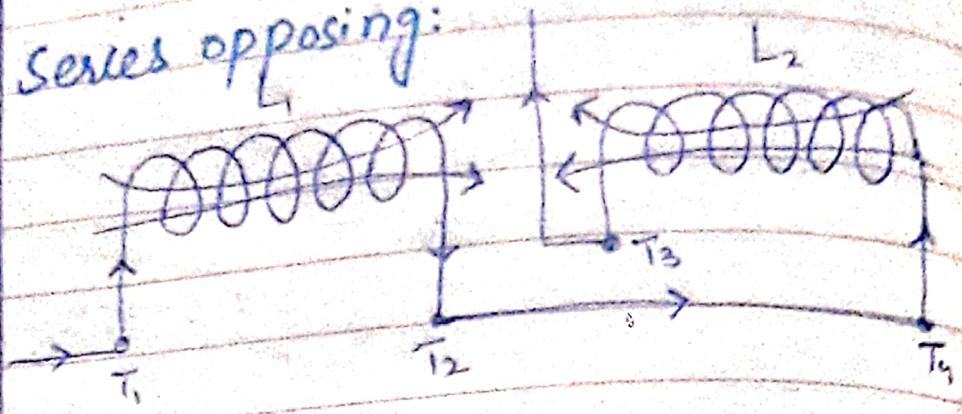
• series aiding:-



For the circuit

$$L_a = L_1 + L_2 + 2M$$

- Series opposing:



For this circuit

$$L_o = L_1 + L_2 - M$$

For mutual Inductance:

Indentlly, it can be deduce from the above two equations that

$$L_a - L_o = (L_1 + L_2 + 2M) - (L_1 + L_2 - 2M)$$

$$= \cancel{L_1} + \cancel{L_2} + 2M - \cancel{L_1} - \cancel{L_2} + 2M$$

$$= 2M + 2M$$

$$L_a - L_o = 4M$$

$$M = \frac{L_a - L_o}{4}$$

Write a note on capacitors?

Capacitor:

The capacitor is a passive two terminal electrical component. The effect of a capacitor is known as capacitance. The basic function of capacitor is to store electrical energy and give this energy again to the circuit when necessary.

Symbol: 

capacitance:-

It means the ability of capacitor to store charge. It may be defined as the amount of charge required to create a unit potential difference b/w its plates.

$$C = \frac{Q}{V} \text{ Farad.}$$

* Types:
  - Fixed capacitors
    - a) non-electrolytic type
      - i) Paper capacitors
      - ii) Mica capacitors
      - iii) ceramic capacitors.
    - b) Electrolytic type
  - variable capacitors

Fixed capacitors:

The can be grouped into two classes.

a) non-electrolytic type:

It includes paper

mica and ceramic capacitors. such capacitors have no polarity requirement i.e, they can be ~~divided~~ connected in either direction in a circuit.

i) **Paper capacitor:**

It consist of two tinfoilsheets which are separated by thin tissue, paper or waxed paper. The sandwich of foil and paper is then rolled into a cylindrical shape and enclosed in a paper tube or encased in a plastic capsule. The lead at each end is internally attatched to the metal foil.

They have capacitance range of 0.001 to 2[illegible] and voltage rating as 2000 V.

ii) **Mica capacitor:**

It is a sandwich of several thin metal plates separated by thin sheets of mica. Alternate plates are connected together and leads attatched for outside connection. The total assembly is encased in a Plastic capsule or bakelite case. capacitance of these capacitors is (50-500 pF) and voltage ratings (500V and above).

iii) **Ceramic capacitors:**

Such capacitors have disc or hollow tabular-shaped dielectric made of ceramic material such as titanium dioxide and barium titanate. Thin coating

of silver compound are deposit on both sides of disc, which act as capacitor plates.
Because of very high value of dielectric constan of ceramics ($\epsilon_r = 1200$), these type of capacitors have very large capacitance (upto 0.01μF)
capacitance range varies from 1 to 500pF with working voltage 10kV.

b) Electrolytic capacitors:
These are electrolytic because they use an electrolyte (borax or carbon salt) as negative plate.
Such capacitors possess very large capacitance ranging from 1μF to 10,000μF in very compact size.

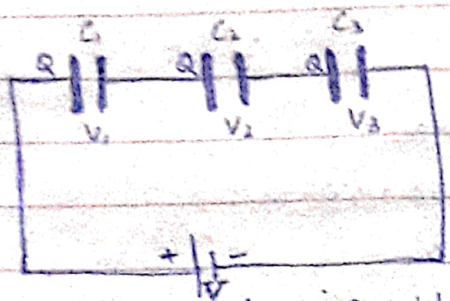
• Variable capacitors:
A capacitor whose capacitance can be changed by rotating a shaft is called variable capacitor. It consist of two sets of metal plates separated from each other by air. One set of plate is stationary and is called stator. The other set of plates is connected to the shaft and can be rotated. That's why it is called rotor.
Use: as tuning capacitors in radio receivers

Date:

Q: what is series circuit? Derive formulae for equivalent capacitance?

- Series circuit:-

The circuit in which capacitors are arranged in a chain, so the charge has only path.



Hence combined capacitance is less than smallest individual values.

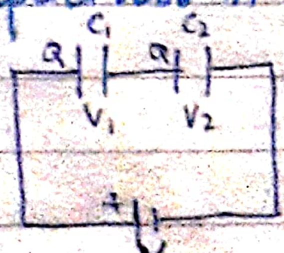
1- Charge on each capacitor is same
2- P.d across each capacitor is different
3- Sum of all voltages equals to applied voltage

$$V = V_1 + V_2 + V_3$$

4- Combined capacitance is find by.

$$\frac{1}{C_{eq}} = \frac{1}{C_1} + \frac{1}{C_2} + \frac{1}{C_3}$$

- Two capacitors in series:



1- $$\frac{1}{C_{eq}} = \frac{1}{C_1} + \frac{1}{C_2}$$

$$\frac{1}{C_{eq}} = \frac{C_2 + C_1}{C_1 C_2}$$

$$C_{eq} = \frac{C_1 C_2}{C_1 + C_2}$$

2- $V_1 = ?$

$$Q = C_1 V_1$$

$$V_1 = \frac{Q}{C_1}$$

$$= \frac{C_{eq} V}{C_1}$$

$$= \frac{C_1 C_2}{C_1 + C_2} \times \frac{V}{C_1}$$

$$V_1 = \frac{C_2 V}{C_1 + C_2}$$

$$Q = CV$$

$$\therefore V = \frac{Q}{C}$$

$$\therefore C_{eq} = \frac{C_1 C_2}{C_1 + C_2}$$

3- $V_2 = ?$ $\quad V_2 = \frac{Q}{C_2}$

$$Q = C_2 V_2$$

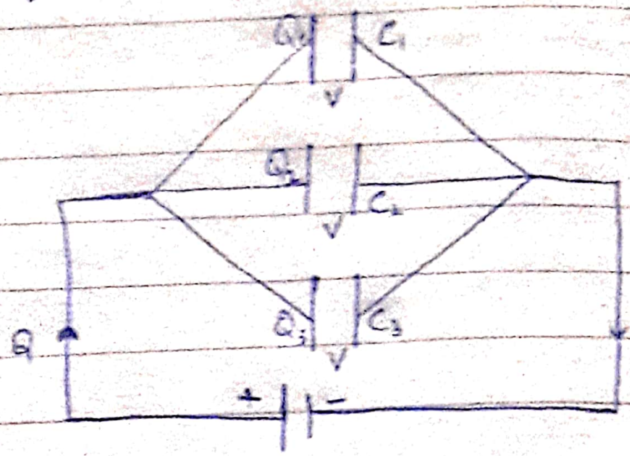
$$= \frac{C_{eq} V_2}{C_2}$$

$$= \frac{C_1 C_2}{C_1 + C_2} \times \frac{V}{C_2}$$

$$V_2 = \frac{C_1 V}{C_1 + C_2}$$

8. Capacitors in parallel:

Connecting capacitors in parallel is equivalent to adding their plate areas hence combined capacitance is equals the sum of individual capacitances.



1- Charge across each capacitor is different

2- P.d across each capacitor is the same i.e applied voltage

3- Sum of individual charge equals to the total charge applied by power source

$$Q = Q_1 + Q_2 + Q_3$$

4- combined capacitance is equals to sum of individual capacitance

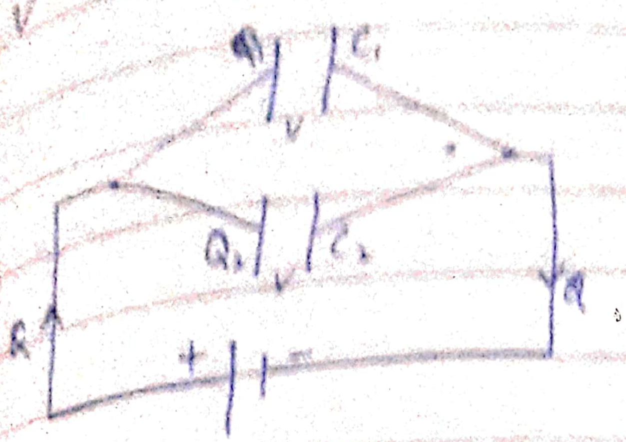
$$C = C_1 + C_2 + C_3$$

5- Voltage provided to each capacitor is same

$$V = V_1 = V_2 = V_3$$

Two capacitors in parallel:-

V is same across both capacitors.



$$V = \frac{Q_1}{C_1} = \frac{Q_2}{C_2} \quad \text{or} \quad \frac{Q_1}{Q_2} = \frac{C_1}{C_2}$$

2- $Q_1 = ?$

$$Q_1 = C_1 V$$
$$= C_1 \frac{Q}{C_{eq}} \qquad \because C_{eq} = C_1 + C_2$$

$$Q_1 = \frac{C_1 Q}{C_1 + C_2}$$

3- $Q_2 = ?$

$$Q_2 = C_2 V$$
$$= C_2 \frac{Q}{C_{eq}}$$

$$Q_2 = C_2 \frac{Q}{C_1 + C_2}$$