Gayathri Vidya Parishad College of Engineering for Women
(Autonomus)

I B.Tech I semester Regular Exams Dec/ Jan 2025 (1)

Fundamentals of Electrical Engineering

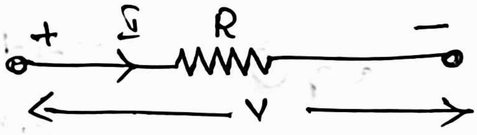
Solutions

1) a) Electrical Circuit elements – Resistor, Inductor, Capacitors → (1m)

Resistor :- The Resistor is an energy dissipating element used in an electrical circuit. The property of Resistor is Resistance which is described by ohm's law. Its states that the Voltage across Resistor is directly Proportional to the Current through it at constant temperature and pressure. → (2m)

$$V = IR \quad \text{volts}$$

I – current in amperes
R – Resistance in ohms
V – Voltage.



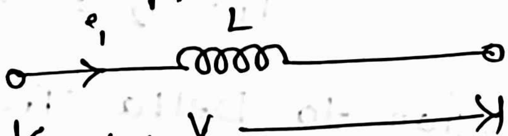
A physical device offering resistance to the flow of current is called Resistor. The power dissipated by the resistor is given by

$$P = Vi = IRi = i^2R$$

$$P = i^2R \quad \text{(or} \quad P = \frac{V^2}{R} \quad \text{— eq (1)}$$

Inductor :- It stores the magnetic energy. It is property of Inductance.

$$V = L\frac{di}{dt} \quad \text{— eq (2)}$$



The property L is known as self inductance. The voltage drop across the element is proportional to the rate of change of current. → (2m)

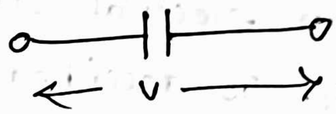
i – current in amperes
V – voltage across it.

The unit of inductance is henry (H). The effect of inductance is to oppose the change of current flowing through it. ②

eq ② can be written as
$$e_1 = \frac{1}{L}\int v\,dt$$

Capacitor :- It is used to represent charge storage. A capacitor is a condensor. It is an electrical device consisting of two conductors separated by an insulating medium. The ratio of charge on one of the conductor of the capacitor to potential difference between the two conductors is called capacitance.

$$C = \frac{q}{V} \text{ farads} \quad \text{— eq ③}$$



q - charge in coulombs → (2m)

V - potential difference in volts

1b) eq ① — $-4 + I_1 0.5 - 12 + (I_1 + I_2) 2 = 0$

$$2.5 I_1 + 2 I_2 - 16 = 0 \quad \rightarrow (2m)$$

eq ② — $-12 + (I_2 + I_1) 2 + I_2 5 = 0$

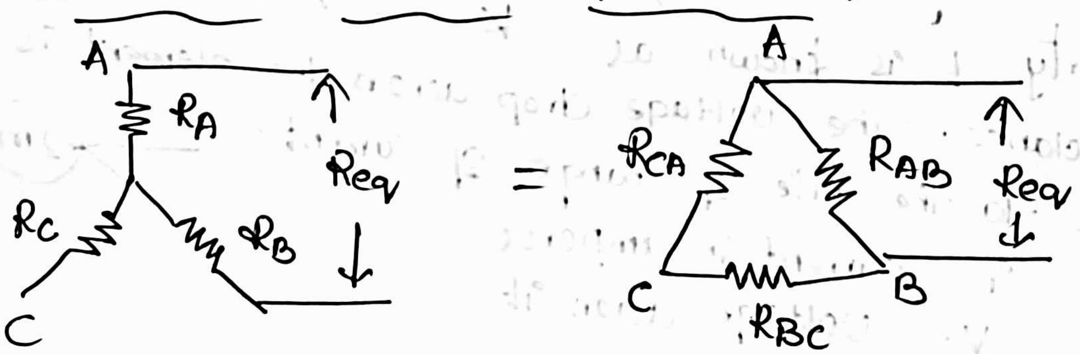
$$2 I_1 + 7 I_2 - 12 = 0 \quad \rightarrow (2m)$$

$I_1 = 6.51 A$ → (1m)

$I_2 = 6.36 A$ → (1m)

$I_1 - I_2 = 0.148 A$ → (1m)

2) a) Star to Delta Transformation :-



$$R_A = \frac{R_{CA} R_{AB}}{R_{AB} + R_{BC} + R_{CA}} \quad \text{--- (1)}$$

$$R_B : \frac{R_{AB} R_{BC}}{R_{AB} + R_{BC} + R_{CA}} \quad \text{--- (2)}$$

$$R_C = \frac{R_{CA} R_{BC}}{R_{AB} + R_{BC} + R_{CA}} \quad \text{--- (3)}$$

By eq (1)/(2)

$$\frac{R_A}{R_B} = \frac{\frac{R_{CA} R_{AB}}{R_{AB} + R_{BC} + R_{CA}}}{\frac{R_{BC} R_{AB}}{R_{AB} + R_{BC} + R_{CA}}} = \frac{R_{CA}}{R_{BC}} \quad \text{--- (4)}$$

$$R_{CA} = \frac{R_A}{R_B} R_{BC} \quad \text{--- (5)}$$

similarly by eq (1)/(3)

$$\frac{R_A}{R_C} = \frac{\frac{R_{CA} R_{AB}}{R_{AB} + R_{BC} + R_{CA}}}{\frac{R_{CA} R_{BC}}{R_{AB} + R_{BC} + R_{CA}}} = \frac{R_{AB}}{R_{BC}} \quad \text{--- (6)}$$

$$R_{AB} = \frac{R_A}{R_C} R_{BC} \quad \text{--- (7)}$$

Putting eq (5) & (7) in eq (1)

$$R_A = \frac{R_{AB} R_{AC}}{R_{AB} + R_{BC} + R_{CA}}$$

(4)

$$R_A = \frac{\frac{R_A}{R_C} R_{BC} \cdot \frac{R_A}{R_B} R_{BC}}{\frac{R_A}{R_C} R_{BC} + R_{BC} + \frac{R_A}{R_B} R_{BC}}$$

$$R_A = \frac{R_A^2 R_{BC}}{R_A R_B + R_C R_B + R_A R_C}$$

$$R_{BC} = \frac{R_B R_A + R_C R_B + R_A R_C}{R_A^2 / R_A}$$

$$R_{BC} = R_B + R_C + \frac{R_C R_B}{R_A} \longrightarrow (2m)$$

Illy $$R_{CA} = R_C + R_A + \frac{R_C R_A}{R_B} \longrightarrow (2m)$$

$$R_{AB} = R_B + R_A + \frac{R_B R_A}{R_C} \longrightarrow (2m)$$

2) b) Ohms law – At constant temperature the current flows through the conductor is directly proportional to potential difference and inversely proportional to the resistance across its ends $\longrightarrow$ (2m)

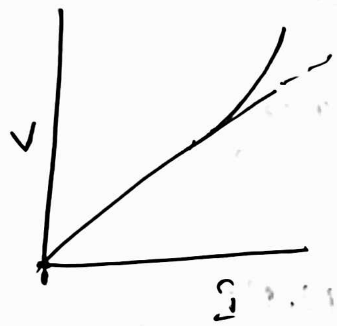
$I \propto V$

$I \propto \frac{1}{R}$

$\boxed{I = \frac{V}{R}}$ $\boxed{V = IR}$ $\boxed{R = \frac{V}{I}}$ — (2m) limitations of ohms law :-

1. Ohms law depends on temperature were the temperature should be constant for a given circuit of conductor. → (2m)
2. Non ohmic materials (diode, Transistors) do not obey ohms law as their resistance changes with voltage (or) current
3. it is not applicable to non linear components eg: Thyristor

V-I characteristics (graph) :- → (1m)



3) a) Self inductance :- It is the property of a coil due to which opposes the sudden change of current flowing through it self.

1st method :- $e = L\frac{di}{dt}$ —(1)

$e = N\frac{d\phi}{dt}$ —(2)

eq (1) & (2)

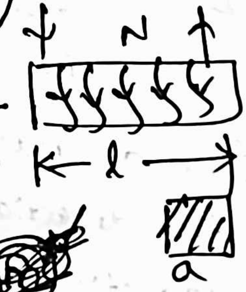
$L\frac{di}{dt} = N\frac{d\phi}{dt}$

$Li = N\phi$

$$L = \frac{N\phi}{I}$$ Wb turns/amp (or) Henry.

2nd method → (3m)

$L = N\frac{d\phi}{dI}$ (1/2m)



$\phi = \frac{Ni}{\frac{l}{a\mu_0\mu_r}}$

Differentiating ϕ w.r.t I we get

$\frac{d\phi}{dI} = \frac{Na\mu_0\mu_r}{l}$

$L = \frac{N^2a\mu_0\mu_r}{l}$

$$L = \frac{N^2}{S}$$ Henry

Mutual inductance :- The property of one coil due to which oppose the change of current in Neighbouring coil (6)

1st method

$$e_m = M \frac{di_1}{dt}$$

$$e_m = \frac{d}{dt}(M i_1)$$

$$e_m = N_2 \frac{d\phi_{12}}{dt}$$

$$e_m = \frac{d}{dt}(N_2 \phi_{12})$$

from these we have

$$M i_1 = N_2 \phi_{12}$$

$$\boxed{M = \frac{N_2 \phi_{12}}{I_1}}$$

2nd method

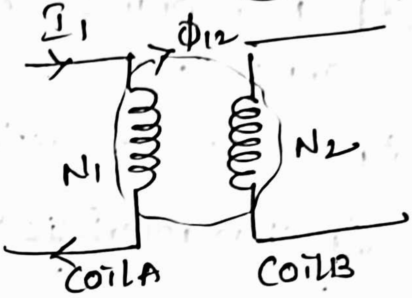
$$\phi_{12} = \frac{N_1 I_1}{\frac{l}{a \mu_0 \mu_r}}$$

$$M = \frac{N_2 \phi_{12}}{I_1}$$

$$M = \frac{N_1 N_2 \, a \mu_0 \mu_r}{l}$$

$$\boxed{M = \frac{N_1 N_2}{\frac{l}{a \mu_0 \mu_r}} = \frac{N_1 N_2}{S}}$$

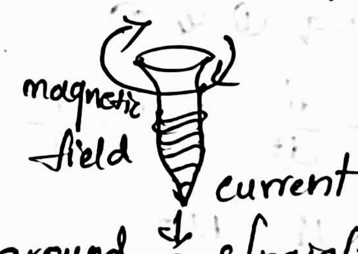
(3m)



(1/2 m)

3) b) Maxwell Cork screw Rule :-

Hold the cork screw in your right hand & rotate it in a direction of current. Then such a way that it advances in the direction of the direction in which the hand rotates will be the direction of magnetic lines of force → (3m)



Explanation :- We know that a current carrying conductor creates a magnetic field around it. The nature of magnetic field around a straight current carrying conductor is like concentric circles having their centre at the axis of the conductor. The direction of these circular magnetic lines is dependent upon the direction of current. The density of the induced magnetic field is directly proportional to the magnitude of the current.

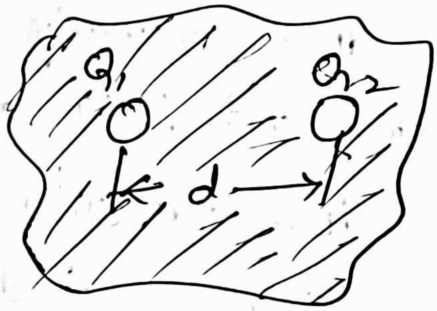
Direction of the Circular magnetic field lines given by Maxwell's Right hand grip rule (or) Right hand Cork screw rule. —— (4m)

4) a) Coulombs ~~flaw~~ first Law :- —— (3m)

This law relates to the nature of force between two Charged bodies and may be stated as like charge repel each other while unlike charges attract each other.

Coulombs Second Law :- —— (3m)

The force between two points is directly proportional to Product of their magnitudes & inversely proportional to Square of distance between them.



$$F \propto \frac{Q_1 Q_2}{d^2}$$

(or)

$$F = k \frac{Q_1 Q_2}{d^2}$$

Where k is constant whose value depends upon medium in which the charges are placed.

$$k = \frac{1}{4\pi \varepsilon_0 \varepsilon_r}$$

ε_0 - Absolute permittivity of air

ε_r - Relative Permittivity of medium

$\varepsilon_0 = 8.854 \times 10^{-12}$ F/m

$$F = \frac{Q_1 Q_2}{4\pi \varepsilon_0 \varepsilon_r d^2}$$ —— (1m)

4) b) Lenz law :- —— (2M)

- An induced current will flow in such a direction so as to oppose the cause that produces it.

Biot Savart's law :- —— (3m)

It states that the magnetic field intensity (H) or magnetic flux density (B) at any point due to current (I) flowing through the element of length (dl) is directly proportional to

i, dB ∝ current carried by the element (I)

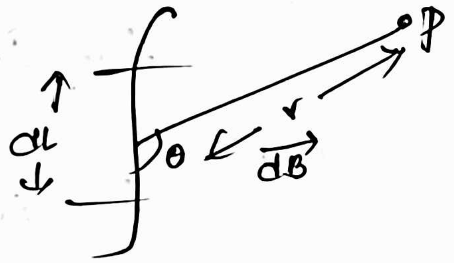
ii, dB is proportional to length of the element (dl)

iii, dB is proportional to sin θ at point P.

iv, dB is inversely proportional to square of the distance from point P to dl.

$dB \propto I\,dl \sin\theta$

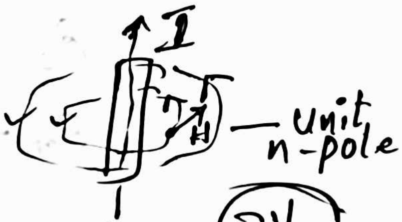
$$dB = \frac{\mu_0 I\,dl \sin\theta}{4\pi r^2}$$



Ampere Circuital law :- —— (2M)

it states that the line integral of magnetic field intensity (H) over a closed loop is equal to μ_0 times the total current enclosed by the path.

$$\oint H\,dl = \mu_0 I$$



3) a)

Moving Coil (3½)	Moving Iron (3½)
1) It can measure direct current (DC) only	1) It can measure DC as well as AC also.
2) In this the deflection of pointer is directly proportional to the current in the coil $\theta \propto I$	2) The deflection of the pointer is directly proportional to square of the current. $\theta \propto I^2$

3) A measuring instrument which involves the movement of a coil in a magnetic field of a permanent magnet to measure the electric current (or) voltage is called the instrument	3) The measuring instrument in which a core of soft iron moves in a magnetic field of an electromagnet to measure the electrical current (or) voltage is called M.I instrument. (9)
4) uniform reading scale	4) Cramped at starting, Non uniform scale.
5) Accurate	5) less accurate
6) Permanent Magnet	6) electromagnet
7) More sensitive	7) less
8) Eddy current damping	8) Air friction damping
9) less Robust	9) Robust
10) less Power Consumption	10) More Power Consumption
11) Hysteresis loss doesnot occur	11) Hysteresis loses take place.
12) Current range 10 µA to 100 mA	12) Current range high 10mA to 100A.
13) electrodynamometer, PMMC - examples	13) voltmeter, ammeter - examples
14) Expensive	14) less expensive.
15) Control spring to provide Controlling torque	15) Tc is provided by gravity (or) Spring Control

5) b) Single phase dynamometer type wattmeter

(3m)

Construction :-

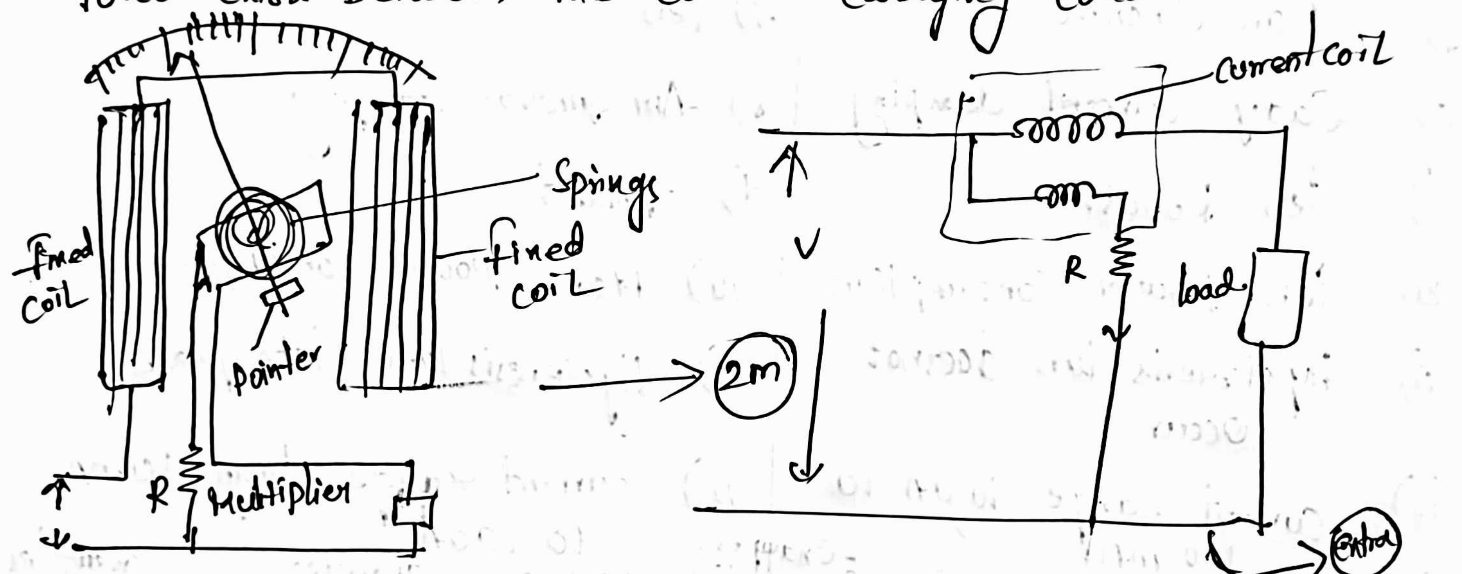
1) when a dynamometer instrument is used as wattmeter the fixed coils (FF) are connected in series with the load and carry load current. (I_1) This is called as current coil.

2) The moving coil (m) is connected across the load to a series multiplier (R) and carries a current (I_2) proportional to the load voltage this is known as potential coil

3) This Controlling torque is provided by spiral springs which also serve the additional purpose of leading current into & out of moving coil.
4) Air friction damping is provided and a pointer is attached to the movable coil.

Principle :- ——— (2m)

1) This is used for the measurement of both DC as well as AC
2) These instruments are based on the principle that mechanical force exists between the two current carrying conductors.



6) a) Single phase induction type energy meter

Construction :- ——— (3m)

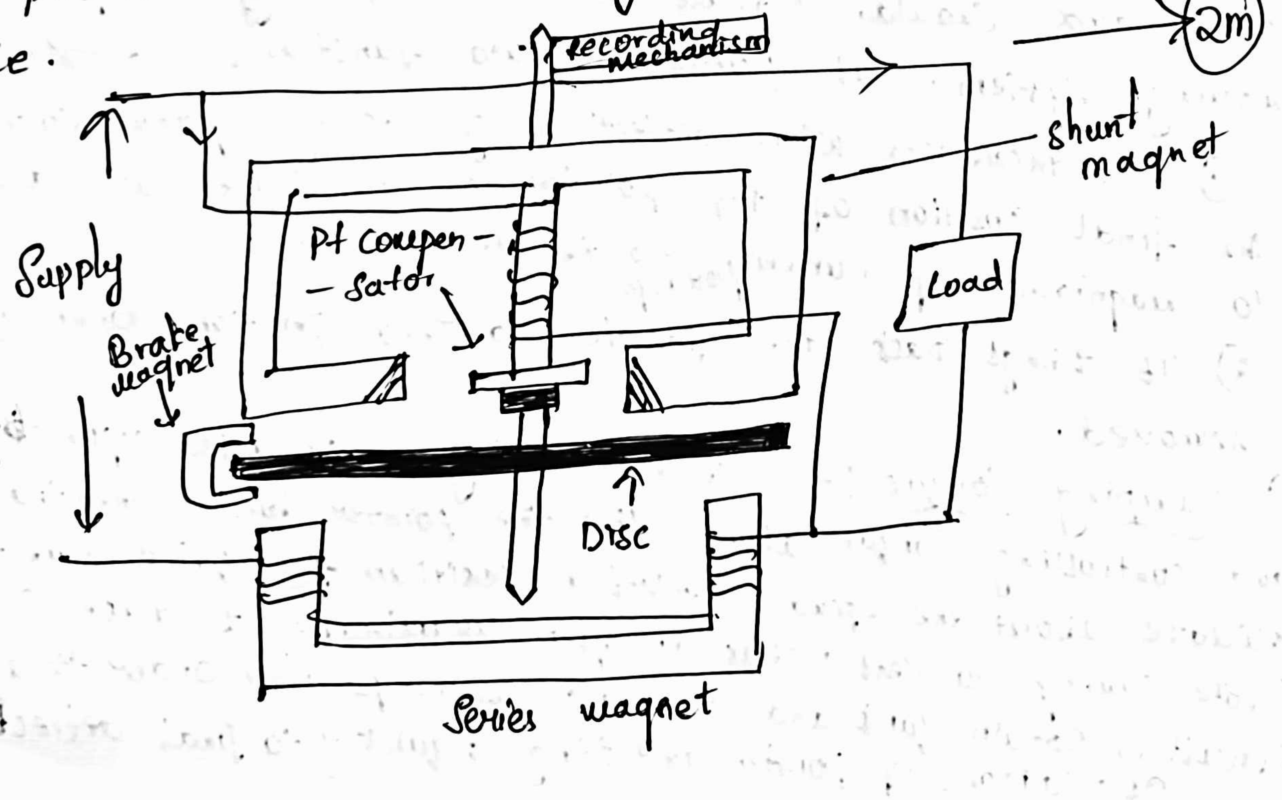
1) It consists of two Laminated electromagnets. One is called shunt magnet is connected across the supply & carries current proportional to the supply voltage. The coil of this magnet is made highly inductive so that the current in it Lags behind the supply voltage by 90°. The other electromagnet called series magnet is connected in series with the supply & carries the load current. The coil of the magnet is made highly non inductive so that angle of lag (or) lead is determined by the load.

A thin aluminium disc mounted on the spindle is placed between the two magnets so that it cuts the flux of both the magnets. The controlling torque is provided by spiral spring. The damping is electro magnet and is usually provided by permanent magnet embracing the aluminium disc. Two (or more closed copper rings (called shading rings) are provided on the central limb of the shunt magnet. By adjusting the position of these rings, the shunt magnet flux can be made of lag behind the supply voltage by exactly 90°

Working :- → 2m

When the wattmeter is connected in the circuit to measure ac power the shunt magnet carries current proportional to the supply voltage & series magnet carries the load current. The two fluxes produced by the magnets induce fluxes ce eddy currents produces the deflecting torques on the disc, causing the pointer connected to the moving system to move over a scale. The pointer comes to rest at a position where deflecting torque is equal to controlling torque.

→ 2m



6) b) Various forces acting on indicating instruments:- (12)

It consits of moving s/m pivoted in jewel bearings. A pointer is attached to the moving system which indicates on a graduated scale, the value of the electrical quanity being measured. In order to ensure proper operation the various forces are required.

① Deflecting (or operating torque
② Controlling (or) Restoring torque
③ Damping torque. → (1m)

① **Deflecting torque** :- It causes the moving system to move from zero position to indicate on a graduate scale the value of electrical quantity being measured. → (2m)

② **Controlling torque** :- If deflecting torque were acting alone the pointer would continue to move indefinitely and would swing over the maximum deflected position irrespective of the magnitude of current to be measured. This necesitates to provide some form of controlling torque. where it oppose the deflecting torque and should increase with the deflection of the moving system. It performs two functions → (2m)

① It increases with deflection of moving system so that the final position of the pointer on the scale will according to magnitude of current/voltage to be measured.

② It brings back the pointer to zero position when T_d is removed.

③ **Damping torque** :- If the moving s/m is acted upon deflecting and controlling torque alone, then the pointer due to inertia will oscillate about the final deflected position for quite some time before coming to rest. this is often undesirable because it makes difficult to obtain quick and accurate readings. In order to avoid these oscillations of pointer and bring it quickly to final deflected position a damping torque is provided in the indicating instruments. → (2m) (13)

7) a) i) Dielectric Loss :- → (3m)

* For dielectric losses only volume leakage currents is taken into consideration.
* The power loss due to I_s is dissipated as heat into the surroundings and this loss doesn't influence the heating of the dielectric

$$P = 2\pi f C V^2 \tan\delta \text{ watts}$$

V- Voltage , C = Actual capacitance of the dielectric

$\tan\delta$: Dielectric loss tangent

* Dielectric power loss $\propto$ frequency.
* However 'C' & $\tan\delta$ → depends upon frequency.
* the dielectric losses are greater at high frequencies and this make it more difficult to select insulating materials for high frequency applications
* In high frequency engineering quality factors of the insulation (Q_f) is taken instead of $\tan\delta$.

$$Q_f = \frac{1}{\tan\delta}$$

* The $\tan\delta$ (or) Q_f serves to characteristics not only a given material but also insulation system of machine.
* For liquid & solid dielectrics '$\tan\delta$' ranges from several ten thousands to several tenths.

7) a) ii, Piezo electric materials:- → (2m)

It is the one in which an electric potential appears across a crystal if the dimensions of the crystals are changed by the application of mechanical force. This potential is produced by the displacement of external charges. The effect is reversible ie, conversely, if a varying potential is applied to the proper axis of the crystal, it will change the dimensions of the crystal thereby deforming it. This effect is known as Piezo electric effect.

$$E = \frac{gtF}{A} = gtp$$

$g = \frac{k}{t}$, k = piezoelectric constant, t = thickness of the crystal.

g - voltage sensitivity in Vm/N
F - force in N (newton)
A - Area of the crystal in m²
P - Pressure $= \left(\frac{F}{A}\right)$ in N/m²

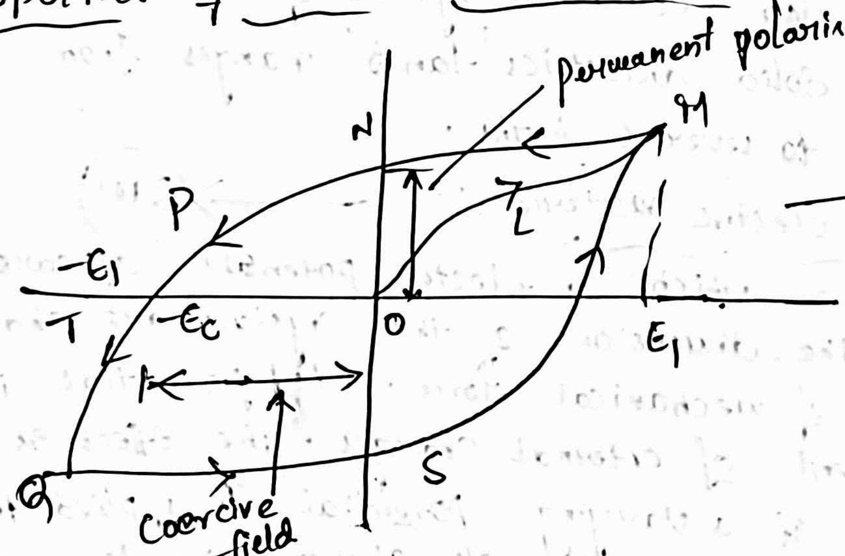
7) a) (iii) Pyroelectric materials :- → (2M)

Polarisation due to permanent dipoles present inside an insulator depends on the temperature, as such, a change in the temperature of the crystal produces a change in polarisation which can be detected. Thus it is called pyroelectric effect.

$$\Delta P = \lambda \Delta T$$

ΔP - change in polarisation
λ - Pyroelectric constant
ΔT - change in temperature

7) b) Properties of Ferroelectric materials → (5M)



→ (2M)

Consider a virgin specimen of a ferroelectric material i.e., a specimen with no initial polarisation.

* On application of a progressively increasing electric field E, the polarisation increases along the curve OLM.
* Next let the field be reduced so that polarisation reduces from its initial value at M along the curve MNPQ. It may be seen that when $E=0$, there exists a certain residual polarisation P_r. Stated otherwise the material is spontaneously polarised.
* On further reducing the electric field E in the negative direction the polarisation is ultimately reduces to zero at $E=-E_C$ at point P on the curve. This is electric field. E_C is refered to as coercive field.
* If the electric field is made further −ve, the polarisation also becomes −ve and finally reaches a value equal to $-E_1$. Point Q represent this condition.
* Next on increasing E from $-E_1$ to $+E_1$ the polarisation moves along the curve QSM. The closed curve MNPQSM constitutes the so called hystresis curve.
* Any further reversal of E between the limits E_1 and $-E_1$ results in retracing of the same hysteresis curve. The curve OLM traced during the initial polarisation of the material is called the initial polarisation curve.

8) a) i, Spontaneous Magnetization :— ⟶ (3m)

* Ferromagnetic materials exhibit spontaneous magnetisation below curie temperature.
* Let $B = 1\ Wb/m^2$ ⟶ Remanent flux density

$$\therefore H=0;\quad M_r = \frac{B_r}{\mu_0} \simeq 10^6\ A/m$$

Also magnetic dipole moment in an atom $\simeq 10^{-23}$ amp-m²

$M = N \times$ dipole moment

∴ No's of atoms per m3 volume of a soild = 10^{29}

* M – indicates parallel alignment of essentially all the dipoles in the materials.

* In ferromagnetic materials, according to weis, the internal field seen by a given dipole is equal to the applied field plus a contribution from the neighbouring dipoles which tend to align it in the same direction as its neighbours.

$$H_i = H + \gamma M$$

H_i – Internal field

H – applied field.

γ – A measure of tendency of environment to align a particular dipole parallel to the magnetisation already existing.

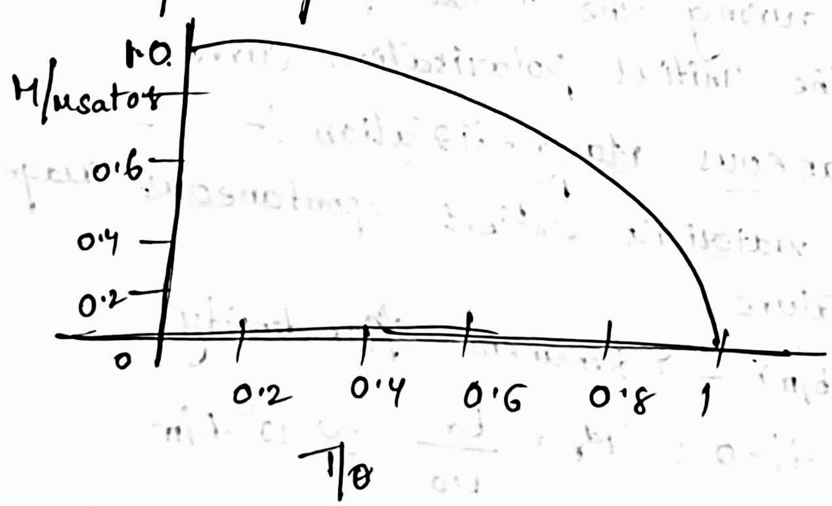
γ → Internal field constant (shows interaction which takes place b/w poles)

M – magnetisation

M_{sat} – Saturation value of magnetisation

T – Temperature

θ – paramagnetic Curie temperature



8) a) ii, Ageing of Magnets :- ⟶ (2m)

It is a process of normal change, under continued normal (or specified artifical conditions in the strength of the magnetic field maintained. The change in field strength due to ageing is usually expressed in percent.

It is of two types
① Metallurigical
② Magnetic.

These may occur either singly (or in combination with the other.

8) a) iii, Spontantaneous Polarisation :- ⟶ (2m)

let E = field intensity applied to the specimen
E_i = induced internal field
P = polarisation
γ = Internal field constant
ε_0 = Permitivity of vaccum
α = polarisability
N = No. of small cube units in the materials.

This vanishes at curie temperature of the material. The polarisation will occur at

$E = 0$, if $N\alpha\gamma = \varepsilon_0$

In common insulating materials of solid nature there is an induced internal field.

$$E_1 = E + \frac{\gamma P}{\varepsilon_0}$$

The polarisation of the material is given by

$$P = N\alpha E_i$$

$$= N\alpha \left[E + \frac{\gamma P}{\varepsilon_0} \right]$$

$$P = \frac{N\alpha E}{1 - \frac{N\alpha\gamma}{\varepsilon_0}}$$

The spontaneous polarisation will take place that p has a non vanishing value at

$$E = 0 \text{ if } \left[1 - \frac{N\alpha\gamma}{\varepsilon_0} \right] = 0$$

if $N\alpha$ is very large the spontaneous polarisation will take place. this will occur if γ is large that is interaction between atoms is very large.

8) b) Characteristics of soft magnetic materials :- → (3m)

The magnetically soft materials are characterised as follow

1) They have high permeability.
2) The magnetic energy stored is not high.
3) They have negligible coercive force
4) They have low remanence.

Ex:- Ingot iron (or) pure iron, cast iron, carbon steel (1/2m)

Characteristics of Hard magnetic materials :- → (3m)

magnetically hard materials are used for making permanent magnets and have the following characteristics

1) they possess high values of B-H product
2) High retentivity
3) High coercivity
4) Strong magnetic reluctance.

5). Hysteresis loop is more rectangular in shape (19)

ex:- Tungsten steel, Cobalt steel, chromium steel Alnico, cunife, etc. → (1/2m)

9) a) i) Conductor Sizes:- → (3m)

The cables are specified in no. of ways such as type of Conductor material, no. of Cores that the Cable consists.

i) $\frac{7}{20}$ VIR Aluminium Conductor, twin Core, 650/1100 grade.

The numerator 7 indicates no. of strands in Cable

the denominator 20 represents the gauge no. of each strand.

the cable has 2 cores made with aluminium with VIR insulation and is used for 650/1100 Voltage.

ii) $\frac{19}{1.12}$ Aluminium Conductor, $3\frac{1}{2}$ Core, 1100 V ; pvc cable pvc sheathed.

19 strands each strand have a diameter of 1.12 mm the Conductor is made with Aluminium insulation is made with pvc is Covered with pvc sheathing and is used for 1100V supply system.

9) a) ii) Current ratings:- → (2m)

The size of Cable should be such that it should Carry the maximum Circuit Current Continuously without overheating. Copper conductor

S.NO	Size of cable: No. of dia of wire in mm	Size of cable: No. of size of equivalent SWG	Nominal cross Section area in mm²	Current rating at 40°C in ampere: Single core Cable	Current rating at 40°C in ampere: 3(or) 4 Cable
1.	1/1.12	1/18	1.0	5	5
2.	3/0.736	3/22	1.5	10	10
3.	3/0.915	3/20	2.0	17	13

— Aluminium Conductor.

Size of the Cable				Current rating at 40°C in ampere.	
S.No.	No. & dia of wire in mm	No. & size of equivalent SWG	Nominal Cross sectional in mm²	Single core Cables	3 or 4 Cables
1.	1/1.40	3/22	1.5	10	9
2.	1/1.80	3/20	2.5	15	11
3.	1/2.24	7/22	4.0	20	16

→ 2m

Q5) a) iii, Services Mains :-

The line (or) cable that brings electrical energy from the suppliers distributing lines to the consumer premises is known as service mains (or) service lines.

① Over head service mains
② Under ground service mains

① The service lines provided above the ground level is known as over head service mains.

② The service line provided below the ground level is known as underground service line.

9) b) Principle of Miniature circuit breaker : ---------------(4M)

A **Miniature Circuit Breaker (MCB)** is an electro-mechanical device that provides automatic protection to electrical circuits from **overloads** and **short circuits**. It operates by interrupting the current flow when it exceeds the rated limit. MCBs are widely used in residential, commercial, and industrial systems as safer and more reliable alternatives to traditional fuses.

Under normal conditions, the MCB operates as a manual switch to turn the circuit ON or OFF. When an overload or short circuit occurs, the MCB automatically trips to disconnect the circuit and prevent damage.The MCB uses two protection mechanisms: **thermal tripping** and **magnetic tripping**

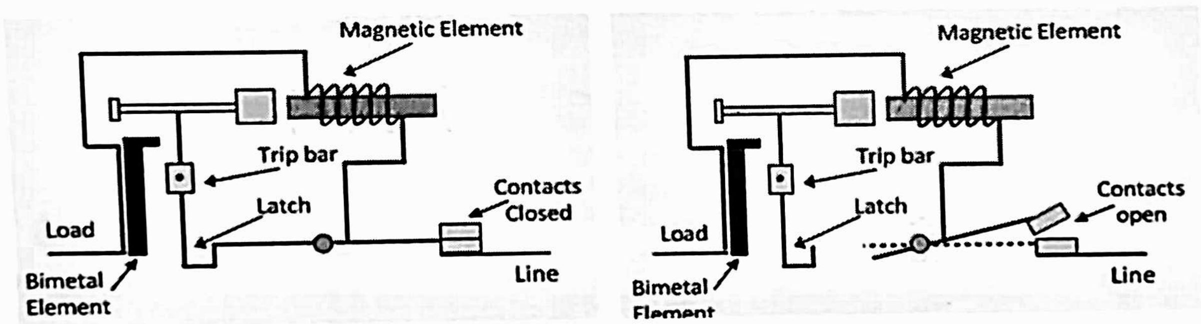
Thermal Tripping:

1. The current passing through a **bimetallic strip** causes it to heat up. This deflection of the strip activates the trip mechanism, disconnecting the circuit in case of overload.
2. The bimetallic strip is made of two metals with different expansion rates (typically brass and steel). Under normal current, the strip does not deflect. However, when the current exceeds the rated value, the strip bends due to thermal expansion, triggering the tripping mechanism.

2. Magnetic Tripping:

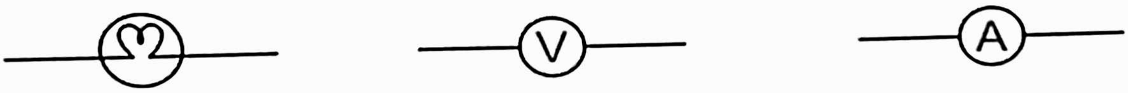
1. In case of a short circuit or heavy overload, a **magnetic coil** generates a strong magnetic field that pulls on a magnetic slug. This movement activates the tripping mechanism, causing the MCB to trip quickly and disconnect the circuit.
2. The magnetic system is designed to respond to fast, high-current faults, such as short circuits.

Diagram: -------------- (3M)



10) a) i) Electrical symbols: ----------------(3M)

In general, an electrical symbol is a small image that is used to represent an electrical or electronic function or device. They are also called circuit symbols or schematic symbols as they are used in electrical diagrams and schematics.



Bulb Voltmeter Ammeter

Resistance

Ground

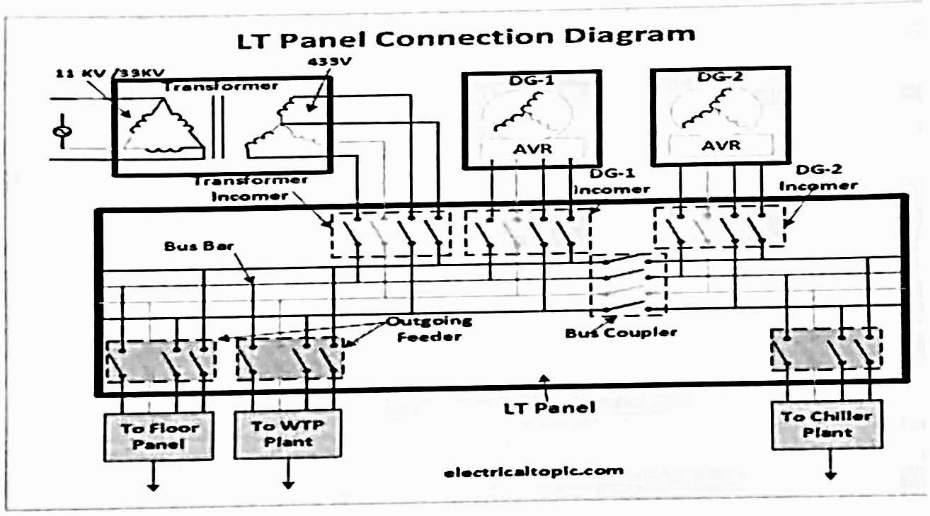
10) a) ii) Distribution board:-------------------(2M)

A distribution board is a component of an electricity supply system that divides an electrical power feed into subsidiary circuits, while providing a protective fuse or circuit breaker for each circuit in a common enclosure. A distribution board is also known as panelboard, breaker panel, or electric panel.

10) a) iii) Meter Board: ------------- (2M)

A meter board contains the electricity meter, which is responsible for recording the amount of energy you consume for your retailer to bill you for it.

10) b) LT Panel wiring Diagram : --------------------- (3M)



List of components : ---------------------- (1M)

1-Measuring meters.

2- Indicator and Selector switches:

3- Protection relays.

4- Circuit Breakers

Explanation ----------------------- (3M)

1-Measuring meters.

Measuring meters are used for measuring the system parameters like as volt meter, amp meter, multifunction meter etc.

A- Digital Multifunction Meter: Digital multifunction meters are used for measuring the amp, current, voltage, energy, power factor etc.

B- Energy meter: Different types energy meters are used for measuring the power like as 3 phase dual source, 3 phase single source etc.

2- Indicator and Selector switches:

A- Indicators: Indicators are used for knowing the status of panel operation. Different type of indicators are used with different color.

- R Phase.
- Y Phase.
- B Phase.
- ACB ON.
- ACB OFF.
- ACB Trip.
- MCCB ON
- MCCB OFF
- MCCB Trip.

B- Selector Switches: selector switch is used for auto and manual function.

3- Protection relays.

- A protection relay is an automatic switching device which senses the abnormality in electrical circuit and provides a tripping signal to the circuit breaker for tripping resultant the rest equipment remains safe.
- Protection relay is used for LT panel safety which is installed in LT Panel as different types like as differential relay, reverse power relay, over voltage relay, under voltage relay and earth fault relay.
- Differential relay: The differential relay is commonly used in generators and transformers panel which is used for protection of any abnormality in input and output power supply of DG panel or LT panel. The main function of differential relay is to compare input and output current difference. If any side current value is low or high as per set value then differential relay will be active and circuit breaker will be trip.
- Over Voltage Relay: OVR is an automatic switching device when senses any abnormality in voltage variation as per preset value then it will provide tripping signal to the circuit breaker so that system will safe. Over voltage relay is used for protection against over voltage because due to over voltage the insulation may be failure.Over voltage relay is used in multiply of 5% voltage of 415 volt. It is used in LT panel or isolation panel of transformer outgoing.

4- Circuit Breaker: Circuit breaker is used in LT panel for switching power supply incomer or outgoing feeders. Generally, two types breakers are used in LT panel as ACB and MCCB.

Air circuit breaker (ACB): This breaker is used in LT panel. It is works as a switching device manually or auto. It is used for control and protect of Electrical system from overload and short-circuit. In which breaker the air is used as arc quenching medium that breaker is called as air circuit breaker.

B- MCCB- Molded Case Circuit Breaker: MCCB Circuit breaker is used in LT panel for switching and controlling the power supply from overload and short-circuit. Generally it is used 100 Amp to 800 Amp in LT panel. It is installed for switching the power supply to the outgoing feeders.

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