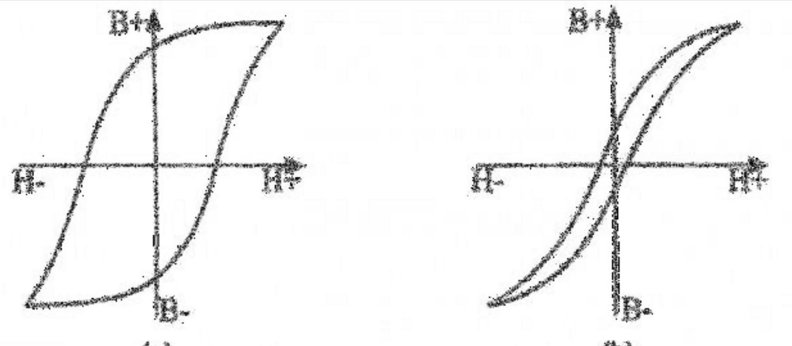
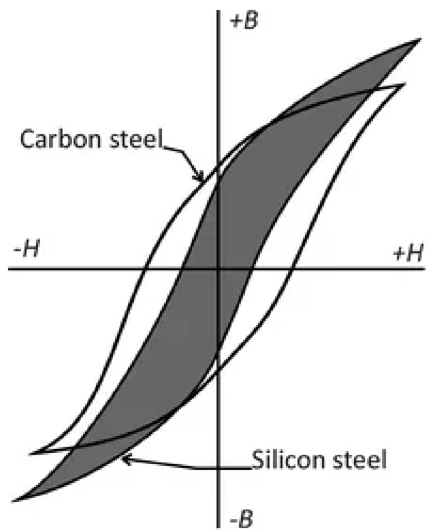
WINTER- 2019 Examinations

Important suggestions to examiners:

1) The answers should be examined by key words and not as word-to-word as given in the model answer scheme.
2) The model answer and the answer written by candidate may vary but the examiner may try to assess the understanding level of the candidate.
3) The language errors such as grammatical, spelling errors should not be given more importance. (Not applicable for subject English and communication skills)
4) While assessing figures, examiner may give credit for principle components indicated in a figure. The figures drawn by candidate and model answer may vary. The examiner may give credit for any equivalent figure drawn.
5) Credits may be given step wise for numerical problems. In some cases, the assumed constant values may vary and there may be some difference in the candidate's answers and model answer.
6) In case some questions credit may be given by judgment on part of examiner of relevant answer based on candidate understands.
7) For programming language papers, credit may be given to any other program based on equivalent concept.

Q.1	**Attempt any FIVE of the following : 10 Marks**
a)	**Define the term resistance and state its unit.**
Ans	**Resistance(R) :** **(Definition: 1 Mark & Unit: 1 Marks, Total 2 Marks)** It is defined as the opposition offered by conductor to electric current. It is measured in ohm (Ω) and represented by R.
b)	**State Krichhoff's current law and Krichhoff's voltage law.**
Ans	**(Kirchhoff's current law 1 Mark, Kirchhoff's voltage law 1mark, Total 2 Marks)** **i) Kirchhoff's current law**: - **(1 Mark)** It states that in any electrical circuit, at any node or junction, the algebraic sum of currents is equal to zero. **OR** At any node or junction in an electric circuit, the total incoming current is equal to the total outgoing current i..e $\Sigma I = 0$ **ii) Kirchhoff's voltage law**: - **(1 Mark)** It states that in any closed circuit or mesh, the algebraic sum of all the emfs and the voltage drops (IR) is equal to zero. **OR** In any closed loop or mesh, the total voltage rise ie equal to the total voltage drop. i.e. Σ emf + Σ IR = 0
c)	**Give two types of capacitor and give one example of each.**
Ans	**Types of Capacitor and examples:** **(Any two types expected: 1 Mark each, total: 2 Marks)**

	The capacitor is a passive component and it stores the electrical energy into an electrical field. The effect of the capacitor is known as a capacitance. It is made up of two close conductors and separated by the dielectric material. There are two main types of capacitors : 1) Polarised and 2) Non polarized Capacitors can also be classified according to type of supply used: 1) AC capacitors 2) DC capacitors Another way to classify capacitors is 1) Fixed capacitors 2) Variable capacitors Examples of different capacitors are 1) Polarised capacitors Electrolytic capacitors, tantalum capacitors 2) Non polarized capacitors Paper capacitors, ceramic capacitors, mica capacitor, film capacitors
d)	**Define the following terms and state their units : (i) MMF (ii) Reluctance.**
Ans	**(Each definition & unit : 1 Marks, Total 2 Mark)** **i) MMF:** It is the force that drives magnetic flux through magnetic circuit. ➢ Unit : It is measured in amp-turns.(AT) **ii) Reluctance:** The opposition offered by magnetic circuit to establish magnetic flux in it, is called as "Reluctance". ➢ **Its unit is** AT/weber.
e)	**Draw Hysteresis loop for hard steel and Silicon steel.**
Ans	**(Each Hysteresis loop: 1 Mark. Total 2 Marks)** **Fig. (a) Hysteresis loop for hard steel.** **Fig. (b) Hysteresis loop for Silicon steel.**

	 (a) (b)
	or  equivalent diagram
f)	**State the expression to determine energy stored in a magnetic field.**
Ans	Energy Stored in Magnetic Field: **(2 Mark)** $E = \frac{1}{2}(L \times I^2)$ **Joule** where, E = Energy stored in inductor in joule. L = Inductance in henry I = Current in ampere.
g)	**Name the factors affecting the inductance of a coil.**
Ans	**(Any Two point expected: 1 Mark each, Total 2 Marks)** **The factors affecting the inductance of a coil:** **Inductance is given by equation :** $L = \frac{N^2}{S}$ & $L = \frac{\mu_0 \mu_r a N^2}{l}$

i) Number of turns (N): Anything that affects the magnetic field, also affects the inductance of coil. Thus an increase in number of turns of coil causes an increase in the self-inductance of coil.

ii) Relative permeability (μ_r) of material surrounding the coil: As permeability increases, inductance also increases.

iii) Cross sectional area (a) of core: By increasing cross sectional area, the self-inductance can be increased.

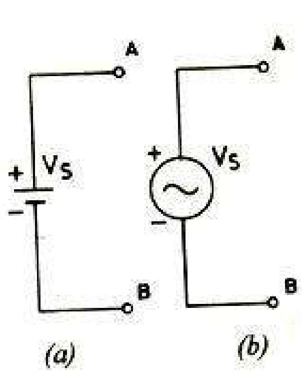
iv) Length of core (*l*): By decreasing length if core, self-inductance can be increased.

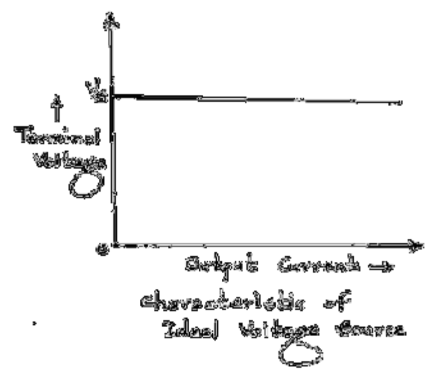
Q.2	**Attempt any THREE of the following :**	**12 Marks**
a)	**Draw the symbol and characteristics of ideal voltage source and practical voltage source.**	

Ans: **(Each source 2 marks, Total 4 Marks)**

i) Ideal voltage source: **(2 Marks)**

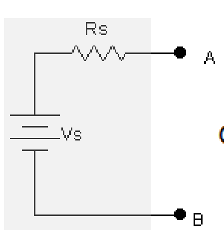
A voltage source whose terminal voltage always remains constant for all values of output current, is known as an ideal voltage source. It has zero internal resistance.



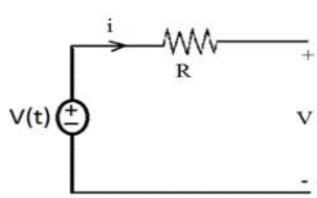


ii) Practical voltage source: **(2 Marks)**

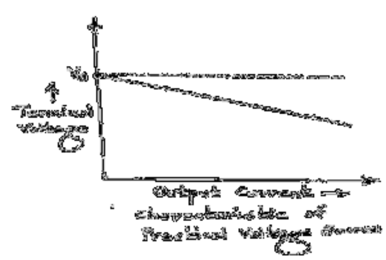
A voltage source whose terminal voltage falls with the increase in the output current due to the voltage drop in the internal resistance.



OR



Practical voltage source



b) **Define the following terms as related to electric circuits : (i) Node (ii) Branch (iii) Loop and (iv) Mesh**

Ans: **(Each defination 1 mark, total 4 marks)**

i) Node: **(1 Mark)**

A point or junction where two or more elements of the network are connected together is called as node.

ii) Branch: **(1 Mark)**

A part of an electric network which lies between two junctions or nodes is known as branch.

iii) Loop: **(1 Mark)**

Any closed path in an electric circuit where each element or branch is traversed only once.

iv) Mesh: **(1 Mark)**

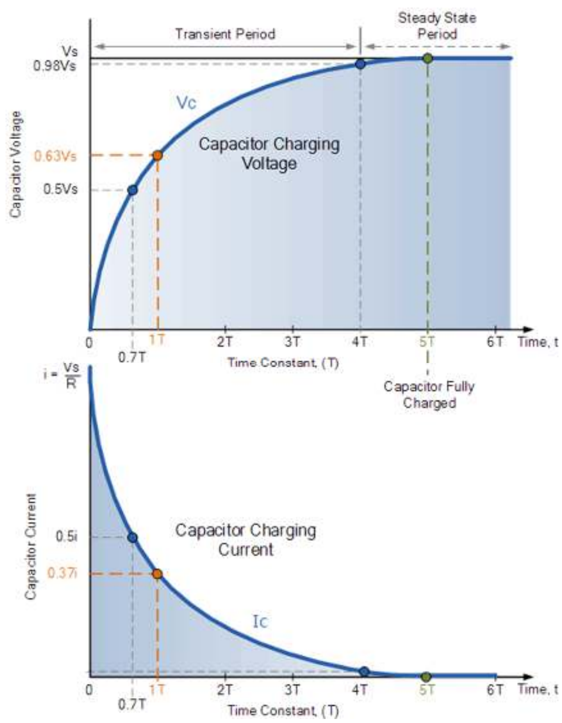
A set of branches forming a closed path (same as loop) in an electric circuit. **OR**

A loop that does not contain any other loop inside

c) **Plot charging voltage and current curves of capacitor, also write expression for them.**

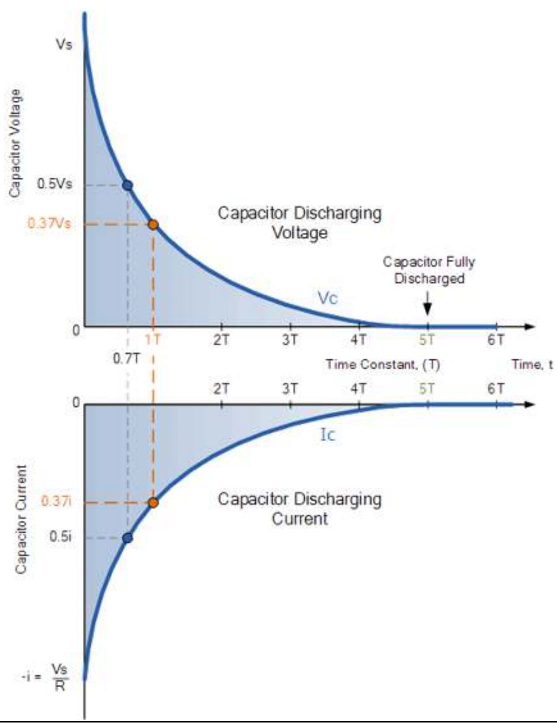
Ans: **Plot charging voltage and current curves of capacitor:**

i) Voltage curves during charging and discharging of a capacitor: **(2 Marks)**



$$V_C = V_S(1 - e^{(-t/RC)})$$

ii) Current curves during charging and discharging of a capacitor: **(2 Marks)**



$$V_C = V_S \times e^{-t/RC}$$

d) Compare statically induced emf with dynamically induced emf (any four points).

Ans: **(Any Four Point expected: 1 Mark each, Total 4 Marks)**

S.No	Particulars	Statically induced emf	Dynamically induced emf
1	Movement of coil or magnet	Neither coil or magnet moves	Either coil moves or magnet moves
2	Current through coil of electromagnet	Must vary with respect to time	Can remain constant
3	Expression for induced voltage	e = L (di/dt) or –N (dϕ/dt)	e = Blv sinΘ
4	Applications	Transformer	DC Generators, Back emf in DC motors, Induction motor
5	Types	i) Self-induced emf ii) Mutual induced emf	No sub-types

Q.3 Attempt any THREE of the following : 12 Marks

a) Define electric work and electric power. Give their SI units.

Ans: **i) Electric work:** **(Definition: 1 Mark & Unit: 1 Mark, Total: 2 Marks)**

	Electrical work is the work done on a charged particle by an electric field. The electrical work per unit of charge, ➢ The SI unit of Electric work**: Joule** **ii) Electric work:** **(Definition: 1 Mark & Unit: 1 Mark, Total: 2 Marks)** Electric power is the rate, per unit time, at which electrical energy is transferred by an electric circuit. ➢ The **SI unit** of **power:** is the watt, one joule per second.
b)	**A coil consists of 2000 turns of copper wire having a cross-sectional area of 0.8 mm². The mean length per turn is 80 cm and the resistivity of copper wire is 0.02 micro-ohm-meter. Find the resistance of the coil and the power adsorbed by the coil when connected across 110 V D.C supply.**
Ans:	$N = 2000 \qquad A = 0.8mm^2 = 0.8\times10^{-6} m^2$ $\rho = 0.02\,\mu\,\Omega - m \qquad l/turn = 80\ cm$ **i) Total Length = No. of Turns x Length/turn** $l_{total} = 2000\times80 = 160000 cm$ $l_{total} = 160000\times10^{-2} m$ -- **(1 Mark)** **ii) Resistance in the coil:** $R = \rho\frac{l}{A}$ $R = 0.02\times10^{-6}\frac{160000\times10^{-2}}{0.8\times10^{-6}}$ $R = 40\ \Omega$ -- **(1 Mark)** **iii) Current:** $I = \frac{V}{R}$ $I = \frac{110}{40}$ $I = 2.75\ Amp$ - -- **(1 Mark)**

iv) Power adsorbed by the coil :

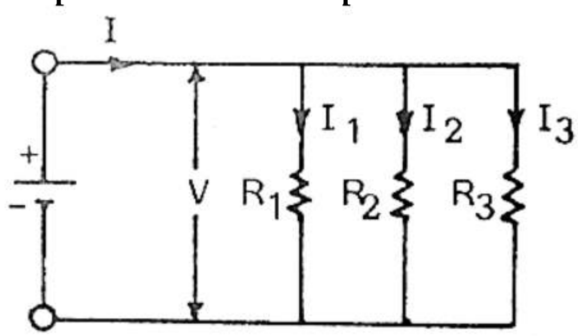
$$P = V \times I$$

$$P = 110 \times 2.75$$

$$P = 302.5 \ watt$$ - -- **(1 Mark)**

c) **Derive an expression for equivalent resistance in parallel connection.**

Ans: **Derive an expression for equivalent resistance in parallel connection:** **(4 Marks)**



Consider three resistances R_1 , R_2 and R_3 ohms connected in parallel across a battery of V volts as shown in figure. The total current I divides into three parts: I_1 flowing through R_1 , I_2 flowing through R_2 and I_3 flowing through R_3 . The voltage across each resistance is the same and there are as many current paths as the number of resistances.

By ohms law the current through each resistance is

$$I_1 = \frac{V}{R_1}; \quad I_2 = \frac{V}{R_2}; \ and \ I_3 = \frac{V}{R_3}$$

Now

$$I = I_1 + I_2 + I_3 = \frac{V}{R_1} += \frac{V}{R_2} += \frac{V}{R_3}$$

$$= V\left(\frac{1}{R_1} += \frac{1}{R_2} += \frac{1}{R_3}\right) \ or \ \frac{1}{V} = \frac{1}{R_1} += \frac{1}{R_2} += \frac{1}{R_3}$$

But $\frac{V}{I}$ is equivalent resistance Rp of [parallel resistances so that

$$\frac{V}{I} = \frac{1}{R_P}$$

	$\frac{1}{R_P} = \frac{1}{R_1} += \frac{1}{R_2} += \frac{1}{R_3}$ When 'n' number of resistances are connected in parallel, reciprocal of total resistance is equal to the sum of the 'n' reciprocals of the individual resistances.
d)	**List four factors affecting the capacitance of a capacitor.**
Ans:	**Factors affecting the capacitance of capacitor:** **(4 Marks)** The capacitance of a capacitor is given by, $C = \frac{\varepsilon_0 \varepsilon_r A}{d}$ i) **Area of Plates**: Greater the area (A) of capacitor plates, more is the value of capacitance and vice versa. ii) **Thickness of dielectric:** Smaller the thickness (d) of dielectric, more is the value of a capacitance and vice versa. iii) **Relative permittivity of dielectric:** Greater the relative permittivity ($\in$) of dielectric material more is the value of capacitance and vice versa.
Q.4	**Attempt any THREE of the following :** **12 Marks**
a)	**State the effect of temperature on resistance.**
Ans:	The resistance of a conductor increases with an increase in temperature. The resistivity (and resistance) of a metal (conductor) increases as the temperature is increased. The resistance of a semiconductor decreases, and its conductivity increases, as the temperature is increased. Insulators have the same kind of temperature dependence as semiconductors.

For conductors

$$R = R_{ref}\,[1 + \alpha(T - T_{ref})]$$

Where,

R = Conductor resistance at temperature "T"

R_{ref} = Conductor resistance at reference temperature T_{ref}, usually 20°C, but sometimes 0°C.

α = Temperature coefficient of resistance for conductor material.

T = Conductor temperature in degrees Celcius.

T_{ref} = Reference temperature that α is specified at for the conductor material

b) **Find the current I supplied by 100V source in the Figure No. (1).**

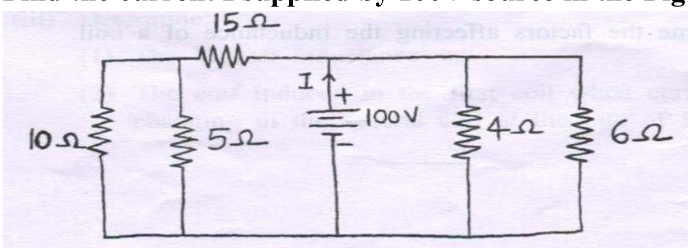


Fig. No. 1

Ans: **Given Data :** $R_1 = 15\ \Omega$ $R_2 = 10\ \Omega$, $R_3 = 5\ \Omega$, $R_4 = 4\ \Omega$ and $R_5 = 6\ \Omega$

i) For Resistor R_2 =10 ohm & R_3 = 5 ohm:

$$R_{T1} = \frac{R_2 \times R_3}{R_2 + R_3}$$ -- **(1/2 Mark)**

$$R_{T1} = \frac{10 \times 5}{10 + 5} = \frac{50}{15}$$

$$R_{T1} = 3.33\,\Omega$$

-- **(1/2 Mark)**

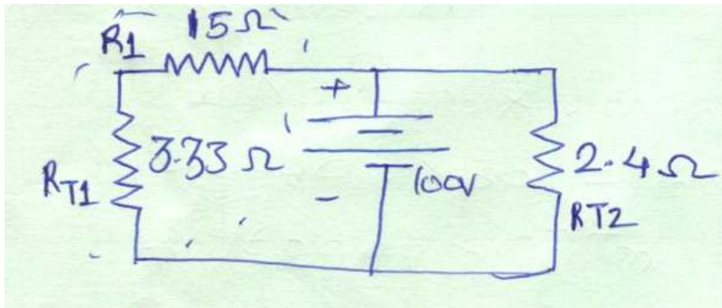
For Resistor R_4= 4 ohm & R_5= 6 ohm:

$$R_{T2} = \frac{R_4 \times R_5}{R_4 + R_5}$$ -- **(1/2 Mark)**

$$R_{T2} = \frac{4 \times 6}{4 + 6} = \frac{24}{10}$$

$R_{T2} = 2.4\ \Omega$

-- (1/2 Mark)

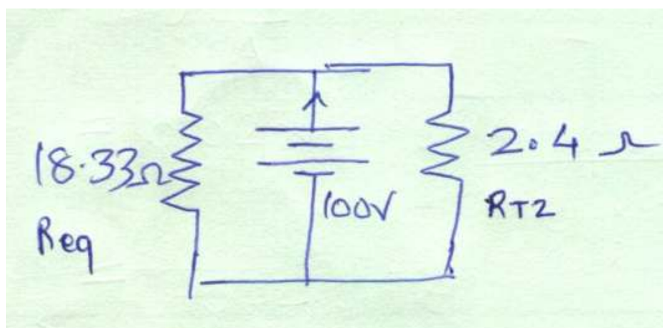


ii) For Resistor 15 ohm series with 3.33 ohm:

$$R_{eq} = R_1 + R_{T1} = 15 + 3.33 = 18.33\Omega$$

$$R_{eq} = 18.33\Omega$$

-- (1/2 Mark)



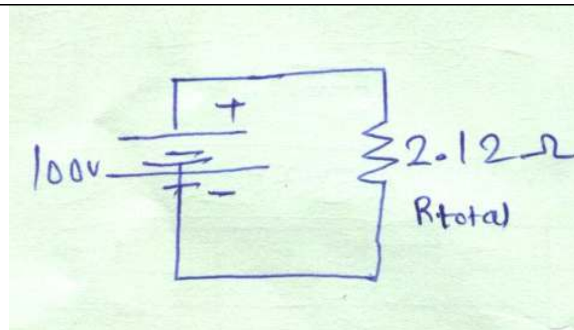
iii) For Resistor Req = 18.33 Ω and Resistor R_{T2} = 2.4 Ω

$$R_{total} = \frac{R_{eq} \times R_{T2}}{R_{eq} + R_{T2}}$$

$$R_{total} = \frac{18.33 \times 2.4}{18.33 + 2.4}$$

$$R_{total} = 2.12\ \Omega$$

--- (1/2 Mark)



iv) Total Current supplied by 100 V:

$$I = \frac{V}{R_{total}}$$

$$I = \frac{100}{2.12}$$

$$I = 47.16 \quad Amp$$ -- **(1 Mark)**

c) **By applying Kirchhoff's law find the current through 1051 resistor Figure No. (2).**

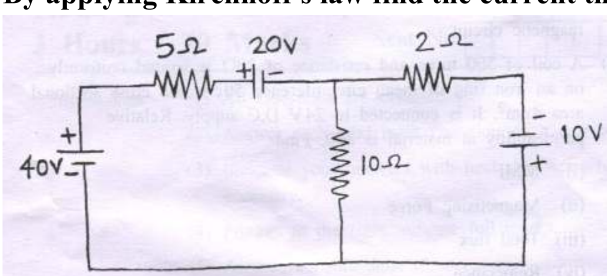


Fig. No. 2

Ans: Apply KVL for loop ABEFA :

$– 5I_1 – 20 – 10 (I_1 – I_2) + 40 = 0$

$– 5I_1 – 10 I_1 + 10 I_2 + 20 = 0$

$– 15I_1 + 10 I_2 = -20$ ……………………….Eq.(1) -------------------- **(1/2 Mark)**

Apply KVL for loop BCDEB :

$– 2I_2 +10 – 10 (I_2 – I_1) = 0$

$– 2I_2 – 10 I_2 + 10I_1 = 10$

$10I_1 – 12 I_2 =-10$ ……………………….Eq.(2) ------------------------- **(1/2 Mark)**

Multiplying eq. (1) by 2 and multiplying eq. (2) by 3, we get

$-30I_1 + 20\,I_2 = -40$ ……………………………Eq.(3) ------------------------ (1/2 Mark)

$30I_1 - 36\,I_2 = -30$ ……………………………Eq.(4) ------------------------ (1/2 Mark)

Adding Eq. (3) from Eq. (4),

$-16\,I_2 = (-70)$

$$I_2 = \frac{-70}{-16}$$

$I_2 = 4.375\,Amp$ -- (1/2 Mark)

Substituting I_2 in eq. (2),

$-15I_1 + 10\,I_2 + 20 = 0$

$-15I_1 + 10\,(4.375) = -20$

$-15I_1 + 43.75 = -20$

$-15I_1 = -63.75$

$$I_1 = \frac{-63.75}{-15}$$

$I_1 = 4.25\,Amp$ -- (1/2 Mark)

Total Current through 10 ohm =

$I = I_1 - I_2$

$I = 4.25 - 4.375$

$I = -0.125\ Amp$ -- (1 Mark)

OR Student May Write this way

By Cramers rule :

$$\Delta = \begin{vmatrix} -15 & 10 \\ 10 & -12 \end{vmatrix}$$

$\Delta = \ (-15 \times (-12)) - (10 \times 10)$

$\Delta = \ 80$ -- (1/2 Mark)

$$\Delta_1 = \begin{vmatrix} -20 & 10 \\ -10 & -12 \end{vmatrix}$$

$$\therefore \Delta_1 = (-20 \times (-12)) - (10 \times (-10))$$

$$\therefore \Delta_1 = 340$$ --- **(1/2 Mark)**

$$\Delta_2 = \begin{vmatrix} -15 & -20 \\ 10 & -10 \end{vmatrix}$$

$$\therefore \Delta_1 = (-15 \times (-10)) - (-20 \times 10)$$

$$\therefore \Delta_1 = 350$$ --- **(1/2 Mark)**

Find Current :

$$I_1 = \frac{\Delta_1}{\Delta} = \frac{340}{80}$$

$$I_1 = 4.25\,Amp$$ --- **(1/2 Mark)**

Find Current :

$$I_2 = \frac{\Delta_2}{\Delta} = \frac{350}{80}$$

$$I_2 = 4.375\,Amp$$ --- **(1/2 Mark)**

Total Current through 10 ohm =

$$I = I_1 - I_2$$ --- **(1/2 Mark)**

$$I = 4.25 - 4.375$$

$$I = -0.125\ Amp$$ --- **(1 Mark)**

OR Student May Write this way

Apply KVL at node B :

$I_1 + I_2 + I_3 = 0$ --- **(1/2 Mark)**

$$=\frac{V_B+20-40}{5}+\frac{V_B}{10}+\frac{V_B}{10}+\frac{V_B+10}{2}=0$$

$$=\frac{V_B}{5}+\frac{20}{5}-\frac{40}{5}+\frac{V_B}{10}+\frac{V_B}{10}+\frac{V_B}{2}+\frac{10}{2}=0$$

$$=\frac{V_B}{5}+\frac{V_B}{10}+\frac{V_B}{2}=-\frac{20}{5}+\frac{40}{5}-\frac{10}{2}$$

$$V_B=\frac{1}{5}+\frac{1}{10}+\frac{1}{2}=-1$$

$$0.8V_B=-1$$

$V_B=-1.25V$ -- **(1 Mark)**

Total Current through 10 ohm =

$I=\frac{V_B}{10}$ -- **(1/2 Mark)**

$$I=\frac{-1.25}{10}$$

$I=-0.125\ Amp$ -- **(2 Mark)**

d) **Calculate the value of equivalent capacitance of the combination given in Figure No. 3.**

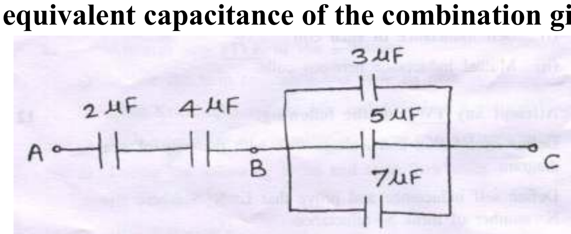


Fig. No. 3

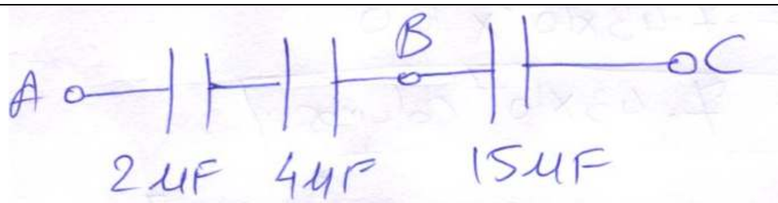
Ans: **Value of equivalent capacitance:**

i) $3\ \mu F, 5\ \mu F\ and\ 7\ \mu F$ for parallel combination with each other:

$C_{eq}=C_1+C_2+C_3$ ________________________________ **(1 Mark)**

$$C_{eq}=3+5+7$$

$C_{eq}=15\ \mu F$ ________________________________ **(1 Mark)**



ii) $2\ \mu F, 4\ \mu F\ and\ 15\ \mu F$ for Series combination with each other

$$\frac{1}{Ceq} = \frac{1}{C_1} + \frac{1}{C_2} + \frac{1}{C_3}$$ ——— **(1 Mark)**

$$\frac{1}{Ceq} = \frac{1}{2} + \frac{1}{4} + \frac{1}{15}$$

$$\frac{1}{Ceq} = 0.87$$

$$C_{eq} = 1.22\mu F$$ ——— **(1 Mark)**

e)	**Calculate the capacitance, charge, electric flux density and energy stored in a parallel plate capacitor of two metal plates 60 cm x 60 cm separated by a dielectric of 1.5 mm and relative permittivity is 3.5. The potential difference of 100 V is applied across it.**

Ans: **Given Data:**

A = 60 cm x 60 cm = 3600cm^2 = 3600 x 10^{-4} m^2

d= 1.5 mm = 1.5 x10^{-3}m

Relative permittivity Er = 3.5 and voltage V = 100V

i) Calculate Capacitance C =

$$C = \frac{E_0 \times E_r \times A}{d}$$

$$C = \frac{8.85 \times 10^{-12} \times 3.5 \times 3600 \times 10^{-4}}{1.5 \times 10^{-3}}$$

$$C = 7.43 \times 10^{-9}\ F$$ ——— **(1 Mark)**

ii) Calculate Charge Q =

$$Q = C\ V$$

$$Q = 7.43 \times 10^{-9} \times 100$$

$$Q = 7.43 \times 10^{-7} \ colombs$$ ________________ (1 Mark)

iii) Calculate Flux density =

$$D = \frac{Q}{A}$$

$$D = \frac{7.43 \times 10^{-7}}{3600 \times 10^{-4}}$$

$$D = 2.065 \times 10^{-6} \ c/m^2$$ ________________ (1 Mark)

iv) Calculate energy stored in parallel plate =

$$E = \frac{1}{2} C V^2$$

$$E = \frac{1}{2} \times 7.43 \times 10 - 3 \times (100)^2$$

$$E = 37.15 \ \ J$$ ________________ (1 Mark)

Q.5 Attempt any TWO of the following : 12 Marks

(a) Give any six points of comparison between electric circuit and magnetic circuit.

Ans: Compare Magnetic and Electric circuit:

(Any Six points are accepted from following or equivalent 1 Mark each point, total 6 Marks)

S.No	Electric circuit	Magnetic circuit
1	Path traced by the current is known as electric current.	The magnetic circuit in which magnetic flux flow
2	EMF is the driving force in the electric circuit. The unit is Volts.	MMF is the driving force in the magnetic circuit. The unit is ampere turns.
3	There is a current I in the electric circuit which is measured in amperes.	There is flux φ in the magnetic circuit which is measured in the weber.
4	The flow of electrons decides the current in conductor.	The number of magnetic lines of force decides the flux.
5	Resistance (R) oppose the flow of the current. The unit is Ohm	Reluctance (S) is opposed by magnetic path to the flux. The Unit is ampere turn/weber.
6	R = ρ. l/a.	S = l/ ($\mu_0\mu_r$a).

7	The current I = EMF/ Resistance	The Flux = MMF/ Reluctance
8	The current density	The flux density
9	Kirchhoff current law and voltage law is applicable to the electric circuit.	mmf law and flux law is applicable to the magnetic flux.

b) **A coil of 500 turns and resistance of 200 is wound uniformly on an iron ring of mean circumference 50cm and cross sectional area 4cm². It is connected to 24V D.C supply. Relative permeability at material is 800, Find (i) MMF (ii) Magnetising Force (iii) Total flux (iv) Reluctance**

Ans: **Given data :**

N= 500 , R = 20 ohm, l = 50 cm = 50 x10^{-2} m   A = 4 cm^2 = 4 x$10^{-4}m^2$

$\mu_r = 800$ v = 24 V

$$I = \frac{V}{R} = \frac{24}{20}$$

$$I = 1.2 A$$ ———— (1 Marks)

(i) To Find MMF =

$$MMF = N \times I \quad \therefore \; = 500 \times 1.2$$

$$MMF = 600 \; AT$$ ———— (1 Marks)

(ii) To find Magnetizing Force :

$$H = \frac{N \times I}{l} = \frac{500 \times 12}{50 \times 10^{-2}}$$

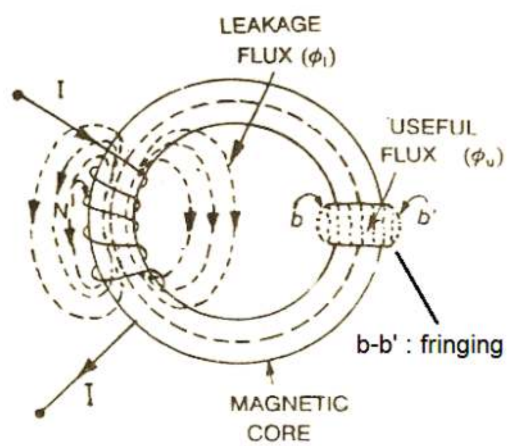
$$H = 1200 \;\; AT/m$$ ———— (1 Marks)

iii) To find Reluctance (S):

$$S = \frac{l}{\mu_0 \mu_r \times A}$$ ———— (1/2 Marks)

$$S = \frac{50 \times 10^{-2}}{4 \times \pi \times 10^{-7} \times 800 \times 4 \times 10^{-4}}$$

	$S = 1243397.993 \quad AT/wb$ ———— (1 Marks) **iv) To find Total Flux :** $\phi = \frac{MMF}{S}$ ———— (1/2 Marks) $\phi = \frac{600}{1243397.993}$ $\phi = 4.8255 \times 10^{-4} \quad wb$ ———— (1 Marks)
c)	**Two coils A and B of 500 and 750 turns respectively are connected in series on the same magnetic circuit of reluctance 1.55 x 10^6 AT/Wb. Assuming that no leakage flux Calculate: (i) Self-inductance of each coil (ii) Mutual inductance between coils.**
Ans:	**Given data :** Coil A = N_1= 500 turns , Coil B = N_2= 750 turns , and Reluctance S = 1.55 x 10^6 AT/Wb **(i) Self-inductance of coil 'A':** $L_1 = \frac{(N_1)^2}{S}$ ———— (1/2 Marks) $L_1 = \frac{(500)^2}{1.55 \times 10^6}$ $L_1 = 0.1613 \ H$ ———— (1 Marks) **Self-inductance of coil 'B':** $L_2 = \frac{(N_2)^2}{S}$ ———— (1/2 Marks) $L_2 = \frac{(750)^2}{1.55 \times 10^6}$ $L_2 = 0.3629 \ H$ ———— (1 Marks) **(ii) Mutual inductance between coils (m) =**

	$M = \frac{(N_1 \times N_2)}{S}$ ——————— (1 Marks) $M = \frac{500 \times 750}{1.55 \times 10^6}$ $M = 0.2419\ H$ ——————— (2 Marks)
Q.6	**Attempt any TWO of the following : 12 Marks**
a)	**Define useful flux and leakage flux with the help of neat diagram.**
Ans:	**Useful flux & leakage flux with the help of neat diagram : (2 Marks)**  **i) Useful flux:- (2 Marks)** The flux in the air gap which is actually utilized for various purposes depending upon the application is called as useful flux **ii) Leakage flux: (2 Marks)** Some flux while passing through the magnetic circuit, leaks through the air surrounding the core. This flux is called as leakage flux.
b)	**Define self inductance and prove that $L=N^2/S$ where N=number of turns S=reluctance.**
Ans:	**(i) Self inductance: (2 Marks)** It is the property of a coil by virtue of which it opposes any change in current flowing through it. In fact, when the current flowing through the coil attempts to change, an emf in induced and according to Lenz's rule, it acts in such a way that the change in current is opposed. **Prove that $L = N^2/S$: (4 Marks)**

	$$L = \frac{N\phi}{I}$$ ------------------------------------ equation No.1 Ohms Law of magnetic circuit: $$\phi = \frac{MMF}{Reluctance}$$ $$\phi = \frac{MMF}{S}$$ $$\therefore\ MMF = N \times I$$ $$\phi = \frac{N \times I}{S}$$ ------------------------------------ equation No.2 Subsisting equation No. 2 in equation No.1 : $$L = \frac{N \times N \times I}{I \times S}$$ $$L = \frac{N^2}{S}\ Henry$$ ------- Hence proved **OR** L = (N x Φ) / I But, Φ = (m.m.f.) / Reluctance ∴Φ = (N x I) / S ∴ L = (N / I) [(N x I) / S] ∴ L = N^2 / S Henry……. Hence proved
c)	**(i) State the term Mutual inductance (ii) Two coils of 800 and 200 turns are wound on a common magnetic circuit having a reluctance of 160 x 10^3 AT/Wb** **(iii) Determine:** **(1) The Mutual inductance (2) The emf induced in the first coil when current is changing in the second coil at the rate of 500 A/second.**
Ans:	**(i) State the term Mutual inductance:** ———————————— **(2 Marks)** **Mutual Inductance** between the two coils is defined as the property of the coil due to which it opposes the change of current in the other coil, or you can say in the neighbouring coil. When the current in the neighbouring coil changes, the flux sets up in the coil and because of this, changing flux emf is induced in the coil called Mutually Induced emf and the phenomenon is known as **Mutual Inductance**.

OR

Mutually induced emf :

The emf induced in a coil due to the change of flux produced by another neighbouring coil linking to it, is called **Mutually Induced emf.**

$$e_m \ \alpha \frac{dI_1}{dt} or \ \ e = M \ \frac{dI_1}{dt}$$

(ii) Two coils of 800 and 200 turns are wound on a common magnetic circuit having a reluctance of 160 x 10^3 AT/Wb

Given data:

Coil A = N_1= 800 turns , Coil B = N_2= 200 turns , and Reluctance S = 160 x 10^3 AT/WSSb

$$\frac{d\ I}{d\ t} = 500 \ \ A/\sec$$

- (2 Marks)

(iii) Determine:

(1) The Mutual inductance

(2) The emf induced in the first coil when current is changing in the second coil at the rate of 500 A/second.

i) The Mutual inductance:

$$M \ = \frac{(N_1 \times N_2)}{S}$$

$$M \ = \frac{800 \times 200}{160 \times 10^3}$$

$$M \ = 1 \ H$$ (1 Marks)

ii) Emf induced in first coil E_1:

$$E_1 \ = - \ M \ \frac{d\ I}{d\ t}$$

$$E_1 \ = - 1 \times 500$$

$$E_1 \ = - \ 500 \ V$$ (1 Marks)

-- END--