SCHEME OF VALUATION

(Scoring Indicators)

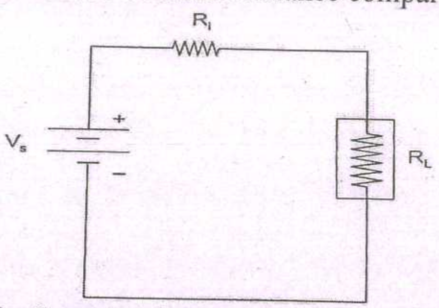
Revision: 2015

Course Code: 2031

Course Title: BASIC ELECTRICAL ENGINEERING

Quest No	Scoring Indicators	Split up score	Sub total	Total
	PART - A			
I(1)	Electrical power is the rate at which work is done in an electric circuit. It is represented by the letter symbol P, and is measured in watt (W). ie, Electric power, P = work done in electric circuits / time	2	2	2
I(2)	It states that "In any linear bilateral resistive network having two or more voltage sources the current through any branch (resistance or source) is the algebraic sum of the currents produced by each source acting alone at a time, when all other sources are replaced by their internal resistances".	2	2	2
I(3)	The ratio of the electric flux density, D to electric field intensity, E at any point is called as the permittivity, ε. i.e. $\varepsilon = D/E$	2	2	2
I(4)	It is the ratio of the magnetic flux passing per unit area which is normal to the flux. It is represented by the letter B and is measured in tesla (T) or Wb/m^2.	2	2	2
I(5)	It is the property of a coil due to which it opposes the variation of current through it. And is measured in Henry (H)	2	2	2

	PART - B			
II(1)	Kirchhoff's laws **First law** It is also known as Kirchhoff's current law (KCL) or point law. It states that "The algebraic sum of the currents meeting at an electric junction(or point or node) in a network is equal to zero" OR "In an electric network, the sum of the currents flowing towards an electric junction is equal to the sum of the currents flowing away from the junction". **Second Law** It is also known as Kirchhoff's voltage law (KVL) or mesh law. It states that: "In any closed mesh or path, the algebraic sum of the products of current and resistance in each of the conductor plus the algebraic sum of the e.m.f.'s in that path is equal to zero". OR "The sum of all e.m.f.'s and resistive drops with their proper signs in a closed mesh or path is equal to zero".	3 3	6	6
II(2)	Effect of temperature on resistance of a material. When a potential is applied to the ends of a conductor, the current flows. The movement of electrons is opposed by the ions of the material. At lower temperature these ions are assumed to be stationary, but as the temperature of the material increases, these ions gain energy and oscillate about their mean position. The amplitude of this oscillation is dependent upon the temperature of the material. Higher the temperature the greater is the amplitude of oscillation. The ions up and down (random) movement opposes the electron movement andincreases the chances of collision. Hence due to increase of this opposition to the movement of the electrons, the resistance of the conductor increases. If the temperature of the conductor decreases, the amplitude of the oscillation decreases and the chances of collision of electrons decreases and hence the resistance of the conductor decreases. The resistance of alloys also increases with the increase in temperature but this increase is very small and irregular. And the resistance of all insulating materials (paper, mica, and rubber), electrolytes and semi-conductor (Ge, Si) decreases with increase in temperature.	6	6	6

II(3)	**Thevenin's theorem** Thevenin's theorem states that 'Any linear network consisting of voltage sources and resistances, if viewed from any two terminals in the network can be replaced by an equivalent voltage source Vth in series with an equivalent resistanceRth. Vth=Thevenin's voltage that would appear across the terminals AB (with no. load connected across AB). Vth is also known as open-circuit voltage. Rth=Thevenin's resistance that would appear across the terminals AB with voltage sources short circuited. Thevenin's theorem is a method used to change a complex network into a simple equivalent network, especially in determining the current through a specified branch of a network.	6	6	6
II(4)	**Maximum power transfer theorem.** It states that "maximum power is transferred from the source to the load when the resistance of the load is equal to the internal resistance of the source." The efficiency of power transfer (ratio of output to input power) from the source to the load increases as the load resistance is increased. The efficiency approaches 100 percent as the load resistance approaches a relatively large value compared with that of the source, since less power is lost in the source. The efficiency of power transfer is only 50 percent at the maximum power transfer resistance of 5 ohm and approaches zero efficiency at relatively low values of load resistance compared with that of the source.  Vs -Source voltage (v) Ri -internal resistance or source resistance (Ω) RL-Load resistance (Ω) Maximum power is transferred from source to load when **$R_i=R_L$** If V_s = 100V, $R_i = 5\ \Omega$ then $P_{max} = 100 \times 5 = 500$ watt	2+ 4	6	6

<table>
<tr><td>II(5)</td><td>

Energy stored in a capacitor.

If at any instant during charging period the voltage on the capacitor is V and charge on plate is q, by definition, V is equal to the work done is shifting one coulomb of charge from one plate to another. If 'dq' is the charge next transferred, then the work done is

dw=V. dq
But $q = Cv$,
or $dq = C\,dv$
$dw = Cv\,dv$

Total work done on a capacitance of C (farad) to a voltage of V volt is

$$W = \int_0^V dW = \int_0^V cv\,dv = C\left[\frac{v^2}{2}\right]_0^V = \frac{1}{2}CV^2 \text{ joule}$$

Hence the energy stored equals the work W

$$\boxed{E = \frac{1}{2}CV^2 = \frac{Q^2}{2C}} \text{ joule}$$

</td><td>6</td><td>6</td><td>6</td></tr>
<tr><td>II(6)</td><td>

Applications of capacitors.

1. Widely used in electronic circuits to perform variety of tasks, such as smoothing, filtering, bypassing etc
2. The most common use for capacitors is energy storage.
3. Power conditioning.
4. Signal coupling or decoupling.
5. Electronic noise filtering
6. Remote sensing
7. Power factor improvement

</td><td>6

(Any 6 points)</td><td>6</td><td>6</td></tr>
<tr><td>II(7)</td><td>

Statically Induced E.m.f.	Dynamically Induced E.m.f
1. The e.m.f. Induced by variation of flux in a stationary conductor or coil is termed as "statically induced e.m.f".	1. The e.m.f. Induced by variation of flux in a moving conductor or coil is termed as "dynamically induced e.m.f".
2. Neither condcutor nor magnet moves. (Both are stationary)	2. Dynamically Induced E.m.f Conductor moves andmagnet (flux)OR Conductor stationary and magnet moves (Any one is moving the other is stationary,
3. Magnets are formed due to flow of current.	3. Permanent(orelectromagnets- are required.

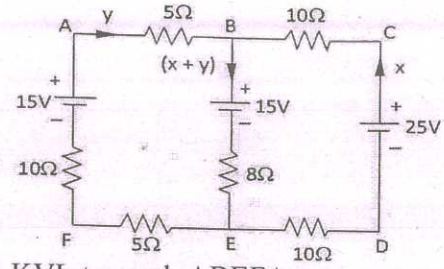
</td><td>3 comparison

(2 marks each)</td><td>6</td><td>6</td></tr>
</table>

	PART - C			
III(a)	**Ohm's law** "The current flowing in a circuit is directly proportional to the potential difference driving it, provided the temperature is constant". OR "The ratio of potential difference between the two terminals of a conductor to the current flowing through it is constant. Provided the temperature does not change." **Laws of Resistance** (Factors on which Resistance depend) It has been practically determined that the resistance of a material depends upon the following factors. i. The resistance of a conductor is directly proportional to its length,l ie, $R \propto l$ ii. The resistance of a conductor is inversely proportional to its cross sectional area, a i.e., $R \propto 1/a$ iii. The resistance of a conductor depends upon the material with which it is made. Various substances have different atomic structure and therefore they offer different resistances for the same length and area of cross section. iv. The resistance of a conductor depends upon the working temperature. From the first three factors, we can say that $R \propto l/a$ Or $\mathbf{R = \rho\, l/a}$ Where ρ(Greek letter 'Rho') is a proportionality constant and is called resistivity or specific resistance of the conductor material and It depends upon the nature of the conductor material.	4 4	8	8
III(b)	Voltage rating of each lamp = 230 V Voltage applied to each lamp = 200 V	1(Given data)		
	Resistance of 100 W lamp, $R1 = V^2 / P1 = 230^2/100 =$ **529 Ω.**	1		

	Resistance of 200 W lamp, R2= $V^2 / P2 = 230^2/200 =$ **264.5 Ω.**	**1**		
	Resistance of 200 W lamp, R23= $V^2 / P3 = 230^2/500 =$ **105.8Ω.**	**1**		
	Power dissipation of 100 W lamp at 200 V $=V^2 / R1 = 200^2/529 =$ **75.6W**	**1**	7	7
	Power dissipation of 200 W lamp at 200 V $=V^2 / R2 = 200^2/264.5 =$ **151.23W**	**1**		
	Power dissipation of 500 W lamp at 200 V $=V^2 / R3 = 200^2/105.8 =$ **378.1W**	**1**		
IV(a)	**Phenomenon of electric shock** An electric shock occurs when a person comes into contact with an electricalenergy source. Electrical energy flows through a portion of the body causing a shock. Exposure toelectrical energy may result in no injury at all or may result in devastating damage or death.	**3**		
	Every employee or worker in the electric field or those who are having electric supply should make themselves familiar with the instructions given below. 1. **Removal from Contact**: When a person gets a shock and still he is in contact with the supply/conductor, first switch off the switch or main. If the switch or main is not found, cut the cable with the help of axe or plastic handle knife but don't use scissor. If cable cutting is also not possible in case of L'T supply, the first aider should stand on an insulated material which is dry, if available rubber gloves should be worn, if not dry coat, cap, thing or folded news-paper should be used while removing the casualty victim. 2. See the victim's clothes and extinguish the spark's if smoldering. 3. Check the victim if he/she is breathing but unconscious ring/send for a doctor. If the victim is not breathing, immediately start artificial respiration as detail below until doctor or first-aid arrives.	**3**	3	6

<table>
<tr>
<td>IV(b)</td>
<td>
The current in each branch is as shown.



Applying KVL to mesh ABEFA.

-5Y-15-8 (x + y)-5y-10y +15=0

-8x-28y = 0

or 2x +7y = 0 .... (1)

Applying KVL to mesh BCDEB.

10x-25+10x +8 (x+ y) +15=0

28x +8y = 10

or 14× +4y = 5 .... (2)

Multiply equation (1) by 7 then

Subtract equation (2) from equation (1). We get

$(1) \times 7 \rightarrow 14x + 49y = 0$

$(2) \times 1 \rightarrow 14x + 4y = 5$

$\quad - \quad - \quad -$

$45y = -5$

$\therefore \quad y = -\frac{5}{45} = -\frac{1}{9}$ **Ans.**

Negative sign represents the battery in branch AF is charging.

Substitute the value of y in equation (1) we get

$2x + 7\left(-\frac{1}{9}\right) = 0$

$\therefore \quad x = \frac{7/9}{2} = \frac{7}{18}$ **A Ans.**

Current in branch BE is

$(x + y) = \frac{7}{18} - \frac{1}{9} = \frac{7-2}{18} = \frac{5}{18}$ **A Ans.**
</td>
<td>1+

2+

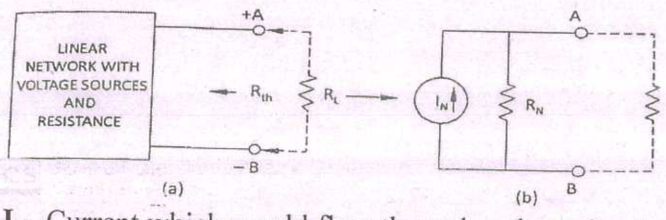
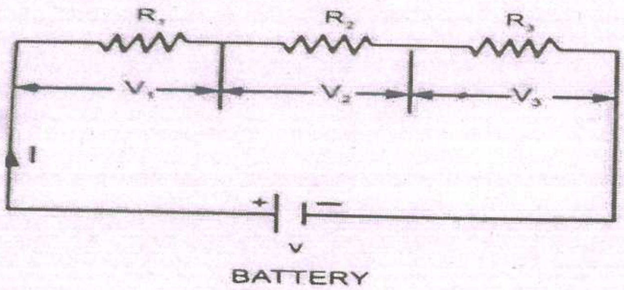
2+

1+

1+

1+

1</td>
<td>9</td>
<td>9</td>
</tr>
<tr>
<td>V(a)</td>
<td>Norton's theorem is used to simplify a network in terms of currents instead of voltages, this theorem can be used to reduce complicated networks in to simple parallel circuit.</td>
<td></td>
<td></td>
<td></td>
</tr>
</table>

	Norton's theorem states that "Any linear network consisting of voltage sources and resistances, if viewed from any two terminals in the network, can be replaced by an equivalent current source ' I_N in parallel with an equivalent resistance R_N"  ' I_N -Current which would flow through a short circuit placed across AB as shown in Figure' I_N is also known as short-circuit current. R_N -Resistance of the network viewed through terminals AB with all voltage sources replaced by their internal resistances.	3+ 2+ 1	6	6
V(b)	**Series combination of Resistors**  Let R_1, R_2, R_3 = resistance of three resistors connected in series. I = current flowing in the circuit (or in all the resistors) V=applied voltage V_1, V_2, V_3 = voltages across each resistor R_1, R_2, R_3respectively V volt which causes same current I to flow in each ofthem but the potential across each of them will be different. So the sum of all these potentials V_1, V_2, V_3will be equal to the applied voltage V. Figure represents the progressive fall in potential across each of the resistors. Applying ohm's law to each of the resistors we get $V_1 = IR_1,\ V_2 = IR_2,\ V_3 = IR_3$ $\therefore\ V = V_1 + V_2 + V_3 = IR_1 + IR_2 + IR_3$ $\frac{V}{I} = R_1 + R_2 + R_3$	2+	4.5	9

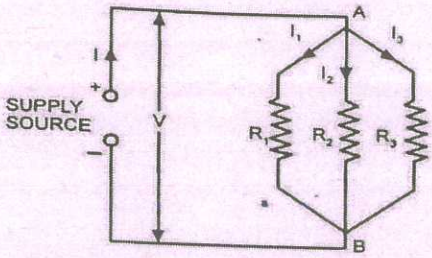
If R is the total combined resistance of all the resistors, then

$$\boxed{R = R_1 + R_2 + R_3}$$

In general if 'n' number of resistors having resistances of R_1, R_2, ...R_n are connected in series, then the total resistance of the combination is

$$\boxed{R = R_1 + R_2 + \ldots\ldots\ldots + R_n}$$

Parallel combination of Resistors



RESISTANCES CONNECTED IN PARALLEL

2.5+

Let I = supply current

I_1, I_2, I_3 = current in individual resistors

Applying Ohm's law to each resistor

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

Also $I = I_1 + I_2 + I_3$

2+

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

$$\frac{1}{V} = \frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3}$$

If R is the combined or total resistance of the circuit, it will be equal to V/I

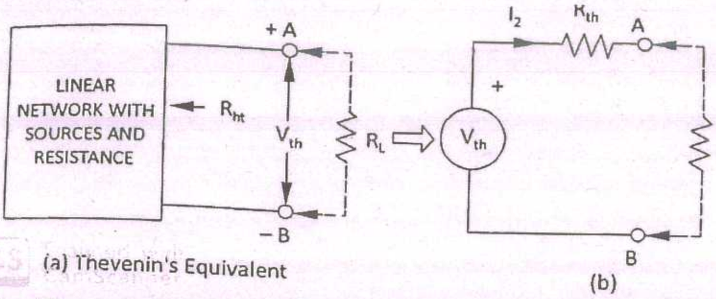
2.5

$$\text{or} \quad \boxed{\frac{1}{R} = \frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3}}$$

In general if 'n' number of resistors having R_1, R_2 .... R_n resistances connected in parallel then the total resistance R is given by

4.5

$$\boxed{\frac{1}{R} = \frac{1}{R_1} + \frac{1}{R_2} + \ldots\ldots\ldots \frac{1}{R_n}}$$

VI(a)	**Thevenin's theorem** Thevenin's theorem states that 'Any linear network consisting of voltage sources and resistances, if viewed from any two terminals in the network can be replaced by an equivalent voltage source Vth in series with an equivalent resistanceRth.  (a) Thevenin's Equivalent (b) V_{th}=Thevenin's voltage that would appear across the terminals AB (with no. loadconnected across AB). Vth is also known as open-circuit voltage. R_{th}= Thevenin's resistance that would appear across the terminals AB with voltage sources short circuited. R_L-Any load resistance. If current 'IL through load resistance R_L connected across A and B of a linear network Figure (a) is to be found, then; Step-1: Find R. by removing RL viewed from A & B terminals. IStep-2: Find V. across A and B by removing RL again. Step-3: Now current ' IL through RL. is [Figure(b)] given by $I_L = \frac{V_{th}}{(R_{th} + R_L)}$	2+ 2+ 2+ 2	8	8
VI(b)	The two resistors are R_1 and R_2 When R_1 and $R_2$are connected in series equivalent resistance $R_S = R_1 + R_2$. and is given as $R_1 + R_2 = 9\Omega$ ....(1) When R_1 and R_2 are connected in parallel equivalent resistance $R_p = 1/(1/R_1 + 1/R_2)$ Or $R_P = R_1R_2/(R_1 + R_2) = 2\ \Omega$ ....(2) Comparing (1) and (2) =>$R_1R_2/9 = 2$...............(3) ⇨ $R_1R_2 = 18$ =>$R_2 = 18/R_1$...............(4) ⇨ $R_1 + (18/R_1) = 9$	2+ 2	7	7

	⇨ $R_1^2+18 = 9R_1$ ⇨ $R_1^2-9R_1+18=0$ ⇨ $(R_1-6)(R_1-3) = 0$ ⇨ $R_1=6$ or $R_1=3$ ⇨ If $R_1= 6\Omega \Rightarrow R_2= 18/6 =3\Omega$ from eqn (4) So the resistances of coductors are **6 Ω and 3 Ω.**	3		
VII(a)	<u>Coulombs Laws Of Electrostatics</u> **1st Law** It states that"Like charges of electricity repel each other, where as unlike charges of electricity attract each other ". **2nd Law:** It states that"the force exerted between two point charges is i. Directly proportional to the product of their strength. ii. Inversely proportional to the square of the distance between them, and iii. Inversely proportional to the absolute permittivity of the surrounding medium". This law is also known as Inverse square law. Mathematically the second law can be expressed as $F \alpha \frac{Q_1Q_2}{\varepsilon d^2}$ or $F = K \frac{Q_1Q_2}{\varepsilon d^2}$ Where, F=force between two charges (newton) Q1, Q2, -strength of the two point charges (coulomb) d=distance between two point charges(metre) ε= absolute permittivity of the surrounding medium and $\varepsilon_0 \times \varepsilon_r$ F/m (farad/metre) ε_0= absolute permittivity of the free space or vacuum and is equal to 8.854×10^{-2} farad/metre. ε_r= relative permittivity of the medium (dimensionless) or specific Inductive capacity K=Proportionality constant.	2+ 2+ 3	7	7

$$K = \frac{1}{4\pi}$$

Hence, $$\boxed{F = \frac{Q_1 Q_2}{4\pi\varepsilon_o\varepsilon_r d^2} \text{ newton}}$$

$$F = \frac{Q_1 Q_2}{4\pi \times 8.854\times10^{-12} \times \varepsilon_r d^2} N$$

$$= \frac{9\times10^9 Q_1 Q_2}{\varepsilon_r d^2} \text{ N .... in a medium}$$

VII(b) Parallel plates capacitor with uniform dielectric medium

Consider a parallel plate capacitor withuniform dielectric medium as shown in Figure.

Let

Q=charge on each plate (coulomb)

A=cross-sectional area of each plate (m^2)

D=electrical flux density (C/m^2)

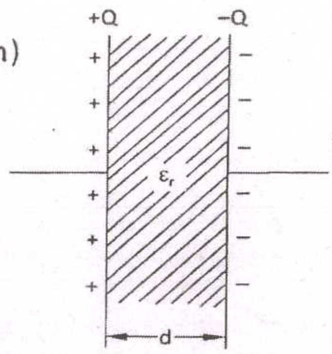
E=electric intensity (V/m) — 2+

$\pm$

V = p.d. between the plates (V)

d = distance between the plates (m)

ε_r = relative permittivity of the dielectric medium used in between the plates. — 2+ — 8 — 8



Elec. flux density, $D = \frac{Q}{A}$ C/m^2

Elec. intensity, $E = \frac{D}{\varepsilon} = \frac{Q}{\varepsilon_0\varepsilon_r A} V/m$

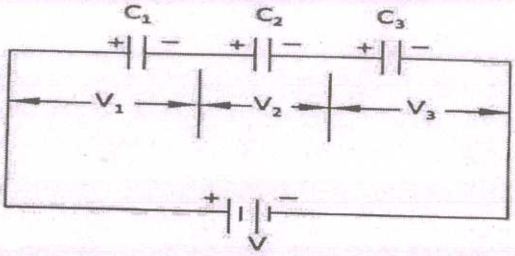
The p.d between the plates $V = E \times d = \frac{Q}{\varepsilon_0\varepsilon_r A} \times d$ — 2+

$$\frac{Q}{V} = \frac{\varepsilon_0\varepsilon_r A}{d}$$

$$C = \frac{\varepsilon_0\varepsilon_r A}{d} \text{ coulomb / volt or farad.}$$ — 2

VIII(a)	CAPACITORS IN SERIES AND PARALLEL			

i. **Series combination of Capacitors**



(1+)

Figure shows three capacitors connected in series.
The same charging current must flow through all the three capacitors. If a charging current of I ampere flows for time t, the charge on each capacitor is same

i.e.,$Q=Q_1= Q_2=Q_3$

Let C_1, C_2, C_3 = capacitances of three capacitors

V_1, V_2, V_3= p.d's across three capacitors

V=applied voltage

C=equivalent or total or combined capacitance.

In series combination, charge on all capacitors is same but the p.d's across each will vary according to their capacitances.

$$V_1 = \frac{Q}{C_1}, \qquad V_2 = \frac{Q}{C_2}, \qquad V_3 = \frac{Q}{C_3}$$

(8) (8)

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

or $$V = V_1 + V_2 = V_3$$

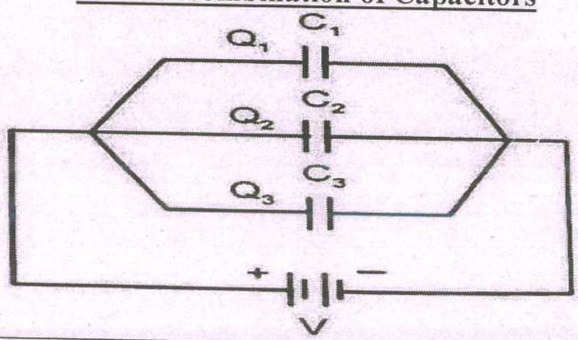
$$\frac{Q}{C} = \frac{Q}{C_1} + \frac{Q}{C_2} + \frac{Q}{C_3}$$

$$\boxed{\frac{1}{C} = \frac{1}{C_1} + \frac{1}{C_2} + \frac{1}{C_3}}$$

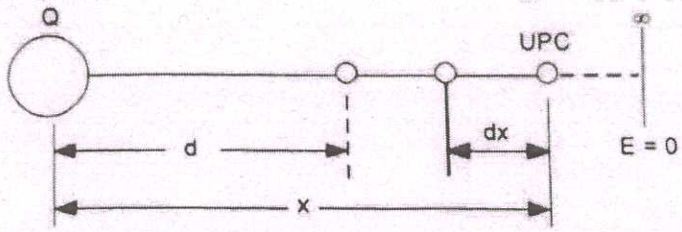
(3+)

In general $\frac{1}{C} = \frac{1}{C_1} + \frac{1}{C_2} + \ldots\ldots\ldots \frac{1}{C_n}$

ii. **Parallel combination of Capacitors**



(1+)

	Figure shows three capacitors are connected in parallel across a source voltage V. The total charge supplied by the source will be shared by each capacitor and it will depend on their capacitances. $Q_1 = C_1 V$ $Q_2 = C_2 V$ $Q_3 = C_3 V$ and $Q = CV$ $Q = Q_1 + Q_2 + Q_3$ $CV = C_1V + C_2V = C_3V$ $C = C_1 + C_2 + C_3$ In general $C = C_1 + C_2 + \ldots\ldots\ldots + C_n$	3		
VIII(b)	**Electric potential:** As defined earlier, the capacity of a charged body to do work is called electric potential. or Potential at a point in an electric field may be defined as numerically equal to the work done in bringing a positive charge of one coulomb form infinity to that point against the electric field. Consider a positive charge of Q coulomb placed in air as shown in Figure. Also consider a unit positive charge(UPC) at a distance of X meter from Q, the force on UPC is $\frac{Q}{4\pi\varepsilon_0 x^2}$ N  Suppose this UPC is moved towards Q through a small distance of dx meter. Then, The work done = Force X distance $= \frac{Q}{4\pi\varepsilon_0 x^2} \times (-dx)$ joule The negative sign is considered because dx is measured in opposite direction of X.	2+ 2+	7	7

The total work done in bringing the UPC from infinity to any point d meter from Q is given by

$$W = \int_{\infty}^{d} \frac{-Q}{4\pi\varepsilon_0 x^2}\, dx = \frac{-Q}{4\pi\varepsilon_0}\int_{\infty}^{d}\frac{1}{x^2}\, dx$$

$$= \frac{-Q}{4\pi\varepsilon_0}\cdot\left[-\frac{1}{x}\right]_{\infty}^{d} = \frac{Q}{4\pi\varepsilon_0 d}\ \text{joule}$$

By definition, this work is numerically equal to the potential at that point in volt.

$$\therefore\quad V = \frac{Q}{4\pi\varepsilon_0 d} = 9\times 109\ \frac{Q}{d}\ \text{volt ..... in air}$$

$$\text{and}\quad V = \frac{Q}{4\pi\varepsilon_0\varepsilon_r d} = 9\times 10^9\ \frac{Q}{\varepsilon_r d}\ \text{volt ..... in medium}$$

It should be observed that at $d = \infty$, the $V = 0$.

3

IX(a) Comparison between electric and magnetic circuits

Electric circuit	Magnetic circuit
1. EMF (in volt)	1. MMF (in amp-turns)
2. Current (in ampere)	2. Flux (in weber)
3. Resistance, R	3. Reluctance, S
4. Current = EMF/Resistance $I = V/R$	4. Flux = MMF/Reluctane. $\Phi = NI/S$
5. Current density $J = I/A$ ampere/m²	5. Flux density $B = \Phi/A$ Wb/ m²
6. Resistivity.	6. Reluctivity
7. Closed path for current is called electric circuit	7. Closed path for flux is called magnetic circuit.
8. Insulators for electricity exists.	8. No magnetic insulator exists (flux passes through all mediums)
9. EMF drop = IR	9. MMF drop = ΦS

(Any 7 points)

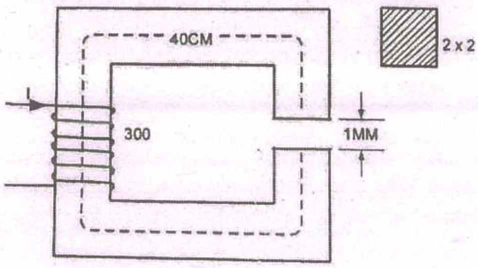
7 | 7 | 7

IX (b) Given Data

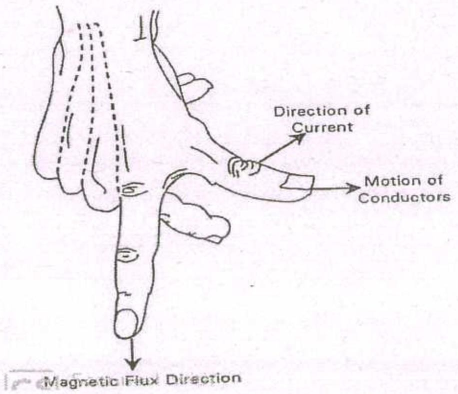
$l = 0.4$ m
$A = 2\times 2\times 10^{-4} m^2$
$\Phi = 600\times 10^{-6}$ Wb
$l_g = 1\times 10^{-3}$ m
N=300

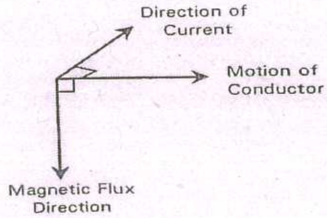
1 (Given data)

$$B = \frac{600\times 10^{-6}}{4\times 10^{-4}} = 1.5\ T$$

	 **(i) MMF for air gap :** $H_g = \frac{B}{\mu_0} = \frac{1.5}{4\pi \times 10^{-7}} = 1193662$ $AT_g = H_g \times l_g = 1193662 \times 1 \times 10^{-3} = 1193.7$ **(ii) MMF for iron :** $H_i = 1500$ (from characteristic curve) $AT_i = H_i \times l_i = 1500 \times 0.4 = \mathbf{600}$ Total $AT = AT_g + AT_i = 1193.7 + 600 = \mathbf{1793.7}$ $I = \frac{AT}{N} = \frac{1793.7}{300}$ $= \mathbf{5.979\ A}$ **Ans.**	1+ 2+ 1+ 1+ 2	8	8
X (a)	**Faraday's laws** of electromagnetic induction **1st Law** It states that"Whenever the magnetic flux links with a coil or circuit changes, an emf. Is induced in it". Or "Whenever a conductor cuts the magnetic flux, an e.m.f. is induced in the conductor". **2nd Law** It states that: "The magnitude of the induced emf is equal to the rate of change of flux linkages". Let e = induced e.m.f. (V) N=number of turns in a coil Φ_1 = initial flux linkages (Wb) Φ_2 = final flux linkages (Wb) t = time taken to change the flux from Φ_1 to Φ_2(orΦ_2 to Φ_1) (second)	2+ 2+	7	7

<table>
<tr>
<td></td>
<td>
Initial flux linkages $= N\phi_1$
Final flux linkages $= N\phi_2$
Change of flux linkages $= N\phi_2 - N\phi_1$
$= N(\phi_2 - \phi_1)$ ωb-turns
According to Faraday's second law
Induced e.m.f., $e = \dfrac{\text{change of flux linkages}}{\text{time}}$
$= \dfrac{N(\phi_2 - \phi_1)}{t}$ volt
Putting the above equation in differential form, we get
$e = \dfrac{d}{dt}(N\phi)$
$= N\dfrac{d\phi}{dt}$ volt
$\boxed{e = -N \cdot \dfrac{d\phi}{dt} \text{ volt}}$

</td>
<td>3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>X(b)</td>
<td>
i. Flemings Right Hand Rule is used to determine the direction of Induced currents in a conductor / coil (i.e , in generators)
"Place the fore-finger(first finger), middle-finger(second finger) and thumb of the right hand mutually perpendicular to each other such that, the fore-finger should point the direction of magnetic field and thumb should point the direction of motion of the conductor then the middle finger gives the direction of induced current flowing in the conductor."




</td>
<td>4+</td>
<td>8</td>
<td>8</td>
</tr>
</table>

	ii. **Applications of electromagnets** The following are the various applications of magnets 1. Electrical motors and generators 2. Lifting machines 3. Measuring instruments 4. Relays 5. Speakers 6. Electric bells 7. Compass for navigation etc	**(Any 4 points)** **4**		