
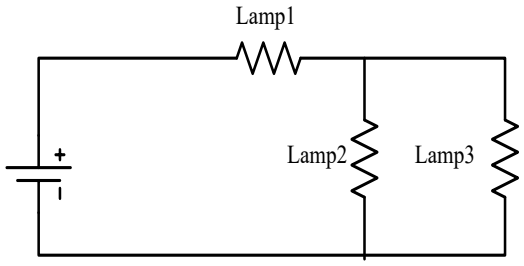


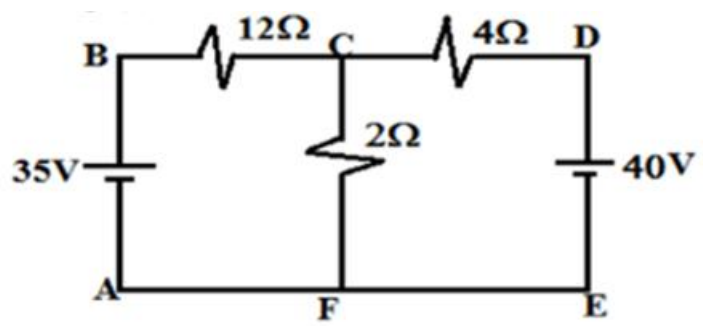
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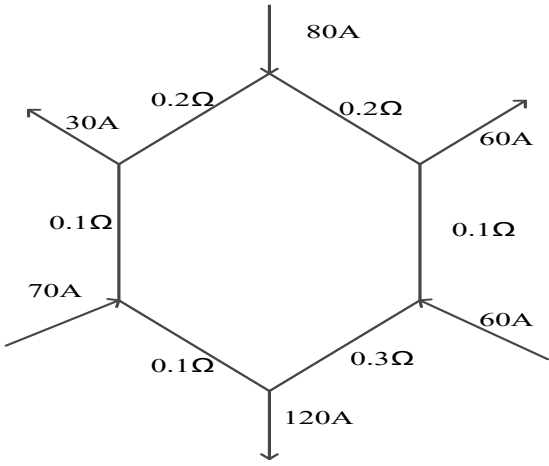
Internal Assessment Test –I

Sub:	Introduction to Electrical Engineering						Code:	1BESC104B	
Date:	7/11/2025	Duration:	90 mins	Max Marks:	50	Sem:	I sem	Branch:	Chemistry cycle(I, J, K and L)

Answer any FIVE FULL Questions

		Marks	OBE	
			CO	RBT
1 a)	State and explain Ohm's law, List out its limitations.	[4]	CO1	L1
b)	Three 60W 240V lamps are connected across a 240V power supply as shown in the figure. Calculate the i) Potential drop across each lamp ii) Total power dissipated in the lamp. <div style="text-align: center;">  </div>	[6]	CO1	L3
2 a)	For the circuit shown in the figure calculate the current in 2Ω resistor	[5]	CO1	L3



b)	Explain with a neat block diagram of Hydro Power generation	[5]	CO1	L2
3 a)	Explain voltage and current relationships with phasor diagram and waveforms in a pure resistive circuit	[5]	CO2	L3
b)	Define the following : (a) Frequency (b)RMS value (c)Average value (d)Form factor (e)Peak factor	[5]	CO2	L1
4 a)	For the given circuit , calculate current through all the branches 	[5]	CO1	L3
b)	State and explain Kirchoff's Laws, as applied to D.C. Circuit.	[5]	CO1	L2
5	With the help of circuit diagram and phasor diagram, find the phase angle, impedance and power in case of R-L series circuit.	[10]	CO1	L3
6.a)	With neat single line diagram explain the various steps of electrical power transmission and distribution system.	[5]	CO1	L3
b)	A circuit consists of a resistance of 20 ohm and an inductance of 0.05H connected in series, A supply voltage of 230V, 50 Hz is applied across the circuit. Find the current, PF, and power consumed by the circuit. Draw the vector diagram	[5]	CO2	L3
7a)	Define active power, reactive power and apparent power	[5]	CO2	L1

b)	<p>A circuit having a resistance of 15Ω, an inductance of 0.18 H, and a capacitance of $100 \mu\text{F}$ in series is connected across a 100 V, 50 Hz supply.</p> <p>Calculate:</p> <p>i) Impedance ii) Current iii) Power factor iv) Phase difference between the current and supply voltage v) Power.</p>	[5]	CO2	L1
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1.a Ohm's law can be defined when the potential difference applied at the ends of the **conductor** is 'V' and the current moving through it is 'I', and other conditions such as temperature remain constant, such that the potential difference is directly proportional to the current.

Mathematically, we have $V \propto I$

The limitations of Ohm's law include:

- Ohm's law cannot be applied to unilateral networks. Unilateral networks allow the current to flow only in one direction. Examples of such networks include **diodes, transistors**, etc.
- Additionally, Ohm's law is not applicable in the case of non-linear objects. In these components, the current is not proportional to the voltage applied. This is because, for each value of voltage and current, these components have different resistance values. Examples of non-linear components include the thyristor.
- Ohm's Law will not work in the case of non-metallic conductors.
- Calculation using Ohm's law can be difficult in the case of complicated circuits.

b.

$P = V \cdot I$
 $R_A = R_B = R_C = R$
 $R = \frac{V^2}{P}$
 $= \frac{240^2}{60W}$
 $= 960\Omega$
 $R_A = R_B = R_C = 960\Omega$

Resistance = $R_A + (R_B || R_C)$
 $= 750 + (960 || 960)$
 $= 750 + 480$
 $= 1230\Omega$

$I_A = \frac{V}{R_{eq}} = \frac{240}{1230} = 0.1951A$

$I_B = I_A \times \frac{R_C}{R_B + R_C} = 0.1951 \times \frac{960}{960 + 960}$
 $= 0.0975A$
 $I_C = I_B = 0.0975A$

$V_A = I_A R_A = 0.1951 \times 750 = 146.33V$
 $V_B = I_B R_B = 0.0975 \times 960 = 93.6V$
 $V_C = I_C R_C = 0.0975 \times 960 = 93.6V$

Power = $P_A + P_B + P_C$
 $= I_A^2 R_A + I_B^2 R_B + I_C^2 R_C$
 $= 0.1951^2 \times 750 + 0.0975^2 \times 960 + 0.0975^2 \times 960$
 $= 283.5W$

2. a) For the circuit shown, calculate currents

$35 - 12I_1 - 2(I_1 + I_2) = 0$
 $-14I_1 - 2I_2 = -35$
 $14I_1 + 2I_2 = 35$

$40 - 4I_2 - 2(I_1 + I_2) = 0$
 $-2I_1 - 6I_2 = -40$
 $2I_1 + 6I_2 = 40$

$I_1 = 1.625A$ $I_2 = 6.125A$
 $I_{2\Omega} = I_1 + I_2 = 7.750A$

2.a.

b.

HYDEL POWER PLANT

1. Water Source: Hydropower plants are built near a water source such as a dam, river or reservoir.
2. Dam: A dam is built to create a reservoir, which stores the water. The dam controls the flow of water to the power plant.
3. Penstock: The water from the reservoir flows through a penstock, which is a large pipe or conduit. The penstock carries the water to the turbine.
4. Turbine: The water turns a turbine, which is connected to a generator.
5. Generator: The generator converts the mechanical energy from the turbine into electrical energy.
6. Transformer: The electrical energy from the generator is then sent to a transformer, which increases the voltage to the level needed for transmission.
7. Transmission Lines: The electricity is then transmitted through high-voltage transmission lines to the end-users.
8. End-Users: The electricity generated is distributed to the end-users such as homes, businesses, and industries.

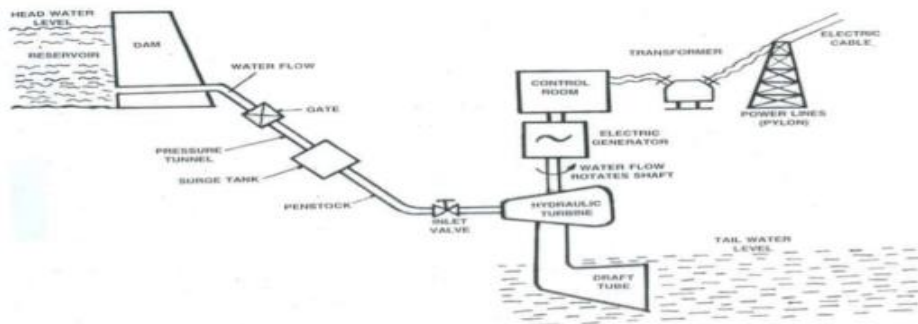
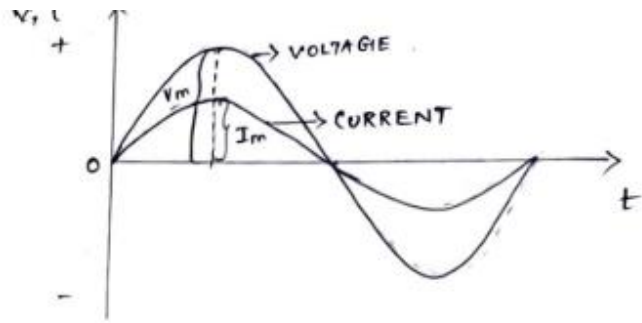
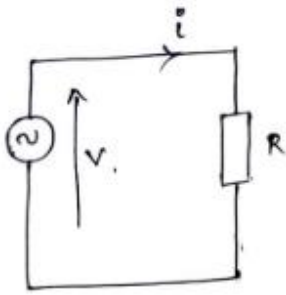


Fig.Layout of Hydro electric Power plant

3.a



$$i = \frac{V}{R}$$

⇒ current and voltage both are in-phase. ✓

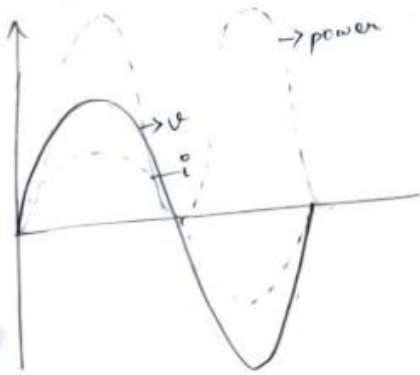
PHASOR DIAGRAM:



$$v = V_m \sin \omega t$$

$$i = \frac{V_m}{R} \sin \omega t$$

i) Power thro pure R circuit



$$v = V_m \sin \omega t$$

$$i = I_m \sin \omega t$$

instantaneous power

$$p = vi = V_m I_m \sin^2 \omega t$$

$$= \frac{V_m I_m}{2} (1 - \cos 2\omega t)$$

$$\text{power} = \frac{V_m I_m}{2} - \frac{V_m I_m}{2} \cos 2\omega t$$

\downarrow constant part \downarrow fluctuating part

for complete cycle average value of $\frac{V_m I_m}{2} \cos 2\omega t$ is 0.

$$\therefore \text{Power} = \frac{V_m I_m}{2} = \frac{V_m}{\sqrt{2}} \cdot \frac{I_m}{\sqrt{2}}$$

$$= V \times I$$

V - rms value of applied voltage
 I - rms value of the current

* in a purely resistive circuit power is never zero.

3.b. The **RMS (Root Mean Square)** value (also known as **effective** or **virtual** value) of an alternating current (AC) is the value of direct current (DC) when flowing through a circuit or resistor for the specific time period and produces same amount of heat which produced by the alternating current (AC) when flowing through the same circuit or resistor for a specific time.

For AC sine wave, RMS values of current and voltage are:

$$I_{\text{RMS}} = 0.707 \times I_M, V_{\text{RMS}} = 0.707 V_M$$

It is the ratio between maximum value and RMS value of an alternating wave.

$$\text{Peak Factor} = \frac{\text{Maximum Value}}{\text{R.M.S Value}}$$

For a sinusoidal alternating voltage:

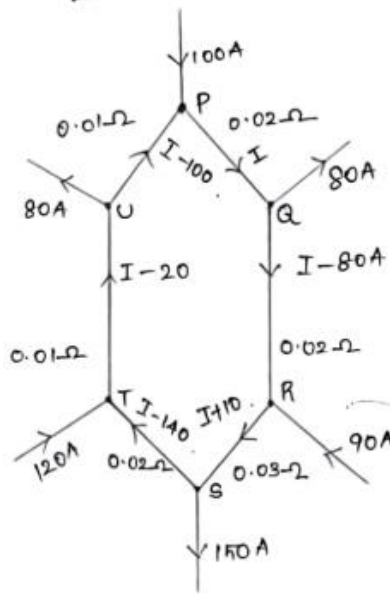
$$\frac{E_M}{0.707 E_M} = 1.414$$

❓ **Frequency:** The number of cycles of a waveform that occur in one second, measured in Hertz (*Hz*). It is the reciprocal of the period ($1/T$)

$$f = 1/T$$

❓ **Average Value:** The mean value of the signal over one complete cycle. It is calculated by integrating the function over one period and dividing by the period, or by using specific formulas for different waveforms.

4.a



$$\begin{aligned}
 I_{Pa} &= I &= 48.18 \text{ A} \\
 I_{QR} &= I - 80 \text{ A} &= -31.81 \text{ A} \\
 I_{RS} &= I + 10 \text{ A} &= 58.18 \text{ A} \\
 I_{ST} &= I - 140 \text{ A} &= -91.82 \text{ A} \\
 I_{TU} &= I - 20 \text{ A} &= 28.18 \text{ A} \\
 I_{UP} &= I - 100 \text{ A} &= -51.82 \text{ A}
 \end{aligned}$$

$$-0.02I - 0.02(I - 80) - 0.03(I + 10) - 0.02(I - 140) - 0.01(I - 20) - 0.01(I - 100) = 0$$

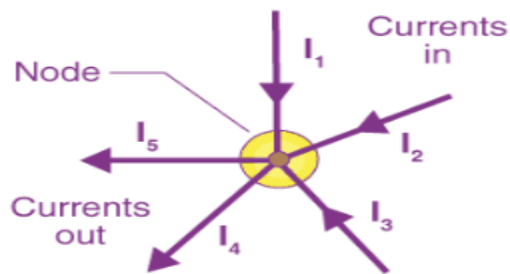
$$-0.02I - 0.02I + 1.6 - 0.03I - 0.3 - 0.02I + 2.8 - 0.01I + 0.2 - 0.01I + 1 = 0$$

$$\begin{aligned}
 5.3 - 0.11I &= 0 \\
 0.11I &= 5.3 \\
 I &= 48.18 \text{ A}
 \end{aligned}$$

the

4.b

According to Kirchhoff's Current Law, The total current entering a junction or a node is equal to the charge leaving the node as no charge is lost.

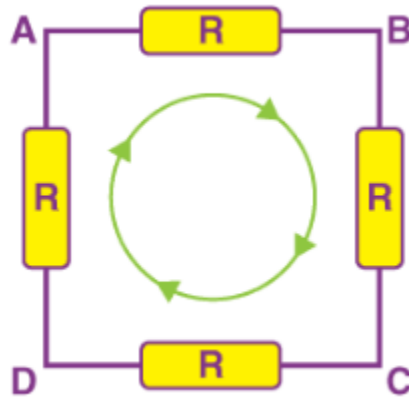


$$I_1 + I_2 + I_3 + (-I_4 + -I_5) = 0$$

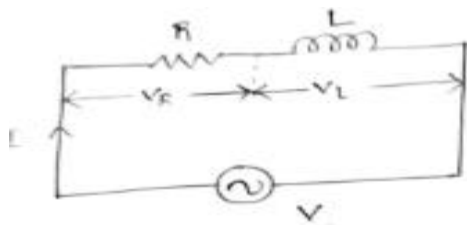
According to Kirchhoff's Voltage Law, The voltage around a loop equals the sum of every voltage drop in the same loop for any closed network and equals zero.

The sum of all the voltage drops around the loop is equal to zero

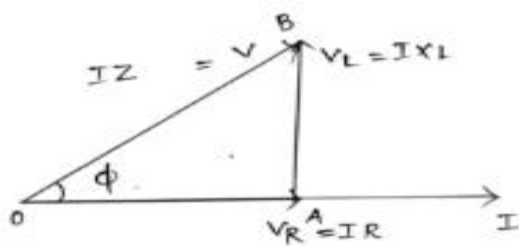
$$V_{AB} + V_{BC} + V_{CD} + V_{DA} = 0$$



5.



Let V - rms value of the applied voltage
 I - rms value of the applied current
 $V_R = IR$ (V_R in phase with I)
 $V_L = IX_L$ (V_L leads I by 90°).



Take that quantity as reference which is common in the ckt

$$\begin{aligned} \vec{V} &= \vec{V}_R + \vec{V}_L \Rightarrow \sqrt{V_R^2 + V_L^2} \\ &= \sqrt{(IR)^2 + (IX_L)^2} \\ &= I \sqrt{R^2 + X_L^2} \end{aligned}$$

$$I = \frac{V}{\sqrt{R^2 + X_L^2}} \Rightarrow \frac{V}{Z}$$

the ckt

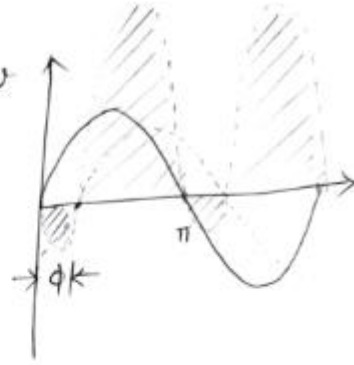
Phase angle:-

$$Z = \sqrt{R^2 + X_L^2} \quad i, v$$

$$Z = R + jX_L$$

$$\tan \phi = \frac{V_L}{V_R} = \frac{IX_L}{IR}$$

$$\tan \phi = \frac{X_L}{R}$$



i.e. $v = V_m \sin \omega t$

$i = I_m \sin(\omega t - \phi)$

i.e. in an inductive circuit, current lags behind the applied voltage by ϕ .

Power:- Instantaneous power $p = vi$

$$= V_m \sin \omega t \times I_m \sin(\omega t - \phi)$$

$$= V_m I_m \sin \omega t \sin \omega t - \phi$$

$$= \frac{V_m I_m}{2} [\cos(\omega t - \omega t + \phi) - \cos(\omega t + \omega t - \phi)]$$

$$\sin A \sin B = \frac{1}{2} [\cos(A-B) - \cos(A+B)]$$

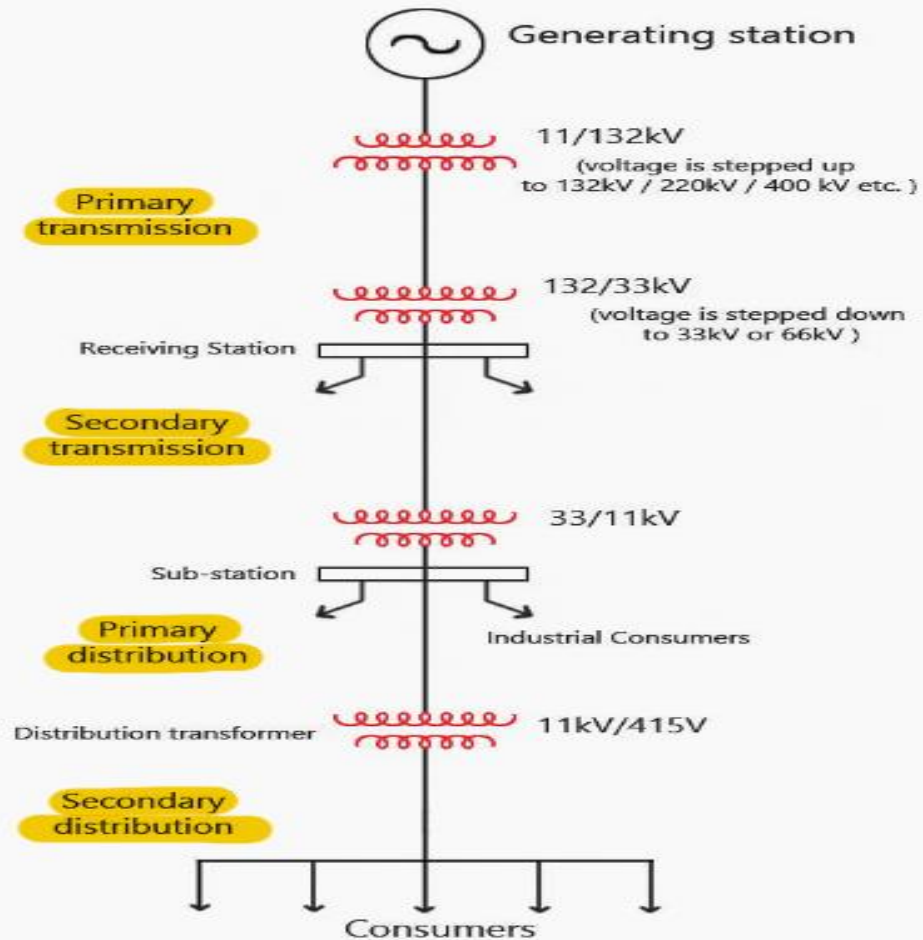
$$= \frac{V_m I_m}{2} [\cos(\omega t - \omega t + \phi) - \cos(\omega t + \omega t - \phi)]$$

$$= \frac{V_m I_m}{2} (\cos \phi - \cos(2\omega t - \phi))$$

$$= \frac{V_m I_m \cos \phi}{2} - \frac{V_m I_m \cos(2\omega t - \phi)}{2}$$

↓
const part whose avg value is same

↓
fluctuating part whose avg value is zero.



6.a

Electrical power transmission and distribution system can be divided into several steps, including:

1. Generation: Electricity is generated at power stations using various sources such as coal, natural gas, nuclear energy, hydroelectricity, wind, or solar energy.
2. Step-up transformers: The voltage of the generated power is stepped up using step-up transformers to reduce energy losses during long-distance transmission.
3. Transmission: High-voltage transmission lines are used to transmit the electricity over long distances from the power station to the substations.
4. Substations: At the substations, the voltage is stepped down using step-down transformers for local distribution.
5. Distribution: Low-voltage distribution lines are used to distribute the electricity to

residential, commercial, and industrial consumers.

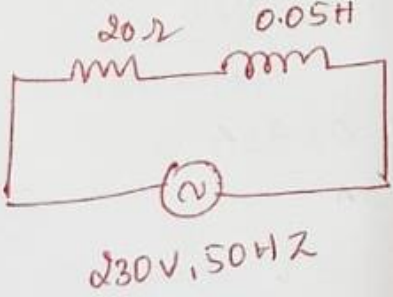
6. Distribution transformers: At the end of the distribution lines, distribution transformers are used to step down the voltage to the levels suitable for consumer use.

7. Consumption: The electricity is finally consumed by various appliances and devices in homes, businesses, and industries.

Overall, electrical power transmission and distribution system involves the generation, transmission, distribution, and consumption of electricity to meet the needs of the society.

b.

6. b.



$X_L = 2\pi fL = 2\pi \times 50 \times 0.05$
 $= 15.7 \Omega$

$Z = \sqrt{X_L^2 + R^2} = 25.42$
 $= \sqrt{15.7^2 + 20^2}$

$I = \frac{V}{Z} = \frac{230}{25.42}$
 $= 9.047 \text{ A}$

$\cos \phi = \frac{R}{Z}$
 $= \frac{20}{25.42}$
 $= 0.786$

$P = VI \cos \phi = 230 \times 9.047 \times 0.786$
 $= \underline{\underline{1634 \text{ W}}}$

7. a The power which is actually consumed or utilised in an AC Circuit is called **True power** or **Active power** or **Real power**. It is measured in kilowatt (kW) or MW. It is the actual outcomes of the electrical system which runs the electric circuits or load.

The power which flows back and forth that means it moves in both the directions in the circuit or reacts upon itself, is called **Reactive Power**. The reactive power is measured in kilo volt-ampere reactive (kVAR) or MVAR.

The product of root mean square (RMS) value of voltage and current is known as **Apparent Power**. This power is measured in kVA or MVA.

7.b.

$$X_L = 2\pi \times 50 \times 0.18 = 56.54 \Omega$$

$$X_C = \frac{1}{2\pi f C} = \frac{1}{2\pi \times 50 \times 100 \times 10^{-6}} = 31.83 \Omega$$

$$Z = \sqrt{R^2 + (X_L - X_C)^2} = 28.9 \Omega$$

$$\cos \phi = \frac{R}{Z} = \frac{15}{28.9} = 0.518$$

$$\phi = \cos^{-1}(0.518) = 58.74^\circ \text{ lagging}$$

$$I = \frac{V}{Z} = \frac{100}{28.9} = 3.46 \text{ A}$$

$$P = V \times I \times \cos \phi$$

$$= \underline{\underline{179.2 \text{ W}}}$$