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Internal Assesment Test –I											
Sub:	Introduction to Electrical Engineering								Code:	BESCK104B	
Date:	2/11/2023	Duration:	90 mins	Max Marks:	50	Sem:	1st sem		Branch:	Chemistry cycle	
Answer any FIVE FULL Questions											
									Marks	OBE	
										CO	RBT
1 a)	State and explain Ohm's law, List out its limitation.								[4]	CO1	L1

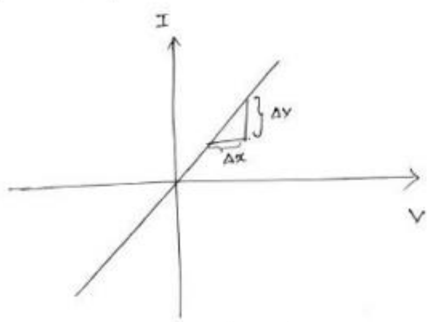
s law :-

The ratio of potential difference (V) between any two points on a conductor to the current (I) flowing between them is constant, provided the temperature of the conductor doesn't change.

$$\frac{V}{I} = \text{constant}$$
$$= R(\Omega)$$

R - constant of proportionality
- resistance of the conductor.

Graphical representation of Ohm's law:



$$\text{Slope} = \frac{\Delta Y}{\Delta X} = \frac{I}{V} = \frac{1}{R} = G$$

where G is conductance (siemens) ($\mho$).

Limitations - OHM'S LAW

1) It cannot be applied to non-linear devices like diodes, zener diodes, transistors, voltage regulator etc.
2) Ohm's law is applicable as long as temperature and other physical parameters remains constant
3) It cannot be applied to complicated ckts having more no of branches and emf sources.
4) Not suitable for non-metallic conductors like silicon carbide, graphite etc.

b)	Explain Nuclear power generation	[6]	CO5	L2

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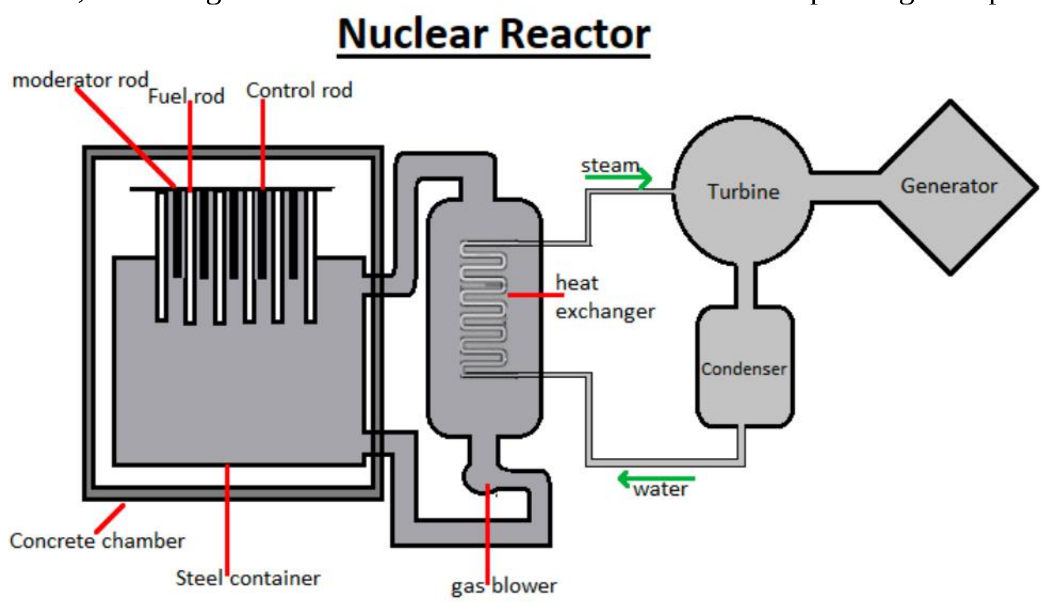
<td>A nuclear power plant is a facility that generates electricity using nuclear reactions. Nuclear power plants use the heat generated by nuclear reactions to produce steam, which drives a turbine that generates electricity.
The basic components of a nuclear power plant include: Reactor: The reactor is the heart of the nuclear power plant. It contains nuclear fuel, which undergoes controlled nuclear reactions, producing heat. The heat produced is then used to create steam. Steam Generator: The steam generator takes the heat generated by the reactor and uses it to produce steam. The steam is then used to drive a turbine.
Turbine: The turbine converts the energy in the steam into mechanical energy that is used to turn a generator.
Generator: The generator uses the mechanical energy from the turbine to produce electricity.
Cooling system: The cooling system is used to remove the heat produced by the nuclear reaction, ensuring that the reactor remains at a safe operating temperature.


Nuclear power plants can use different types of nuclear reactors, including pressurized water reactors (PWRs) and boiling water reactors (BWRs). In PWRs, water is used as both a coolant and a moderator to control the nuclear reaction. In BWRs, the water is allowed to boil and create steam directly in the reactor. One of the main advantages of nuclear power plants is that they produce large amounts of electricity without emitting greenhouse gases, such as carbon dioxide. However, they also produce nuclear waste, which can remain radioactive for thousands of years and require careful handling and storage. Safety concerns, such as the risk of accidents or nuclear proliferation, are also important considerations for nuclear power plant operation.</td>
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<td>2 a)</td>
<td>Calculate the loop currents using KVL for the given circuit below?</td>
<td>[6]</td>
<td>CO1</td>
<td>L3</td>
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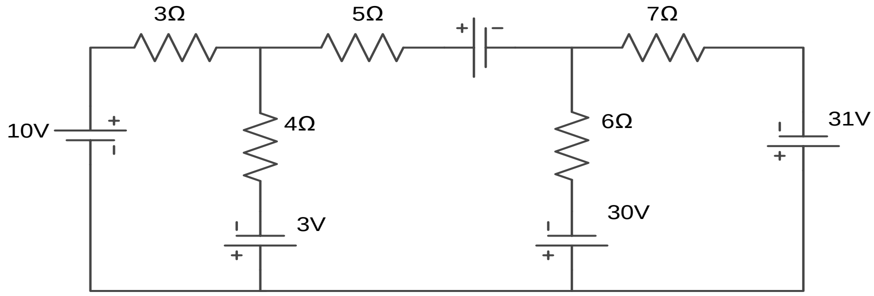
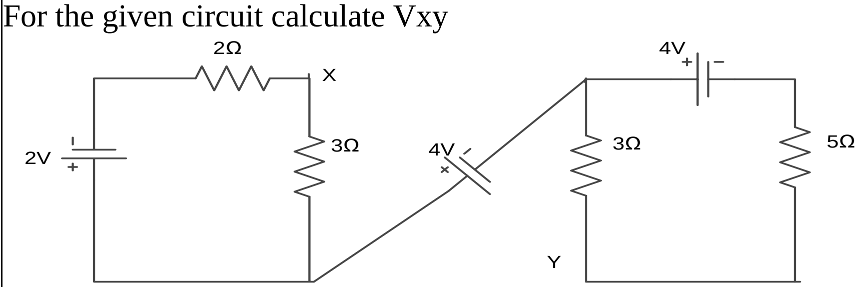
	 KVL @ loop 1:- $10 - 3i_1 - 4(i_1 - i_2) + 3 = 0$ $10 - 3i_1 - 4i_1 + 4i_2 + 3 = 0$ $10 - 7i_1 + 4i_2 + 3 = 0$ $-7i_1 + 4i_2 + 0i_3 = -13$ — (1) KVL @ loop 2:- $-5i_2 - 5 - 6(i_2 - i_3) + 30 - 3 - 4(i_2 - i_1) = 0.$ $-5i_2 - 5 - 6i_2 + 6i_3 + 27 - 4i_2 + 4i_1 = 0.$ $-5i_2 - 5$ $4i_1 - 15i_2 + 6i_3 = -22$ — (2) KVL @ loop 3:- $-7i_3 + 31 - 30 - 6(i_3 - i_2) = 0.$ $-7i_3 + 1 - 6i_3 + 6i_2 = 0.$ $0i_1 + 6i_2 - 13i_3 = -1$ — (3). Solving, $i_1 = 3.57A$; $i_2 = 3.01A$; $i_3 = 1.46A$.			
b)	For the given circuit calculate Vxy 	[4]	CO1	L3

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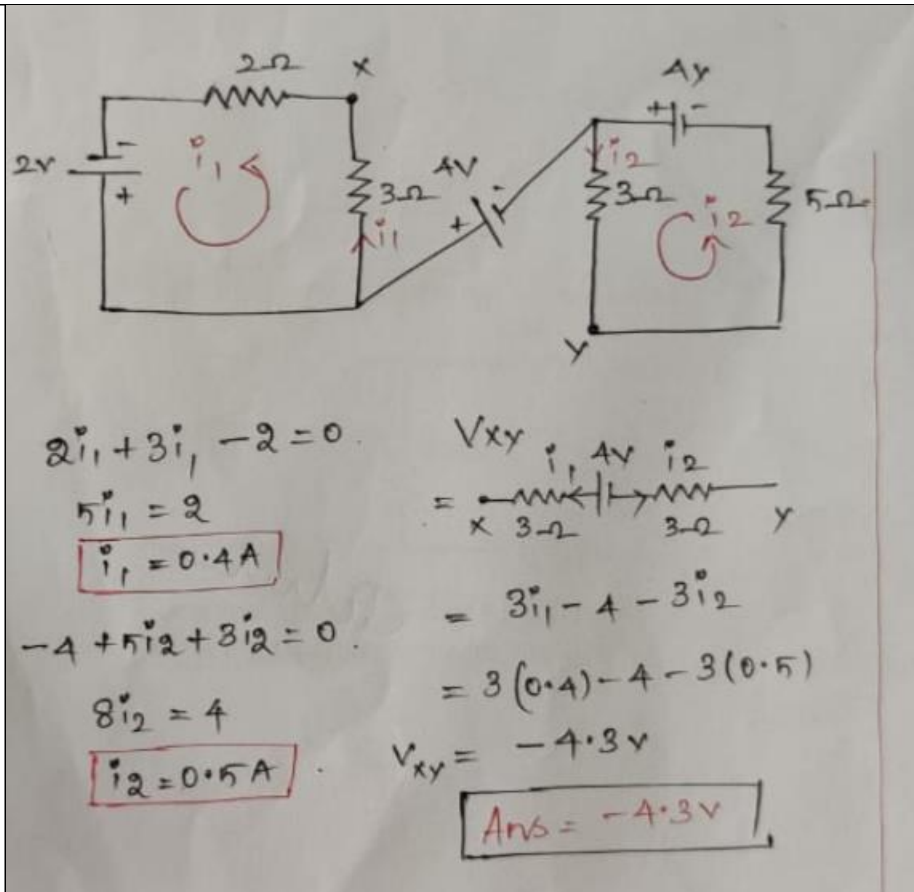
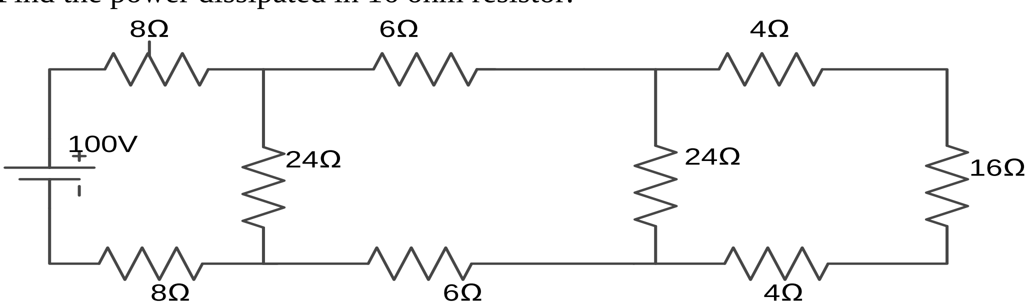
<tr><td></td><td>
</td><td></td><td></td><td></td></tr>
<tr><td>3 a)</td><td>Find the power dissipated in 16 ohm resistor.

</td><td>[5]</td><td>CO1</td><td>L3</td></tr>
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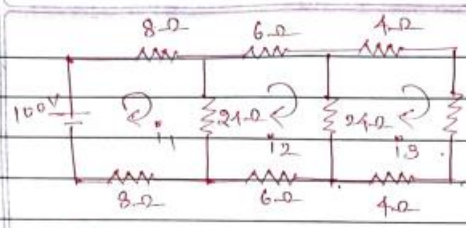
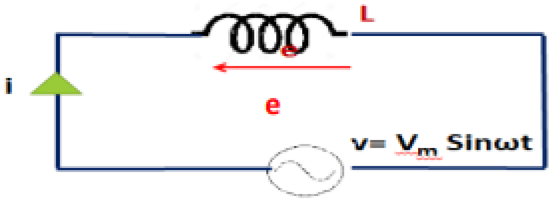
	8 a)  KVL @ L1, $-8i_1 - 24(i_1 - i_2) - 8i_1 + 100 = 0$ $-8i_1 - 24i_1 + 24i_2 - 8i_1 = -100$ $-40i_1 + 24i_2 + 0i_3 = -100$ — (1) KVL @ L2, $-6i_2 - 24(i_2 - i_3) - 6i_2 - 24(i_2 - i_1) = 0$ $-6i_2 - 24i_2 + 24i_3 - 6i_2 - 24i_2 + 24i_1 = 0$ $24i_1 - 60i_2 + 24i_3 = 0$ — (2) KVL @ L3, $-4i_3 - 16i_3 - 4i_3 - 24(i_3 - i_2) = 0$ $-4i_3 - 16i_3 - 4i_3 - 24i_3 + 24i_2 = 0$ $0i_1 + 24i_2 - 48i_3 = 0$ — (3) Solving above equations, $i_1 = 3.57$ A $i_2 = 1.78$ A $i_3 = 0.89$ A. Current through 16Ω resistor is i_3 ∴ Power dissipated $= i_3^2 \times 16$ $= 0.89^2 \times 16$ $= 12.67$ W P = 12.67 W.			
b)	For a pure inductor excited by sinusoidal varying AC voltage, show that the average power consumed by inductor is zero with necessary diagrams and waveforms Answer:-	[5]	CO2	L2



Consider a simple circuit consisting of a pure inductance of L henries, connected across a voltage given by the equation, $v = V_m \sin \omega t$.

Pure inductance has zero ohmic resistance. Its internal resistance is zero. The coil has pure inductance of L henries.

When alternating quantity i flows through inductance 'L', it sets up an alternating magnetic field around the inductance. This changing flux links the coil and due to self inductance, emf gets induced in the coil. This emf opposes the applied voltage.

The self induced emf in the coil is given by, $e = -L\frac{di}{dt}$

At all instant, the applied voltage v is equal and opposite to the self induced emf

$$v = -e = -(-L\frac{di}{dt})$$

$$v = L\frac{di}{dt}$$

$$V_m \sin \omega t = L\frac{di}{dt}$$

$$di = \frac{V_m}{L}\sin \omega t$$

$$i = \int di = \int \frac{V_m}{L}\sin \omega t = \frac{V_m}{L}\left(\frac{-\cos \omega t}{\omega}\right)$$

$$= -\frac{V_m}{\omega L}\sin\left(\frac{\pi}{2} - \omega t\right) \quad \text{as } \cos \omega t = \sin\left(\frac{\pi}{2} - \omega t\right)$$

$$i = \frac{V_m}{\omega L}\sin\left(\omega t - \frac{\pi}{2}\right)$$

$$\mathbf{i = I_m \sin\left(\omega t - \frac{\pi}{2}\right)}$$

where $I_m = \frac{V_m}{\omega L} = \frac{V_m}{X_L}$

where $X_L = \omega L = 2\pi f L\ \Omega$

The term, X_L is called **Inductive Reactance** and is measured in **ohms**

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Power

The instantaneous power in a.c. circuits can be obtained by taking product of the instantaneous values of current and voltage.

$$P = v*i = V_m \sin \omega t * I_m \sin(\omega t - \frac{\pi}{2})$$

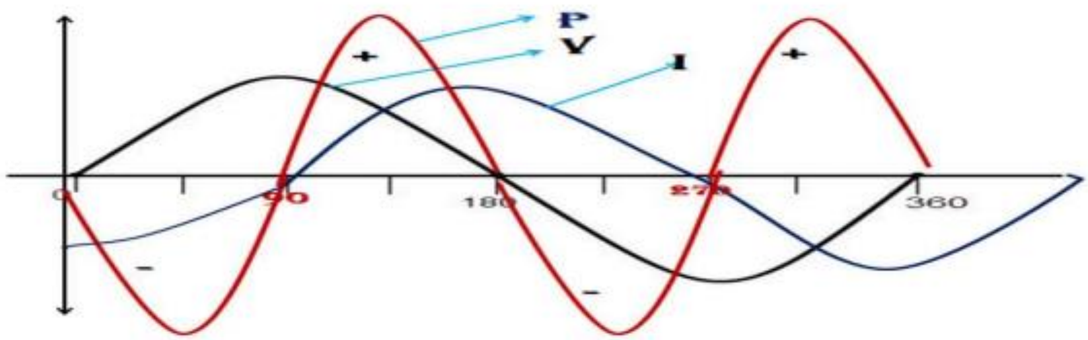
$$= - V_m I_m \sin(\omega t) \cos(\omega t)$$

$$\mathbf{P} \quad = - \frac{V_m I_m}{2} \sin(2\omega t)$$

The average value of sine curve over a complete cycle is always zero

$$P = \int_0^{2\pi} \frac{V_m I_m}{2} \sin(2\omega t) \; d(\omega t) = 0$$

<u>P = 0</u> [Hence Proved]



It can observed from it that when power curve is positive, energy gets stored in the magneticfield established due to increasing current while during negative power curve, this power is returned back to the supply. The areas of positive loop and negative loop are exactly same and hence, average powerconsumption is zero.

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<td>4 a)</td>
<td>For the given circuit , calculate current through all the branches</td>
<td>[5]</td>
<td>CO1</td>
<td>L3</td>
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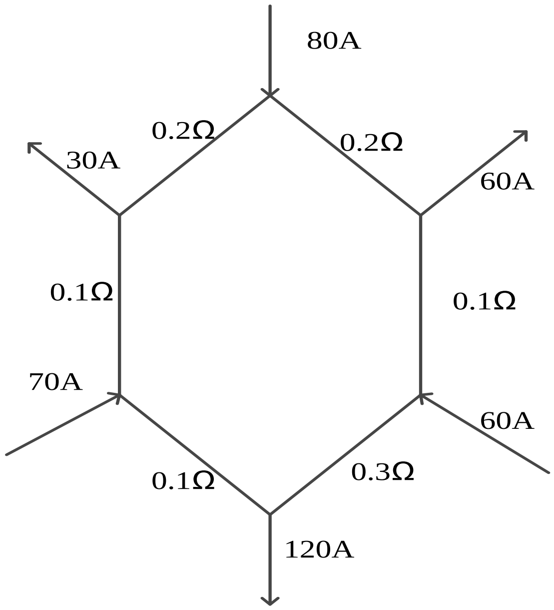
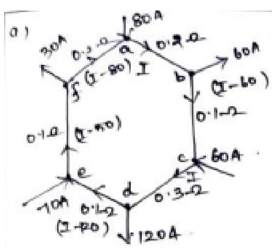




Let us assume current through branch ab, be I (A). Applying KCL at remaining nodes, the current through all other branches are written as follows

$I_{ab} = I(A)$; $I_{bc} = (I-60)\,A$; $I_{cd} = I(A)$; $I_{de} = (I-120)\,A$

$I_{ef} = (I-50)\,A$; $I_{fa} = (I-80)\,A$.

Apply KVL for the loop abcdefa,

$$-0.2I - 0.1(I-60) - 0.3I - 0.1(I-120) - 0.1(I-50) - 0.2(I-80) = 0.$$

$$-0.2I - 0.1I + 6 - 0.3I - 0.1I + 12 - 0.1I + 5 - 0.2I + 16 =$$

$$I - 39 = 0$$

$$\boxed{I = 39\,A}.$$

$I_{ab} = 39A$; $I_{bc} = 39-60 = -21A$; $I_{cd} = 30A$

$I_{de} = I-120 = 39-120 = -81A$; $I_{ef} = -11A$;

$I_{fa} = -41A$.

b)	State and explain Kirchhoff's Laws, as applied to D.C. Circuit.	[5]	CO1	L2

The current or voltage of any circuit branch can also be calculated using Kirchhoff's Law. These laws are valid in AC and DC networks at low frequencies.

Kirchhoff's laws are classified into two types:

- Kirchhoff's Current Law (KCL)
- Kirchhoff's Voltage Law (KVL)

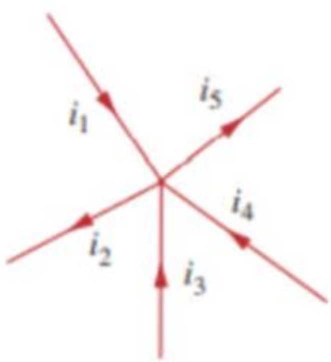
Kirchhoff's Current Law

Kirchhoff’s current law is also known as Kirchhoff's First law or Kirchhoff's Law of the junction, but the most used term is Kirchhoff's Current Law or KCL. KCL is based on the law of conservation of charge.

Kirchhoff’s current law states that the algebraic sum of currents entering a node or a closed boundary equals zero.

If there are N number of branches connected to a node and it is the current of the nth branch, then mathematically, KCL states,

$\sum_{n=1}^{N} i_n = 0$



Applying KCL to the above node,

$$-i_1 + i_2 - i_3 - i_4 + i_5 = 0$$

$$i_2 + i_5 = i_1 + i_3 + i_4$$

Current leaving=current entering

	Kirchhoff's Voltage Law Kirchhoff's Voltage Law is also known as Kirchhoff's Second law or KVL. KVL is based on the law of conservation of energy. **Kirchhoff's Voltage Law:** Kirchhoff's Voltage Law states that the algebraic sum of voltages around a closed path or loop in a circuit equals zero. If there are M number of voltages in a loop and V_m is the m^{th} voltage, then mathematically, KVL can be written as: $^{M}\sum_{n=1} v_m = 0$			
5	Calculate i) Current through each resistor ii) Unknown resistance x? iii) Req. iv) Power consumed.	[10]	CO1	L3

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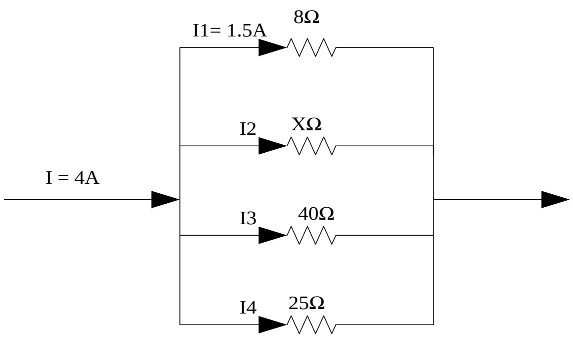
<td>
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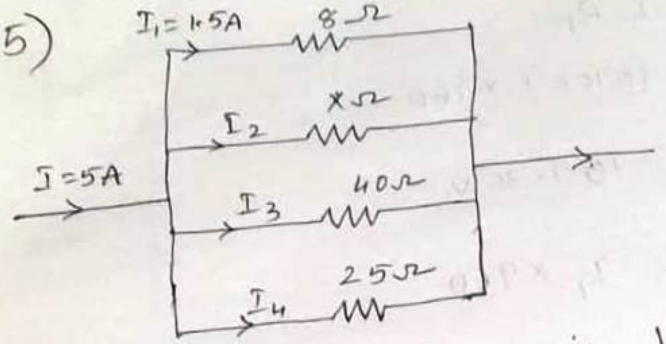


Voltage drop across 8Ω is $V_{8\Omega} = I_1 \times 8$

$V_{8\Omega} = 12V.$

12V is Voltage across all $\parallel^{el}$ resistors.

i) $I_3 = \frac{V}{40} = 0.3A.$

$I_4 = \frac{V}{25} = 0.48A.$

$I = I_1 + I_2 + I_3 + I_4.$

$I_2 = I - (I_1 + I_3 + I_4)$

$= 5 - (1.5 + 0.3 + 0.48)$

$I_2 = 2.72A.$

ii) $V = I_2 \times x \Rightarrow x = \frac{V}{I_2} = \frac{12}{2.72}$

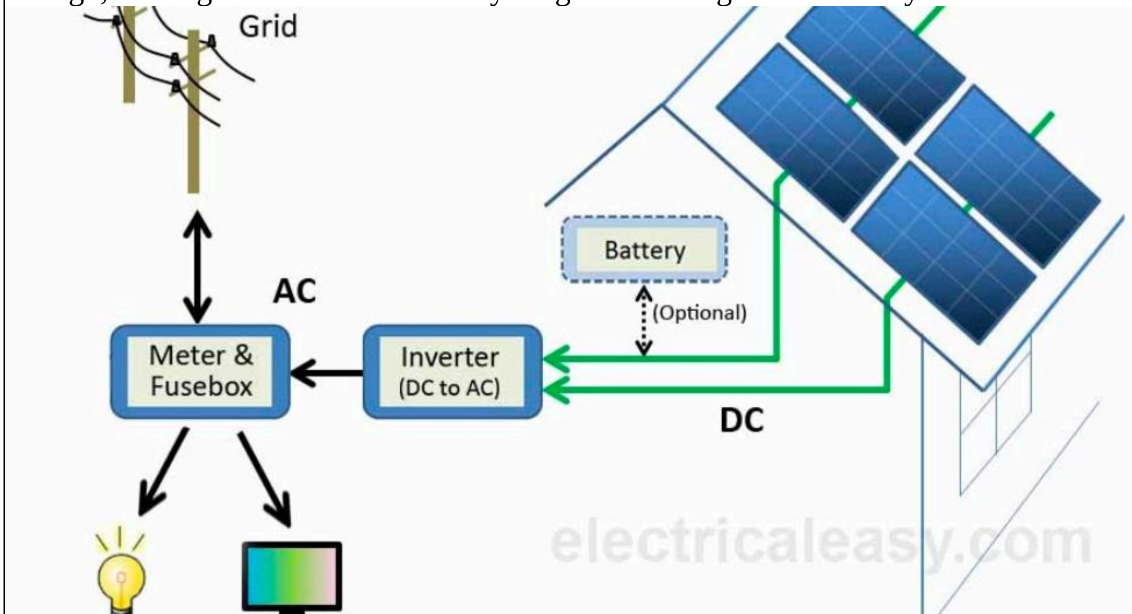
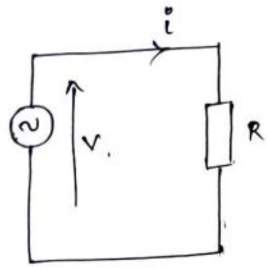
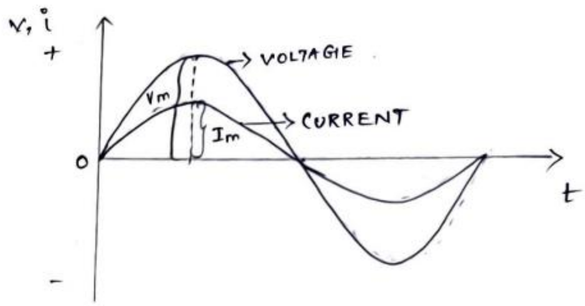
$x = 4.4\Omega.$

iii) $\frac{1}{R_{eq}} = \frac{1}{8} + \frac{1}{4.4} + \frac{1}{40} + \frac{1}{25}$

$R_{eq} = 2.39\Omega$

iv) $P = V \times I = 12 \times 5 = 60W$

6	Define the RMS, average value, form factor and peak factor for a sinusoidal signal. **Average Value:** The average of all the instantaneous values of an alternating voltage and currents over one complete cycle is called **Average Value.** If we consider symmetrical waves like sinusoidal current or voltage waveform, the positive half cycle will be exactly equal to the negative half cycle. Therefore, the average value over a complete cycle will be **zero**. **RMS Value:** That steady current which, when flows through a resistor of known resistance for a given period of time than as a result the same quantity of heat is produced by the alternating current when flows through the same resistor for the same period of time is called **R.M.S** or effective value of the alternating current. **Peak Factor** is defined as the ratio of maximum value to the R.M.S value of an alternating quantity. The alternating quantities can be voltage or current. The maximum value is the **peak value** or the **crest value** or the amplitude of the voltage or current. **Form Factor:** The ratio of the root mean square value to the average value of an alternating quantity (current or voltage) is called Form Factor. The average of all the instantaneous values of current and voltage over one complete cycle is known as the average value of the alternating quantities.	[10]	CO1	L2
7 a)	Explain Solar power generation with Block diagram Solar power generation is the process of converting sunlight into electricity. This is done through the use of solar panels, which capture the energy from the sun and convert it into usable electricity. The basic components of a solar power generation system include: Solar Panels: Solar panels are made up of photovoltaic cells, which convert sunlight into direct current (DC) electricity. They are typically installed on rooftops or in fields where they can be exposed to the maximum amount of sunlight. Inverter: The inverter is used to convert the DC electricity produced by the solar panels into alternating current (AC) electricity, which can be used to power appliances and equipment. Battery Storage: Solar power generation systems can be equipped with batteries to store excess electricity generated during the day for use at night or during periods of low sunlight. Monitoring System: A monitoring system is used to track the performance of the solar power generation system and identify any issues that may arise. Solar power generation has several advantages over conventional energy sources, including: Renewable: Solar power is a renewable energy source that will never run out. Environmentally Friendly: Solar power generation produces no greenhouse gas emissions and has a minimal impact on the environment. Cost-Effective: The cost of solar power generation has decreased significantly in recent years, making it more accessible to homeowners and businesses. However, solar power generation also has some limitations, such as its dependence on sunlight and its intermittent nature, which means that energy storage solutions are needed to ensure a	[5]	CO5	L2

	consistent supply of electricity. Additionally, the initial cost of installing solar panels can be high, although this is often offset by long-term savings on electricity bills  			
b)	Explain the voltage and current relationships with phasor diagram and waveforms in a pure resistive circuit ALTERNATING CURRENT IN A RESISTIVE CIRCUIT:   $i = \frac{v}{R}$ ⇒ current and voltage both are in-phase. PHASOR DIAGRAM:  $v = V_m \sin \omega t$ $i = \frac{V_m}{R} \sin \omega t$	[5]	CO1	L2

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