Question Paper

Exam Date & Time: 13-Jan-2024 (09:30 AM - 12:30 PM)

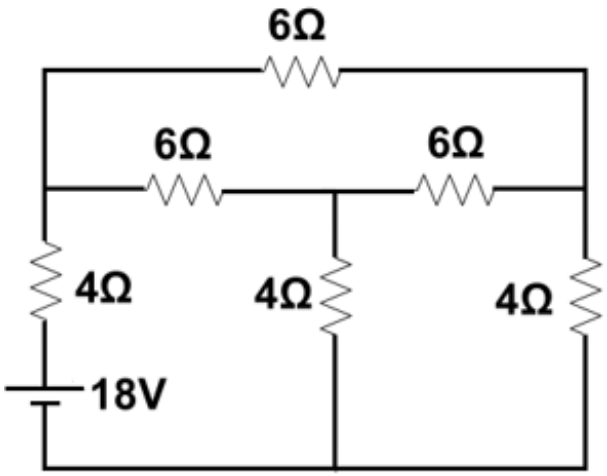
MANIPAL ACADEMY OF HIGHER EDUCATION

FIRST SEMESTER B.TECH. EXAMINATIONS -JANUARY 2024
SUBJECT: ELE 1071 / ELE-1071 - BASIC ELECTRICAL TECHNOLOGY

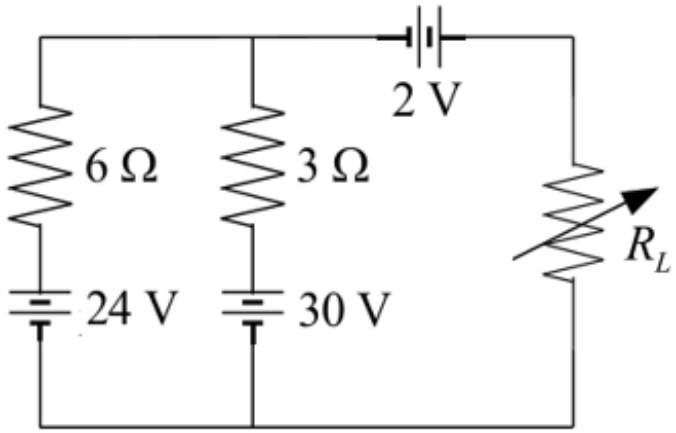
Marks: 50 **Duration: 180 mins.**

Answer all the questions.

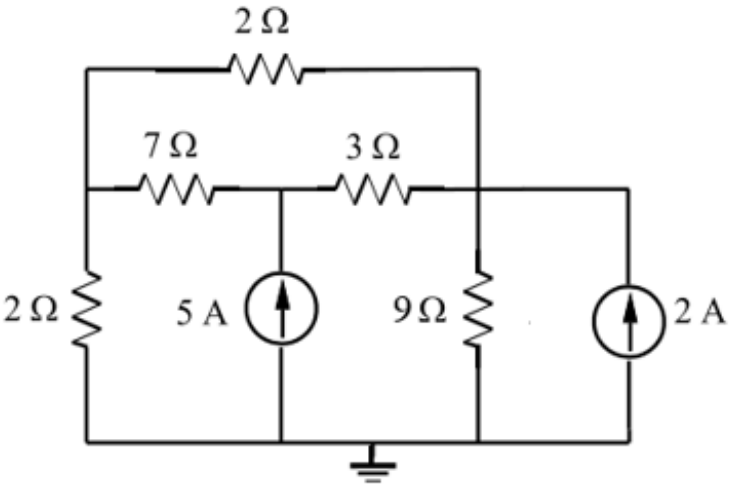
1A) Determine the power supplied by the source in the given network. (3)



1B) Obtain the **maximum power** that could be delivered to the load resistor (R_L), which is variable, in the circuit shown. (3)



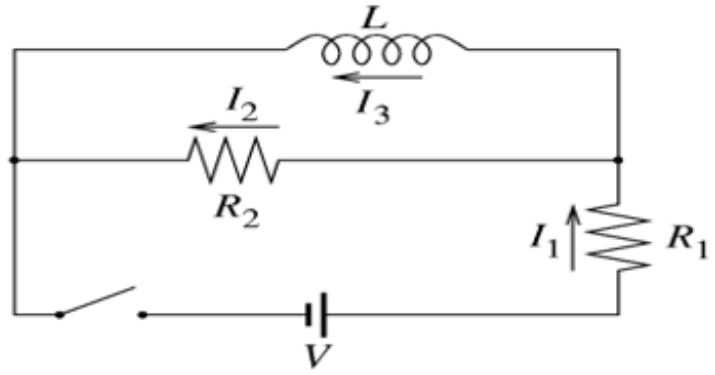
1C) Determine the power dissipated in **3 Ω** resistor in the given circuit. (4)



2A) The switch in the circuit below has been open for a long time. Determine the currents I_1, I_2, and I_3 in the resistors and in the **self-inductance (L)** (3)

i) just after the switch is closed.

ii) A long time after the switch is closed.The internal resistance of the battery is negligible. Express your answers in terms of **V, R_1, R_2** and **L.**

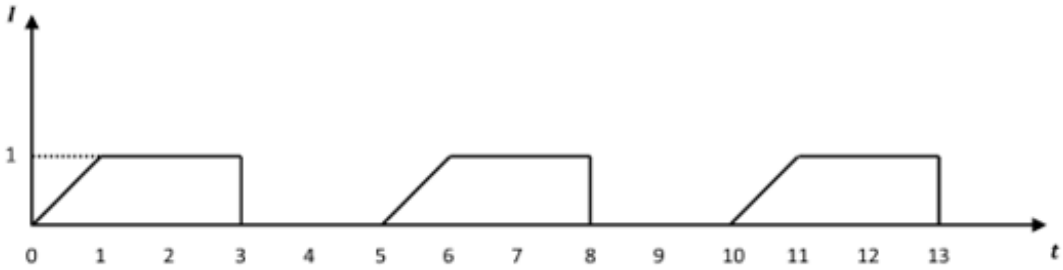


2B) A ring forming a magnetic circuit is made from two materials; one part is mild steel (relative permeability = **2000**) of mean length **25 cm** and cross-sectional area **4 cm^2**, and the remainder is cast iron (relative permeability = **1350**) of mean length **20 cm** and cross-sectional area **7.5 cm^2.** Determine the total **MMF** required to cause a flux of **0.30 mWb** in the magnetic circuit. Also find the total reluctance of the circuit. (4)

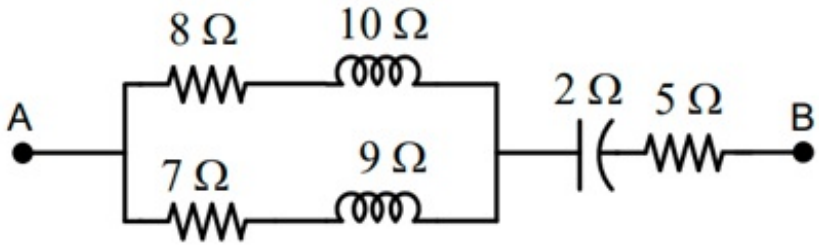
$(\text{Absolute permeability of air } = 4\,\pi \times 10^{-7}\ \text{H/m})$

2C) Two coils connected in a series-aiding fashion have a total inductance of **250 mH**. When connected in a series-opposing configuration, the coils have a total inductance of **150 mH**. If the inductance of one coil is three times the other, find the self-inductance of each coil and the mutual inductance. Also, determine the coupling coefficient. (3)

3A) Find the **RMS** value of the current signal shown. Also, find the average power consumed if the current signal is fed to a circuit of resistance of **3 Ω.** (3)



3B) For the arrangement shown below, determine the impedance between **A & B,** power factor of the circuit and the total power consumed if the applied voltage is **200 $\angle 30^o$.** (3)

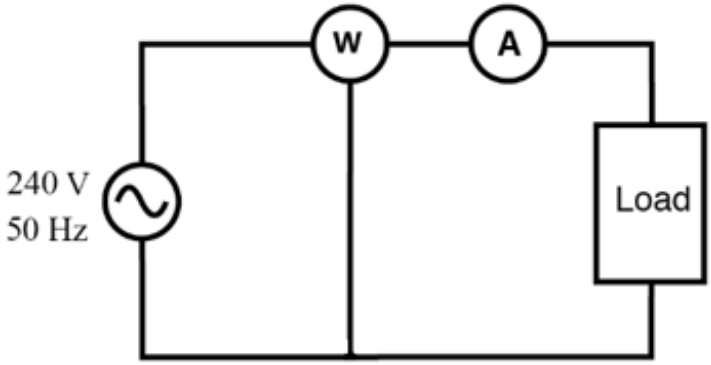


3C) In a **1-Φ** AC circuit, the two parallel branches **A** and **B** are in series with **C**. The branch impedances are $\mathbf{Z_A = (8 + j\ 6)\ \Omega}$, $\mathbf{Z_B = (10 - j\ 8)\ \Omega}$ and $\mathbf{Z_C = (4 + j\ 2)\ \Omega}$. The voltage across **C is (58 + j 0) V**. Determine, (4)

a) Currents $\mathbf{I_A}$, $\mathbf{I_B}$ and $\mathbf{I_C}$

b) Phase angle between currents $\mathbf{I_A}$ & $\mathbf{I_B}$ and $\mathbf{I_A}$ & $\mathbf{I_C}$

4A) In the arrangement shown, wattmeter reading (W) = **1.5 kW** and ammeter reading (A) = **9.615 A**. Calculate the value of shunting capacitor required to raise the power factor to **unity**. Obtain the new ammeter reading after power factor correction. (4)



4B) Three similar coils, each of resistance **7 Ω** and inductance **0.03 H,** are connected in **delta** to a **400 V, 3-Φ, 50 Hz, RYB** system. Assuming $\mathbf{V_{RY}}$ as the reference voltage phasor, calculate a) line currents and b) active, reactive, and complex powers. (6)

5A) When connected to a delta-connected load, the two-wattmeter method produces wattmeter readings of **1560 W** and **2100 W**. If the line voltage is **220 V**, calculate, (4)

i) the per-phase average power

ii) the per-phase reactive power, and

iii) the power factor

5B) Explain the operation of a transformer. Obtain the expressions for primary and secondary induced EMF in a transformer. (3)

5C) Sketch a one-line diagram of a power system network architecture indicating voltage levels at various stages. (3)

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