MANIPAL INSTITUTE OF TECHNOLOGY

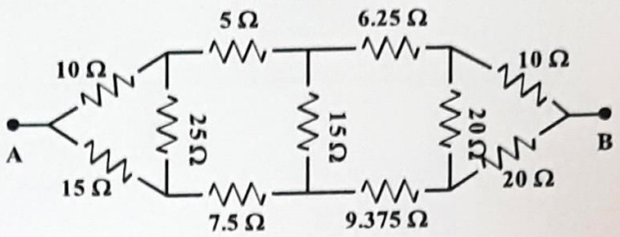
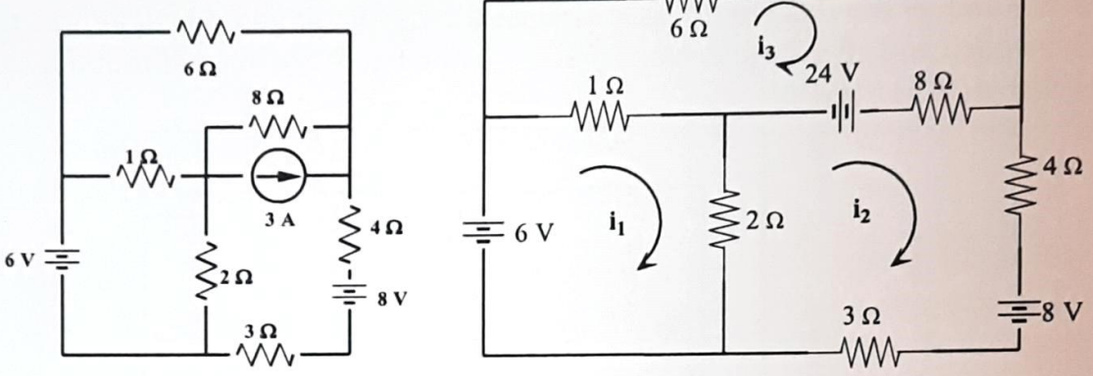
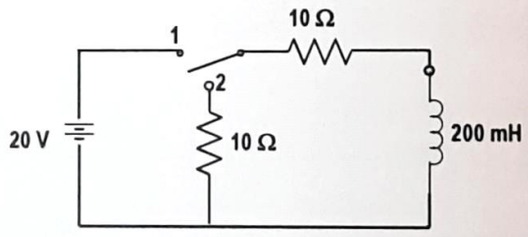
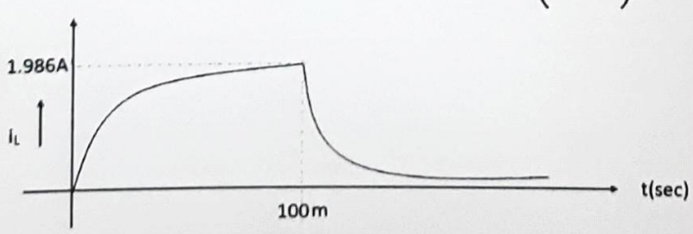
MANIPAL

(A constituent unit of MAHE, Manipal)

DEPARTMENT OF ELECTRICAL & ELECTRONICS ENGINEERING

ELE 1051: BASIC ELECTRICAL TECHNOLOGY

Makeup Examination: *Scheme of Evaluation*

Q. No.	Description	Marks
1 A.	Resistance between the terminals A & B in the circuit shown in **Fig. 1 A** is  **Fig. 1 A** Each correct transformation ----------1 M $R_{AB} = 20.32\Omega$ ----------1 M	4
1 B.	Using mesh current method, find the current delivered by 6 V voltage source in the circuit given in **Fig. 1 B**  **Fig. 1B** ----------1M $\begin{bmatrix} 3 & -2 & -1 \\ -2 & 17 & -8 \\ -1 & -8 & 15 \end{bmatrix} \begin{bmatrix} i_1 \\ i_2 \\ i_3 \end{bmatrix} = \begin{bmatrix} 6 \\ 16 \\ -24 \end{bmatrix}$ ----------1M $i_{6V} = 2.073\ A$ ----------1M	3
1 C.	In the circuit shown **Fig. 1C**, the switch is initially in position 1 for 100 ms and then it is moved to position 2. Find the current through inductor in the intervals (a) 0 ≤ t ≤ 100 ms (b) t >100 ms  Fig. 1C For time 0 ≤ t ≤ 100 ms; $i_L = 2\left(1 - e^{\frac{-t}{20m}}\right) A$ ----------1M For time t >100 ms; $i_L = 1.986\left(e^{\frac{-t'}{10m}}\right) A$ ----------1M  ----------1M	3

2 A. If the maximum power transferred by the circuit in **Fig. 2A** to the load resistance is 40 W. Determine the value of Vs?

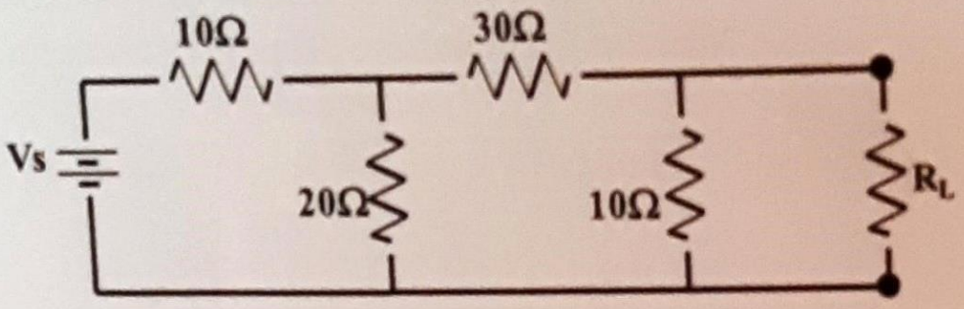


Fig. 2A

$R_L = 7.86\ \Omega$ ---------- 1M

$V_{TH} = 248.69\ V$ ---------- 1M

$V_S = 35.53\ V$ ---------- 1M

2 B. A 900 turn coil is wound on the limb A of the cast steel frame shown in **Fig. 2B**. Cross sectional area of the frame is 16 cm^2. Find the current through the coil in order to produce a total flux of 2 mWb in the air gap of the central limb B. Assume uniform flux density and all the flux lines passes straight across the air gap. Given air gap thickness 0.1 cm each and all the dimensions marked in the figure are in centi-meters. Assume μ_r for cast steel as 1200.

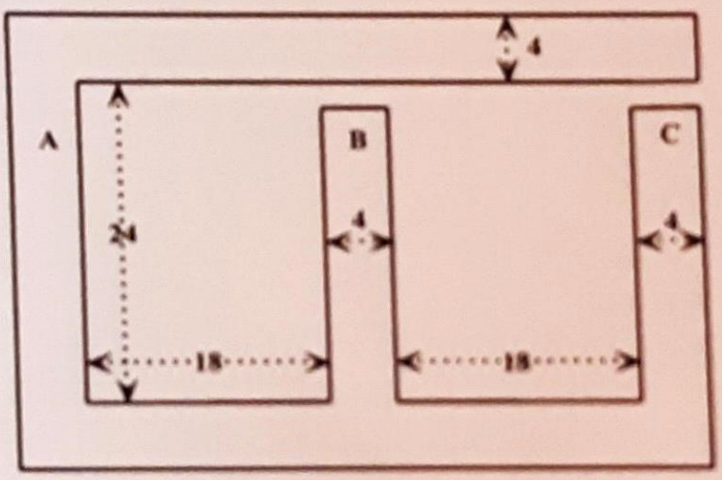


Fig. 2 B

$S_{LEFT} = 298415.52\ AT/Wb$

$S_{R\ AIRGAP} = S_{C\ AIRGAP} = 497359.2\ AT/Wb$ ---------- 1M

$S_{RIGHT} = 298001.1\ AT/Wb$

$S_C = 115636.01\ AT/Wb$ ---------- 1M

$NI = \phi_{LEFT} * S_{LEFT} + \phi_{CENTRAL}(S_{CENTRAL} + S_{AIRGAP})$

$\phi_{CENTRAL}(S_{CENTRAL} + S_{AIRGAP}) = \phi_{RIGHT}(S_{RIGHT} + S_{R\ AIRGAP})$ ---------- 2M

$\phi_{LEFT} = \phi_{RIGHT} + \phi_{CENTRAL}$

$\phi_{RIGHT} = 1.54m\ Wb$

$\phi_{LEFT} = 3.54m\ Wb$ ---------- 1M

$I = 2.54\ A$ ---------- 1M

For network shown in **Fig. 3 A**, find the two branch currents and the total current. Also sketch the phasor diagram taking source voltage as reference.

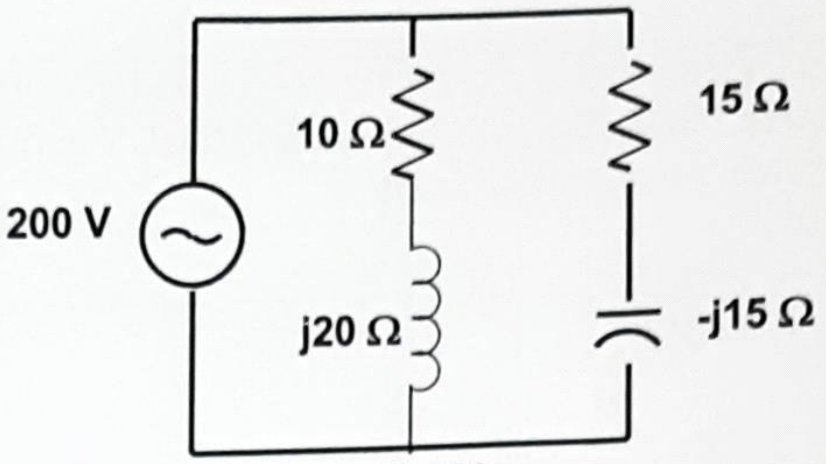
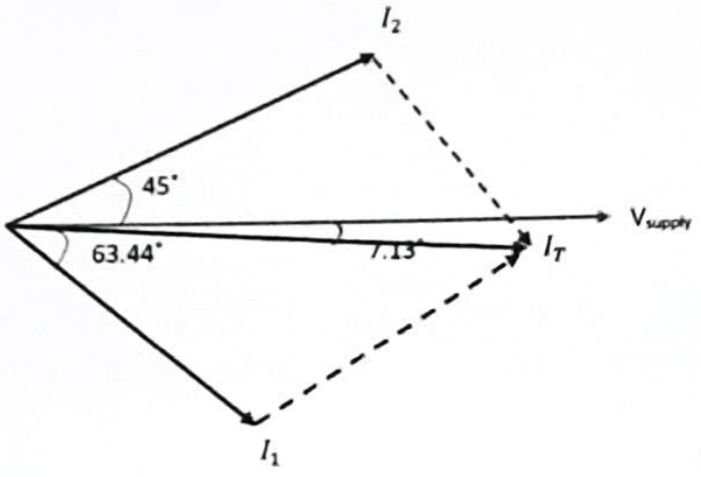


Fig. 3A

$I_1 = 8.95\angle -63.44° \text{ A} = 4 - \text{j}8 \text{ A}$ ----------1M

$I_2 = 9.43\angle 45° \text{ A} = 6.67 + \text{j}6.67 \text{ A}$ ----------1M

$I_T = 10.75\angle -7.125° \text{ A} = 10.67 - \text{j}1.33 \text{ A}$ ----------1M



----------1M

A 500 kVA transformer is at full load with power factor 0.6 lagging. What should be the kVAR rating of the shunt capacitor needed to improve its operating power factor to 0.9 lagging? What will be the kVA rating of the transformer after power factor correction?

$P_T = 300\ KW$
$Q_T = 400\ KW$ ----------1M
$\theta_T = 53.13^\circ$

For 0.9 lag p.f , $\theta = 25.85^\circ$

$Q_F = 145.349\ KW$

$Q_C = Q_T - Q_F = 145.349\ KW$ ----------1M

kVA rating of the transformer after p.f correction is unchanged = 500 kVA---------1M

A parallel circuit shown in the Fig. 3C connected to a variable frequency voltage source. Find the frequency at which the circuit resonates.

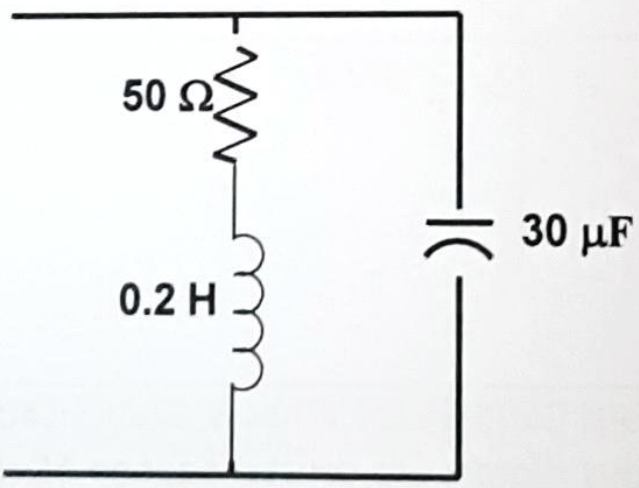
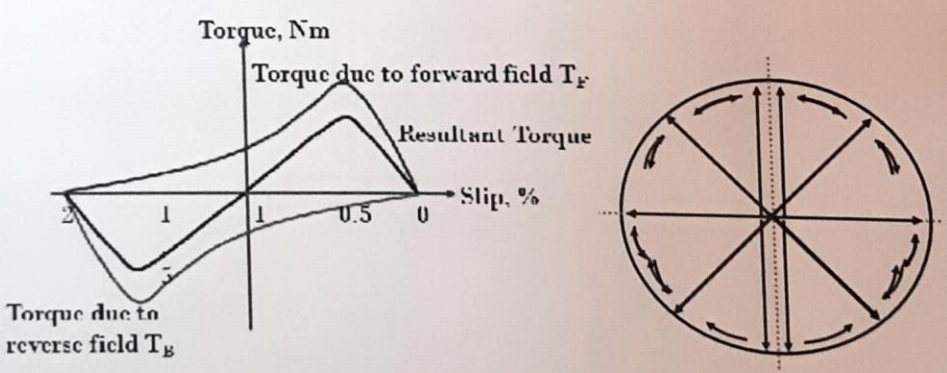


Fig. 3C

$\omega_c = 104166.67 rad/sec = 16.578 kHz$

4 A.	Three identical impedances of $20\angle 30°\ \Omega$ are connected in delta to a 3 phase, 3 wire, 400 V, RYB system. Taking V_{RY} as reference, find the line currents I_R, I_Y, I_B and the total power. Also sketch the phasor diagram. $V_{RY} = 400\angle 0°V$ $V_{YB} = 400\angle -120°V$ $V_{BR} = 400\angle -240°V$ ----------1M $I_{RY} = 20\angle -30°A$ $I_{YB} = 20\angle -150°A$ $I_{BR} = 20\angle 90°A$ ----------1M $I_R = 34.64\angle -60°A$ $I_Y = 34.64\angle -180°A$ $I_B = 34.64\angle 60°A$ ----------2M $P_T = 20.784\ kW$ ----------1M	6
4 B.	The watt-meters in the lines A and B of a 3 phase, 3 wire, 173.2 V, 60 Hz, ABC system reads -300 W and 1327 W respectively. Find the impedance of the balanced star connected load. $w_1 = V_L I_L Cos(30° + \theta) = -300\ W$ $w_2 = V_L I_L Cos(30° - \theta) = 1327\ W$ ----------2M $\theta = 70^{\circ}$ $I_L = 10\ A$ $Z_L = 10\angle 70^{\circ}A$ ----------2M	4
5 A.	Write a note on any two renewable sources of energy highlighting the technical challenges in harnessing it. Any two renewable sources of energy with technical challenges	4
5 B.	Explain the working principle of a single phase Induction Motor. Double field revolving theory 	3
5 C.	What is Synchronous Condenser? What is its application? ▶ Synchronous motors are constant speed AC motors which always run at synchronous speed irrespective of connected load. ▶ Its power factor of operation is controllable. ▶ Field system is DC excited or made up of permanent magnets ▶ Synchronous condensers are used for power factor improvements.	3