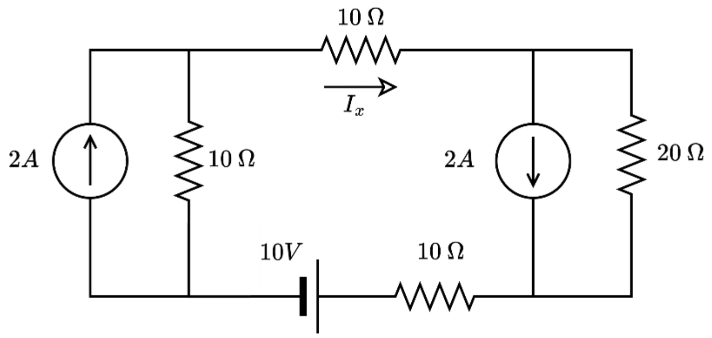
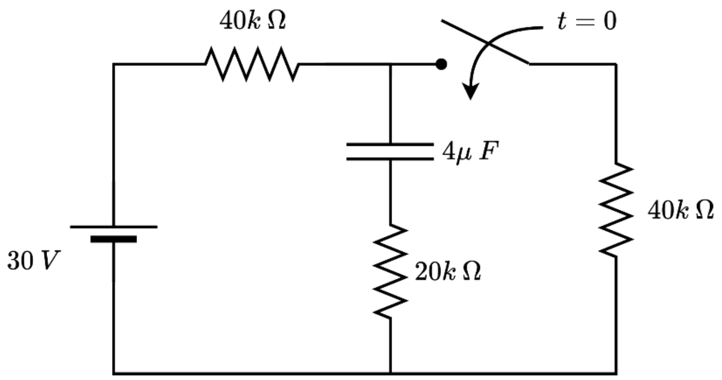
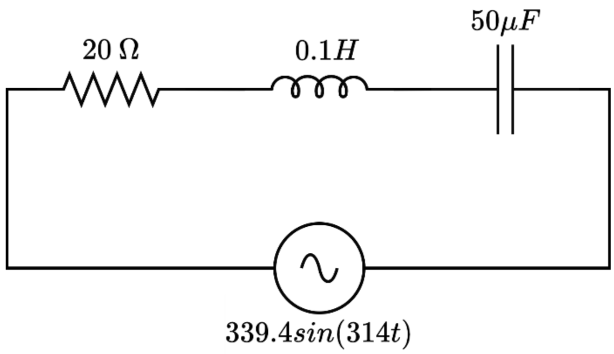
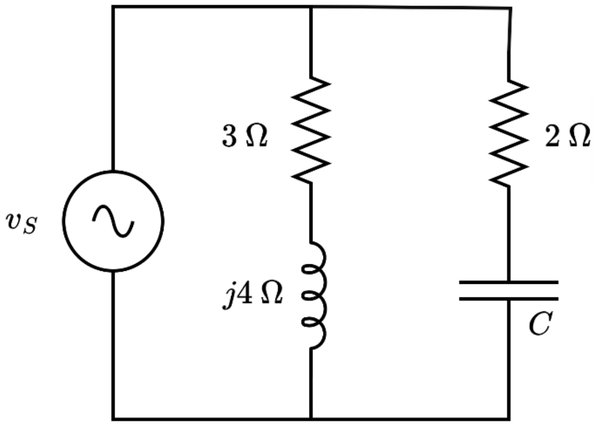
MANIPAL INSTITUTE OF TECHNOLOGY
MANIPAL
(A constituent unit of MAHE, Manipal)

Mid Semester Test (MISAC)			
Course:	**Fundamentals of Electrical Engineering**	**Exam Scheme:**	**Mid Term, Marks: 30, Duration: 90 Min**
Course Code:	**ELE 1072**	**Date & Time:**	**24 September 2024, 08:30 – 10:00 AM**
Semester:	**Second (Sections – CA to CH)**	**Branch:**	**Chemistry Cycle**

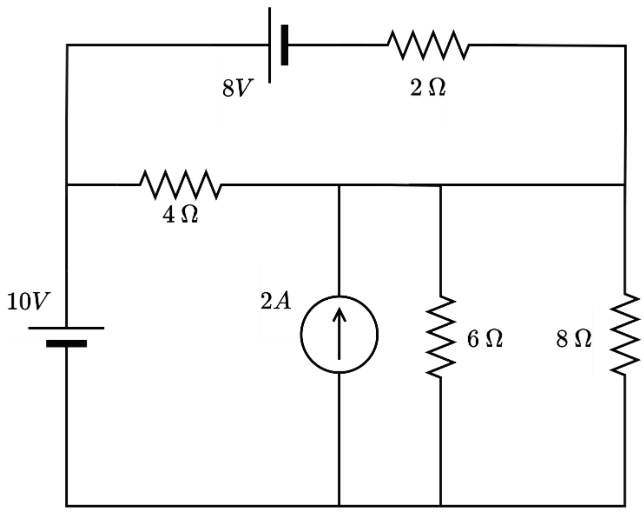
Part A – Objective Questions

Q. No.	Question	Marks
1	In the circuit, the current I_x is,  a) - 0.5 A b) 2 A c) -1 A **d) 1A**	1
2	In the circuit, the switch is kept open for a long time and is closed at time t=0. Find the initial value and the final value of the voltage across the capacitor, and the minimum time taken for the capacitor voltage to reach the final value.  a) 15 V, 30 V, 0.16 s b) 30 V, 30 V, 0.8 s c) 30 V, 15 V, 0.16 s **d) 30V, 15V, 0.8 s**	1

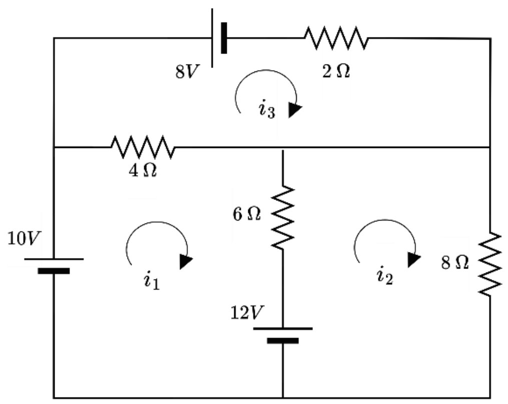
3	The power factor of the following circuit is,  a) 0.725 lead b) 0.725 lag c) 0.527 lag **d) 0.527 lead**	1
4	The value of the capacitance **C** which causes resonance at 400 Hz is  a) **1.59 mF** b) **31 μF** c) **144 μF** **d) 72 μF**	1
5	For a balanced three-phase star-connected load with phase sequence ABC, $\bar{V}_{BN}$ is $240\angle 0°\ V$. The line voltage $\bar{V}_{AB}$ is given by, a) $415\angle\ 30°$ V **b) $415\angle 150°$ V** c) $415\angle -150°$ V d) $415\angle -90°$ V	1

Part B – Descriptive Questions

Q. No.	Question	Marks
6	For the circuit shown below, determine the power dissipated in the 8 Ω resistor using mesh current analysis.	5



Soln:



------(1M)

$$\begin{bmatrix} 10 & -6 & -4 \\ -6 & 14 & 0 \\ -4 & 0 & 6 \end{bmatrix} \begin{bmatrix} i_1 \\ i_2 \\ i_3 \end{bmatrix} = \begin{bmatrix} -2 \\ 12 \\ -8 \end{bmatrix}$$ -------- (2M)

On solving

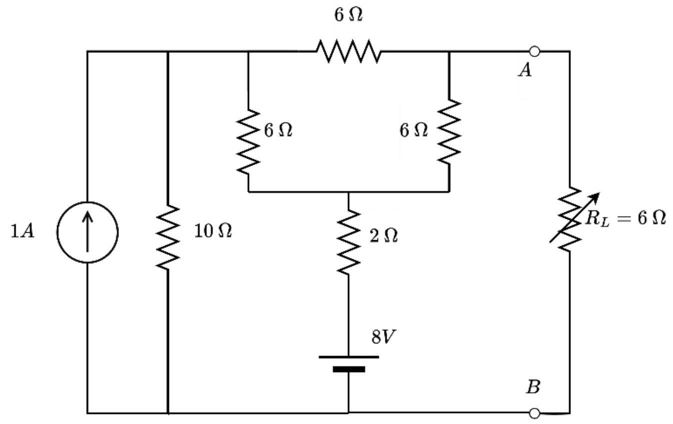
$i_1 = -0.46\ A;\ i_2 = 0.66\ A;\ i_3 = -1.64\ A$ ------(1M)

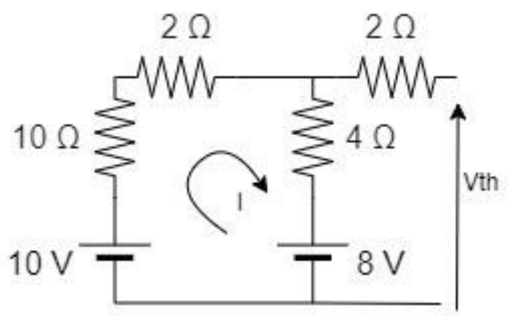
Power through 8 Ω resistor = $i_2^2 \times 8 = 3.4848W$ ------(1M)

7 Using Thevenin's theorem, — **5**

(i) Find the value of the current through the load resistor R_L

(ii) Determine the value of R_L for which power transfer is maximum and find the value of the maximum power.





Star delta conversion .... 1 M

$I = \frac{2}{16} = 0.125\ A$ 1M

10-12*0.125 = Vth: Vth = 8.5 V 1M

$R_{th} = 5\ \Omega$ 1M

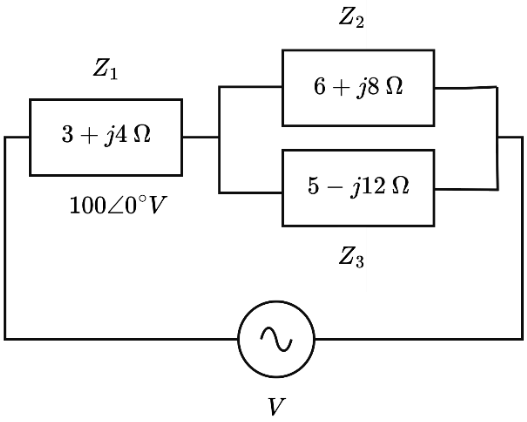
i_L= 0.772 A, P_{max} = 3.6125 W ...1M

8 In the circuit, the voltage across the impedance Z_1 is $100\angle 0°\ V$. Determine, — **5**

(i) Supply current

(ii) Supply voltage

(iii) Power factor of the circuit.



Supply current = $I_S = \frac{100\angle 0}{Z_1} = \mathbf{20\angle -53.13°\ A}$ ---- (1M)

Parallel Impedance, $Z_p = \mathbf{11.1\angle 5.73°\ \Omega}$ ------ (1 M)

Voltage across Z_p, $V_2 = \mathbf{222.13\angle -47.4°\ V}$ ------- (1M)

Supply voltage, V $= 100\angle 0 + V_2 = \mathbf{299.025\angle -33.147°\ V}$ ----- (1M)

Power factor = **0.94 (lag) ------ (1M)**

9	The two loads connected to a 230 V, 50 Hz AC supply are: • Heating load of 2 kW at unity power factor • Motor load of 2 kVA at 0.6 power factor lagging Calculate, (i) Active, reactive and apparent power drawn from the source. (ii) Value of the capacitor to be connected across the load so that the operating power factor is 0.95 lag	**5**

P1 = 2 kW, Q1 = 0 kVAR (0.5M)

P2 = 1.2 kW, Q2 = 1.6 kVAR (0.5M)

P_T = 3.2 kW, Q_T = 1.6 kVAR, S_T = 3.577 KVA (1M)

Q_{old} = 1.6 kVAR, Q_{new}= 3.2tan(18.19^0) = 1.0515 kVAR (1M)

Q_c= Q_{old} - Q_{new} =0.5485 kVAR (0.5M)

$X_c = \frac{V^2}{Qc} = \frac{230^2}{0.5485\times 10^3} = 96.44\ \Omega$ (1M)

$C = \frac{1}{2\pi f X_c} = 33.005\ \mu F$ (0.5M)

10	Consider a balanced 3-phase, 4-wire, 415 V, 50 Hz RYB system supplying a star-connected load, with $\boldsymbol{Z_R} = \boldsymbol{Z_Y} = \boldsymbol{Z_B} = (7 + j24)\ \Omega$. Calculate, (i) Line currents and the neutral current (ii) Active, reactive, and apparent power of the load	**5**	

$V_{RN} = 239.6\angle 0$ (ref.)

$V_{YN} = 239.6\angle -120$

$V_{BN} = 239.6\angle 120$

$I_R = 9.584\angle -73.7397$

$I_Y = 9.584\angle 166.260$

$I_B = 9.584\angle 46.260$ (2M)

$I_N = I_R + I_Y + I_B = 0$ (1M)

P = 3 * 239.6*9.584*cos (73.73) = 1.93 kW

Q = 3 * 239.6*9.584*sin (73.73) = 6.613 kvar

$S = \sqrt{(P^2+Q^2)} = 6.889$ kVA (2M)