Enrolment No./Seat No_____

GUJARAT TECHNOLOGICAL UNIVERSITY

BE - SEMESTER–III EXAMINATION – SUMMER 2025

Subject Code:3130906 Date:29-05-2025

Subject Name: Electrical Circuit Analysis

Time:02:30 PM TO 05:00 PM Total Marks:70

Instructions:

1. **Attempt all questions.**
2. **Make suitable assumptions wherever necessary.**
3. **Figures to the right indicate full marks.**
4. **Simple and non-programmable scientific calculators are allowed.**

			MARKS
Q.1	**(a)**	State and explain Superposition theorem for analysis of electrical circuits.	**03**
	(b)	State and explain Thevenin's theorem for analysis of electrical circuits.	**04**
	(c)	In the circuit of fig. 1, determine the value of R_L for which the power dissipated in R_L will become maximum. Also find the value of P_{max}.	**07**
Q.2	**(a)**	Define Z–parameters for a two port network and draw equivalent circuit of the network in terms of Z-parameters.	**03**
	(b)	Derive Y-parameters as functions of Z-parameters.	**04**
	(c)	In the circuit shown in fig. 2, use mesh analysis to determine the current through 10 Ω resistance.	**07**
		OR	
	(c)	Calculate Z-parameters for the two port network shown in fig. 3.	**07**
Q.3	**(a)**	Give reasons for the following. (i) The current through an inductor cannot change instantaneously (ii) The voltage across a capacitor cannot change instantaneously	**03**
	(b)	In the circuit shown in fig. 4, steady state is achieved with the switch S open. Now, the switch closes at time t = 0. Determine the values of *i*, *di/dt* and d^2i/dt^2 at time t = 0+.	**04**
	(c)	In the circuit shown in fig. 5, the switch closes at time *t = 0*. Solve the circuit and find the value of capacitor voltage at time *t = 5* second. Assume that the capacitor is initially uncharged.	**07**
		OR	
Q.3	**(a)**	Two mutually coupled inductors are connected in series as shown in fig. 6. The inductors have self-inductances L_1 = 3 H and L_2 = 5 H respectively and a mutual inductance M = 2 H. If the polarity markings are as shown by dots on the diagram, find equivalent inductance of the series connection.	**03**
	(b)	Define and explain the term 'Time Constant' with reference to (i) R-L circuit. (ii) R-C circuit	**04**
	(c)	A series R-L-C circuit with *R = 9* Ω, *L = 1 H* and *C = 0.05 F* is energized by a source of constant d.c. voltage *V = 20 V* by closing a switch at time *t = 0*. Assuming that the capacitor is initially uncharged, find particular solution for current *i(t)* through the circuit.	**07**
Q.4	**(a)**	Derive Laplace transform of the function $f(t) = \frac{di}{dt}$	**03**
	(b)	Derive step response of a series R-C circuit using Laplace transform.	**04**

(c) Using Laplace transformation, solve the following differential equation. **07**

$$\frac{d^2i}{dt^2} + 2\frac{di}{dt} + 5i = 4e^{-t}$$

It is given that $i(0+) = 3$ and $\frac{di}{dt}(0+) = -3$.

OR

Q.4 **(a)** Draw transform networks of the following elements. **03**

(i) Inductor with initial current $i_L(0-)$

(ii) Capacitor with initial voltage $v_C(0-)$

(b) Explain the difference between Zero Radian frequency and Zero Neper frequency. **04**

(c) For the LC network shown in fig. 7, determine the transform impedance *Z(s)* and plot poles and zeros of this network function. **07**

Q.5 **(a)** Explain the following term in relation to single phase a.c. circuits. (1) RMS Value (2) Active Power (3) Power Factor **03**

(b) In the circuit shown in fig. 8, an unknown impedance of Z Ω is connected in series with a (5 + j8) Ω coil. If I = 2.5 ∠-150 A, find value of Z. **04**

(c) A Δ-connected load having $\boldsymbol{Z_{RY} = j10}\ \Omega$, $\boldsymbol{Z_{YB} = 10\angle 0°}\ \Omega$ and $\boldsymbol{Z_{BR} = -j10}\ \Omega$ is being supplied from a balanced 100 V, 50 Hz, 3-phase supply. Determine (i) Phase Currents and (ii) Line Currents **07**

OR

Q.5 **(a)** Discuss Resonance in series R-L-C circuits. **03**

(b) In the circuit shown in fig. 9, find the current drawn from the source. **04**

(c) In the circuit of fig 10, if current $I = 5\angle 60°$ A, find ***Z.*** **07**

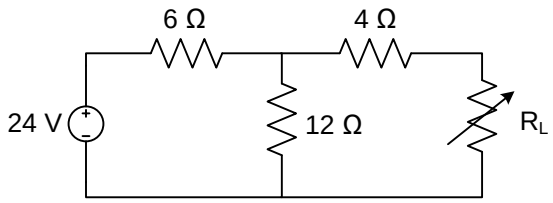

Figure 1

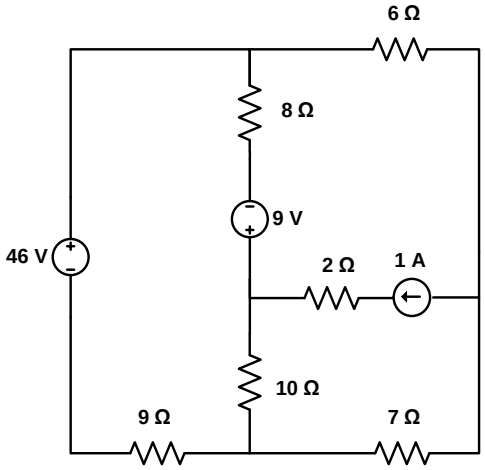

Figure 2

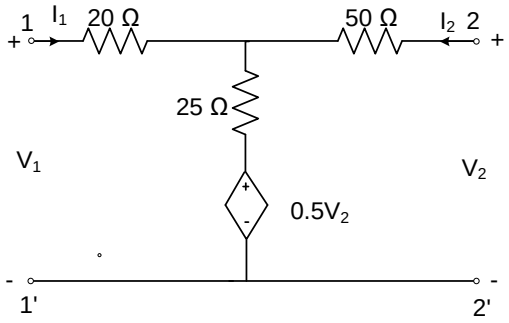

Figure 3

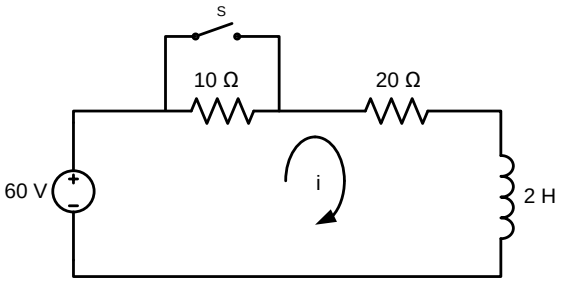

Figure 4

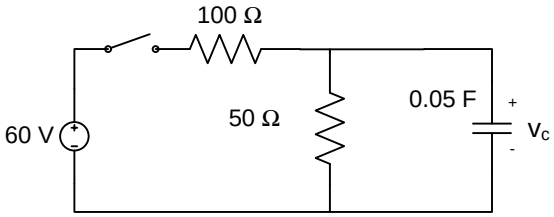

Figure 5

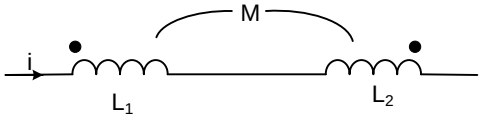

Figure 6

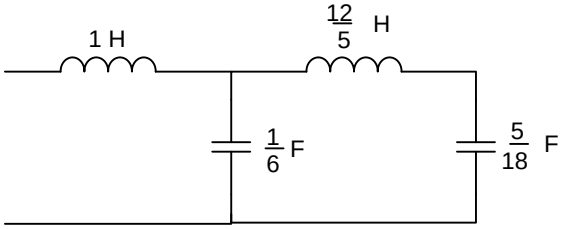

Figure 7

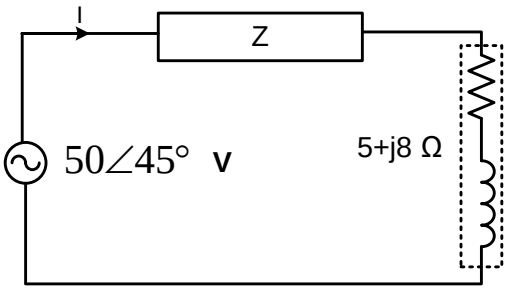

Figure 8

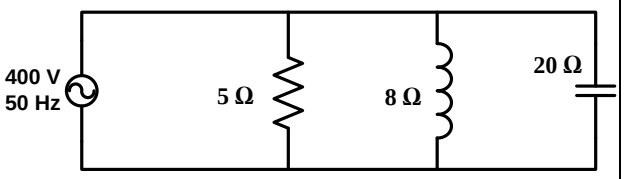

Figure 9

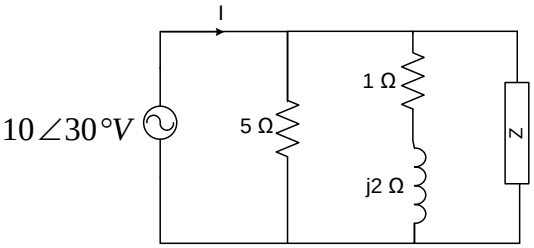

Figure 10

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