GUJARAT TECHNOLOGICAL UNIVERSITY

BE 3 SEMESTER – OLD PAPER – W22 TO S26 – QUESTION BANK

Subject Name & Code: Electrical Circuit Analysis - 3130906

Chapter 1 – Network Theorems

Repeated Questions:

1. Network Theorems (Theory):

- **Q.** State and explain Reciprocity theorem. / Explain Reciprocity theorem with suitable example. **(WINTER 2022, 3 Marks; WINTER 2025, 3 Marks; SUMMER 2026, 7 Marks OR)**
- **Q.** State and explain Superposition theorem. / Explain Superposition theorem with suitable example / Develop a step-by-step approach to solving electrical networks using the superposition theorem. **(SUMMER 2024, 3 Marks; WINTER 2025, 4 Marks; SUMMER 2026, 7 Marks)**
- **Q.** State and explain Maximum power transfer theorem with suitable example. **(WINTER 2022, 4 Marks; SUMMER 2024, 4 Marks; WINTER 2025, 7 Marks - AC condition derivation; SUMMER 2026, 4 Marks - AC conditions)**
- **Q.** State Thevenin and Norton theorem. / Explain Norton's theorem. **(SUMMER 2024, 4 Marks; SUMMER 2026, 3 Marks)**

2. Kirchhoff's Laws and Circuit Elements (Theory):

- **Q.** Explain Kirchhoff Current Law and Kirchhoff Voltage Law using an appropriate example. **(WINTER 2025, 4 Marks OR; SUMMER 2026, 4 Marks)**
- **Q.** Point out the relations between voltage and current for the following elements: (1) Resistor (2) Inductor. **(WINTER 2022, 3 Marks OR; WINTER 2025, 3 Marks OR)**

3. Duality (Theory):

- **Q.** Explain steps to obtain dual of a network with suitable example. / Explore the dual of the network shown in Fig.5 / Draw the exact dual network for the network shown in Figure-8. [Diagram required – refer to the original question paper] **(WINTER 2022, 3 Marks OR; WINTER 2025, 4 Marks; SUMMER 2026, 3 Marks)**

Other Important Questions:

1. Sources and Circuit Elements (Theory):

- **Q.** List difference between ideal and practical voltage source and Describe about source transformation. **(SUMMER 2026, 4 Marks OR)**
- **Q.** In terms of two terminal elements, define: 1) Unilateral elements, 2) Passive elements, 3) Time-variant elements. **(SUMMER 2024, 3 Marks OR)**
- **Q.** Draw and explain the dependent controlled sources. **(SUMMER 2024, 3 Marks OR)**
- **Q.** Explain characteristic of an ideal voltage source. **(SUMMER 2024, 4 Marks OR)**

2. Nodal Analysis (Numerical):

- **Q.** Find the voltage across R3 resistance of figure 3 using Nodal Analysis. [Diagram required – refer to the original question paper] **(SUMMER 2024, 7 Marks OR)**
- **Q.** Determine the node voltages for the circuit shown in Figure-4. [Diagram required – refer to the original question paper] **(WINTER 2022, 7 Marks)**
- **Q.** Determine the node voltages V_1 and V_2 in a network of Fig.1 using node analysis. [Diagram required – refer to the original question paper] **(WINTER 2025, 7 Marks)**
- **Q.** Apply the theory of nodal analysis and find the nodal voltages V_1, V_2 and V_3 as shown in Fig.6. [Diagram required – refer to the original question paper] **(WINTER 2025, 7 Marks OR)**

3. Mesh Analysis (Numerical):

- **Q.** Determine the voltage across 4Ω resistor using mesh analysis for the network of Figure-5. [Diagram required – refer to the original question paper] **(WINTER 2022, 7 Marks OR)**
- **Q.** In the two mesh network shown in fig.8, Identify the mesh currents I_1 and I_2. [Diagram required – refer to the original question paper] **(SUMMER 2026, 3 Marks OR)**

4. Superposition Theorem (Numerical):

- **Q.** Determine the value of the voltage across 30Ω resistor using superposition theorem for the network of figure-1. [Diagram required – refer to the original question paper] **(WINTER 2022, 7 Marks)**
- **Q.** Find the voltage across 1 kΩ resistor in the circuit shown in Fig 2 using superposition theorem. [Diagram required – refer to the original question paper] **(WINTER 2025, 7 Marks OR)**

5. Thevenin's and Norton's Theorems (Numerical):

- **Q.** Determine the voltage across 4Ω resistor using Thevenin theorem for the network of Figure-3. [Diagram required – refer to the original question paper] **(WINTER 2022, 4 Marks)**
- **Q.** Determine the current flowing through the 3Ω resistor using Norton theorem for the network of Figure-10. [Diagram required – refer to the original question paper] **(WINTER 2022, 4 Marks)**

6. Maximum Power Transfer Theorem (Numerical):

- **Q.** Find the value of load resistance when maximum power is transferred across it and also find the value of maximum power transferred for the network of the circuit shown in Figure 1. [Diagram required – refer to the original question paper] **(SUMMER 2024, 7 Marks)**

7. Other Network Problems (Numerical):

- **Q.** Find the current through the resistors shown in the network of Figure-2. [Diagram required – refer to the original question paper] **(WINTER 2022, 3 Marks)**
- **Q.** In the network shown in fig.1, contains two voltage sources V_1 and V_2. With $V_1 = 30\angle 0°$ V, Calculate V_2 such that the current in the 2 + j3 Ω impedance is zero. [Diagram required – refer to the original question paper] **(SUMMER 2026, 7 Marks)**

Chapter 2 – Solution of First and Second Order Networks

Repeated Questions:

1. Time Constant and Initial Conditions (Theory):

- **Q.** Explain time constant in case of series R-L and series R-C circuit. / What is time constant? What is its significance? **(WINTER 2022, 4 Marks; SUMMER 2024, 3 Marks; WINTER 2025, 3 Marks; WINTER 2025, 4 Marks)**
- **Q.** Explain the initial condition in different passive electrical elements. What is the importance of initial conditions in network analysis? **(SUMMER 2024, 3 Marks; WINTER 2025, 4 Marks)**

Other Important Questions:

1. Theory:

- **Q.** Why are there no simultaneous changes in the voltage in the capacitor and the current in the inductor? **(WINTER 2025, 3 Marks OR)**
- **Q.** Describe the solution of non-homogeneous differential equation for particular integral. **(SUMMER 2024, 4 Marks)**

2. Initial Conditions at $t = 0^+$ (Numerical):

- **Q.** In the network of Figure-6, the switch k is closed at t = 0, a steady state having previously been attained. Find i at $t = 0^+$. [Diagram required – refer to the original question paper] **(WINTER 2022, 3 Marks)**
- **Q.** For the circuit shown in Figure 2 switch K is changed from position a to b at t = 0, steady state condition having been reached before switching. Find the values of i; di/dt, d^2i/dt^2 at $t = 0^+$. [Diagram required – refer to the original question paper] **(SUMMER 2024, 7 Marks)**
- **Q.** In the network shown in Fig. 3 a steady state is reached with the switch k open with V = 100 V, $R_1 = 10\ \Omega$, $R_2 = R_3 = 20\ \Omega$, L = 1 H and C = 1 µF. At time t = 0, the switch is closed. Determine (i) Voltage across C before the switch is closed and the polarity. (ii) i_1 and i_2 at $t = 0^+$. [Diagram required – refer to the original question paper] **(WINTER 2025, 7 Marks OR)**
- **Q.** In the network shown in fig.3, a steady state is reached with the switch k open. At time t = 0, switch k is closed. For the element values given, Figure out the values $Va(0^-)$ and $Va(0^+)$. [Diagram required – refer to the original question paper] **(SUMMER 2026, 7 Marks)**
- **Q.** In the network shown in fig.4, the switch k is moved from position 1 to 2 at t = 0 a steady state having previously been attained. Find out $d^2i/dt^2(0^+)$ at $t = 0^+$. [Diagram required – refer to the original question paper] **(SUMMER 2026, 7 Marks OR)**

3. Transient Response (Numerical):

- **Q.** In the network of Figure-7, a steady state is reached with the switch k open, at t = 0, the switch k is closed. Find i(t) for the given values. [Diagram required – refer to the original question paper] **(WINTER 2022, 7 Marks)**
- **Q.** In the network of Figure-9, the switch k is open at time t = 0. Obtain particular solution for v(t). Assume zero initial condition. [Diagram required – refer to the original question paper] **(WINTER 2022, 7 Marks OR)**
- **Q.** In the network of Fig 4, the switch is closed for a long time and at t = 0, the switch is opened. Determine the current through the capacitor. [Diagram required – refer to the original question paper] **(WINTER 2025, 7 Marks OR)**
- **Q.** In the circuit shown in fig.2, a dc voltage suddenly applied to a series circuit. The inductor and capacitor are initially uncharged. Determine the particular solution for current i(t) in the circuit. [Diagram required – refer to the original question paper] **(SUMMER 2026, 3 Marks)**
- **Q.** In the network shown in fig.6, a steady state is reached with the switch k open. At t = 0 the switch k is closed, Compute i(t) for the numerical values given. [Diagram required – refer to the original question paper] **(SUMMER 2026, 4 Marks)**

- **Q.** In the network shown in fig.9, the network attains a steady state, and at t = 0, the switch is closed. Calculate Va(t) for t ≥ 0. [Diagram required – refer to the original question paper] **(SUMMER 2026, 4 Marks OR)**

Chapter 3 – Sinusoidal Steady State Analysis

Repeated Questions:

None identified.

Other Important Questions:

1. Theory:

- **Q.** Define the term (i) RMS values (ii) Apparent power (iii) Complex power. **(WINTER 2025, 3 Marks)**
- **Q.** Explain the importance of Dot convention in coupled circuit with suitable example. **(SUMMER 2024, 4 Marks)**
- **Q.** Draw impedance triangle for R-L and R-C circuit and explain related terms. **(WINTER 2022, 4 Marks OR)**

2. Three-Phase Circuits (Numerical):

- **Q.** Three phase coils each having a resistance of 8Ω and inductance of 0.02 H are connected in delta to a three phase 480V, 50Hz supply. Calculate line current, phase current and power absorbed. **(WINTER 2022, 7 Marks OR)**

Chapter 4 – Electrical Circuit Analysis Using Laplace Transforms

Repeated Questions:

1. Network Functions and Laplace Basics (Theory):

- **Q.** Define poles and zeros of network function. Explain significance of poles and zeros in different network functions. / Define the term Poles and Zeros with suitable example. **(WINTER 2022, 3 Marks; SUMMER 2024, 4 Marks - alternative set; SUMMER 2024, 7 Marks; WINTER 2025, 7 Marks)**
- **Q.** Define unit ramp function. Obtain Laplace transform of unit ramp function. **(SUMMER 2024, 4 Marks OR; SUMMER 2024, 3 Marks)**

2. Step Response (Theory):

- **Q.** Explain and derive the step response to R-L series circuit using Laplace Transformation method. **(WINTER 2022, 4 Marks OR; SUMMER 2024, 7 Marks)**

Other Important Questions:

1. Theory:

- **Q.** Explain concept of Laplace transformation. What are the advantages and disadvantages of Laplace transformation? **(WINTER 2025, 3 Marks)**
- **Q.** What are the properties of Laplace transformation? Explain in detail. **(WINTER 2025, 4 Marks)**
- **Q.** State the procedure to obtain solution of a network using Laplace transform method. State advantage of Laplace method over a classical method. **(SUMMER 2024, 7 Marks OR)**

2. Circuit Analysis Using Laplace Transform (Numerical):

- **Q.** In a series R-L-C circuit of Figure-11 the switch k is closed at time t = 0. Obtain particular solution for the current using Laplace transform method. Assume zero initial conditions in the element. [Diagram required – refer to the original question paper] **(WINTER 2022, 7 Marks)**
- **Q.** In the network of fig.7, the switch k is opened at time t = 0. Evaluate the particular solution for voltage v(t) across the parallel circuit using Laplace transformation. Assume that there is no charge across the capacitor C and no current in the inductor L before switching. [Diagram required – refer to the original question paper] **(SUMMER 2026, 7 Marks)**
- **Q.** In a series R-L-C circuit, R = 5 Ω, L = 1 H and C = 0.25 F and $v(t) = 8e^{-2t}$ Volts. Switch k is closed at time t = 0. Evaluate particular solution for the current using Laplace transform method. Assume zero initial conditions in the elements. **(SUMMER 2026, 7 Marks OR)**
- **Q.** For the network shown in fig.10, the switch k is closed at time t = 0. Capacitor C is initially charged to V_o volts. Using Laplace transformation method, discover the expression for the current i(t). [Diagram required – refer to the original question paper] **(SUMMER 2026, 7 Marks)**
- **Q.** In R-L circuit shown in fig.11, the switch is in position 1 long enough to establish steady state conditions and at t = 0 is switched to position 2. Discover the expression for the current in the circuit using Laplace transform. [Diagram required – refer to the original question paper] **(SUMMER 2026, 7 Marks OR)**

Chapter 5 – Two Port Network and Network Functions

Repeated Questions:

1. Parameter Relationships and Conditions (Theory):

- **Q.** Derive relationship between h-parameters and z-parameters. / Generalize relationship of h-parameter to z-parameters. **(WINTER 2025, 7 Marks; SUMMER 2026, 4 Marks)**
- **Q.** Generalize relationship of ABCD to z-parameters. / Derive expression of ABCD parameters in terms of Z parameters. **(WINTER 2022, 4 Marks; WINTER 2025, 4 Marks OR)**
- **Q.** Find symmetry/reciprocity condition for two-port parameters. **(WINTER 2022, 3 Marks OR - reciprocity and symmetry in terms of Y-parameters; SUMMER 2024, 3 Marks - symmetry of all two-port parameters; alternative set; WINTER 2025, 3 Marks - ABCD symmetry; SUMMER 2026, 3 Marks OR - inverse ABCD symmetry)**

Other Important Questions:

1. Interconnection of Two-Port Networks (Theory):

- **Q.** Elaborate series-series connection for two-port network. **(WINTER 2025, 3 Marks OR)**
- **Q.** Elaborate series-parallel connection for two-port network. **(SUMMER 2026, 3 Marks)**
- **Q.** Explain parallel-parallel connection for two-port network. **(SUMMER 2026, 3 Marks OR)**

2. Parameters: Definitions and Relationships (Theory):

- **Q.** Define H-parameter of a two-port network. **(SUMMER 2024, 3 Marks)**
- **Q.** Briefly describe h parameters for a two port network. **(WINTER 2025, 4 Marks OR)**
- **Q.** Discuss short-circuit admittance parameters and draw equivalent circuit for short circuit admittance parameters. **(SUMMER 2026, 4 Marks)**
- **Q.** Find out reciprocity condition for g-Parameters. **(SUMMER 2026, 3 Marks)**
- **Q.** Derive expression of Y parameters in terms of Z parameters. **(SUMMER 2024, 4 Marks)**
- **Q.** Generalize relationship of ABCD-parameters to y-parameters. **(SUMMER 2026, 4 Marks OR)**

3. Z-Parameters (Numerical):

- **Q.** Find z parameters of the network shown in figure 4. [Diagram required – refer to the original question paper] **(SUMMER 2024, 7 Marks)**
- **Q.** Determine Z-parameters of the circuit shown in Figure-12. [Diagram required – refer to the original question paper] **(WINTER 2022, 7 Marks)**
- **Q.** Obtain Z-parameters for network shown in Fig.5. Draw the z-parameter equivalent model. [Diagram required – refer to the original question paper] **(WINTER 2025, 7 Marks)**

4. Y-Parameters (Numerical):

- **Q.** Determine Y-parameters of the circuit shown in figure 5. [Diagram required – refer to the original question paper] **(SUMMER 2024, 7 Marks - alternative set)**
- **Q.** Determine the Y-Parameter of a two port network from the given open circuit Impedance parameters $Z_{11} = 5\ \Omega$, $Z_{12} = 3\ \Omega$, $Z_{21} = 3\ \Omega$, $Z_{22} = 4\ \Omega$. **(WINTER 2022, 3 Marks)**

5. h and Transmission Parameters (Numerical):

- **Q.** A two port network is represented by following equations: $V_1 = 24I_1 + 8I_2$, $V_2 = 8I_1 + 32I_2$. Determine h-parameter. **(WINTER 2022, 4 Marks OR)**
- **Q.** Determine transmission parameters of the circuit shown in Figure-13. [Diagram required – refer to the original question paper] **(WINTER 2022, 7 Marks OR)**

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