GUJARAT TECHNOLOGICAL UNIVERSITY

BE 3 SEMESTER – OLD PAPER – W25 TO S26 – QUESTION BANK

Subject Name & Code: Electrical Circuit Analysis - BE03009031

Chapter 1: Network Theorems and Coupled circuits

Repeated Questions:

1. Maximum Power Transfer Theorem:

- **Q.** Explain the Maximum Power Transfer Theorem with the help of a suitable example. / Derive the condition of maximum power transfer in DC circuit. **(WINTER 2025, 3 Marks; SUMMER 2026, 4 Marks)**

Other Important Questions:

1. Sources and Network Theorems (Theory):

- **Q.** What is an ideal source? Explain the difference between ideal & practical source. **(SUMMER 2026, 3 Marks)**
- **Q.** State & explain superposition theorem. **(SUMMER 2026, 4 Marks)**

2. Network Analysis (Numerical):

- **Q.** Find the Thevenin's equivalent and Norton's equivalent of the circuit with respect to terminals a and b. [Diagram required – refer to the original question paper] **(SUMMER 2026, 7 Marks)**
- **Q.** Determine the mesh currents i_1, i_2 & i_3 in the given network using mesh analysis. [Diagram required – refer to the original question paper] **(SUMMER 2026, 7 Marks)**
- **Q.** Find V_1, V_2 & V_3 for the given circuit. [Diagram required – refer to the original question paper] **(SUMMER 2026, 7 Marks)**

3. Dual Networks and Dependent Sources:

- **Q.** Draw the dual network of the network shown in the figure. [Diagram required – refer to the original question paper] **(WINTER 2025, 4 Marks)**
- **Q.** State and explain the classification of dependent sources with neat diagrams. **(WINTER 2025, 7 Marks)**

4. Inductance and Coupled Circuits:

- **Q.** Obtain the effective inductance of the network shown in figure. [Diagram required – refer to the original question paper] **(WINTER 2025, 4 Marks)**
- **Q.** Define self-inductance and mutual inductance of a coil. **(SUMMER 2026, 3 Marks OR)**

Chapter 2: Initial and Final Conditions

Repeated Questions:

1. Step Response of Series RL Circuit:

- **Q.** Explain the step response of a series RL circuit by solving the differential equation. / Derive the step response to R-L series circuit using Laplace Transformation method / A series RL circuit has R=20 Ω and L=0.5 H... Derive the differential equation for the current i(t) / Given the series RL circuit with R=2Ω and L=1H... use Laplace transform to determine... [Data truncated in source – refer to the original question paper] **(WINTER 2025, 7 Marks; WINTER 2025, 7 Marks OR; WINTER 2025, 7 Marks; SUMMER 2026, 4 Marks)**

2. Transient and Steady-State Terms:

- **Q.** Define the terms (i) Transient Time (ii) Time Constant (iii) Natural response (iv) Steady state response. / Explain the concept of transient and steady-state response in an RL circuit with the help of a neat sketch. **(WINTER 2025, 3 Marks; SUMMER 2026, 4 Marks OR)**

Other Important Questions:

1. Time Constant and Initial Conditions (Theory):

- **Q.** What do you mean by time constant in series RL or RC circuit? **(SUMMER 2026, 3 Marks)**
- **Q.** Develop an equivalent circuit for inductor and capacitor at $t=0^+$ when there is no initial energy & when the parameters are initially charged. **(SUMMER 2026, 4 Marks)**
- **Q.** Why the current in inductor and voltage in capacitor cannot change simultaneously? **(SUMMER 2026, 3 Marks)**

2. Transient Response of RC and RLC Circuits (Theory):

- **Q.** Discuss how values of R, L & C govern the response of an RLC series circuit excited by a DC source. **(SUMMER 2026, 7 Marks OR)**
- **Q.** Explain the zero-input and zero-state responses of a series RC circuit for a step input. Include the governing equations and a neat sketch for each response. **(WINTER 2025, 7 Marks OR)**

3. Transient Analysis (Numerical):

- **Q.** A steady state is reached with switch k open. At t=0, switch k is closed. Find i(t) for the given circuit. [Diagram required – refer to the original question paper] **(SUMMER 2026, 7 Marks)**
- **Q.** A series RLC circuit has R=10Ω, L=0.1 H, and C=100μF. It is excited by a DC step voltage of 50 V applied at t=0. Derive the differential equation governing the current i(t). Find the damping factor (α) and undamped natural frequency (ω_0). Determine the nature of the transient response (overdamped, underdamped, or critically damped). Sketch and analyse the expected shape of the current response i(t) over time, commenting on transient and steady-state behavior. **(WINTER 2025, 7 Marks)**

Chapter 3: Sinusoidal Steady State Analysis

Repeated Questions:

None identified.

Other Important Questions:

1. Power and AC Definitions (Theory):

- **Q.** Give the relationship between apparent power, average power & reactive power. **(SUMMER 2026, 3 Marks)**
- **Q.** Define (i) Average value (ii) RMS value (iii) Form factor. **(SUMMER 2026, 3 Marks OR)**

2. Phasor Analysis (Numerical and Concept):

- **Q.** A series R-L circuit has R=20 Ω and L=0.2 H connected to a sinusoidal voltage source v(t)=50sin(200t) V. 1. Explain how the circuit can be represented in the phasor domain. 2. Determine the phasor current in the circuit. 3. Explain how the sinusoidal steady-state voltage across the inductor can be obtained from the phasor current. **(WINTER 2025, 7 Marks)**
- **Q.** Explain the concept of a phasor and its significance in analysing AC circuits. Transform a simple series R-C circuit (R = 10 Ω, C = 100 μF) with a sinusoidal voltage source v(t)=10sin(100t) into its phasor equivalent. Determine the phasor current and explain how the sinusoidal steady-state response of the circuit can be obtained from it. **(WINTER 2025, 7 Marks OR)**

Chapter 4: Electrical Circuit Analysis Using Laplace Transforms

Repeated Questions:

1. Poles and Zeros of Network Functions:

- **Q.** What are poles & zeroes of a network function? / Explain the concept of poles and zeros of a transfer function. How do their locations in the s-plane influence the stability and transient response of an electrical circuit? Illustrate your answer with a suitable example. **(WINTER 2025, 4 Marks; SUMMER 2026, 3 Marks OR)**

2. Initial and Final Value Theorems:

- **Q.** State & prove initial value theorem. / Explain the Initial Value Theorem (IVT) and Final Value Theorem (FVT) of the Laplace Transform. Derive the expressions for both and discuss their significance in analysing circuit responses. Provide one example for illustration. **(WINTER 2025, 4 Marks OR; SUMMER 2026, 7 Marks)**

Other Important Questions:

1. Laplace Transform and s-Domain Fundamentals (Theory):

- **Q.** Define unit ramp function. Obtain Laplace transform of unit ramp function. **(SUMMER 2026, 4 Marks OR)**
- **Q.** Analyse how the Laplace Transform simplifies the process of solving differential equations in electrical circuits. Explain how this approach helps in determining the total response of the system. **(WINTER 2025, 3 Marks)**
- **Q.** What is the significance of the s-domain equivalent of circuit elements? Explain how representing resistors, inductors, and capacitors in the s-domain helps in solving circuit differential equations. Give one simple example. **(WINTER 2025, 3 Marks)**

2. Transfer Function and Network Functions:

- **Q.** Explain the concept of a transfer function. How can it be used to determine the output of a circuit for any given input? Illustrate your explanation with a simple example. **(WINTER 2025, 3 Marks OR)**
- **Q.** A system is represented by the transfer function $H(s) = 10(s + 2) / (s^2 + 3s + 2)$. Analyse the location of poles and zeros, and explain how they affect the stability and transient behavior of the system. **(WINTER 2025, 7 Marks OR)**

3. Laplace Analysis of Circuits (Numerical):

- **Q.** A series RLC circuit has R=4Ω, L=1 H, and C=0.25 F. A step voltage V(t)=12u(t) V is applied. Using Laplace transform: 1. Determine the s-domain equivalent circuit. 2. Find the Laplace transform of the capacitor voltage $V_C(s)$. 3. Obtain the time-domain response $v_C(t)$. 4. Analyse whether the circuit is overdamped, underdamped, or critically damped, and explain the transient behaviour. **(WINTER 2025, 7 Marks OR)**

Chapter 5: Two Port Network and Network Functions

Repeated Questions:

None identified.

Other Important Questions:

1. Two-Port Parameters: Definitions and Derivations (Theory):

- **Q.** Define H-parameter of a two-port network. **(SUMMER 2026, 3 Marks)**
- **Q.** Derive condition of symmetry for h parameters **(SUMMER 2026, 7 Marks OR)**
- **Q.** Derive condition of reciprocity of y-Parameters **(SUMMER 2026, 4 Marks)**
- **Q.** Derive relationship of h-Parameter in terms of g-Parameters **(SUMMER 2026, 4 Marks OR)**

2. ABCD (Transmission) Parameters:

- **Q.** Write a short note on ABCD parameters of a two port network. **(SUMMER 2026, 7 Marks)**
- **Q.** Explain the significance of the transmission (ABCD) parameters of a two-port network. How can these parameters be used to analyse the cascade connection of two two-port networks? Provide a simple illustrative example. **(WINTER 2025, 4 Marks)**
- **Q.** Evaluate the advantages and limitations of using transmission (ABCD) parameters for representing long-distance communication or power transmission networks. Justify your evaluation. **(WINTER 2025, 3 Marks OR)**

3. Comparison and Applications of Two-Port Parameters:

- **Q.** Explain the concept of a two-port network and its practical significance. Choose any one type of two-port parameter (e.g., Z-parameter or Y-parameter) and describe how it relates the input and output voltages and currents of the network. Give a simple example. **(WINTER 2025, 4 Marks OR)**
- **Q.** Compare Z-parameters and Y-parameters of a two-port network. Which type of parameter is more suitable for networks connected in series and which for networks connected in parallel? Justify your answer. **(WINTER 2025, 3 Marks)**
- **Q.** A two-port network can be represented by Z-parameters, Y-parameters, or ABCD parameters. Evaluate the advantages and disadvantages of using each type of parameter in practical circuit analysis. **(WINTER 2025, 4 Marks)**
- **Q.** Evaluate the advantages of using two-port network parameters for analyzing complex electrical circuits instead of directly applying Kirchhoff's laws. Justify your answer with practical examples. **(WINTER 2025, 4 Marks OR)**

4. Two-Port Parameters (Numerical):

- **Q.** Obtain Z parameters for the given network. [Diagram required – refer to the original question paper] **(SUMMER 2026, 7 Marks OR)**

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