GUJARAT TECHNOLOGICAL UNIVERSITY

BE 3 SEMESTER – OLD PAPER – WINTER 2022 TO SUMMER 2024 – QUESTION BANK

Subject Name & Code: Network Theory - 3131103

Chapter 1: Circuit Variables and Circuit Elements and Sources

Repeated Questions:

1. Sources and Network Elements (Theory):

- **Q.** Explain ideal and practical current and voltage sources with their characteristics and differentiate them with respect to ideality and practice. **(WINTER 2022, 4 Marks; SUMMER 2023, 3 Marks; WINTER 2023, 3 Marks; SUMMER 2024, 3 Marks)**
- **Q.** Briefly describe active, passive, lumped and distributed elements. **(WINTER 2022, 4 Marks; SUMMER 2023, 4 Marks; WINTER 2023, 3 Marks; WINTER 2023, 3 Marks OR; SUMMER 2024, 3 Marks)**
- **Q.** State the possible types of controlled sources and draw their symbols. **(WINTER 2022, 3 Marks; SUMMER 2023, 3 Marks)**

2. Coupled Coils and Dot Convention:

- **Q.** Explain dot convention for coupled coils with suitable example. / Establish polarity markings for the windings and write KVL equations. [Diagram required – refer to the original question paper] **(WINTER 2022, 7 Marks; SUMMER 2023, 3 Marks; SUMMER 2024, 4 Marks)**

Other Important Questions:

1. Circuit Concepts and Network Parameters (Theory):

- **Q.** Differentiate between an open circuit and a short circuit. Draw their characteristics in v-i plane. **(WINTER 2022, 3 Marks)**
- **Q.** Name the three parameters of electric network. Discuss the characteristics of each one of them. Write equation for voltage-current and energy relation. **(SUMMER 2024, 7 Marks)**

Chapter 2: Nodal Analysis and Mesh Analysis of resistive Circuits

Repeated Questions:

1. Source Transformation:

- **Q.** Discuss rules for source transformation. / Determine the branch current using source transformation method. [Diagram required – refer to the original question paper] **(SUMMER 2023, 4 Marks; WINTER 2023, 4 Marks; SUMMER 2024, 7 Marks; SUMMER 2024, 7 Marks OR)**

2. Mesh Analysis (Numerical):

- **Q.** Determine mesh currents using mesh analysis. [Diagram required – refer to the original question paper] **(WINTER 2022, 7 Marks; SUMMER 2023, 7 Marks; WINTER 2023, 7 Marks; SUMMER 2024, 7 Marks)**

3. Nodal Analysis (Numerical):

- **Q.** Determine voltage across resistor / unknown node-to-reference voltages using node analysis. [Diagram required – refer to the original question paper] **(WINTER 2022, 7 Marks OR; SUMMER 2023, 7 Marks OR; SUMMER 2024, 4 Marks; SUMMER 2024, 7 Marks OR)**

Other Important Questions:

None identified.

Chapter 3: Circuit Theorems and Their Applications in Electric Networks

Repeated Questions:

1. Maximum Power Transfer Theorem:

- **Q.** State and explain maximum power transfer theorem with necessary derivation. / Determine the value of R_L for maximum power transfer. [Diagram required – refer to the original question paper] **(WINTER 2022, 4 Marks; WINTER 2022, 7 Marks; SUMMER 2023, 7 Marks OR; WINTER 2023, 3 Marks OR; SUMMER 2024, 7 Marks OR)**

2. Thevenin's Theorem:

- **Q.** State and explain Thevenin's theorem with an example. / Obtain Thevenin's equivalent circuit. [Diagram required – refer to the original question paper] **(SUMMER 2023, 7 Marks; WINTER 2023, 7 Marks; SUMMER 2024, 3 Marks)**

3. Norton's Theorem:

- **Q.** State and explain Norton's theorem with an example. / Find the Norton's equivalent circuit. [Diagram required – refer to the original question paper] **(WINTER 2022, 7 Marks OR; SUMMER 2023, 4 Marks OR; SUMMER 2024, 7 Marks)**

4. Superposition Theorem:

- **Q.** State and explain superposition theorem with suitable example. **(WINTER 2022, 4 Marks OR; SUMMER 2023, 4 Marks; WINTER 2023, 4 Marks OR; SUMMER 2024, 3 Marks OR)**

5. Reciprocity and Millman's Theorems:

- **Q.** Give statements for Reciprocity Theorem. / State Millman's theorem. **(WINTER 2022, 4 Marks; WINTER 2022, 4 Marks OR; SUMMER 2023, 4 Marks)**

Other Important Questions:

None identified.

Chapter 4: Time domain response of First order RL and RC circuits

Repeated Questions:

1. Time Constant and Step Response (Theory):

- **Q.** Define time constant and state its importance in circuit analysis. / Explain time constant in terms of RL circuit. / Obtain step response for R-C series circuit. **(WINTER 2022, 3 Marks OR; SUMMER 2023, 3 Marks OR; WINTER 2023, 4 Marks; WINTER 2023, 4 Marks OR; SUMMER 2024, 4 Marks)**

2. Switching Analysis (Numerical):

- **Q.** Determine particular solution of current i when switch k is closed at t = 0. [Diagram required – refer to the original question paper] **(SUMMER 2023, 7 Marks; WINTER 2023, 7 Marks OR)**

Other Important Questions:

1. Transient Response (Theory):

- **Q.** Explain how to obtain the transient response of a first order system using an appropriate example. **(WINTER 2022, 7 Marks)**

2. First Order Circuits (Numerical):

- **Q.** An exponential voltage $v(t) = 4e^{-5t}$ is applied at time t = 0 to a series R-C circuit having R = 0.2 Ω and C = 1 F. Obtain current i(t) through the circuit. **(WINTER 2022, 4 Marks)**
- **Q.** In the network of Fig. 8, obtain current i(t) when switch is moved from position 'a' to position 'b' at t = 0. [Diagram required – refer to the original question paper] **(WINTER 2023, 7 Marks)**

Chapter 5: Time domain response of Second order linear circuits

Repeated Questions:

None identified.

Other Important Questions:

1. Series R-L-C Circuit Terms (Theory):

- **Q.** Define the terms critical resistance, damping ratio, natural frequency and settling time for a series R-L-C circuit. **(WINTER 2022, 4 Marks OR)**

Chapter 6: Initial conditions

Repeated Questions:

1. Behaviour of Elements (Theory):

- **Q.** Explain initial and final conditions of R, L and C elements. / How the following elements will behave at t = 0 and t = ∞. **(WINTER 2022, 3 Marks; SUMMER 2023, 3 Marks; SUMMER 2024, 3 Marks OR)**
- **Q.** Explain why: (i) The current in an inductor cannot change instantaneously. (ii) The voltage across a capacitor cannot change instantaneously. **(SUMMER 2024, 3 Marks)**

2. Initial Conditions and Switching (Numerical):

- **Q.** Find values of i, di/dt, d^2i/dt^2 at $t = 0^+$ for the given network if switch k is changed from position 1 to 2 at t = 0. / A series RLC circuit with zero inductor current and zero capacitor voltage is excited by 50V dc source. Find $i(0^+)$ and di/dt at $t = 0^+$. [Diagram required – refer to the original question paper] **(SUMMER 2023, 7 Marks; SUMMER 2024, 4 Marks)**
- **Q.** In the network, a steady state is reached with switch k open. At t = 0, switch is closed. Find the voltage across capacitor. / Determine $v_a(0^-)$ and $v_a(0^+)$ for t > 0. [Diagram required – refer to the original question paper] **(WINTER 2022, 7 Marks OR; WINTER 2023, 7 Marks; SUMMER 2024, 4 Marks OR)**

Other Important Questions:

None identified.

Chapter 7: Laplace Transform Analysis and Circuit Applications

Repeated Questions:

1. Laplace Transforms of Standard Functions:

- **Q.** Obtain Laplace transform of (1) Unit Step function (2) Unit Ramp function (3) Unit Impulse function. / u(t − a), r(t − a), δ(t − a). **(WINTER 2022, 3 Marks; WINTER 2022, 3 Marks OR)**

Other Important Questions:

1. Laplace Transform Theorems (Theory):

- **Q.** State and explain initial value theorem. **(SUMMER 2024, 4 Marks OR)**

2. Laplace Transform of Functions (Numerical):

- **Q.** Determine the Laplace transform of $f(t) = e^{5t} \sin 8t$. **(WINTER 2023, 3 Marks)**

Chapter 8: Laplace Transform Analysis and Transfer Function Applications

Repeated Questions:

None identified.

Other Important Questions:

None identified.

Chapter 9: Two-Port Networks

Repeated Questions:

1. Inter-relationships of Two-Port Parameters:

- **Q.** Derive / Determine inter-relationships between two-port network parameters (h in terms of z, z in terms of h, h in terms of y, ABCD in terms of z, ABCD in terms of Y, z in terms of y). **(WINTER 2022, 7 Marks; WINTER 2022, 7 Marks OR; SUMMER 2023, 3 Marks; SUMMER 2023, 4 Marks; WINTER 2023, 4 Marks; SUMMER 2024, 3 Marks; SUMMER 2024, 3 Marks OR; SUMMER 2024, 7 Marks OR)**

2. Parameters of a Given Network (Numerical):

- **Q.** Determine h / z / y parameters for the given network. [Diagram required – refer to the original question paper] **(SUMMER 2023, 7 Marks; WINTER 2023, 7 Marks; SUMMER 2024, 7 Marks; SUMMER 2024, 7 Marks OR)**

3. Reciprocity and Symmetry Conditions:

- **Q.** Derive the condition for reciprocity / symmetry for ABCD / g-parameters. **(SUMMER 2023, 7 Marks OR; WINTER 2023, 4 Marks)**

Other Important Questions:

None identified.

Chapter 10: Introduction to Network Topology

Repeated Questions:

1. Graph Theory Definitions:

- **Q.** Define the following terms: Tree, Connected Graph, Co-tree, Sub-graph, Oriented graph, Node, Tie-set matrix, Incident Matrix, Cut-set, Graph, Planar graph, Non-planar graph, Loop. **(WINTER 2022, 3 Marks; WINTER 2022, 3 Marks OR; SUMMER 2023, 4 Marks; SUMMER 2023, 3 Marks; SUMMER 2023, 3 Marks OR; WINTER 2023, 3 Marks; SUMMER 2024, 4 Marks)**

2. Matrix Relationships:

- **Q.** Derive relationship between incidence matrix (A), fundamental tie-set matrix (B_f) and fundamental cut-set matrix (Q_f). **(SUMMER 2023, 7 Marks OR; WINTER 2023, 7 Marks OR)**

Other Important Questions:

None identified.

Chapter 11: Introduction to Passive Network Synthesis

Repeated Questions:

1. Positive Real Function (PRF):

- **Q.** Briefly explain PRF (Positive Real Function). **(SUMMER 2023, 4 Marks OR; WINTER 2023, 4 Marks)**

2. Network Synthesis:

- **Q.** Briefly describe the network synthesis and its application. / What is network synthesis? **(WINTER 2023, 3 Marks; SUMMER 2024, 4 Marks OR)**

3. Hurwitz Polynomials (Numerical):

- **Q.** Test whether the following polynomial is Hurwitz or not / Determine the range of values of K so that the polynomial is Hurwitz. **(WINTER 2022, 4 Marks; WINTER 2022, 4 Marks OR)**

Other Important Questions:

None identified.

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