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Network Analysis and Synthesis Important Questions PDF

Network Analysis and Synthesis usually covers graph theory, network theorems, transient response with Laplace transform, network functions and two-port parameters, and synthesis of LC and RC networks. Frequent questions are incidence and cut-set matrices, Thevenin with dependent sources, RL and RC transients, Z, Y, h and ABCD parameters, Hurwitz tests and Foster and Cauer forms.

Key takeaways

- Graph theory: tree, co-tree, incidence, tie-set and cut-set matrices.
- Theorems: Thevenin, Norton, superposition, reciprocity, Millman and Tellegen, including dependent sources.
- Transients and network functions: RL, RC and RLC responses, poles and zeros, stability.
- Two-port networks and synthesis: Z, Y, h and ABCD parameters, positive real functions, Foster and Cauer forms.
- These are practice questions based on common syllabus topics, not verified past papers.

About these important questions

These are **practice questions** built from topics that appear in most Indian B.Tech syllabi for Network Analysis and Synthesis, including AKTU and universities that follow the AICTE model curriculum. They are **not verified past papers**, and we do not claim that any question will appear in your exam. Unit numbers and topic order differ between universities, so first match each unit below with your own university syllabus. For real previous papers, use your university's official archive. AKTU students can download them from the AKTU old question paper page.

Each unit lists key definitions, derivations or theory questions, numericals with short answer outlines, and long-answer questions. Use the outlines to check your method, then write full solutions yourself.

Unit 1: Graph Theory and Network Equations

Key definitions: graph, node, branch, tree, co-tree, twig, link, incidence matrix, tie-set (loop) matrix, cut-set matrix, planar and non-planar graphs, dual network.

Results to remember: a tree has n - 1 branches (twigs), and the number of links is b - n + 1, where b is the number of branches and n the number of nodes.

Important questions:

- Draw the oriented graph of a given network, choose a tree and write the reduced incidence matrix.
- Write the fundamental tie-set matrix and the fundamental cut-set matrix, and use one of them to form the network equilibrium equations.
- Draw the dual of a given planar network.

Unit 2: Network Theorems

Theorems to state and apply: superposition, Thevenin, Norton, maximum power transfer (resistive and complex load), reciprocity, Millman, Tellegen, substitution and compensation.

Numericals (answer outline):

- Find the Thevenin equivalent of a circuit with a dependent source. Outline: find Voc, then either find Isc and use Rth = Voc/Isc, or switch off independent sources and apply a test source.
- For an AC network, maximum power transfer occurs when the load is the complex conjugate of the source impedance: ZL = Zth*.
- Verify the reciprocity theorem for a given two-loop network.
- Verify Tellegen's theorem: the sum of the products of branch voltages and branch currents is zero.

Unit 3: Transient Analysis and Network Functions

Key definitions: initial and final conditions, time constant, natural and forced response, damping ratio, overdamped, critically damped and underdamped cases, driving-point and transfer functions, poles and zeros.

Numericals (answer outline):

- An RL series circuit is switched on to a DC source V. Find the current. Answer: $i(t) = (V/R)(1 - e^{(-Rt/L)})$, with time constant $\tau = L/R$.
- An RC circuit is charged through R. Find the capacitor voltage: $v(t) = V(1 - e^{(-t/RC)})$, with $\tau = RC$.
- Series RLC with a step input: find the response and classify it by the damping ratio $\zeta = (R/2)\sqrt{(C/L)}$. $\zeta > 1$ is overdamped, $\zeta = 1$ critically damped, $\zeta < 1$ underdamped.
- Find the initial conditions $i(0+)$, $di/dt(0+)$ and $v(0+)$ after a switch is closed.
- Find the driving-point impedance of a ladder network and plot its poles and zeros.

Long-answer questions: Solve a second-order transient using Laplace transform. Explain the restrictions on the locations of poles and zeros for driving-point and transfer functions.

Unit 4: Two-port Networks

Key definitions: open-circuit impedance (Z), short-circuit admittance (Y), hybrid (h), transmission (ABCD) parameters.

Results to remember:

- Reciprocity: Z12 = Z21, Y12 = Y21, h12 = -h21, AD - BC = 1.

- Symmetry: Z11 = Z22, Y11 = Y22, A = D, h11h22 - h12h21 = 1.
- Interconnections: series connection adds Z parameters, parallel connection adds Y parameters, cascade connection multiplies ABCD matrices.

Numericals (answer outline):

- Find the Z and Y parameters of a T or π network and check reciprocity and symmetry.
- Convert Z parameters into ABCD and h parameters using the standard relations.
- Find the ABCD parameters of two networks connected in cascade.

Unit 5: Network Synthesis

Key definitions: Hurwitz polynomial, positive real function, LC, RC and RL driving-point functions, Foster and Cauer forms.

Important questions:

- Test whether a polynomial is Hurwitz using the continued fraction (Routh) method.
- Test whether a given function is positive real.
- State the properties of LC driving-point impedance functions: poles and zeros are simple, lie on the jω axis and alternate.
- Synthesise $Z(s) = (s^2 + 1)(s^2 + 3)/[s(s^2 + 2)]$ in Foster I form. Outline: dividing gives $Z(s) = s + 1.5/s + 0.5s/(s^2 + 2)$, so the network is a 1 H inductor, a 2/3 F capacitor and a parallel LC (C = 2 F, L = 0.25 H) all in series.
- Realise the same function in Cauer I and Cauer II forms by continued fraction expansion.
- Synthesise an RC impedance function in Foster and Cauer forms.

How to score well in Network Analysis and Synthesis

- Mark node labels, branch numbers and current directions before writing any matrix.
- For two-port questions, write the defining equations first, then set the port conditions (open or short circuit) to find each parameter.
- In synthesis, check the function's properties first, then show each division step of the continued fraction clearly.
- Draw the final realised network with element values.

Short-answer (2-mark) questions for Network Analysis and Synthesis

Short questions test definitions and one-line results. Practise answering each in two to four lines:

1. Define a tree and a co-tree.
2. How many links does a graph with b branches and n nodes have? (Answer: b - n + 1.)
3. State Tellegen's theorem.
4. State Millman's theorem.
5. What is the time constant of an RC circuit?
6. Why does an inductor act as an open circuit at t = 0+ in a de-energised circuit?
7. Define a driving-point function.

8. What is the condition for a two-port network to be reciprocal in ABCD terms? (Answer: AD - BC = 1.)
9. Which parameters are added when two-port networks are connected in parallel? (Answer: Y parameters.)
10. What is a Hurwitz polynomial?
11. State two properties of a positive real function.
12. Name the four canonical forms of LC networks.

A 7-day revision plan for Network Analysis and Synthesis

Use this plan in the last week before the exam. Adjust it to the units and weightage in your own syllabus.

- **Day 1 (Unit 1, Graph Theory and Network Equations):** revise the definitions, then solve the numericals and one long answer from this unit without notes.
- **Day 2 (Unit 2, Network Theorems):** revise the definitions, then solve the numericals and one long answer from this unit without notes.
- **Day 3 (Unit 3, Transient Analysis and Network Functions):** revise the definitions, then solve the numericals and one long answer from this unit without notes.
- **Day 4 (Unit 4, Two-port Networks):** revise the definitions, then solve the numericals and one long answer from this unit without notes.
- **Day 5 (Unit 5, Network Synthesis):** revise the definitions, then solve the numericals and one long answer from this unit without notes.
- **Day 6:** attempt one full three-hour practice paper made from these questions, or an official previous paper from your university archive.
- **Day 7:** go through your formula sheet, the short-answer list and every question you got wrong in the practice paper.

Frequently asked questions

Which unit of Network Analysis is the most scoring?

Two-port networks and network theorems are formula-based and appear in most papers. Once you know the parameter definitions and the conversion table, these questions follow a fixed method.

How do I handle dependent sources in Thevenin's theorem?

Do not switch off dependent sources. Either find the open-circuit voltage and short-circuit current and divide, or switch off independent sources only and apply a test voltage or current at the terminals.

How do I choose between Foster and Cauer forms?

The question usually names the form. Foster forms come from partial fractions, and Cauer forms come from continued fraction expansion. Practise both on the same function so you can check one against the other.

Are these questions from real past papers?

No. These are practice questions based on topics that are common in B.Tech syllabi. They are not verified past papers, and no question is promised to appear in your exam. Check your own university syllabus and official previous papers; AKTU students can use the AKTU old question paper archive.

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