ARYA GROUP OF COLLEGES GUESS PAPERS

(B. Tech. II Year, III Semester, 2025-26)

Subject - ELECTRICAL CIRCUIT ANALYSIS

Subject Code - 3EE4-05

UNIT 1 – NETWORK THEOREMS

Short Answers: (2 Marks Each)

1. What is linearity?
2. Define unilateral and bilateral elements.
3. What is meant by source transformation?
4. Define dependent sources and name their four types.
5. What is a compensated network?
6. State reciprocity theorem.
7. What is maximum power transfer condition for DC circuits?
8. When is Thevenin theorem not applicable?
9. What is the difference between active and passive networks?
10. What is a reference node in nodal analysis?
11. What are super-node and super-mesh?

Long Descriptive Answers: (5 to 20 Marks)

1. Explain the principle and limitations of Superposition theorem.
2. Derive the Thevenin equivalent of a network containing dependent sources.
3. Explain Norton's theorem using source transformation.
4. Prove Maximum Power Transfer Theorem for AC circuits with complex impedances.
5. Discuss Reciprocity theorem for mutually coupled networks.
6. Explain Compensation theorem and derive its expressions.
7. Discuss in detail node voltage analysis with an example containing dependent sources.
8. Explain mesh analysis for circuits with current sources using super-mesh concept.
9. Explain duality in electrical networks and develop rules to form the dual.
10. Write differences between Thevenin and Norton equivalent circuits.

Types of Numerical Problems may be Appeared in the RTU Main Exam (5 to 20 Marks)

1. Determine Thevenin and Norton equivalent for a circuit with combinations of RL, RC elements.
2. Apply superposition theorem for a network having three voltage sources.
3. Use node analysis to find all node voltages in a multi-loop network.
4. Find load resistance for which maximum power transfer occurs in an AC circuit.
5. Solve a circuit containing dependent sources using mesh analysis.
6. Use compensation theorem to find the change in current when a resistor value changes.
7. For a given network, write its dual and verify duality relationships.
8. A circuit contains both voltage and current sources—use source transformation to simplify.

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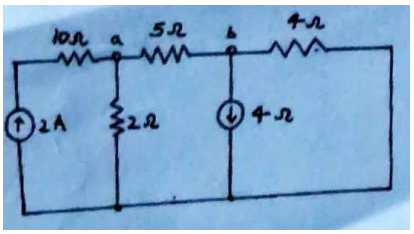
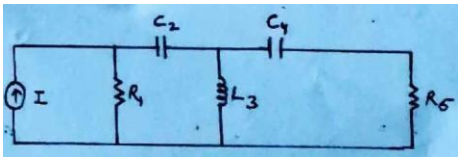
Sample Numerical Question Which Appeared in RTU Exam

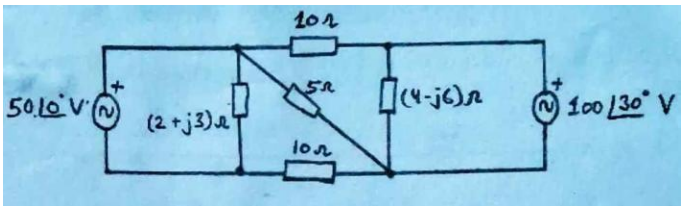
1. Find current through the 5Ω resistor in figure given below



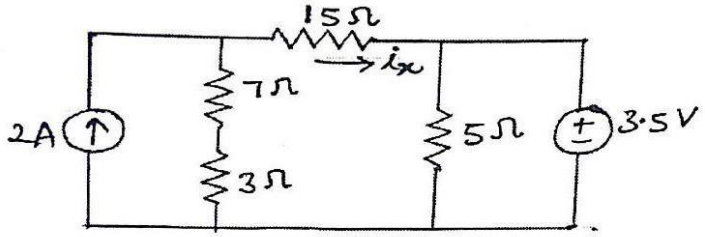
2. Draw the dual of the network given below



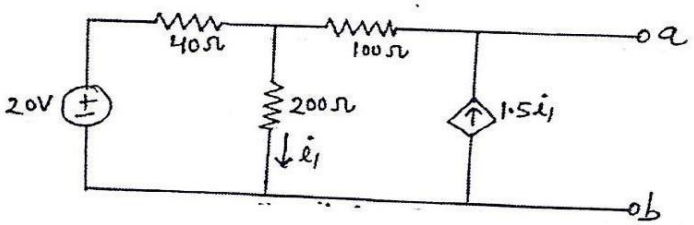
3. Find the current through 5Ω resistor by using superposition theorem.



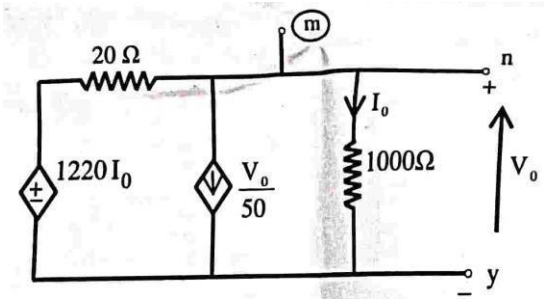
4. For the circuit of figure, use superposition theorem to compute current in 15Ω resister.



5. Find the Thevenin's equivalent of the network shown in the figure. What power would be delivered to be a load of 100Ω at a and b terminals?



6. Find Thevenin's equivalent circuit for network shown in figure at the left of terminals n-y.



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Subject - ELECTRICAL CIRCUIT ANALYSIS

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UNIT 2 – SOLUTION OF FIRST AND SECOND ORDER NETWORKS

Short Answers: (2 Marks Each)

1. Define damping factor.
2. What is critical damping?
3. Define over, under and critically damped RLC system.
4. What is energy stored in an inductor?
5. What is charge-voltage relation of a capacitor?
6. Define transient response duration.
7. What is step response?
8. What is impulse response?
9. Define natural frequency of RLC circuit.
10. What is quality factor for transient RLC?

Long Descriptive Answers: (5 to 20 Marks)

1. Derive the current response of an RL circuit excited by a DC step input.
2. Discuss the effect of switching on RC circuits with necessary waveforms.
3. Derive the differential equation for series RLC network and solve for natural response.
4. Explain the significance of damping in RLC circuits with mathematical conditions.
5. Compare free and forced responses with time-domain expressions.
6. Derive the expression for steady-state sinusoidal response of RLC circuit.
7. Explain initial conditions in L and C elements and why they are important.
8. Explain the concept of energy dissipation in RLC circuits.
9. Derive expression for charging and discharging of capacitor in RC circuits.

Types of Numerical Problems may be Appeared in the RTU Main Exam (5 to 20 Marks)

1. A switch closes at t=0. Determine the transient current in RL circuit.
2. Find capacitor voltage for RC discharge from 10V to 2V.
3. Determine the complete response (natural + forced) of RLC circuit given forcing function.
4. Identify whether system is over/under/critically damped.
5. For given initial conditions, use Laplace transform to determine transient current.
6. Solve a second-order ODE representing series RLC with sinusoidal input.
7. Compute the time constant of RL and RC networks for given R, L, C values.

Sample Numerical Question Which Appeared in RTU Exam

1. In the figure, switch is closed at position A at t=0, the switch moved to position B. find the current in both the cases.

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Subject - ELECTRICAL CIRCUIT ANALYSIS

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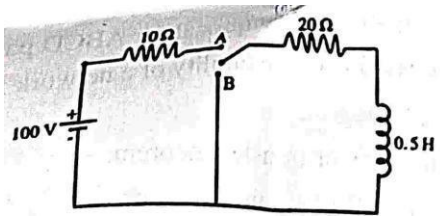
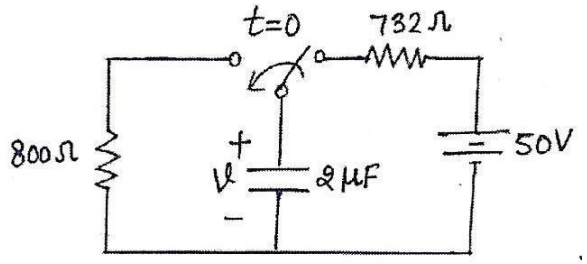


2. Find the expression for $V_c(t)$ valued for t>0 in the circuit shown in figure.

3. Find v(t=0) and v(t=2msec) for the circuit shown in figure.



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UNIT 3 – SINUSOIDAL STEADY STATE ANALYSIS

Short Answers: (2 Marks Each)

1. What is phase angle?
2. Define admittance and its components.
3. Write relation between line and phase values in star connection.
4. What is complex power?
5. Define power factor.
6. What is lagging and leading power factor?
7. Define coefficient of coupling.
8. What is leakage reactance?
9. What is ideal transformer voltage transformation ratio?
10. Define self and mutual inductance.

Long Descriptive Answers: (5 to 20 Marks)

1. Derive expression for impedance of series and parallel RLC circuits.
2. Explain phasor diagrams for RL, RC, and RLC circuits.
3. Discuss balanced 3-phase circuits with line/phase relations for both star and delta.
4. Explain real, reactive, and apparent power with power triangle.
5. Explain dot convention with multiple coupled coils.
6. Derive equations of ideal transformer and explain impedance reflection.
7. Explain resonance in AC circuits and derive conditions for series and parallel resonance.
8. Explain three-phase power measurement methods.
9. Derive expression for equivalent inductance with coupling (additive and subtractive).

Types of Numerical Problems may be Appeared in the RTU Main Exam (5 to 20 Marks)

1. Calculate current, voltage, and power factor for given AC network.
2. Find line current in a 3-phase balanced AC system with delta-connected load.
3. Calculate coupling coefficient with given self and mutual inductances.
4. Determine equivalent inductance for coupled inductors for both dot polarities.
5. A transformer has turns ratio 1:5. Calculate secondary current for given primary supply.
6. Draw phasor diagram for RLC circuit with given values.
7. Find resonant frequency of a given RLC circuit.

Sample Numerical Question Which Appeared in RTU Exam

1. For the circuit shown in figure, calculate: impedance, current, phase angle, voltage across each element, power factor, apparent power, average power and also draw phasor diagram for the circuit. Where input voltage v = 400sin(400t).

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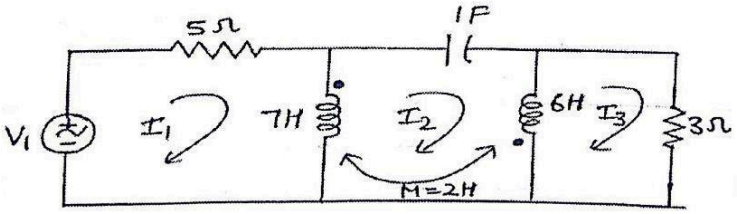
Subject Code - 3EE4-05

2. Write the correct set of equation for the circuit shown in figure.



3. A 3-phase load has a resistance of 10 ohms in each phase and is connected in (a) star and (b) delta against a 400 volts three phase supply. Compare the power consumed in both the cases.

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Subject Code - 3EE4-05

UNIT 4 – ELECTRICAL CIRCUIT ANALYSIS USING LAPLACE TRANSFORMS

Short Answers: (2 Marks Each)

1. Define ROC (Region of Convergence).
2. What is partial fraction expansion?
3. What is transfer function of a system?
4. Define system stability in Laplace domain.
5. What is magnitude response?
6. What is phase response?
7. Write Laplace transform of step, ramp, impulse.
8. What is s-plane?

Long Descriptive Answers: (5 to 20 Marks)

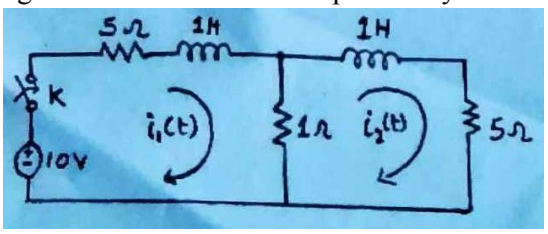
1. Derive Laplace transform of derivative and integral using convolution.
2. Explain solving RLC circuits using Laplace transform with initial conditions.
3. Discuss convolution integral and derive its properties.
4. Explain how poles and zeros determine transient and steady-state behaviour.
5. Explain how frequency response is obtained from transfer function.
6. Describe the effect of pole locations on stability and damping.
7. Explain series & parallel resonances using Laplace transform methods.
8. Discuss the significance of Laplace transform in analysing switching circuits.

Types of Numerical Problems may be Appeared in the RTU Main Exam (5 to 20 Marks)

1. Solve transient current of an RLC circuit using Laplace transform.
2. Find inverse Laplace transform of a 3rd order rational function.
3. Determine poles and zeros from given transfer function.
4. Sketch magnitude and phase response for a simple first-order system.
5. Compute the convolution of two time-domain functions.
6. Convert a differential equation circuit model into Laplace-domain algebraic form.

Sample Numerical Question Which Appeared in RTU Exam

1. Find the inverse Laplace transform of the function given by $F(s) = \frac{50}{s^2+2s+2}$
2. Using Laplace transformation technique, find i2(t) at t=0+following switching at t=0 of switch K in given figure. Assume the network previously de-energized.



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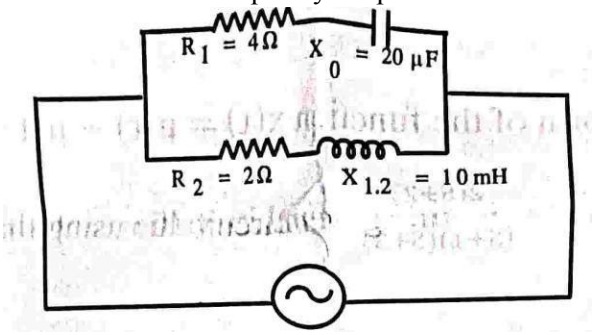
3. Calculate numerical values of resonant frequency (ω_o), exponential damping coefficient (α), natural resonant frequency (ω_d), and resistance ® for a parallel resonant circuit having L = 2.5mH, Q = 5 and C = 0.01μF.
4. Find the resonant frequency for parallel circuit shown in figure.



5. Find the laplace transform of the function $x(t) = u(t) - u(t-\theta)$. Also, a function is given by $X(s) = \frac{2(s+2)}{(s+1)(s+3)}$. Find its value using initial and final value theorem.

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UNIT 5 – TWO PORT NETWORK AND NETWORK FUNCTIONS

Short Answers: (2 Marks Each)

1. Define transmission parameters.
2. What is cascade connection?
3. What is open-circuit impedance?
4. Define short-circuit admittance.
5. What is transfer function of a network?
6. Define driving-point impedance.
7. What is the condition for reciprocity in Z-parameters?
8. Define symmetry of two-port parameters.

Long Descriptive Answers: (5 to 20 Marks)

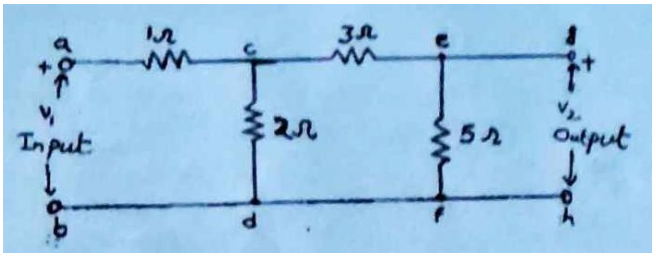
1. Derive Z, Y, h and ABCD parameters for a general two-port.
2. Explain measurement of two-port parameters practically.
3. Derive conversion formulas among Z, Y, h, and ABCD parameters.
4. Explain interconnection of two-port networks (series, parallel, cascade).
5. Discuss network functions and their significance.
6. Explain restrictions on poles and zeros for driving-point functions.
7. Draw equivalent circuits for h-parameters.
8. Explain applications of two-port networks in amplifiers and filters.

Types of Numerical Problems may be Appeared in the RTU Main Exam (5 to 20 Marks)

1. Calculate Z-parameters of a T-network and/or π-network.
2. Determine h-parameters of a given transistor equivalent.
3. Using ABCD parameters, find input impedance for a terminated network.
4. Determine overall parameters for two cascaded two-port networks.
5. Find network function $\frac{V_o(s)}{V_i(s)}$ for RC low-pass filter.
6. Determine poles and zeros of a driving-point admittance function.

Sample Numerical Question Which Appeared in RTU Exam

1. Find the Z parameters for the circuit shown in figure.



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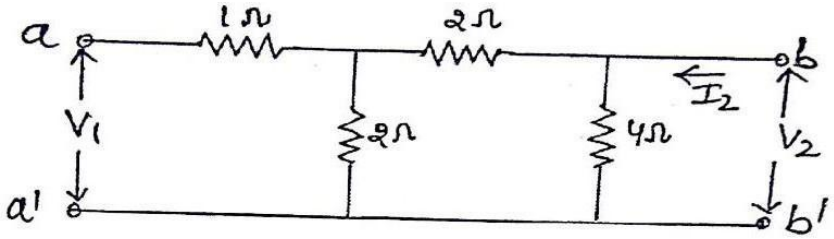
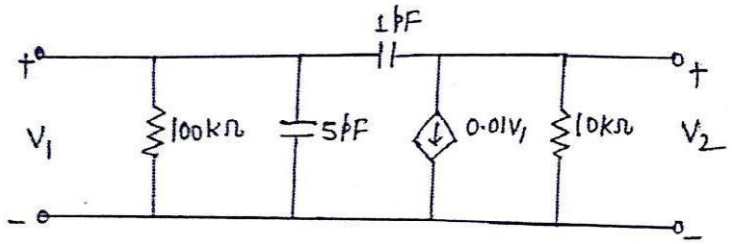
2. Find the Y parameters of the network given.



3. Find the four z-parameters at w = 10^8 rad/sec for the transistor high frequency equivalent circuit shown in figure



4. The Z-parameters of two port network are Z11 = 10 ohms, Z22 = 20 ohms, Z12 = Z21 = 5 ohms.
   a. Find ABCD parameters
   b. Find hybrid parameters of this two-port network.