Registration No.:

Total Number of Pages: 03   **B.Tech**
                                                                                       REE3C002

3rd Semester Back Examination: 2025-26
NETWORK THEORY
BRANCH(S): AEIE, EEE, EIE, ELECTRICAL, ELECTRICAL & C.E.
Time: 3 Hours
Max Marks: 100
Q.Code: U567
Answer Q1 (Part-I) which is compulsory, any eight from Part-II, and any two from Part-III.
The figures in the right-hand margin indicate marks.

Part-I

Q1   **Answer the following questions:**   **(2 x 10)**

a)   A network has open-circuit voltage V_{oc} = 24 V and short-circuit current I_{sc} = 3 A. Find the Thevenin equivalent resistance. Draw the Thevenin and Norton equivalent circuits.

b)   A source with Thevenin voltage V_{th} = 100 ∠0° and Thevenin impedance Z_{th} = 20 + j15 Ω supplies power to a variable load. Find the maximum power delivered to the load.

c)   State and explain Superposition Theorem.

d)   Write the 2-port network expressions in h-parameters and define h_{11}, h_{12}, h_{21}, & h_{22}.

e)   Two coils are magnetically coupled with L_1 = 2 H, L_2 = 8 H, M = 1 H. These are connected in series opposing across a 230∠0 V, 50 Hz supply. Find the phasor current.

f)   Define an Impulse function and write its Laplace Transform.

g)   For a two-port network, if Z_{11} = 4 Ω and Z_{22} = 6 Ω. State the condition for reciprocity and check whether the network can be reciprocal.

h)   Find the expression of voltage in 's' domain across a 2 H inductor assuming 2 A initial current.

i)   In an RC charging circuit, the capacitor voltage reaches 63.2 % of its final value in 4 ms. Determine the time constant of the circuit. Justify the answer.

j)   A parallel resonant circuit has a coil resistance of R = 4 Ω, inductance L = 0.2 H, and capacitance C = 50 μF. Determine the dynamic resistance of the circuit at resonance and state its significance.

Part-II

Q2   **Only Focused-Short Answer Type Questions- (Answer Any Eight out of Twelve)**   **(6 x 8)**

a)   Obtain z-parameters of the 2-port bridged-T network shown in Fig-1.

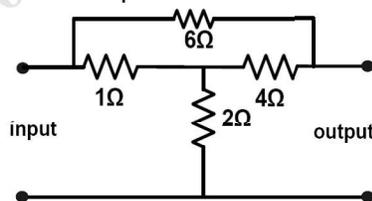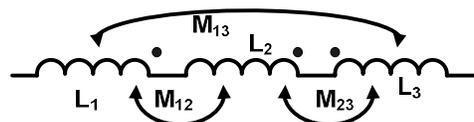Fig.1   Fig.2

b)   Find the equivalent inductance of the set up as shown in Fig.2.

c) The Z-parameters of a two-port network are given as $Z_{11} = (2s + 1/s)$, $Z_{12} = Z_{21} = 2s$, $Z_{22} = (2s + 4)$. Find the T-equivalent of the network.

d) Obtain the pole zero plot and hence the time domain response for the given network function. $I(s) = \dfrac{s}{(s+2)(s^2 + 2s + 2)}$.

e) State and explain Reciprocity theorem with an example.

f) Discuss the restrictions which are imposed on the location of poles and zeros in transfer functions.

g) For the following circuit (Fig.3) determine the current supplied by the voltage source and voltage across the current source.
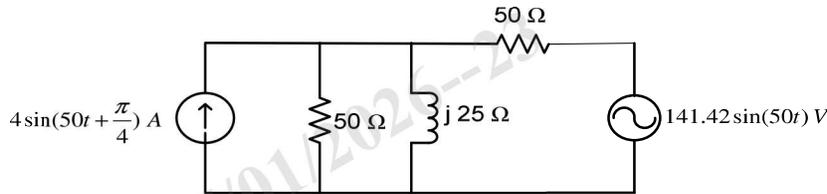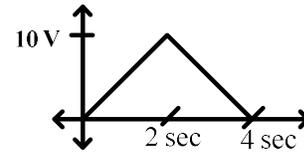

Fig.3

Fig.4

h) Determine the average and rms value of the given signal. (Fig.4)

i) For an initially relaxed series RC circuit, derive the expression for the charging current through it for a unit step excitation.

j) Write short notes on the various types of interconnections possible in two-port network.

k) In the network shown (Fig. 5), the power dissipated in 'R' when E_1, E_2, or E_3 acting alone is 20 W, 80 W, and 5 W respectively. Calculate the maximum power that can dissipate due to the simultaneous action of all the sources. Also, calculate what will be the minimum power dissipated in 'R' when all the sources are acting simultaneously.

l) For the given network shown in Fig.6, find the transfer functions $Z_{21}(s)$ and driving point impedance $Z_{11}(s)$.
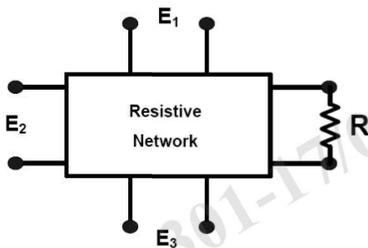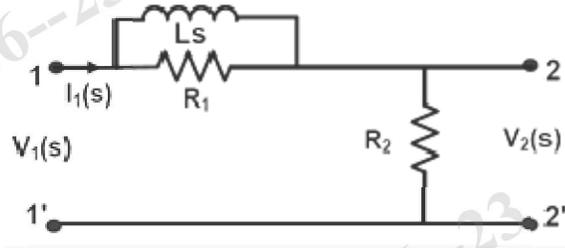

Fig.5

Fig.6

Part-III
Only Long Answer Type Questions (Answer Any Two out of Four)

Q3 **a)** State and prove (all three cases) Maximum Power Transfer Theorem. **(10)**

b) For the circuit shown in the Fig.7, determine the Thevenin's voltage and resistance and find the maximum power delivered to a variable load connected at the terminals a-b. **(6)**
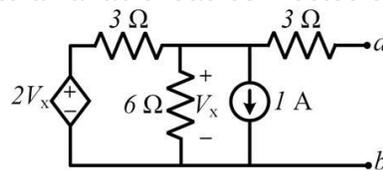

Fig.7

Q4 **a)** Derive the expression for equivalent inductance of two coils having self-inductances L_1 and L_2 are connected in parallel. Assume the mutual inductance between two coils to be M. **(8)**

b) In the circuit of Fig.8, find the equivalent inductance, $L_1 = 9$ H and $L_2 = 6$ H. **(8)**
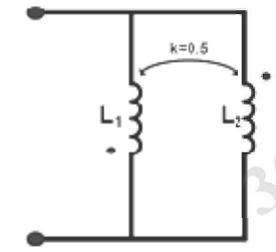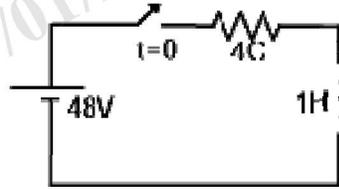

Fig.8   Fig.9

Q5 **a)** Describe in detail the various types of responses in a series R-L-C circuit with a step input. **(10)**

b) The current through the inductor at t = 0 (when the switch is closed in Fig.9) is 3 A. Find the current in the circuit after the switch is closed. **(6)**

Q6 Compare series resonance with parallel resonance in electrical circuits. Derive the relationship for bandwidth, cut-off frequencies, and Quality factor for a series RLC circuit. **(16)**