Registration No.:

Total Number of Pages: 03

Integrated Dual Degree (B.Tech and M.Tech)
Sub_Code: REC4C003

4th Semester Regular/ Back Examination: 2023-24
SUBJECT: NETWORK THEORY
BRANCH(S): ECE, ELECTRONICS & C.E, ETC
Time: 3 Hours
Max Marks: 100
Q.Code: P547
Answer Question No.1 (Part-1) 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: (2×10)

a)   In the following circuit (Fig. 1) find the value of Z_L, for maximum power transfer and value of the maximum power transferred.
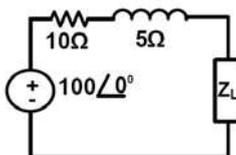

Fig. 1

b)   Draw the frequency response of a series RLC circuit.

c)   Explain about 'Duality' in Electrical Circuits with examples.

d)   Write the conditions for reciprocity for a 2-port network in z, y, h, and ABCD parameters.

e)   A capacitor in an RC circuit with R = 2 Ω and C = 4 F is being charged. How much time is required for the capacitor voltage to reach 63.2% of its steady-state value?

f)   Two inductor coils coupled to each other have self-inductance 30 mH and 30 mH respectively. If the mutual inductance of the combination is 15 mH, find the coefficient of coupling. What is the maximum possible value of the mutual inductance?

g)   Why a sinusoidal ac function is represented in term of its rms value over average value?

h)   Draw a rectangular pulse of width "a" and height 1 and write its Laplace Transform.

i)   State the number of poles and zeros, and obtain the locations in real-imaginary plane for the transfer function

$$F(s) = \frac{25(10s + 4)(s + 6)}{s(s^2 + 1)}$$

j)   Explain briefly the significance of Initial value theorem and Final value theorem.

Part-II

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

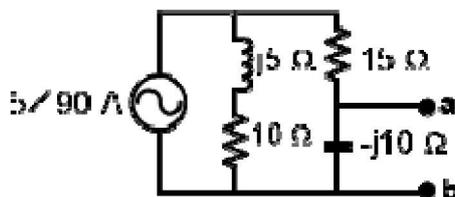a)   For the following network (Fig. 2) verify reciprocity theorem across the indicated terminal (a-b).

Fig. 2

b) State and explain Compensation Theorem with example.

c) The z-parameters of a two-port network are: $z_{11} = 10\Omega$, $z_{22} = 20\Omega$, $z_{12} = z_{21} = 5\Omega$. Find the ABCD-parameters. Also, find the equivalent T-network.

d) A series circuit has R = 10Ω, L = 50mH, and C = 100μF and is supplied with 200V, 50Hz sinusoidal ac supply. Find (I) Impedance (II) current (III) active power (IV) reactive power (V) power factor (VI) voltage drop across each element and draw the phasor diagram.

e) Find the equivalent inductance of the set up as shown in Fig. 3
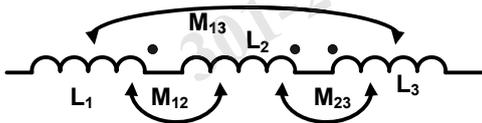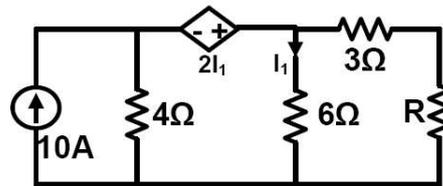

Fig. 3

Fig. 4

f) In the network (Fig. 4), calculate the maximum power that may be dissipated in the external resistor 'R'.

g) For the lattice network shown in Fig. 5, prove that $z_{11} = z_{22} = 1/2(Z_a+Z_b)$ and $z_{12} = z_{21} = 1/2(Z_b-Z_a)$.
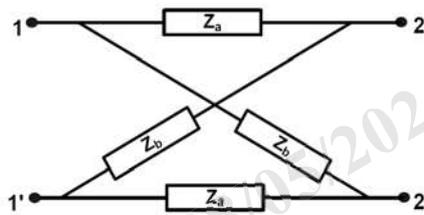

Fig. 5

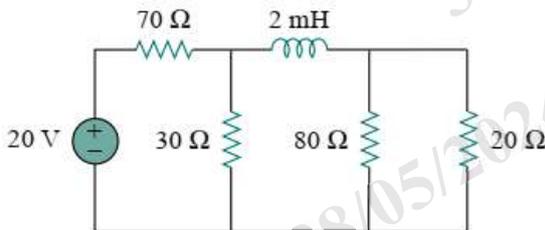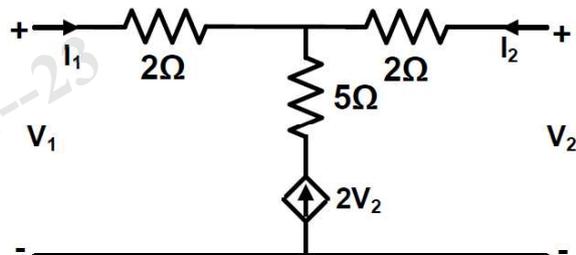**h)** Calculate the time constant of the following (Fig. 6) circuit.

Fig. 6

Fig. 7

i) Find the admittance parameters of the network shown in (Fig. 7)

j) Three similar coils of resistance 20 Ω and inductance 0.1 H are connected in delta across a three-phase star connected 440 V, 50 Hz balanced supply. Determine the per phase impedance, phase voltage, line current, phase current, and total power dissipated in the load.

k) Find f(t) given that $F(s) = (s^2 + 12) / s(s + 2)(s + 3)$ where a unit step function can be written as u(t). Draw the component wave forms of f(t).

l) Explain about I) series II) parallel III) cascade interconnections of two two-port networks with examples.

Part-III

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

Q3 **a)** State and prove Maximum Power Transfer Theorem. **(8)**

   b) Determine for the network shown in Fig. 8 (i) the values of R and X that will result in maximum power being transferred to 'R', and (ii) the value of the maximum power transferred. **(8)**
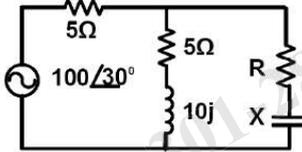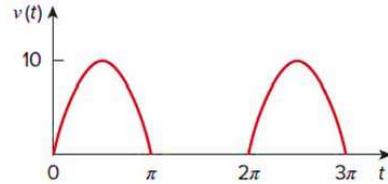

Fig. 8

Fig. 9

Q4 **a)** The waveform shown in Fig. 9 is a half wave rectified sine wave. Find the average and rms value of the waveform. Discuss its significance. **(8)**

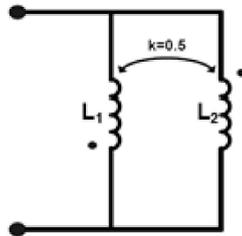   **b)** In the circuit of Fig. 10, find the equivalent inductance. Given K = 0.5. **(8)**

Fig. 10

Q5 **a)** Describe in detail the various types of responses in a series R-L-C circuit with a step input. **(8)**

   b) Assuming zero initial conditions and find i(t) in the circuit given in Fig. 11. **(8)**
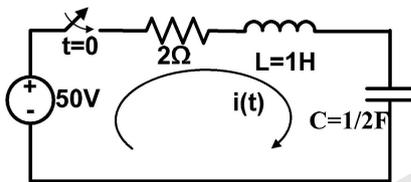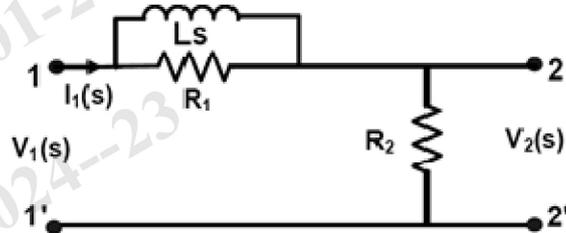

Fig. 11

Fig. 12

Q6 **a)** For the given network shown in Fig. 12, find the transfer functions $G_{21}(s)$, $Z_{21}(s)$, and driving point impedance $Z_{11}(s)$. **(8)**

   b) For a series R-L-C circuit, show that $\omega_0{}^2 = \omega_1 . \omega_2$, where ω_0, ω_1 and ω_2 have their usual meanings. **(8)**