B.TECH/ECE/3RD SEM/ECEN 2102/2021

CIRCUIT AND NETWORK THEORY
(ECEN 2102)

Time Allotted : 3 hrs **Full Marks : 70**

Figures out of the right margin indicate full marks.

Candidates are required to answer Group A and any 5 (five) from Group B to E, taking at least one from each group.

Candidates are required to give answer in their own words as far as practicable.

Group – A
(Multiple Choice Type Questions)

1. Choose the correct alternative for the following: **10 × 1 = 10**

(i) The voltage can never be exactly in phase with the current in a circuit that contains
(a) Only Capacitor (b) Only Resistor
(c) Inductor & capacitor (d) Inductor, capacitor & resistor

(ii) In a series RC circuit, if the output is measured across the resistor, then the circuit can be considered as a
(a) Band Pass Filter (b) Band Reject Filter
(c) Low Pass Filter (d) High Pass Filter

(iii) If the Laplace transform of f(t) is F(s), then the Laplace transform of f(t+α) is
(a) $e^{-s\alpha}$ F(s) (b) $e^{s\alpha}$ F(s)
(c) F(s-α) (d) F(s+α)

(iv) If three 9mH inductors are connected in parallel without mutual inductance, then the total inductance is
(a) 3Mh (b) 9mH
(c) 18mH (d) 27mH

(v) Two port analysis is applicable for the network containing
(a) linear circuit element only
(b) non linear circuit element only
(c) both linear and non linear circuit elements
(d) both bilateral and non linear circuit elements.

(vi) A two-port network to be declared as symmetrical,
(a) $z_{11} = z_{22}$ (b) $y_{21} = y_{12}$
(c) $h_{11} = h_{22}$ (d) AD = BC

(vii) The initial rate of rise of current through a coil of inductance 10 H when suddenly connected to a D.C. supply of 200 V is
(a) 50 A/s (b) 20 A/s
(c) 0.05 A/s (d) 500 A/s

(viii) Two perfectly coupled coils each of 1 H self inductance are connected in parallel so as to aid each other. The overall inductance in henry is
(a) 2 (b) 1 (c) 0 (d) 0.5

(ix) The rank of fundamental cut-set matrix of a connected graph with n number of nodes is
(a) n-1 (b) n (c) 2n+1 (d) n+1

(x) A network has 5 nodes and 9 branches. The number of fundamental loops in the network is
(a) 4 (b) 5 (c) 8 (d) 9

Group- B

2. (a) State the superposition theorem. [(CO1) (Remember/LOCQ)]
(b) Determine the current i_o in the circuit of Fig:1 using superposition theorem.

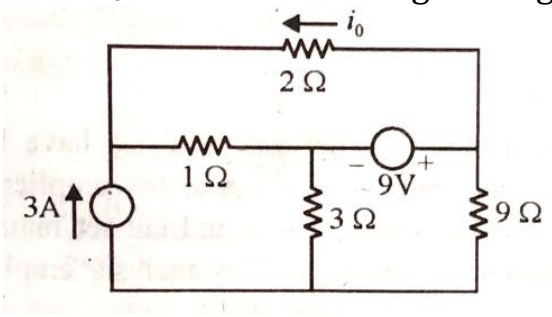

Fig:1 [(CO2) (Apply/IOCQ)]

(c) In the circuit of Fig:2 find the reading of the voltmeter V_m . Interchange the position of the current source and the voltmeter, and again find the reading. Comment on your answers.

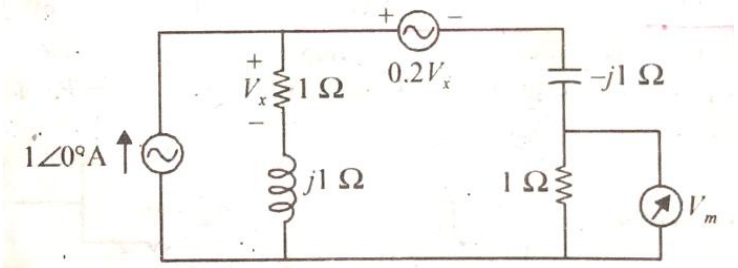

Fig. 2 [(CO2)(Analyze/IOCQ)]

2 + 5 + 5 = 12

3. (a) Explain the Reciprocity theorem with a proper example.
[(CO2) (Understand/LOCQ)]
(b) State the condition for maximum power transfer for a circuit having reactive elements. [(CO2) (Remember/LOCQ)]

(c) Find the equivalent inductance across the terminals a & b of the circuit in fig 3. [(CO1) (Analyse/IOCQ)]

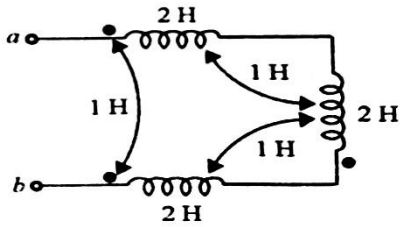

Fig 3

(d) Evaluate the Thevenin's equivalent resistance R_{th}& voltage $V_{th}$for the circuit in the fig 4. [(CO2) (Evaluate/HOCQ)]

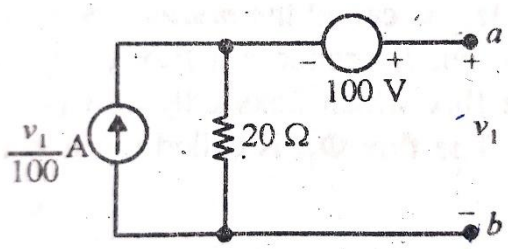

Fig 4

4 + 2 + 3 + 3 = 12

Group - C

4. (a) In a series RC network excited by a voltage source Vu(t), determine the time at which the voltage across the resistor and that across the capacitor are equal. Consider zero initial condition. [(CO3) (Analyze/IOCQ)]

(b) In the circuit of Fig:5, evaluate the voltage v(t) and the current $i_R(t)$ and $i_L(t)$ for t >0. The circulating current at t=0 in the RL loop is 1 A clockwise. [(CO3) (Evaluate/HOCQ)]

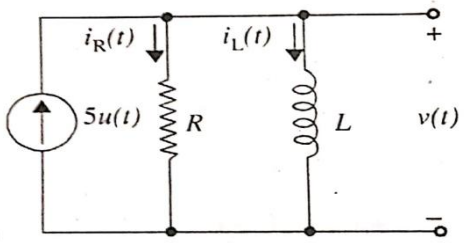

Fig: 5

6 + 6 = 12

5. (a) The switch K in the network of Fig. 6 is closed at t = 0. Calculate the current i(t) for t ≥ 0. [(CO3) (Analyze/IOCQ)]

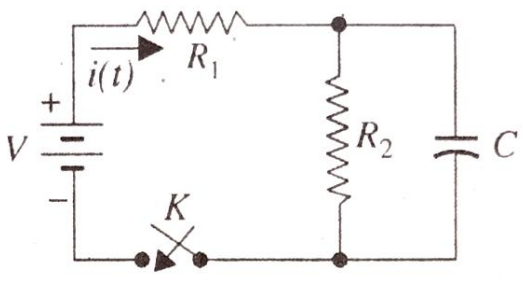

Fig. 6

(b) Determine the Laplace transform of the periodic function in Fig:7. [(CO3) (Apply/IOCQ)]

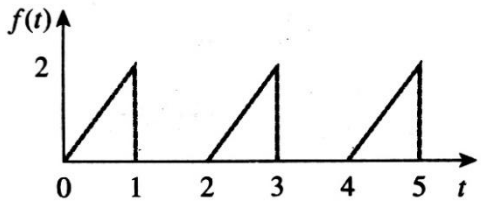

Fig. 7

6 + 6 = 12

Group - D

6. (a) Define all the h-parameters for any two-port network. [(CO5) (Remember/LOCQ)]

(b) Derive the equivalent transmission line parameters of two cascaded two-port networks. [(CO5) (Apply/IOCQ)]

(c) Evaluate the Z parameters for the given network in fig 8. [(CO5) (Evaluate/HOCQ)]

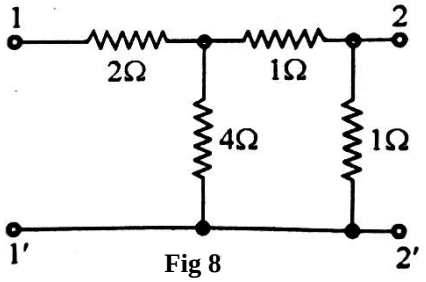

Fig 8

4 + 4 + 4 = 12

7. (a) How many trees are possible for the graph of the network of Fig:9 ? Draw all the trees. [(CO4) (Understand/LOCQ, Create/HOCQ)]

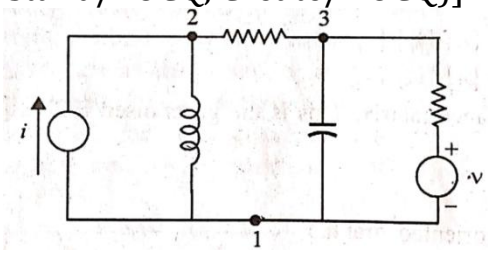

Fig. 9

(b) Obtain the incidence matrix of the graph of the network of Fig:10. Use it to obtain the node admittance matrix. Establish the KCL equation in matrix form and hence find the voltage at the node 2. [(CO4) (Analyze/IOCQ)]

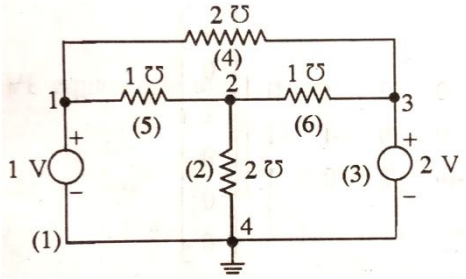

Fig:10

(1 + 5) + 6 = 12

Group - E

8. (a) What are the salient features of active filters? [(CO6) (Remember/LOCQ)]
   (b) Draw the circuit diagram of first order low pass filter and find the transfer function of it. [(CO6) (Understand/LOCQ)]
   (c) Design a second order band pass active filter that has a centre frequency of 1 KHz and a Band-width of 100 Hz. Take the centre frequency gain to be 2. [(CO6) (Create/HOCQ)]

3 + 3 + 6 = 12

9. (a) Write the input file of SPICE to determine the node voltages of the circuit in Fig 11. [(CO6) ((Apply/IOCQ)])]

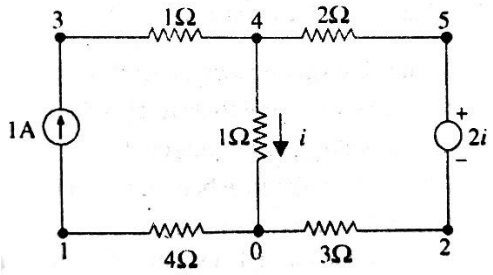

Fig.11

   (b) Design a 1st order active high pass filter with a dc gain of 10 and a corner frequency of 10KHz. [(CO6) (Create/HOCQ)]

6 + 6 = 12

Cognition Level	LOCQ	IOCQ	HOCQ
Percentage distribution	20%	48%	32%

Course Outcome (CO):

After the completion of the course students will be able to

1. Apply the previous knowledge gathered from Basic Electrical Engineering for understanding the basic concepts of this subject.
2. Solve problems in various electric circuits using Network Theorems.
3. Analyze complex circuits in Laplace domain.
4. Understand the application of Graph theory to solve various network behaviour.
5. Evaluate the output of various Two port network without going through the detailed configuration.
6. Design various types of filters using SPICE software.

*LOCQ: Lower Order Cognitive Question; IOCQ: Intermediate Order Cognitive Question; HOCQ: Higher Order Cognitive Question

Department & Section	Submission Link
ECE A	https://classroom.google.com/u/0/w/NDA0OTUzODA1ODk1/tc/NDY4Mjc5ODAxMzI3
ECE B	https://classroom.google.com/w/NDQyMjA3ODQzNjg1/tc/NDc3MzIyNzQ4OTQ4
ECE C	https://classroom.google.com/c/NDA1MTk5MTEwNDIx/a/NDc1MTUxMTIxMDQy/details