#### B.TECH/ECE/3<sup>RD</sup> SEM/ECEN 2102/2023

# CIRCUIT AND NETWORK THEORY (ECEN 2102)

Time Allotted : 2<sup>1</sup>/<sub>2</sub> hrs

Figures out of the right margin indicate full marks.

## Candidates are required to answer Group A and <u>any 4 (four)</u> from Group B to E, taking <u>one</u> from each group.

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

# Group – A

1. Answer any twelve:

Choose the correct alternative for the following

(i)	Reciprocity theor (a) independent s (c) capacitor	e for any circuit having (b) dependent source (d) inductor.				
(ii)	The inverse Lapla (a) e <sup>-t</sup>	ce transform of (1 (b) e <sup>t</sup>	/s+1) is (c) 1	(d) co	os t.	
(iii)	Two two-port networks are connected in cascade. The parameters of the sing equivalent network are obtained by multiplying the individual (a) z-parameter matrices (c) y-parameter matrices(b) h-parameter matrices (d) ABCD-parameter matrices.					
(iv)	In superposition voltage sources at (a) Shorted	theorem when we re (b) Removed	e consider of (c) Undistur	ne voltage bed	source, all the other (d) Opened.	
(v)	After how many t of its final value? (a) 2	ime constants, the (b) 3	transient par (c) 4	rt reaches r	nore than 99 percent (d) 5.	
(vi)	The condition for (a) $Y_{11} = Y_{12}$	Reciprocity of any (b) Y <sub>21</sub> = Y <sub>12</sub>	two port net (c) $Y_{11} = Y_{22}$	work is	(d) $Y_{22} = Y_{12}$ .	
(vii)	A network has 7 nodes and 11 branches. The number of fundamental loops in the network is (a) 4 (b) 5 (c) 6 (d) 7.					
(viii)	The rank of fundam (a) n-1	nental cut-set matrix (b) n	of a connected (c) 2n+1	l graph with	ʻn' number of nodes is (d) n+1	
(ix)	In a circuit contain (a) C only	ning R, L and C, po (b) L only	wer loss can (c) C and L	take place i	n (d) R only.	

Full Marks : 60

 $12 \times 1 = 12$ 

(x) The formula for determining the inductance of two coils connected in series is (a)  $L=L_1+L_2+M$  (b)  $L=L_1-L_2+2M$  (c)  $L=L_1+L_2+2M$  (d)  $L=L_1+L_2-2M$ .

#### Fill in the blanks with the correct word

- (xi) The Kirchoff's Current Law is based on the conservation of \_\_\_\_\_\_.
- (xii) For a series RL network, the time constant is given by \_\_\_\_\_.
- (xiii) The response of the circuit because of its initial condition is called \_\_\_\_\_\_.
- (xiv) The rank of a graph from a network of five nodes is \_\_\_\_\_.
- (xv) In two port network analysis, transmission line parameters are also known as \_\_\_\_\_ parameters.

# Group - B

- 2. (a) Find the mesh currents  $i_1$  and  $i_2$  for the given circuit using mesh analysis method. [(C01)(Apply/IOCQ)]
  - (b) Find the Thevenin equivalent circuit across the terminals 'a' & 'b' for the given circuit. [(CO2)(Analyze/IOCQ)]



6 + 6 = 12

- 3. (a) Show that the Thevenin equivalent resistance of a two terminal bilateral network is the ratio of open circuit voltage and short circuit current across those two terminals. [(CO2)(Understand/LOCQ)]
  - (b) Evaluate the equivalent inductance across the terminals 'a' & 'b' for the given circuit. [(CO1)(Evaluate/HOCQ)]



(c) Find the reading of the voltmeter V for the given circuit. Interchange the positions of the voltmeter and the current source and verify the reciprocity theorem for the same. [(CO2)(Analyze/IOCQ)]



3 + 3 + 6 = 12

# Group - C

## 4. (a) Evaluate the Laplace transform of the following function.

[(CO2)(Analyse/IOCQ)]



(b) In the following circuit, determine the voltage v(t) and the currents  $i_R(t)$  and  $i_L(t)$  for t>0. There is no circulating current at t=0. [(CO3)(Analyse/IOCQ)]



- 5. (a) A step excitation of height 'V' is applied to a series RC network. Derive the current i(t) in the series circuit for t≥0. Also plot the voltages across the resistor and capacitor against time for t≥0.
  [(CO3)(Understand/LOCQ)]
  - (b) Find the expression of  $V_0(t)$  for the given circuit for t > 0. Assume  $V_0(0) = 5V$ . [(CO3)(Evaluate/HOCQ)]

 $10\Omega$   $10e^{-t}u(t) V + 10\Omega$   $V_o(t) = 0.1F + 2\delta(t)A$ 

6 + 6 = 12

#### Group - D

6. (a)Calculate the y-parameters of the<br/>following circuit by applying the mesh<br/>method, and draw the equivalent<br/>П-circuit.П-circuit.[(CO2)(Create/HOCQ)]



(b) Two four terminal networks are connected in series, show that the impedance matrix of the overall network is the sum of the impedance matrices of the individual network. [(CO4)(Remember/LOCQ)]

6 + 6 = 12

7. (a) Find the tie-set and complete incidence matrices for the given oriented graph. [(CO4)(Understand/LOCQ)]



(b) Form the fundamental cut-set matrix for the given network and hence find the matrix form of KCL equations. [(CO4)(Apply/IOCQ)]



## Group - E

8. (a) Derive the transfer function of the given circuit and identify the filter type and order. [(CO3, CO6)(Analyze/IOCQ)]



- (b) Design a 1<sup>st</sup> order low pass filter with voltage gain 10 and cut-off frequency 20 KHz. Also draw the circuit diagram. [(CO3, CO6)(Create/HOCQ)]
- (c) Mention the advantages of active filters over passive filters. [(CO1)(Understand/LOCQ)]

4 + 5 + 3 = 12

9. (a) Write down the input file using PSPICE code for the circuit of Fig:11 to obtain the node voltages. [(CO6)(Apply/IOCQ)]



(b) Write a note on ac analysis using PSPICE.

Cognition Level	LOCQ	IOCQ	HOCQ
Percentage distribution	30.21	48.96	20.83

#### 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.