B.TECH/AEIE/3RD SEM/AEIE 2102(BACKLOG)/2021

CIRCUIT THEORY AND NETWORKS
(AEIE 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) Norton current (I_N) of a circuit comprising of dependent source and resistive components is
(a) indeterminate (b) $0A< I_N<1A$
(c) 0A (d) finite value greater than 1A

(ii) The impedance of an element is given by 2+j 2. The element comprises of
(a) Resistor and inductor (b) resistor and capacitor
(c) capacitor and inductor (d) All of the above.

(iii) In an oriented graph, the reduced incidence matrix is used to find the number of
(a) valid trees (b) KVL equations
(c) KCL equations (d) all of the above.

(iv) The value of coefficient of coupling in a practical magnetically coupled circuit
(a) equal to 0 (b) equal to 1
(c) greater than one (d) greater than zero but less than 1

(v) Time constant of an RC series circuit is
(a) RC (b) R/C (c) 1/RC (d) C/R.

(vi) Time constant of an RL series circuit is
(a) L/R (b) R/L (c) RL (d) R.

(vii) In a series resonant circuit, increasing inductance to its twice value and reducing capacitance to its half value
(a) will change the maximum value of current at resonance
(b) will change the resonance frequency
(c) will change the impedance at resonance frequency
(d) will alter the bandwidth of the circuit.

(viii) A network, described by Z- parameters, will be symmetrical if
(a) $Z_{11} = Z_{22}$ (b) $Z_{12} = Z_{21}$
(c) $Z_{11} = Z_{12}$ (d) $Z_{22} = Z_{21}$

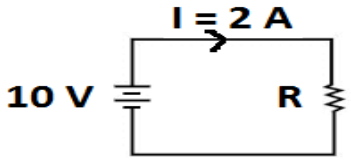
(ix) A network, described by ABCD-parameters, will be reciprocal if
(a) A=D (b) (AD-BC)=1
(c) (AC-BD)=1 (d) (AD-BC)=0

(x) The number of links in an oriented graph having 7 branches and 5 nodes is
(a) 3 (b) 4 (c) 5 (d) 7.

Group- B

2. (a) State Thevenin's theorem. Explain with a circuit diagram. [(CO2), (Remember/LOCQ)]

(b) For the below shown circuit, find the value of R and power dissipation (P) through R. [(CO1) Understand/LOCQ]



(2 + 4) + 6 = 12

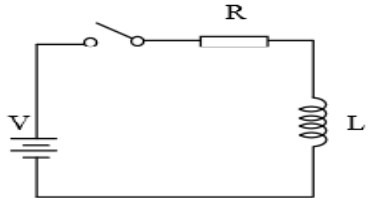
3. (a) Two inductively coupled coils have self inductances L1 = 5 mH and L2 = 10mH.If the coefficient of coupling is 0.5, compute the value of mutual inductance between the coils. [(CO1), (Remember/ LOCQ)]

(b) In a RLC Series resonance circuit, R = 10 Ω, L = 20 mH and C = 0.5 μF. Find (i) resonant frequency, (ii) Quality factor, (iii) half power frequencies, (iv) Bandwidth. [(CO4), Analyze/IOCQ]

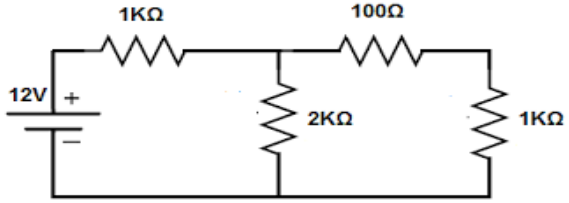
4 + 8 = 12

Group - C

4. (a) Find an expression of current i(t), t> 0 in the RL-circuit as shown in the figure below. [CO6, Analyze/IOCQ]



(b) Using Thevenin's theorem, find the current through the 2 KΩ resistor in the following circuit. [CO2, Analyze/IOCQ]



6 + 6 = 12

5. (a) Find the inverse Laplace transform of the following function. [CO4, Analyze/IOCQ]

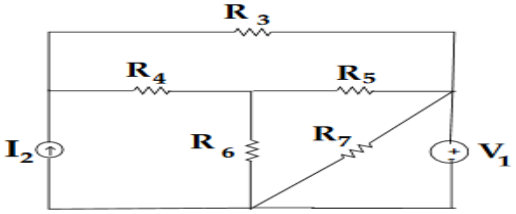
$$F(s)=\frac{(s+2)}{s(s+1)(s+2)}$$

(b) Write the Laplace transforms of the following time domain functions: Unit impulse (ii) unit step (iii) exponentially decaying and (iv) unit parabola. [(CO4), Remember/LOCQ]

6 + 6 = 12

Group - D

6. (a) Consider the electrical circuit shown in the following figure. Obtain the reduced incidence matrix. [(CO5), Analyze/HOCQ]

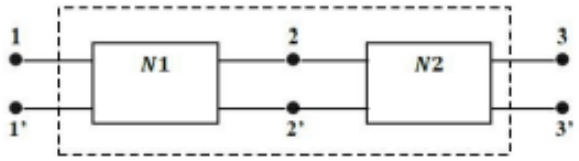


(b) State and prove Maximum Power Transfer theorem in a DC circuit. [(CO3), Remember/LOCQ]

6 + 6 = 12

7. (a) Two 2-port networks N1 and N2 described by ABCD parameters are connected as shown in the figure below.

$$\begin{bmatrix} A & B \\ C & D \end{bmatrix}_{N1}=\begin{bmatrix} 1 & 5 \\ 0 & 1 \end{bmatrix} \text{ and } \begin{bmatrix} A & B \\ C & D \end{bmatrix}_{N2}=\begin{bmatrix} 1 & 0 \\ 0.2 & 1 \end{bmatrix}$$



Find the overall parameters of the combined network. [(CO2), Understand/IOCQ]

(b) Express the Z-parameters in terms of the Y-parameters. [(CO2), Remember/IOCQ]

6 + 6 = 12

Group - E

8. (a) Draw the ideal and practical characteristics of a band-pass and a stop-band filter. [(CO1), Remember/LOCQ]

(b) The driving point impedance of a circuit is given by

$$Z(s)=\frac{(s+2)}{s(s+3)}$$

Realize a circuit using Cauer form-I. [(CO4), Understand/IOCQ]

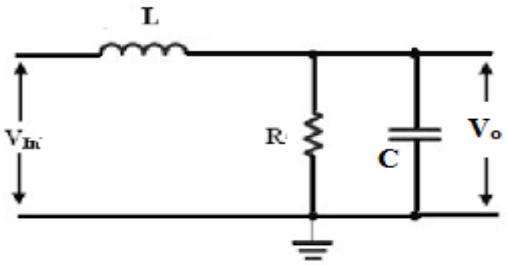
(2 + 2) + 8 = 12

9. (a) The driving point impedance of a circuit is given by

$$Z(s)=\frac{(s+1)}{s(s+2)}$$

Realize a circuit using Foster's form-II. [(CO4), Understand/IOCQ]

(b) A filter circuit, as shown below, receives a signal from a rectifier having certain frequency. Analyse the circuit to know the type of the filter. [(CO4), Analyse/HOCQ]



8 + 4 = 12

Cognition Level	LOCQ	IOCQ	HOCQ
Percentage distribution	37.5 %	50 %	12.5 %

Course Outcome (CO):

After the completion of the course students will be able to

1. Apply knowledge of mathematics, science, and engineering to the analysis and design of electrical circuits.
2. Identify, formulate, and solve engineering problems in the area circuits and systems.
3. Acquire skills in analyzing electrical measuring devices, analog electronic circuits, and power electronic circuits.
4. Analyze and synthesize RL, RC and RLC networks, passive and active filters.
5. Obtain circuit matrices of linear graphs and analyze networks using graph theory.
6. Design an electric system, components or process to meet desired needs within realistic constraints.

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

Department & Section	Submission Link
AEIE	https://classroom.google.com/c/NDc1MTU5MjY0Mjk4/a/NDY4MjgzMzcyNzEz/details