

**CIRCUIT THEORY**  
**(ELEC 3001)**

**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.*

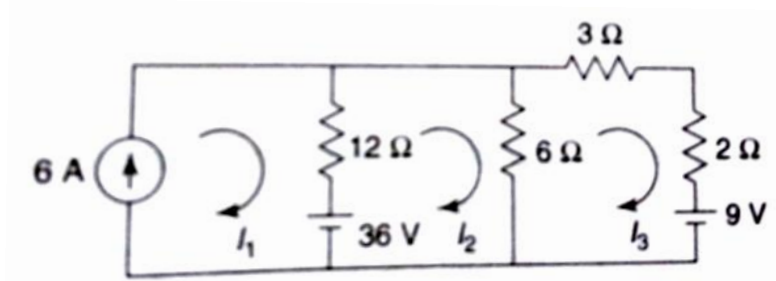
**Group - A**  
**(Multiple Choice Type Questions)**

1. Choose the correct alternative for the following: **10 × 1 = 10**
- (i) Nodal method of the circuit analysis is based on  
(a) KVL and Ohm's law (b) KCL and Ohm's law  
(c) KVL and KCL (d) KVL, KCL and Ohm's law.
- (ii) What should be done, if the dependent current and voltage sources are present in a circuit while applying 'Superposition Theorem'?  
(a) Replace them by open circuit  
(b) Replace them by short circuit  
(c) Keep in their original form without replacing by either open or short circuits  
(d) Either (a) or (b).
- (iii) Inverse Laplace transform of  $\frac{2}{s^2+4}$   
(a)  $\sin 2t$  (b)  $\sinh 2t$  (c)  $\cos 2t$  (d)  $\cosh 2t$ .
- (iv) Laplace Transform analysis give  
(a) time domain response only (b) frequency domain response only  
(c) both (a) and (b) (d) neither (a) nor (b).
- (v) Time constant of a RL circuit is  
(a)  $L/R$  (b)  $RL$  (c)  $1/RL$  (d)  $R/L$ .
- (vi) Which among the statements given below is/are the property of 'Complete Incidence Matrix'?  
(a) Determinant of a loop of a complete incidence matrix is always zero  
(b) Addition of all entries in any column should be equal to zero  
(c) Rank of connected or oriented graph is always 'n-1'  
(d) All of the above.
- (vii) The number of independent loops for a network with n nodes and b branches is  
(a)  $n+1$  (b)  $n-1$  (c)  $b-n+1$  (d)  $b+n-1$ .

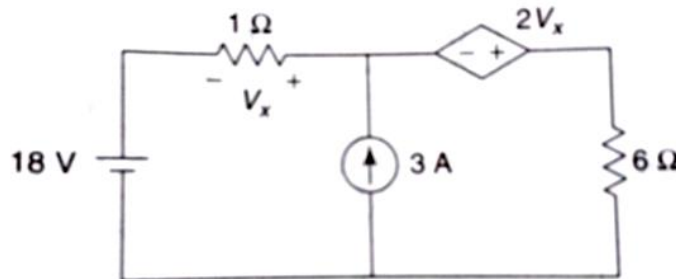
- (viii) A Two Port network has transmission parameter  $\begin{bmatrix} A & B \\ C & D \end{bmatrix}$  the input impedance of the network at port 1 will be  
 (a)  $\frac{A}{C}$                       (b)  $\frac{B}{C}$                       (c)  $\frac{AD}{BC}$                       (d)  $\frac{AB}{DC}$
- (ix) Short circuit forward transfer admittance is  
 (a)  $Y_{11}$                       (b)  $Y_{12}$                       (c)  $Y_{22}$                       (d)  $Y_{21}$ .
- (x) Superposition theorem is applicable in  
 (a) linear and unilateral circuit                      (b) linear and bilateral circuit  
 (c) non linear circuit                      (d) none of the above.

**Group - B**

2. (a) Find the current through  $2 \Omega$  resistor using mesh analysis method for the network shown below. [(CO1)(Analyse/IOCQ)]



- (b) Determine current through  $6 \Omega$  resistance using Thevenin's theorem.

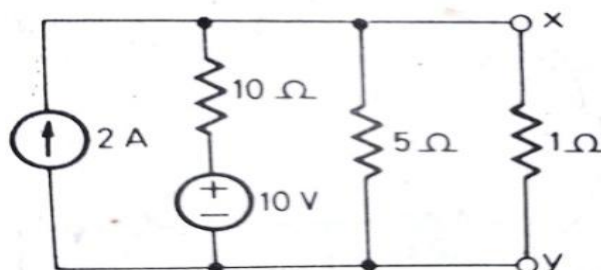


[(CO1)(Evaluate/HOCQ)]  
 6 + 6 = 12

3. (a) What are the differences between independent and dependent sources? Mention the types of dependent source with proper symbol.

[(CO1)(Remember/LOCQ)]

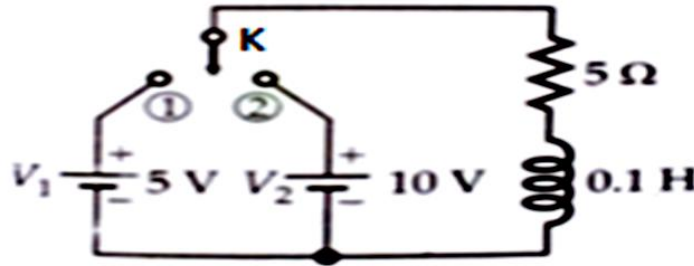
- (b) Using Thevenin's Theorem find the current through  $1 \Omega$  resistor in the following circuit. [(CO1)(Analyse/IOCQ)]



6 + 6 = 12

**Group - C**

4. (a) Define step and delayed step function. [(CO2)(Remember/LOCQ)]  
 (b) What will be the Laplace transform of the given function:  $f(t) = e^{-at}\sin(t)$ . [(CO2)(Analyze/IOCQ)]  
 (c) Derive and sketch transient current response of a RC series circuit. [(CO2)(Analyze/IOCQ)]  
**4 + 2 + 6 = 12**
5. (a) The switch S is in position 1 at a long time and moved to position 2 at  $t = 0$ . Determine the current through the inductor  $I_L(t)$ . [(CO2)(Evaluate/HOCQ)]



- (b) Find inverse Laplace Transform of the following function  $F(S) = \frac{5}{S(S+3)(S+8)}$  [(CO2)(Analyze/IOCQ)]  
**6 + 6 = 12**

**Group - D**

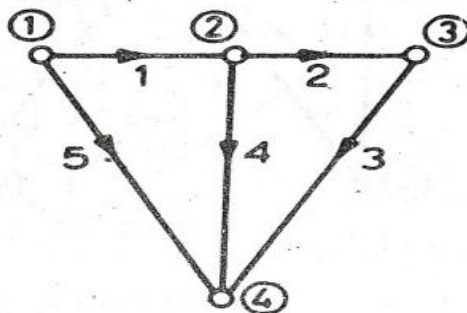
6. (a) What is a tree? Write the properties of a tree. [(CO3)(Remember/LOCQ)]  
 (b) Consider the following incidence matrix and draw the graph.

$$\begin{bmatrix} 1 & 1 & 0 & 0 & 0 & 1 \\ 0 & -1 & 1 & -1 & 0 & 0 \\ 0 & 0 & 0 & 1 & 1 & -1 \end{bmatrix}$$

[(CO3)(Evaluate/HOCQ)]  
**5 + 7 = 12**

7. (a) Write a SPICE program for plotting transient voltage response across R of a RC series circuit. [(CO5)(Analyze/IOCQ)]  
 (b) From the complete incidence matrix for the given graph.

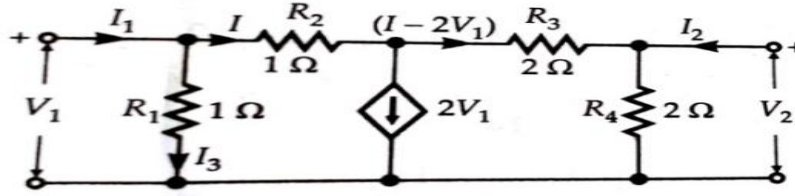
[(CO3)(Evaluate/HOCQ)]



**7 + 5 = 12**

Group - E

8. (a) Obtain Z- parameters for the following circuit. [(CO4)(Analyse/IOCQ)]



- (b) Define Z, Y, ABCD parameters of a two port network, where Z, Y, ABCD have their usual meanings. [(CO4)(Understand/LOCQ)]

6 + 6 = 12

9. (a) What is filter? Mention different types of filter. [(CO6)(Remember/LOCQ)]

- (b) Draw and analyze the 1st order low pass filter and also find out the transfer function and Cut-off frequency of this filter and show from the transfer function how the filter works as low pass filter. [(CO6)(Analyse/IOCQ)]

4 + 8 = 12

Cognition Level	LOCQ	IOCQ	HOCQ
Percentage distribution	26	49	25

**Course Outcome (CO):**

After the completion of the course students will be able to

- Solve electric circuits containing AC and DC sources applying network theorems
- Apply Laplace transform for transient analysis of electrical circuits
- Solve electric circuits applying concepts of graph theory.
- Apply two port network analysis to calculate open circuit impedance parameter, short circuit admittance parameter, transmission parameter and hybrid parameter
- Circuit Simulation using SPICE
- Familiarization with different filter networks.

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