# 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*
*<u>any 5 (five)</u> from Group B to E, taking <u>at least one</u> 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)     How many fundamental cut-sets will be generated for a graph with 'n' number of nodes?
        (a) n+1         (b) n-1         (c) b-n+1         (d) b+n-1.

(ii)     Application of Norton's theorem to a circuit yields
        (a) equivalent current source and impedance in series
        (b) equivalent current source and impedance in parallel
        (c) equivalent voltage source and impedance in series
        (d) equivalent voltage source and impedance in parallel.

(iii)     Time constant of a RL circuit is
        (a) L/R         (b) RL         (c) 1/RL         (d) R/L.

(iv)     What is the initial value of the given transfer function $\frac{1}{S(S+2)}$?
        (a) 0         (b) 2         (c) infinite         (d) 1.

(v)     The circuit has resistors, capacitors and semi-conductor diodes. The circuit will be known as
        (a) non-linear circuit                   (b) linear circuit
        (c) bilateral circuit                    (d) both linear & bilateral.

(vi)     The transfer function of a filter is defined as $G(s) = \frac{s^2}{s^2+10s+100}$. The given filter is an example of
        (a) low pass filter                   (b) high pass filter
        (c) band pass filter                   (d) band reject filter.

(vii)     In PSPICE Voltage Controlled Voltage Source is represented by
        (a) E         (b) F         (c) G         (d) H.

(viii)     A two port network is reciprocal if
        (a) $Z_{11}=Z_{22}$         (b) $Y_{12}=Y_{21}$         (c) $Y_{12}=Y_{22}$         (d) $Y_{11}=Y_{21}$.

(ix) Which variable is independent in Z parameters calculation?
(a) Current      (b) Voltage      (c) Both (a) and (b)      (d) Power.

(x) Superposition theorem is not valid for
(a) voltage responses                   (b) current responses
(c) power responses                    (d) both (a) and (b).

# Group – B

2. (a) Find the current through each resistance of the following circuit using mesh analysis method.
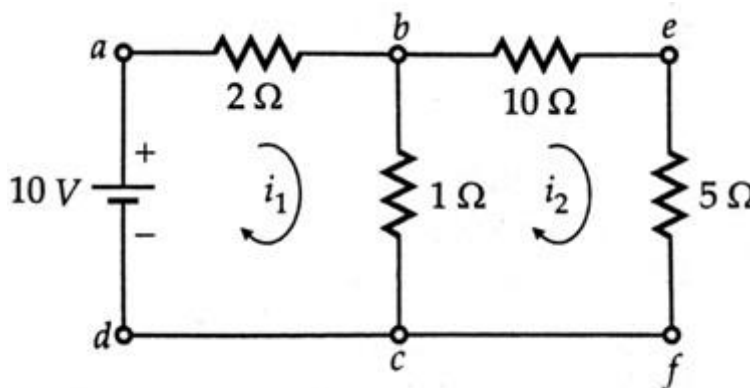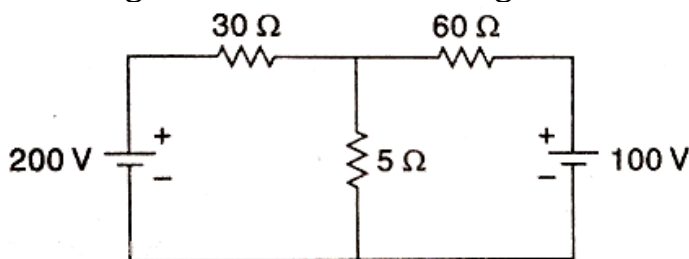


(b) Determine the current through resistor $r_2$ of the network shown below using nodal analysis method,.
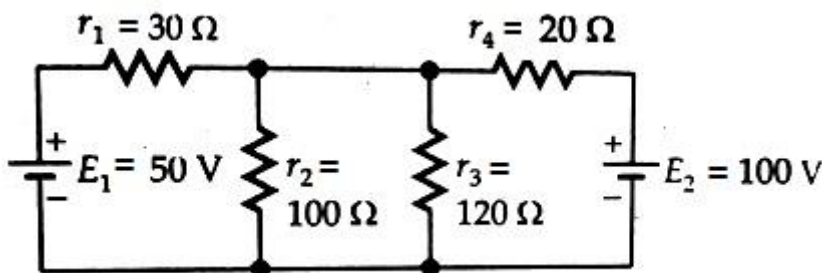


**6 + 6 = 12**

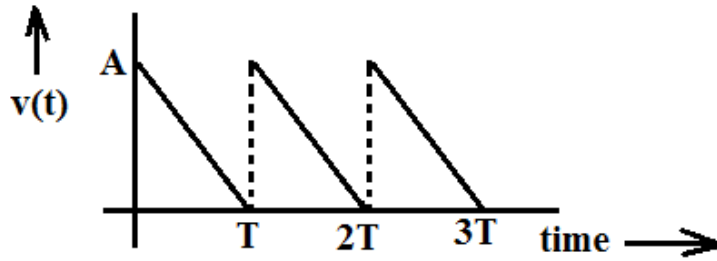3. (a) Find the current through the 5 Ω resistor using Thevenin's theorem.



(b) Find the voltage across 10 Ω resistor using Superposition Theorem.
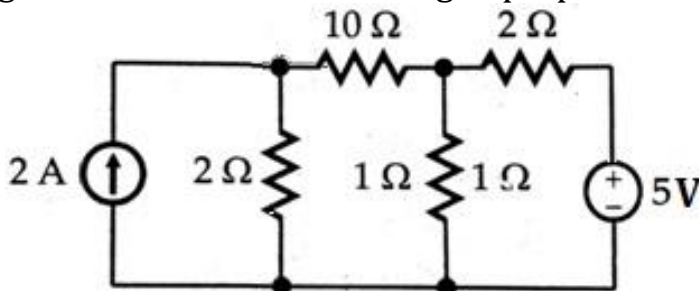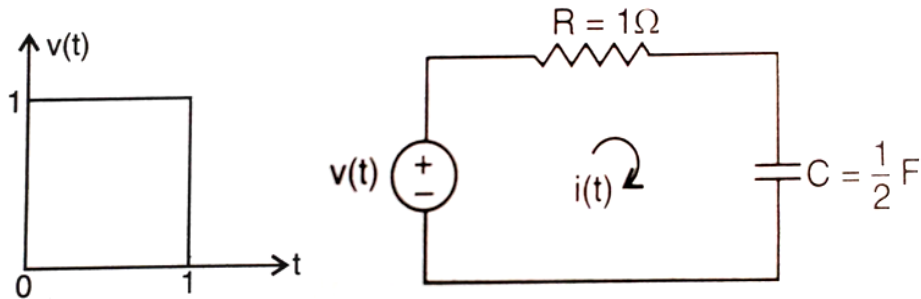


**6 + 6 = 12**

## Group – C

4.  (a)   Define 'Gate' signal and delayed ramp signal where delay time is T.

(b)   Find Inverse Laplace Transform of: $\dfrac{S}{(S+4)(S+6)}$.

(c)   Find Laplace transform of the given signal shown below.



**3 + 3 + 6 = 12**

5.  (a)   In the following circuit input voltage is given. Obtain transient current i(t) through the circuit. Define time constant of a R-C circuit.
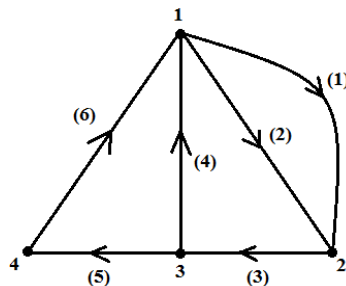


(b)   Derive the current response expression in time domain of a series RC circuit considering input as impulse voltage.
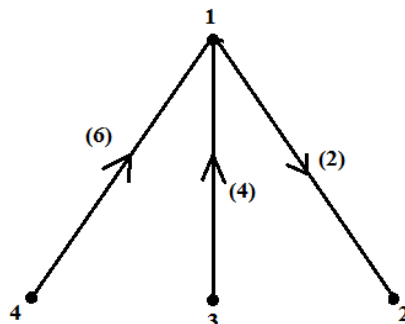
**(6 + 1) + 5 = 12**

## Group – D

6.  (a)   Determine complete incidence matrix from the oriented graph given in the figure below.
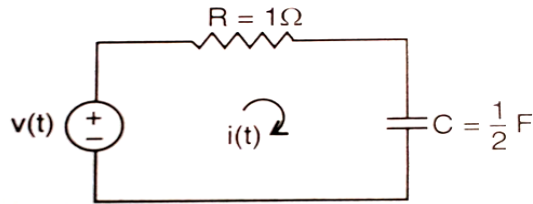


(b)   From the above graph select the tree shown in the following figure and compute tie-set matrix and cut-set matrix.



**4 + (4 + 4) = 12**

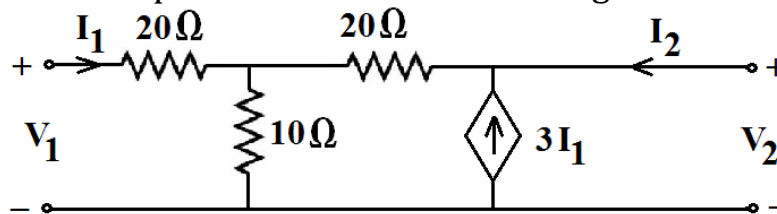7.  (a)   Write a spice program to plot the transient current i(t) of the given figure where v(t)=10V.



(b)   Explain the function of any two of the followings:
(i) .PRINT   (ii) .PLOT   (iii) .AC.

**6 + 6 = 12**

# Group – E

8.  (a)   Define Z-parameters of a two port network.
(b)   Determine the ABCD parameters for the following circuit.



(c)   Find out the condition of symmetry for Y parameter.

**2 + 6 + 4 = 12**

9.  (a)   Draw and analyze the 2ⁿᵈ order low pass filter and also find out the transfer function and cut-off frequency of this filter.
(b)   Design a 1ˢᵗ order high pass filter of cut-off frequency 500 Hz and pass band gain 5.

**(2 + 5 + 1) + 4 = 12**