FUNDAMENTALS OF CIRCUIT THEORY
(ELEC 3221)

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)   The internal resistance of an ideal voltage source is
           (a) Very low   (b) 0 Ω   (c) infinite   (d) very high

   (ii)   Thevenin's Equivalent circuit consist of
           (a) Voltage source in series with a resistance
           (b) Voltage source in parallel with a resistance
           (c) Current source in series with a resistance
           (d) Current source in parallel with a resistance

   (iii)   If the Thevenin's equivalent circuit consists of a voltage source (V_{th}) of 20V in series with a resistance (R_{th}) of 5Ω, the corresponding Norton's equivalent circuit consists of a current source (I_N) in parallel with a resistance (R_N) where
           (a) I_N=4A and R_N=5 Ω   (b) I_N=20A and R_N=10 Ω
           (c) I_N=4A and R_N=20 Ω   (d) I_N=20A and R_N=4 Ω

   (iv)   Time constant of a R-L series circuit is
           (a) $\frac{R}{L}$ (b) $\frac{L}{R}$ (c) RL   (d) $\frac{1}{RL}$

   (v)   If a step function passing through an integrator what will be the nature of output signal?
           (a) Ramp signal   (b) Impulse Signal   (c) Sinusoidal signal (d) Exponential signal

   (vi)   What is the Damping constant of undamped system?
           (a) 1   (b) 0   (c) >1   (d) <1

   (vii)   Consider the following statements about a complete incidence matrix:
           1. The sum of the entries in any column is zero .
           2. the rank of the matrix is n-1 where n is the number of nodes .
           3. the determinant of the matrix of a closed loop is zero .
           which of the statements given above are correct ?
           (a) 1 and 2 only   (b) 2 and 3 only   (c) 1 and 3 only   (d) 1, 2 and 3

   (viii) An electric circuit with 10 branches and 7 nodes will have
           (a) 3 loop equations   (b) 4 loop equations
           (c) 7 loop equations   (d) 10 loop equations

(ix)   Short circuit reverse transfer admittance is
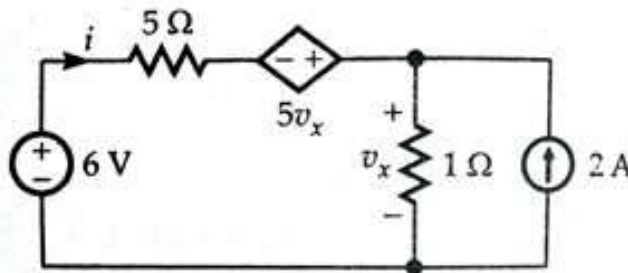   (a) Y_{11} (b) Y_{12} (c) Y_{22} (d)Y_{21}

(x) Y_{21} in terms of Z parameter is
        (a) $\frac{-Z_{22}}{\Delta Z}$ (b) $\frac{-Z_{12}}{\Delta Z}$ (c) $\frac{-Z_{11}}{\Delta Z}$ (d) $\frac{-Z_{21}}{\Delta Z}$

Group – B

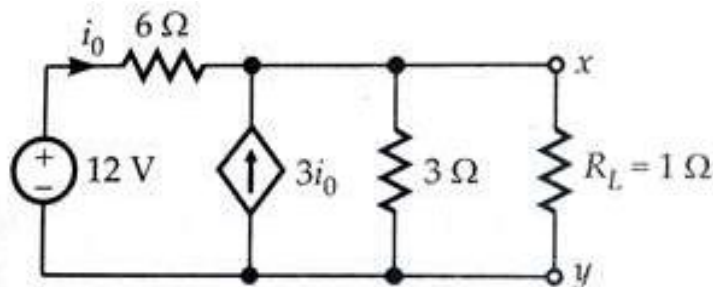2. (a)   For the following circuit find the currents through the resistors using mesh analysis.
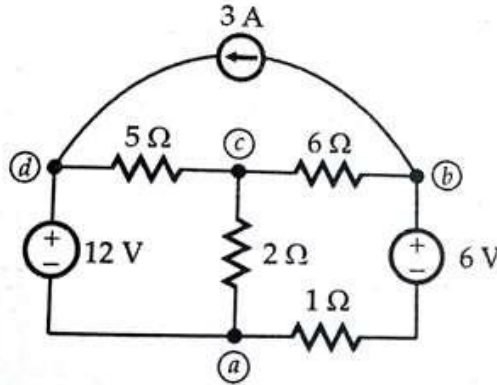
    (b)   Using Superposition theorem find the value of 'i' in the following circuit.

                                                                6 + 6 = 12

3. (a)   Using Norton's theorem, find the current flowing through the load resistor (R_L), in the following circuit.
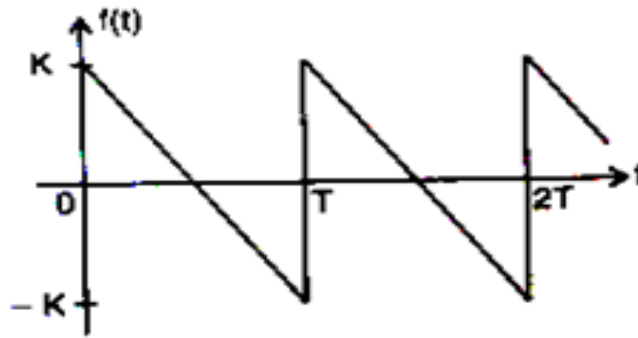

    (b)   State and prove Maximum Power Transfer theorem for a DC network. Also prove that the efficiency of the circuit under Maximum Power Transfer condition is 50%.

                                                                6 + 6 = 12

Group – C

4. (a)   Define the given signals and also find Laplace Transform of them
            (i)unit impulse signal (ii) step signal (iii) ramp signal.

(b)   Find Laplace Transform of the given waveform.

6 + 6 = 12

5. (a)   An R, C series circuit is excited by a dc voltage source of 10. Derive and plot current response of the circuit. Assume R $=1000\Omega$ and C= 0.1 µF and excitation starts at t=o secs. What is the time constant of the given circuit?
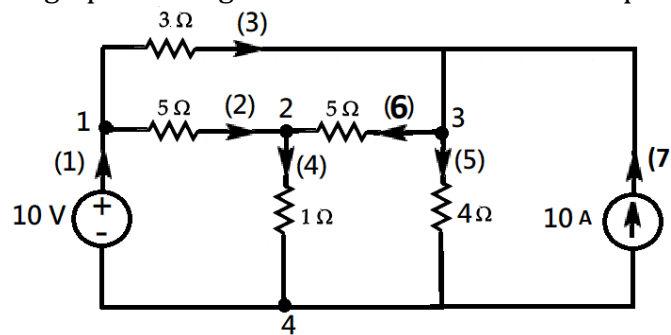
(b)   Initially switch K is at x position for long time. At t= 0 the switch is shifted to y. Find the voltage across the terminal a-b at t>0. Assume zero initial condition for L_2.
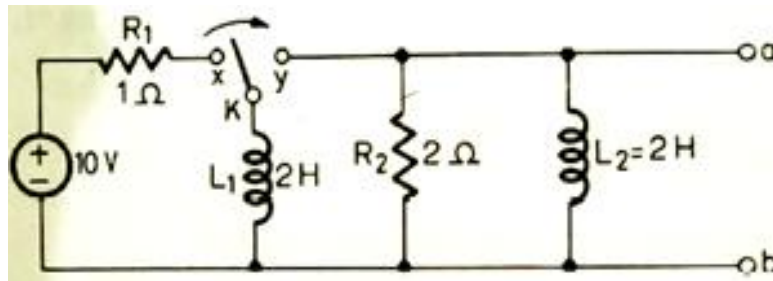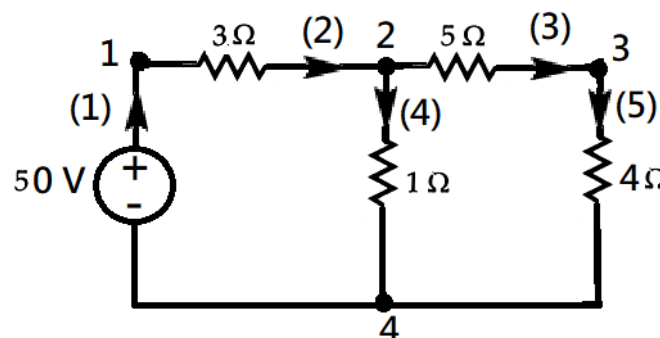

(4 + 2) + 6 = 12

Group – D

6. (a)   Draw the oriented graph for the given circuit. Then find the complete incidence matrix of the graph.

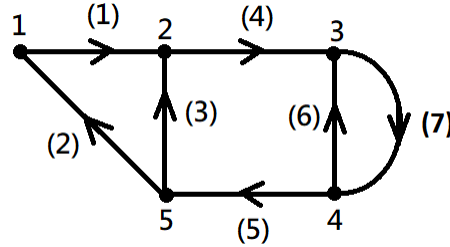(b)   Derive the mesh equation in terms of graph theory for the following circuit.

(c)   Prove that KCL for graph theory is $A_a I_b = 0$
(where A_a= Complete incidence matrix I_b= branch current matrix).
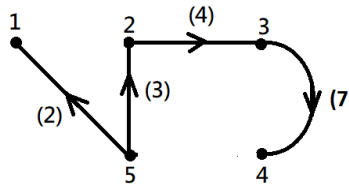
(2 + 3) + 5 + 2 = 12

7. (a) Draw an oriented graph from the following incidence matrix.

$$\begin{bmatrix} 1 & 1 & 1 & 0 & 0 & 0 & 0 & 0 \\ 0 & -1 & 0 & -1 & 1 & 0 & 0 & 0 \\ -1 & 0 & 0 & 0 & -1 & 1 & 0 & 0 \\ 0 & 0 & -1 & 0 & 0 & -1 & 1 & 0 \end{bmatrix}$$
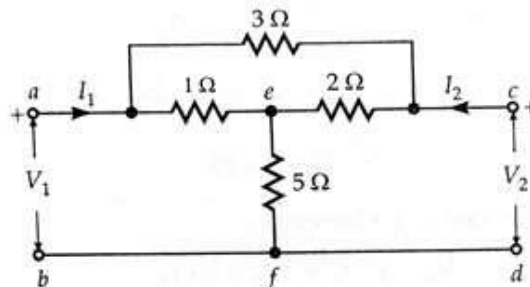
(b)

From the above graph, consider a tree given in the following figure, and compute tie-set matrix and fundamental cut-set matrix.

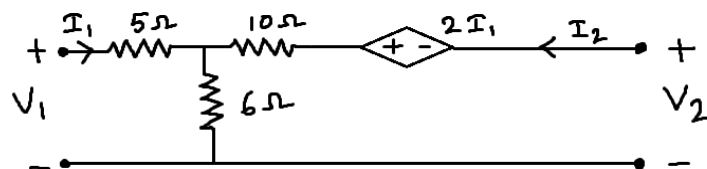4 + (4 + 4) = 12

Group – E

8. (a) Determine the open circuit impedance parameters for the following circuit.

(b) Derive the condition of reciprocity and symmetry for Y-parameters.

6 + 6 = 12

9. (a) Determine the Transmission parameters for the following circuit.

(b) Derive the following interrelationships:
    (i)   ABCD parameters in terms of Z parameters.
    (ii) Y parameters in terms of ABCD parameters.

6 + (3 + 3) = 12

Department & Section	Submission Link
IT	https://classroom.google.com/c/MzAzMTI3NDQwMzc4/a/MzU5MzM3MDkzNzQ1/details