

FUNDAMENTALS OF CIRCUIT THEORY

(ELEC 3221)

Time Allotted: 2½ hrs

Full Marks : 60

Figures out of the right margin indicate full marks.

*Candidates are required to answer Group A and
any 4 (four) from Group B to E, taking one from each group.*

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

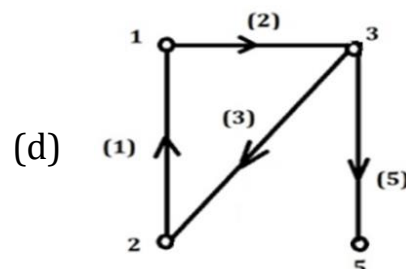
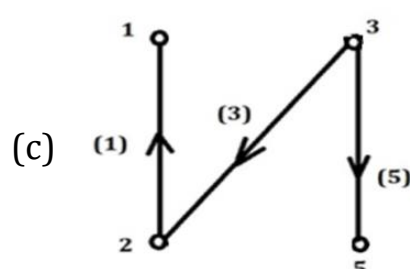
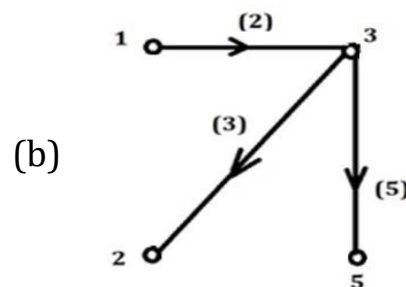
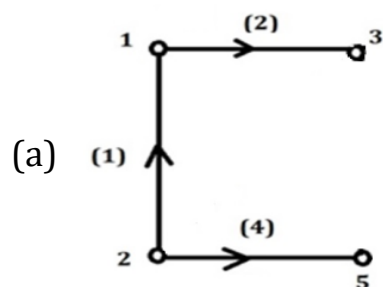
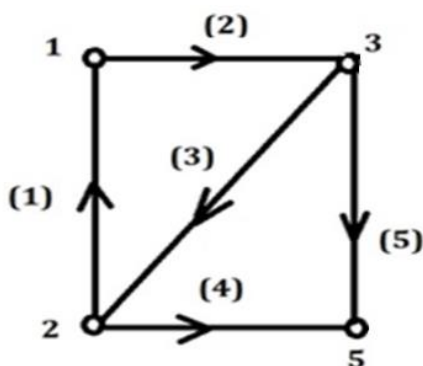
Group – A

1. Answer any twelve:

12 × 1 = 12

Choose the correct alternative for the following

- (i) An ideal current source has
 (a) zero internal resistance
 (b) infinite internal resistance
 (c) terminal voltage in proportion to current
 (d) terminal voltage in proportion to load
- (ii) The superposition theorem requires as many circuits to be solved as there are
 (a) Sources, nodes and meshes
 (b) Sources and nodes
 (c) Sources
 (d) Nodes
- (iii) If the number of branches in a network be B, the number of nodes be N then the number of mesh equations will be
 (a) $B - N - 1$
 (b) $B - N + 1$
 (c) $N - 1$
 (d) $N + 1$
- (iv) Laplace transform of Unit step signal is
 (a) $\frac{1}{s}$
 (b) s
 (c) 1
 (d) 0
- (v) Final value theorem states that
 (a) $\lim_{t \rightarrow 0} f(t) = \lim_{s \rightarrow \infty} sF(s)$
 (b) $\lim_{t \rightarrow 0} f(t) = \lim_{s \rightarrow 0} sF(s)$
 (c) $\lim_{t \rightarrow \infty} f(t) = \lim_{s \rightarrow 0} sF(s)$
 (d) $\lim_{t \rightarrow \infty} f(t) = \lim_{s \rightarrow \infty} sF(s)$
- (vi) Which of the given options is not a tree of the following graph?



- (vii) In RL series circuit $R=2\Omega$ and $L=2\text{mH}$. What is the value of time constant?
 (a) 1msec
 (b) 2msec
 (c) 4msec
 (d) 0 sec
- (viii) Short circuit reverse transfer admittance is:

- (a) Y_{11} (b) Y_{12} (c) Y_{21} (d) Y_{22}
- (ix) The inverse Laplace transform of $F(s) = \frac{1}{(s+1)^2+1}$ is
 (a) $e^{-t} \sin t$ (b) $e^{-t} \cos t$ (c) $\sin t$ (d) e^{-t}
- (x) The Thevenin's equivalent circuit consists of
 (a) Voltage source (V_{th}) in series with internal resistance R_{th}
 (b) Voltage source (V_{th}) in parallel with internal resistance R_{th}
 (c) Current source (I_{th}) in series with internal resistance R_{th}
 (d) Current source (I_{th}) in parallel with internal resistance R_{th}

Fill in the blanks with the correct word

- (xi) Laplace transform of unit impulse signal is _____.
- (xii) At steady state condition inductor behaves as _____.
- (xiii) A $10\ \Omega$ resistor, a 2 H inductor and 3 F capacitor are connected in series. The combination is driven by a unit step voltage. The current flowing through the circuit under steady state condition is _____ A.
- (xiv) The internal resistance of an ideal current source is _____.
- (xv) In Z-parameter representation of a two port network the condition of symmetry is _____.

Group - B

2. (a) Calculate v_0 and i_0 for the circuit of Fig. 1.

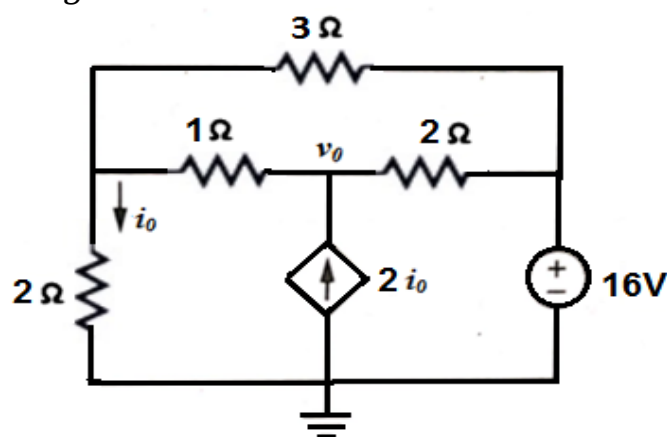


Fig. 1

[[CO1](Apply/IOCQ)]

- (b) Make use of superposition theorem to solve i_0 for the network given in Fig. 2.

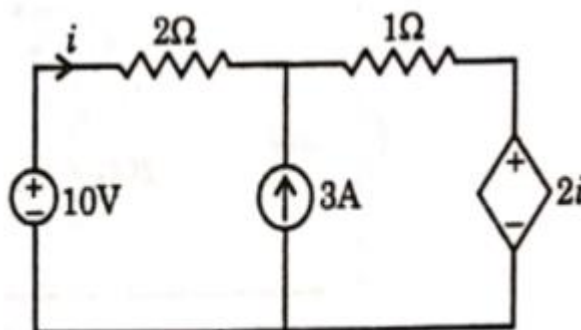


Fig.2

[[CO2](Evaluate/HOCQ)]

6 + 6 = 12

3. (a) Calculate current through $5\ \Omega$ resistance of Fig. 3 using Norton's theorem.

[[CO2](Apply/IOCQ)]

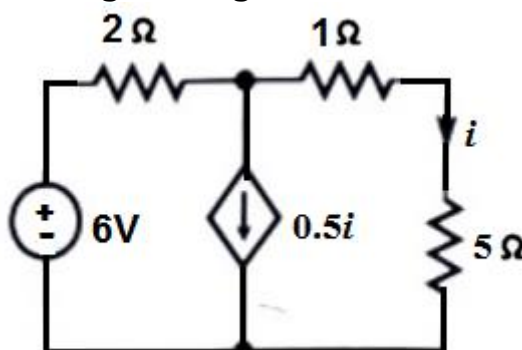


Fig. 3

- (b) In the network shown in Fig. 4, obtain the value of R_L which results in maximum power transfer. Also determine the amount of maximum power.

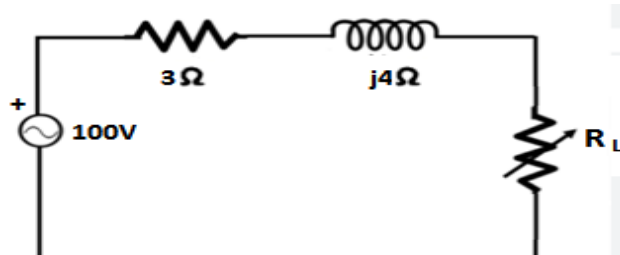


Fig. 4

[[CO2] (Understand/LOCQ)]

Group - C

4. (a) Obtain Laplace transform of the given periodic waveform Fig.5.

[[C03](understand/LOCQ)]

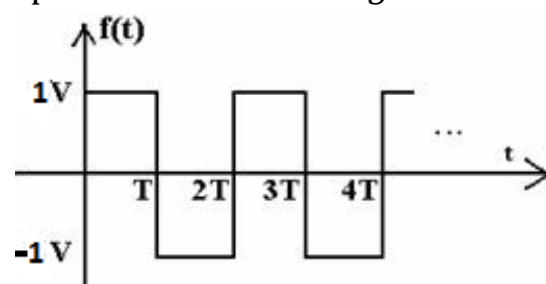


Fig. 5

- (b) In the circuit shown in Fig. 6, the switch 'K' is at position 1 for a long time. Develop the expression for the current through the inductor when the switch is moved from position 1 to 2 at $t=0$.

[[C04](Apply/IOCQ)]

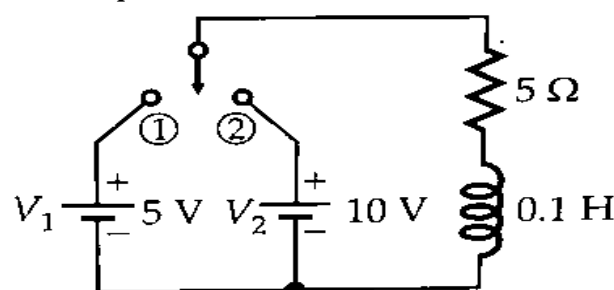


Fig. 6

5 + 7 = 12

5. (a) A constant voltage of 100V is applied at $t=0$ to a series RL circuit having $R=10\Omega$ and $L=10H$. Determine (i) time constant and (ii) the expression of the current flowing through the coil for $t>0$.
 (b) Define unit ramp signal.
 (c) Laplace transform of a function is given by $F(s) = \frac{2s^2 + 80s + 1000}{s(s+10)(s+30)}$. Find its inverse Laplace transform.

[[C04](Analyse/HOCQ)]

[[C03](Remember/LOCQ)]

[[C03](Understand/LOCQ)]

7 + 2 + 3 = 12

Group - D

6. (a) Develop Complete Incidence matrix of the directed graph shown in Fig. 7.
 (b) Assume the sub-graph shown in Fig. 8 as a tree and develop fundamental Cut-set matrix and Tie-set matrix.

[[C05](Create/HOCQ)]

[[C05](Apply/IOCQ)]

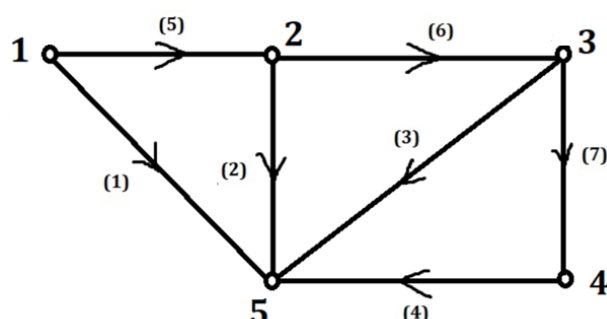


Fig. 7

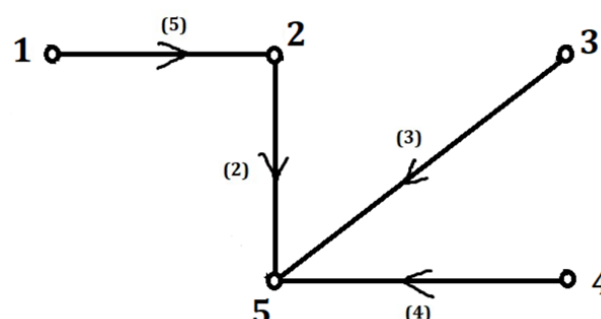


Fig. 8

4 + (4 + 4) = 12

7. (a) What is twig and link? What is the relation between twig and link?
 (b) What are the properties of a tree in a graph?
 (c) Draw the directed graph for the following incidence matrix.

[[C05](Understand/LOCQ)]

[[C05](Remember/LOCQ)]

[[C05](Apply/IOCQ)]

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

(2 + 2) + 3 + 5 = 12

Group - E

8. (a) Define hybrid parameters and Y-parameters. Express Z parameters in terms of Transmission parameters.
 (b) Analyse the circuit shown in Fig. 10 and find open circuit impedance parameters (Z- parameters).

[[C06](Understand/LOCQ)]

[[C06](Analyze/IOCQ)]

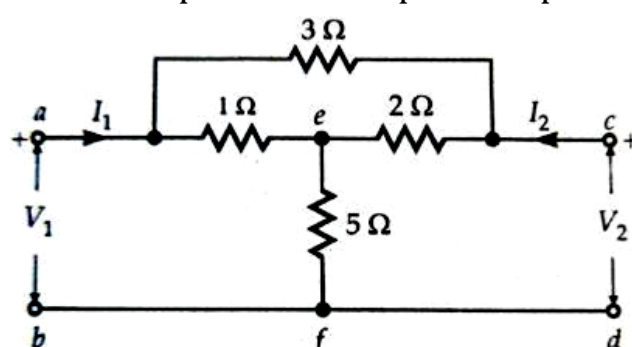


Fig. 10

