B.TECH / EE /3RD SEM/ ELEC 2102/2017

CIRCUIT THEORY
(ELEC 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) The coefficient of coupling for two coils having L_1= 1 H, L_2 = 4 H and M = 1H is :
(a) 1 (b) 4 (c) 2 (d) 0.5.

(ii) The final value of f(t) whose Laplace transform $F(s) = \frac{s+6}{s(s+3)}$ is
(a) 2 (b) ∞ (c) 0 (d) 1.

(iii) Which among the following is also regarded as dual of Thevenin's Theorem'?
(a) Norton's Theorem (b) Superposition Theorem
(c) Reciprocity Theorem (d) Maximum Power Transfer Theorem.

(iv) When a source is delivering maximum power to a load, the efficiency of the circuit is always
(a) 50% (b) 25% (c)75% (d) 100%.

(v) The transient current in a loss – free L-C Circuit when excited from an ac source is an ---------sine wave.
(a) undamped (b) over damped
(c) under damped (d) critically damped.

(vi) If a graph has n number of nodes and b number of branches then the number of twigs and links of the graph are
(a) (n-1) & (b-n) (b) n & (b+ n +1)
(c) (n-1) & (b-n+1) (d) n & (b -n -1) respectively.

(vii) The condition of reciprocity for transmission parameter network is
(a) $A = D$ (b) $AD - BC = 1$
(c) $AD - BC = -1$ (d) $A = C$.

(viii) Two 'two-port' networks are connected in cascade. The combination is to be represented as a single two - port network by multiplying individual
(a) z - parameter matrices (b) y - parameter matrices
(c) h - parameter matrice (d) ABCD parameter matrices.

(ix) '. TRAN' statement in SPICE is use to analyze the network in
(a) frequency domain (b) time domain
(c) both frequency and time domain (d) Laplace domain.

(x) A 10 Ω resistor, a 1 H inductor and 1 μF capacitor are connected in parallel. The combination is driven by a unit step current. Under the steady state condition, the source current flows through
(a) the resistor only (b) the inductor only
(c) the capacitor only (d) all the three elements.

Group - B

2. (a) Find current through 5 Ω resistance using Norton's theorem for the circuit of Fig. 2(a).

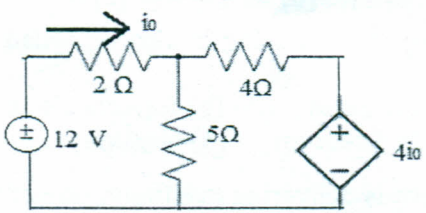

Fig. 2(a)

(b) In the circuit of Fig. 2(b), find v1, v2, v3.

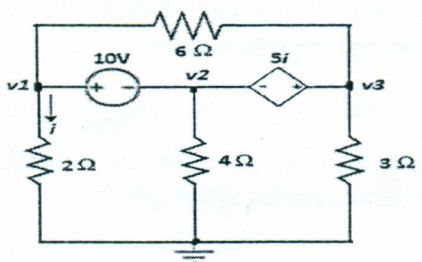

Fig. 2(b)

6 + 6 = 12

3. (a) For the frequency domain circuit shown in Fig. 3(a), determine the value of $v_{out}(t)$ for $v_{in}(t) = 10\cos(377t)$ and a coupling coefficient $k = 0.8$.

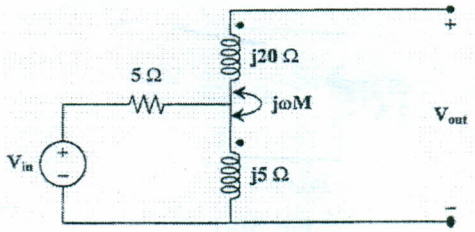

Fig. 3(a)

(b) Draw the dotted equivalent of the circuit shown in Fig. 3(b) and find the equivalent inductive reactance.

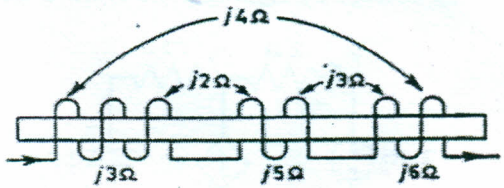

Fig. 3(b)

7 + 5 = 12

Group - C

4. (a) In the circuit of fig. 4 (a), the switch 'S' was at position 'a' for long time. The switch is moved from position 'a' to 'b' at t=0. Find i(t) at t>0 .

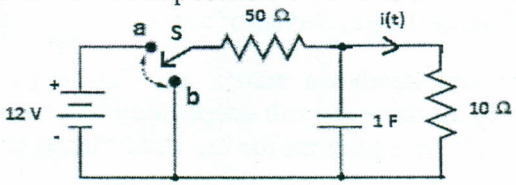

Fig. 4(a)

(b) Find Laplace transform of the waveform shown in Fig. fig. 4 (b).

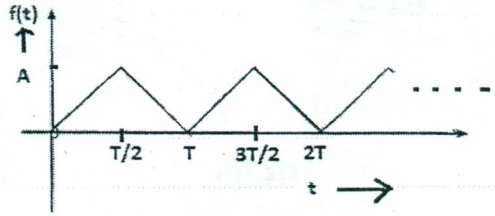

Fig. 4(b)

7 + 5 = 12

5. (a) In a series LC circuit (Fig. 5a) the initial current through the inductor is 2A and initial voltage across capacitor is 10V. Find the voltage across capacitor at t=0+. Assume L=1H and C = $\frac{1}{2}$F.

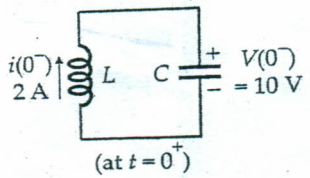

Fig. 5(a)

(b) In the circuit of fig. 5(b) if the initial voltage across capacitor is 1 V with polarity as shown, find the voltage appearing across the capacitor with application of step voltage by closing the switch 'S' at t=0.

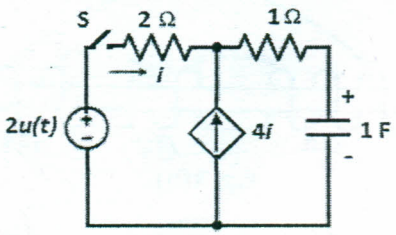

Fig. 5(b)

6 + 6 = 12

Group – D

6. (a) What is 'tree'? State the properties of a tree.

(b) Compute Complete Incidence matrix and Tie-set matrix of the circuit shown in Fig. (6). Assume the sub-graph shown in figure below as a tree, find mesh equilibrium equations for the circuit using graph theory.

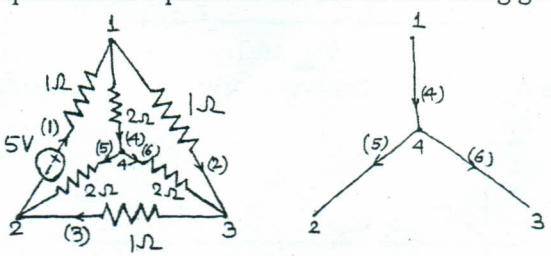

Fig. (6)

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

7. (a) Define 'Transmission' parameters. Derive the relationship between 'Transmission' parameters and 'Z' parameters.

(b) State reciprocity theorem. For hybrid parameters, derive the condition of reciprocity.

(c) Determine short circuit admittance parameters for the circuit shown in fig.7 below.

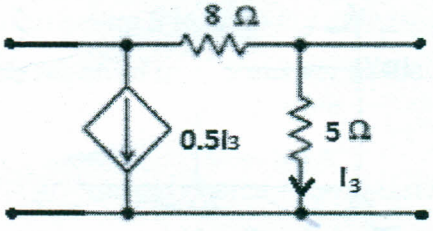

Fig. (7)

(1 + 2) + (1 + 3) + 5 = 12

Group – E

8. (a) What is 'filter'? Classify filters.

(b) State the difference between passive and active filters.

(c) Find $\frac{V_{OUT(S)}}{V_{IN(S)}}$ for the circuits shown in Fig. 8. Determine cut off frequency and type of the filter.

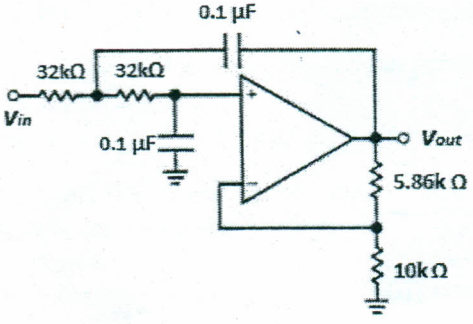

Fig. (8)

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

9. (a) Explain '.OP', '.TF', '.AC' and '.PRINT' statement in SPICE.

(b) A series R - L circuit with L = 5mH is excited by voltage source v(t). Write a SPICE program to plot the current response, voltage across inductor and voltage across resistor for R = 1Ω, 2Ω and 10Ω respectively. The waveform of v(t) is shown in Fig. (9).

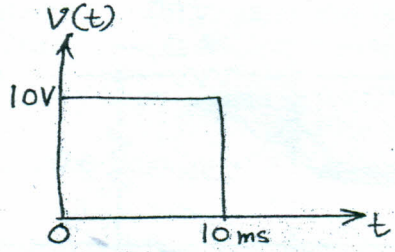

Fig. (9)

4 + 8 = 12