CIRCUIT AND NETWORK THEORY
(ECEN 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) A DC voltage source is connected across a series RLC circuit. Under steady state condition, the applied DC voltage drops entirely across the
(a) R only (b) L only (c) C only (d) R & L combination.

(ii) A series RLC circuit is overdamped when
(a) $R^2/4L^2 > 1/LC$ (b) $R^2/4L^2 = 1/LC$ (c) $R^2/4L^2 < 1/LC$ (d) $R^2/4L^2 \geq 1/LC$.

(iii) The condition for Reciprocity of any two port network is
(a) $Y_{11} = Y_{12}$ (b) $Y_{21} = Y_{12}$ (c) $Y_{11} = Y_{22}$ (d) $Y_{22} = Y_{12}$.

(iv) The condition for symmetry of any two port network is
(a) $Z_{12} = Z_{21}$ (b) $Y_{12} = Y_{11}$ (c) $AC - BD = 1$ (d) $Z_{11} = Z_{22}$.

(v) A network has 10 nodes and 8 fundamental loops. The number of branches in the network is
(a) 10 (b) 15 (c) 17 (d) 18.

(vi) A network containing a dependent source
(a) is always reciprocal (b) may be reciprocal
(c) is always non reciprocal (d) is always symmetrical.

(vii) A coil of negligible resistance has an inductance of 10 mH. The current passing through the coil changes linearly from 2 A to 6 A in 0.1 sec. The voltage across the coil during this time would be _____
(a) 0.8 V (b) 0.6 V (c) 0.4 V (d) 0.2 V.

(viii) Quality factor Q of a series resonant circuit is given by
(a) $(\Delta\omega)\omega_0$ (b) $(\Delta\omega) / \omega_0$ (c) $\omega_0 / (\Delta\omega)$ (d) $\Delta\omega + \omega_0$.

(ix) In a series RC circuit, if the output is measured across the capacitor, the circuit can be considered as a
(a) Band Pass Filter (b) Band Reject Filter
(c) Low Pass Filter (d) High Pass Filter.

(x) Superposition theorem is not applicable for
(a) Current Calculation (b) Voltage Calculation
(c) Power Calculation (d) None of the above.

Group - B

2. (a) State the reciprocity theorem. [(CO4)(Remember/LOCQ)]
(b) Find the value of R which will dissipate maximum power in the network of shown in the Fig.1. Also calculate the maximum power. [(CO2)(Evaluate/HOCQ)]

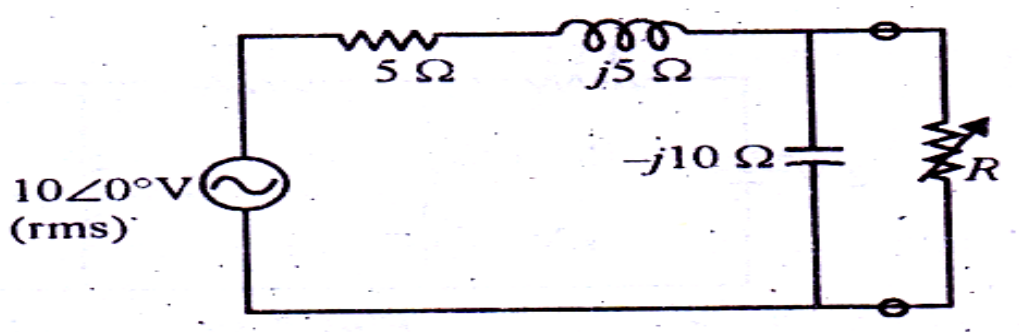

Fig.1

(c) Find the effective resistance faced by the voltage source indicated in the Fig.2. [(CO1)(Analyze/IOCQ)]

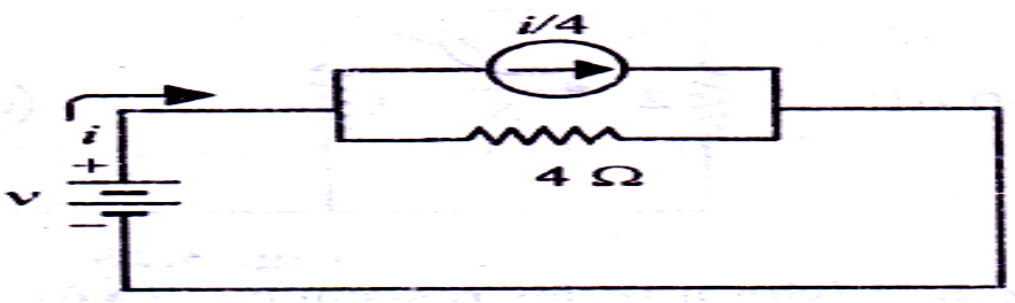

Fig.2

2 + 6 + 4 = 12

3. (a) Find the open circuit voltage across the terminals a and b of the circuit shown in Fig.3. [(CO2)(Evaluate/HOCQ)]

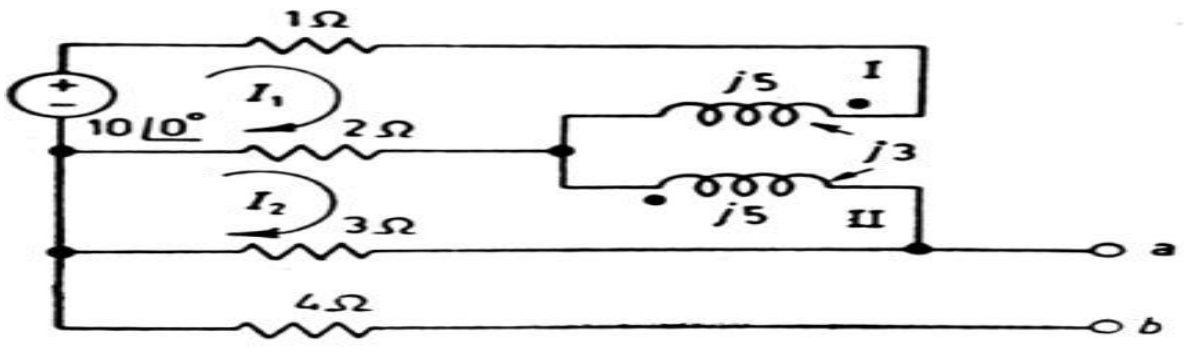

Fig.3

(b) Use mesh analysis to determine i_1, i_2 and i_3 in the circuit shown in Fig.4. [(CO1)(Analyze/IOCQ)]

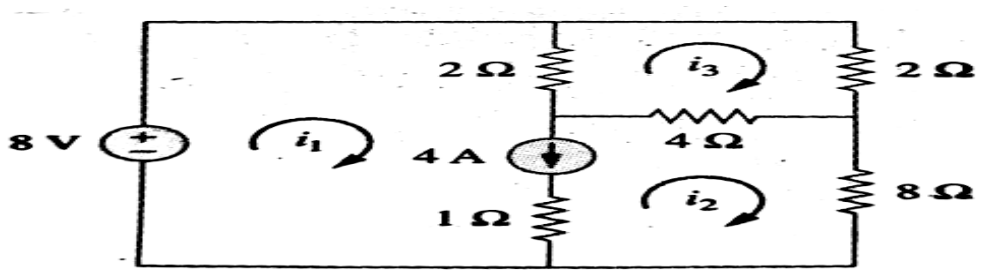

Fig.4

6 + 6 = 12

Group - C

4. (a) The circuit shown in the Fig.5 is initially in steady state with the switch S open. At t=0, the switch S is closed. Obtain the current in the inductor for t>0. [(CO3)(Evaluate/HOCQ)]

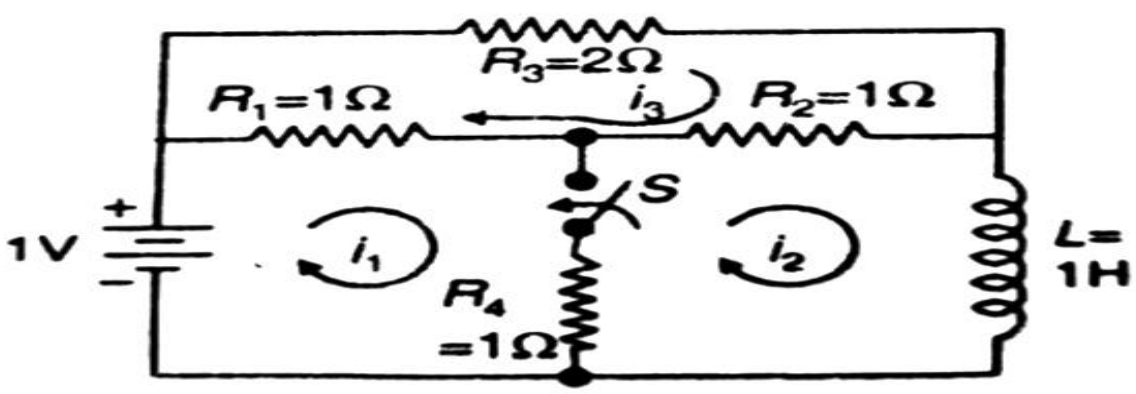

Fig.5

(b) A pulse excitation of height 'V' and width 'a' is applied to a series RC network. Derive the current i(t) in the series circuit for t≥0. Also plot the voltages across the resistor and capacitor against time for t≥0. [(CO3)(Apply/IOCQ)]

6 + 6 = 12

5. (a) Evaluate the Laplace transform of the periodic function as shown in Fig.6. [(CO2)(Evaluate/HOCQ)]

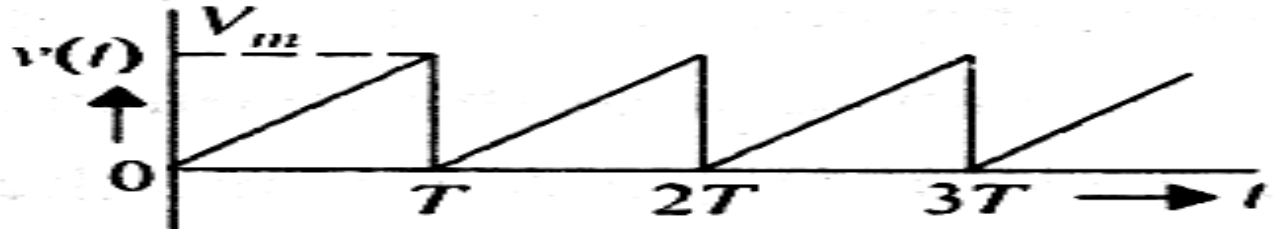

Fig.6

(b) A series R-L network is excited by an unit step voltage. Find the time at which the voltage drop across R and that across L will be equal. [(CO4)(Understand/LOCQ)]

6 + 6 = 12

Group - D

6. (a) What do you mean by driving point impedance of a network? Two four terminal networks are connected in series, show that the impedance matrix of the overall network is the sum of the impedance matrices of the individual network. [(CO4)(Remember/LOCQ)]

(b) Determine the ABCD parameters of the two port network shown in the Fig.7. [(CO2)(Analyse/IOCQ)]

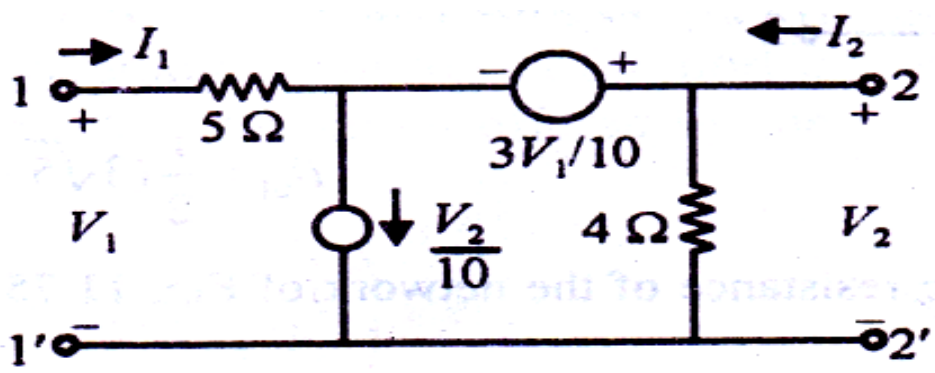

Fig.7

(2 + 4) + 6 = 12

7. (a) Find the reduced incidence and tie-set matrices for the graph given in the Fig.8. [(CO4)(Understand/LOCQ)]

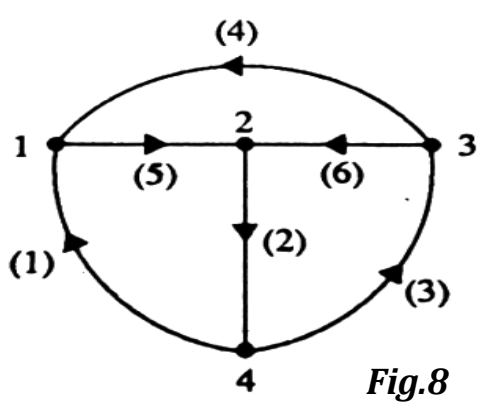

Fig.8

(b) Form the fundamental cut-set matrix for the network given in the Fig.9 and hence find the matrix form of KCL equations. [(CO4)(Apply/IOCQ)]

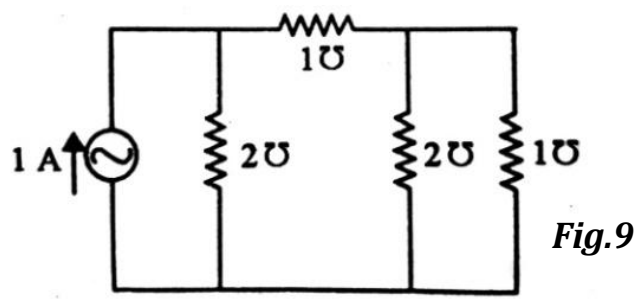

Fig.9

6 + 6 = 12

Group - E

8. (a) Design a 1st order active low pass filter with a dc gain of 4 and a corner frequency of 500 Hz. Derive the transfer function of it. [(CO6)(Create/HOCQ)]

   (b) Derive the transfer function of the circuit shown in the Fig.10 and identify the filter type. [(CO6)(Analyze/IOCQ)]

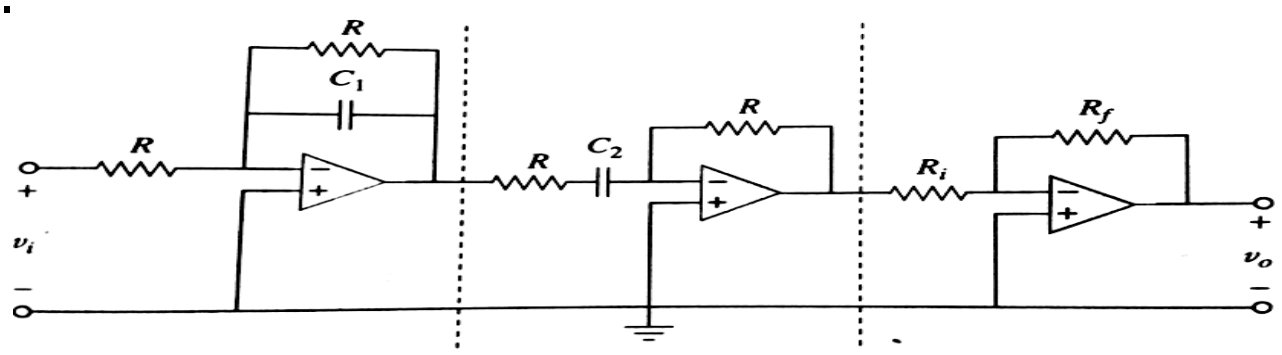

Fig.10

6 + 6 = 12

9. (a) Write down the input file using PSPICE code for the circuit of Fig.11 to obtain the node voltages. [(CO1)(Apply/IOCQ)]

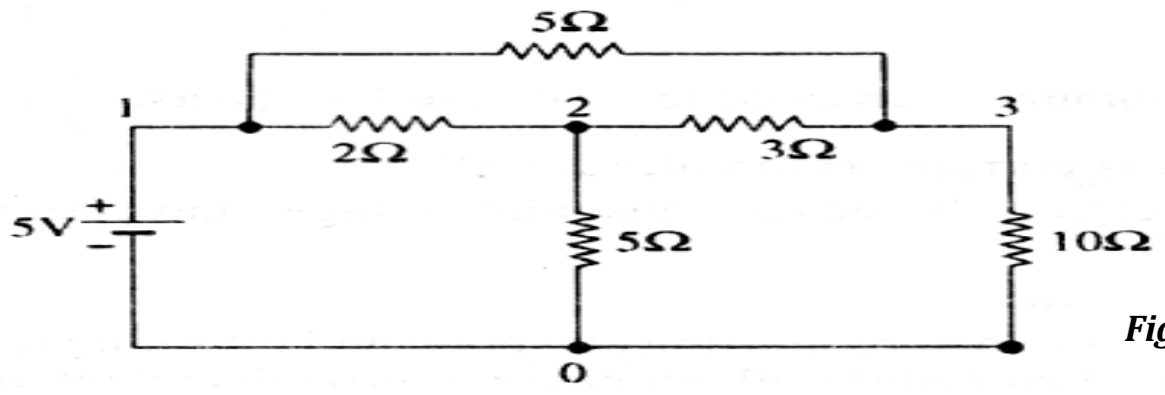

Fig.11

(b) Write a note on ac analysis using PSPICE. [(CO2) (Understand/LOCQ)]

7 + 5 = 12

Cognition Level	LOCQ	IOCQ	HOCQ
Percentage distribution	26.04	42.7	31.26

Course Outcome (CO):

After the completion of the course students will be able to

1. Apply the previous knowledge gathered from Basic Electrical Engineering for understanding the basic concepts of this subject.
2. Solve problems in various electric circuits using Network Theorems.
3. Analyze complex circuits in Laplace domain.
4. Understand the application of Graph theory to solve various network behaviour.
5. Evaluate the output of various Two port network without going through the detailed configuration.
6. Design various types of filters using SPICE software.

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