CIRCUIT THEORY AND FILTERS
(ECEN 2105)

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 open circuit voltage across the terminals of load R_L is 50V. Under the condition of the maximum power transfer the load voltage will be
(a) 50V (b) 100V
(c) 20V (d) 25V

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

(iii) If the Laplace transform of f(t) is F(s), then the Laplace transform of f(t-α) is
(a) $e^{-s\alpha}$ F(s) (b) $e^{s\alpha}$ F(s)
(c) F(s-α) (d) F(s+α)

(iv) The condition for a series RLC circuit to be under-damped when excited with a step input, is
(a) $(R^2/4L^2) > (1/LC)$ (b) $(R^2/4L^2) = (1/LC)$
(c) $(R^2/4L^2) < (1/LC)$ (d) None of these

(v) If two6mH inductors are connected in parallel without mutual inductance, then the equivalent inductance is,
(a) 3mH (b) 12mH
(c) 36mH (d) 1mH

(vi) The power consumed in a circuit element will be least when the phase difference between the current and voltage is
(a)180^0 (b) 90^0
(c) 0^0 (d) 360^0.

(vii) The rank of f-cut-set matrix of a connected graph with n number of nodes is
(a) n-1 (b) n
(c) 2n+1 (d) n+1

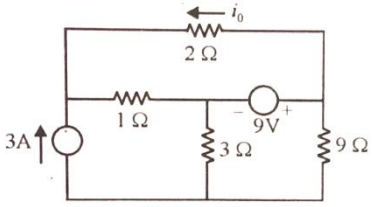
(viii) Two perfectly coupled coils each of 1 H self inductance are connected in parallel so as to aid each other. The overall inductance in henry is
(a) 2 (c) 0
(b) 1 (d) 0.5

(ix) For the same peak value which of the following wave will have the highest r.m.s. value?
(a) Square wave (b) Half wave rectified sine wave
(c) Triangular wave (d) Sine wave

(x) The condition for reciprocity of any two port network is
(a) $Z_{12} = Z_{21}$ (b) $Y_{12} = Y_{11}$
(c) AD –BC = 0 (d) $Z_{12} = Y_{12}$.

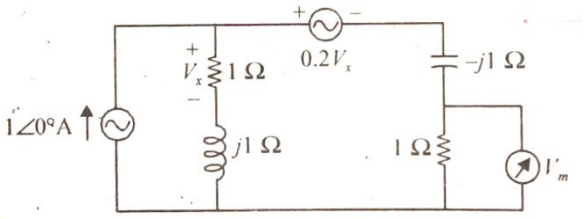
Group- B

2. (a) State the reciprocity theorem. [(CO1) (Remember/LOCQ)]
(b) Determine the current i_o in the circuit of Fig:1 using superposition theorem.



[(CO2) (Apply/IOCQ)] **Fig:1**

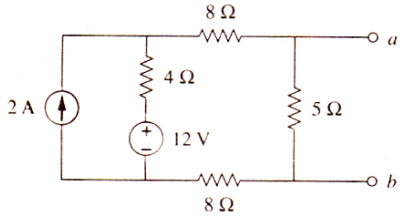
(c) In the circuit of Fig:2 find the reading of the voltmeter V_m . Interchange the position of the current source and the voltmeter, and again find the reading. Comment on your answers.



[(CO2)(Analyze/IOCQ)] **Fig:2**

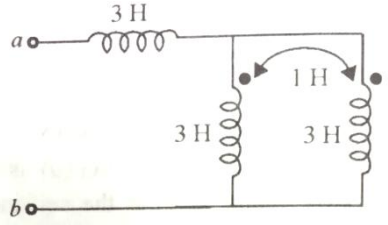
2 + 5 + 5 = 12

3. (a) State the Thevenin'stheorem. [(CO1) (Remember/LOCQ)]
(b) Find the Norton equivalent circuit across the terminals a and b of the following network of Fig:3.



[(CO2) (Apply/IOCQ)] **Fig:3**

(c) Evaluate the equivalent inductance across the terminals a and b Fig:4.



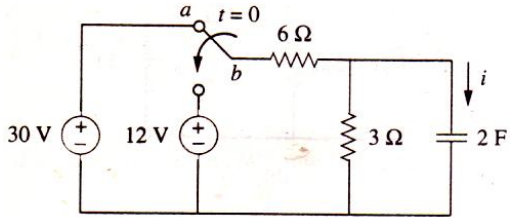
[(CO3)(Evaluate/HOCQ)] **Fig:4**

2 + 6 + 4 = 12

Group - C

4. (a) In a series RC network excited by a voltage source Vu(t), determine the time at which the voltage across the resistor and that across the capacitor are equal. Consider zero initial condition. [(CO3) (Analyze/IOCQ)]

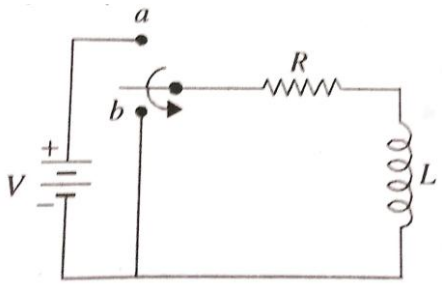
(b) The switch in Fig:5 has been in position 'a' for a long time. At t = 0, it moves to position 'b'. Calculate i for all t > 0.



[(CO3) (Evaluate/HOCQ)] **Fig:5**

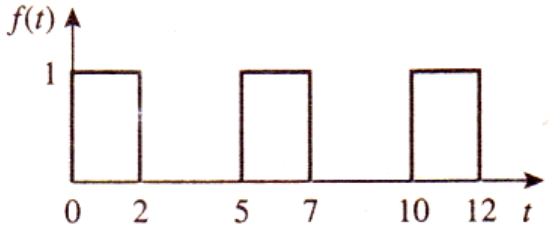
6 + 6 = 12

5. (a) The circuit of Fig:6 is in steady state with the switch in position 'a'. The switch is moved to position 'b' at t = 0. Find the current in the inductor for all t.



[(CO3) (Analyze/IOCQ)] **Fig:6**

(b) Determine the Laplace transform of the periodic function in Fig:7.



[(CO3) (Understand/LOCQ)] **Fig:7**

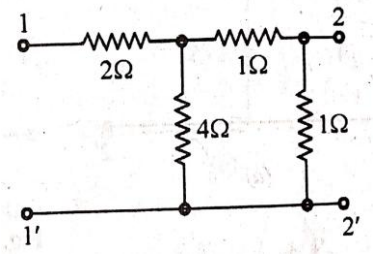
6 + 6 = 12

Group - D

6. (a) Define driving point impedance in a network. [(CO5) (Remember/LOCQ)]

(b) Prove that $A^2 - BC = 1$ for any symmetrical and reciprocal two port network. [(CO5) (Analyze/IOCQ)]

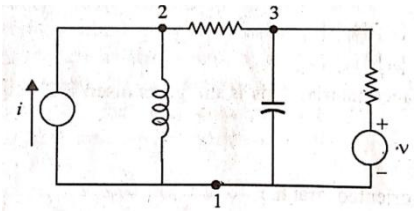
(c) Evaluate the admittance parameters of the network of Fig:8.



[(CO5)(Evaluate/HOCQ)] **Fig:8**

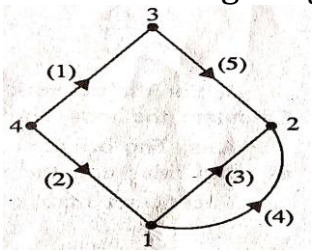
2 + 4 + 6 = 12

7. (a) How many trees are possible for the graph of the network of Fig:9 ? Draw all the trees.



[(CO4) (Understand/LOCQ)] **Fig:9**

(b) Find the tie-set and f-cut-set matrices using the given graph of Fig:10.



[(CO4) (Analyze/IOCQ)] **Fig:10**

6 + 6 = 12

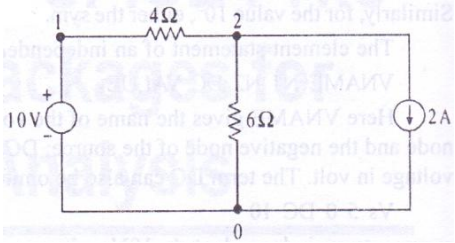
Group - E

8. (a) Draw the circuit diagram of first order low pass filter and find the transfer function of it. [(CO6) (Understand/LOCQ)]

(b) Design a second order band pass active filter that has a centre frequency of 1 KHz and a band-width of 100 Hz. Take the centre frequency gain to be 2. [(CO6)(Create/HOCQ)]

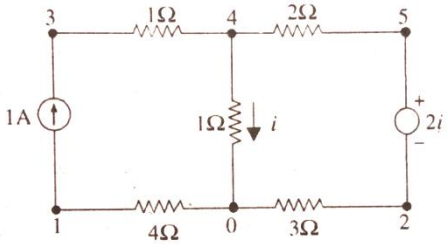
6 + 6 = 12

9. (a) Write the input file in PSPICE for the following circuit of Fig:11 to find the node voltages.



[(CO6) (Understand/LOCQ)] **Fig:11**

(b) Develop the input SPICE file for the following circuit of Fig:12to get the voltage drop across theindependent current source.



[(CO6) (Apply/IOCQ)] **Fig:12**

6 + 6 = 12

Cognition Level	LOCQ	IOCQ	HOCQ
Percentage distribution	30%	47%	23%

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

Department & Section	Classroom Link / Submission Link:
ECE	https://classroom.google.com/c/Mjc0NDM1ODA0MDA4?cjc=vpbpst5