6 + 6 = 12

9.(a) Derive the transfer function of the given circuit and identify the filter type and order. Hence plot the frequency response (Figure 12).

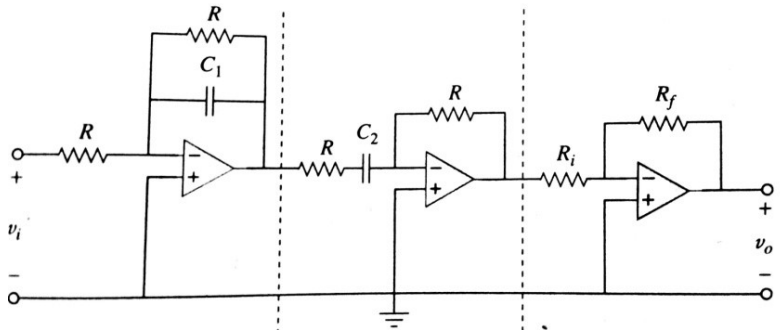

Figure 12

(b) Design a second order band pass filter with a centre frequency of 1kHz and bandwidth of 200Hz. Take the centre frequency gain to be 2.

6 + 6= 12

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) The open circuit voltage at the terminal of load R_L is 60V. Under the condition of the maximum power transfer the load voltage will be
(a) 60V (b) 15V (c) 20V (d) 30V.

(ii) Superposition theorem is not applicable to networks containing
(a) Nonlinear elements (b) dependent voltage sources
(c) transformers (d) dependent current sources.

(iii) Two two-port networks are connected in cascade. The parameters of the single equivalent network are obtained by multiplying the individual
(a) z-parameter matrices (b) h-parameter matrices
(c) y-parameter matrices (d) ABCD-parameter matrices.

(iv) 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.

(v) 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.

(vi) The reciprocity theorem is applicable for a network containing
(a) Independent sources only
(b) Dependent sources only
(c) Both dependent & independent sources
(d) Any one of dependent & independent sources.

(vii) For steady state condition capacitor should behave as
(a) Short circuit (b) Open Circuit
(c) Voltage Source (d) Current Source.

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

(ix) If the Laplace transform of f(t) is F(s), then the Laplace transform of $e^{-at}f(t)$ is
(a)$e^{-sa}F(s)$ (b) $e^{sa}F(s)$ (c) F(s+a) (d) F(s-a).

(x) The centre frequency of a bandpass filter is always equal to
(a) the bandwidth
(b) arithmetic average of the cut off frequencies
(c) 3dB frequency
(d) the product of bandwidth & quality factor

Group – B

2. (a) Find the open circuit voltage across the terminals a & b of the following circuit (Figure 1).

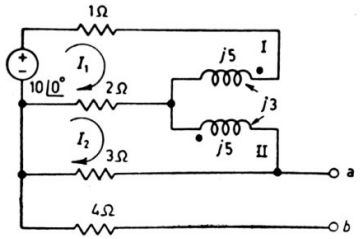

Figure 1

(b) Find the reading of the voltmeter V in the given circuit. Interchange the current source and the voltmeter and verify the Reciprocity theorem (Figure 2).

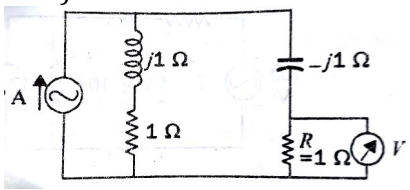

Figure 9

(3 + 3) + 6 = 12

7. (a) What do you mean by driving point impedance of a network? Two four terminal networks are connected in cascade, show that the ABCD matrix of the overall network is the product of the ABCD matrices of the individual network.

(b) Determine the z-parameters for the following network of Figure 10.

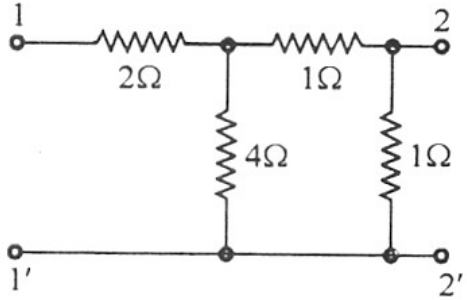

Figure 10

(2 + 4)+ 6 =12

Group – E

8. (a) Design a 1st order low pass filter having a dc gain of 10 and corner frequency of 2KHz using ideal OPAMP.

(b) Derive the transfer function of the following filter of Figure 11. Comment on the type of the filter.

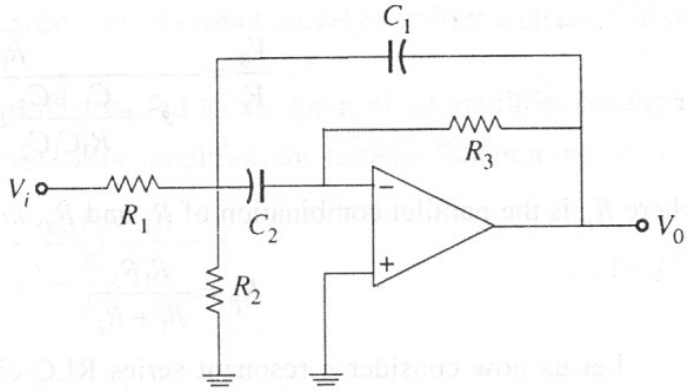

Figure 11

Figure 2

6 + 6 = 12

3. (a) Determine the value of R that will draw the maximum power from the rest of the circuit of Figure 3. Calculate the maximum power.

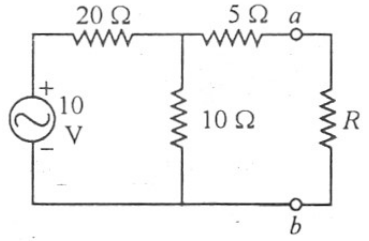

Figure 3

(b) State the superposition theorem. Using any method find i_o in the circuit of Figure 4.

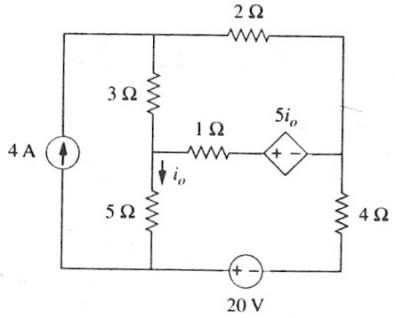

Figure 4

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

Group – C

4. (a) A step input voltage of amplitude 'V' is applied to a series RLC circuit. Determine the current i(t) in the series circuit for t≥0. Explain the over, under and critical damping cases with proper plots.

(b) The given circuit was in steady state before t=0. The switch is closed at t=0. Determine the mesh currents i_1, i_2 & i_3 immediately after the switch closure at $t=0^+$ (Figure 5).

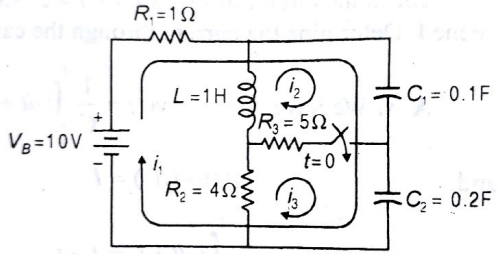

Figure 5

(4 + 3) + 5 = 12

5.(a) In the circuit of Figure 6, determine the voltage v(t) and the currents $i_R(t)$ and $i_L(t)$ for t>0. The circulating current at t = 0- in the RL loop is 1 amp clockwise.

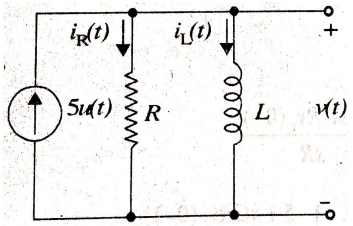

Figure 6

Calculate the Laplace transform of the periodic function as shown in Figure 7.

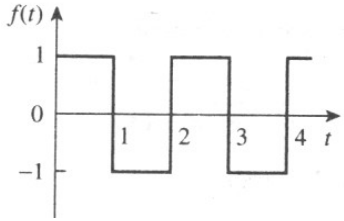

Figure 7

6 + 6=12

Group – D

6. (a) Find the tie-set and f-cut-set matrices using the given graph (Figure 8).

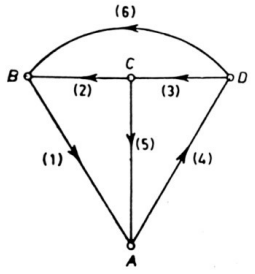

Figure 8

(b) Form the fundamental cut-set matrix for the given network and hence find the matrix form of KCL equations (Figure 9).