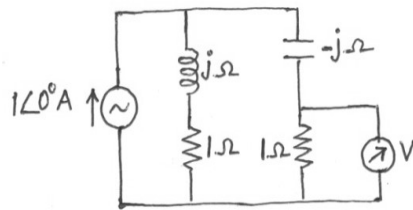


- (viii) If the Laplace Transform of  $f(t)$  is  $F(s)$ , then the Laplace Transform of  $tf(t)$  is  
 (a)  $-d/ds (F(s))$  (b)  $d/ds (F(s))$  (c)  $-s (F(s))$  (d)  $s (F(s))$ .
- (ix) If the Laplace transform of  $f(t)$  is  $F(s)$ , then the Laplace transform of  $f(t-T)$  is  
 (a)  $e^{-sT}F(s)$  (b)  $e^{sT}F(s)$  (c)  $F(s+T)$  (d)  $F(s-T)$ .
- (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.

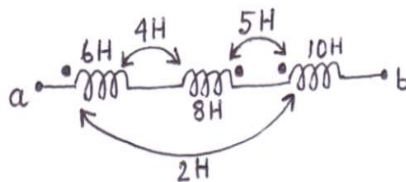
**Group - B**

- 2.(a) Determine the condition for the maximum power transfer to a load in the presence of reactance in the network (the load resistance and reactance can be independently varied.)
- (b) In the circuit of fig. 1, find the reading of the voltmeter  $V$ . Interchange the position of the current source and the voltmeter, and verify the reciprocity theorem.



**fig. 1**

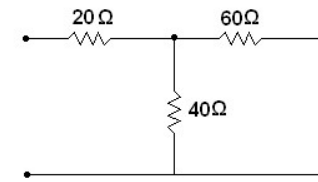
- (c) Find the equivalent inductance across the terminals a, b of the network of fig.2.



**fig. 2**

$4 + 5 + 3 = 12$

3. (a) State and explain the Thevenin's theorem. For the circuit as shown in fig.3, find the Thevenin's equivalent at the terminal a and b.

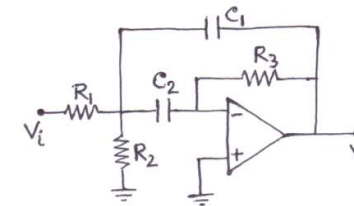


**fig. 9**

$4 + (4 + 4)$

**Group - E**

8. (a) Design a 1<sup>st</sup> order low pass filter having a dc gain of 5 and a cut off frequency of 1000Hz using ideal OPAMP.
- (b) Derive the transfer function of the filter shown in fig.10. Comment on the type of the filter.



**fig. 10**

$6 + 6$

9. (a) Write a short note on ac analysis of electric circuits using PSPICE.
- (b) Write the input file in PSPICE to determine the step response of a series RL circuit.

$6 + 6$

**B.TECH / ECE /3<sup>RD</sup> SEM/ ECEN 2105/2017**  
**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) If  $A=8, B=5, C=11, D=7$ , then it will satisfy:  
(a) symmetry condition (b) reciprocity condition  
(c) dual condition (d) none of these.
- (ii) Superposition theorem is not applicable for  
(a) current calculation (b) voltage calculation  
(c) power calculation (d) none of the above.
- (iii) For steady state current inductor should behave as  
(a) Short circuit (b) Open Circuit  
(c) Voltage Source (d) Current Source.
- (iv) Time constant of series RL circuit is  
(a) RL (b) R/L (c) L/R (d) R+L.
- (v) For a network having N nodes and B branches, the number of links will be  
(a) N (b) N - 1 (c) B - N + 1 (d) B + N -1.
- (vi) If  $V_1=30\sin(\omega t+10^\circ)$  and  $V_2=20\sin(\omega t+50^\circ)$ , which of the statement is true:  
(a)  $V_1$  leads  $V_2$  (b)  $V_2$  leads  $V_1$   
(c)  $V_2$  lags  $V_1$  (d)  $V_1$  and  $V_2$  are in phase.
- (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.

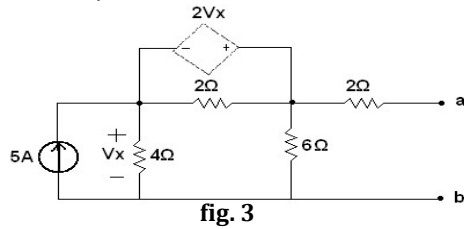


fig. 3

(b) Find the average power delivered to the 50 Ω resistor in the circuit given below.

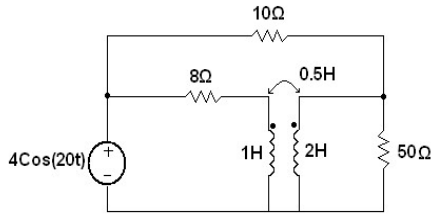


fig. 4

(2 + 5) + 5 = 12

**Group - C**

4. (a) Derive the current expression for a series R-C network excited by a voltage pulse of height V and width T considering zero initial condition. Also plot the current.

(b) In the circuit shown in fig. 5 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 R-L loop is 1 Amp clockwise.

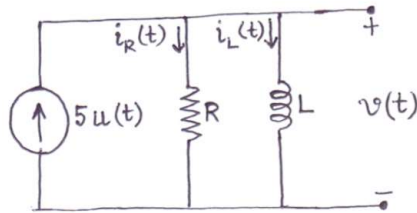


fig. 5

(5 + 1) + 6 = 12

5. (a) Derive a general expression for the transient and steady state response of a series RLC circuit for step input. Also explain different damping conditions from its transient response.

(b) For the circuit shown in fig. 6 if the initial voltage of C is  $V_c(0) = 60V$  find  $I_x$  for  $t > 0$ .

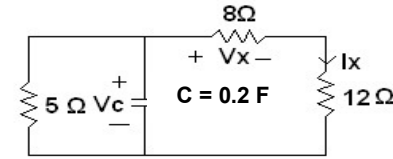


fig. 6

8 + 4

**Group - D**

6. (a) Draw the oriented graph of the network as shown in fig. 7. Determine incidence matrix and use it to find the voltage  $v_1$  and  $v_2$ .

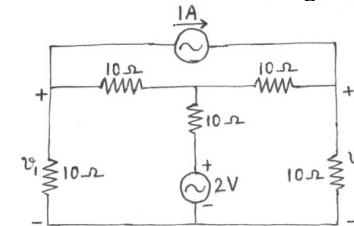


fig. 7

(b) Determine the tie-set and cut-set matrices for the directed graph as in fig. 8.

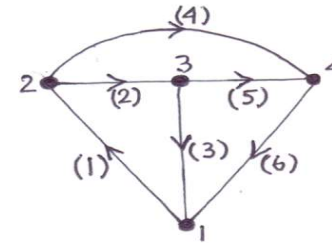


fig. 8

(1 + 2 + 4) + 1

7. (a) Explain the admittance parameters of a linear two port network with diagram. Also find out the expression of the parameters  $Y_{11}$ ,  $Y_{12}$ ,  $Y_{21}$ ,  $Y_{22}$ .

(b) Find the Z parameters and hybrid parameters for the circuit given in fig. 9.