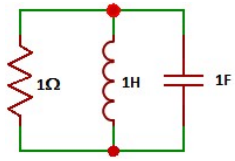
(vii) A two port network to be reciprocal,
(a) $z_{11} = z_{22}$ (b) $y_{21} = y_{12}$
(c) $h_{21} = -h_{12}$ (d) AD – BC = 0.

(viii) A network has 7 nodes and 5 fundamental loops. The number of branches in the network is
(a) 13 (b) 12 (c) 11 (d) 10.

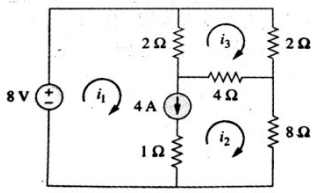
(ix) For the given parallel RLC circuit the response will be
(a) over damped (b) under damped
(c) critically damped (d) none of these.



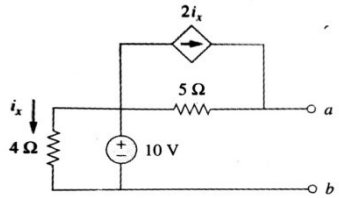
(x) The inverse Laplace transform of $(s+2)/(s+2)^2+1$ is:
(a) $e^{-t}\cos 2t$ (b) $e^{-t}\sin 2t$ (c) $e^{-t}\cos t$ (d) $e^{-2t}\sin 2t$.

Group – B

2. (a) Use mesh analysis to determine i_1, i_2, & i_3 in the given circuit.

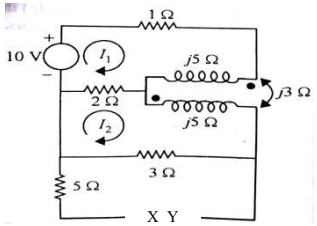


(b) Using Norton's theorem to find R_N & I_N of the circuit in the following figure.



6 + 6 = 12

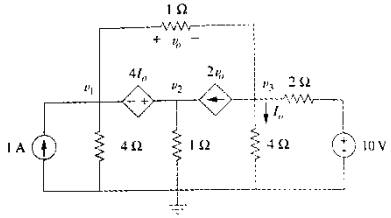
3. (a) Find the open circuit voltage across the terminals A & B of the following circuit.



(b) Design a second order band pass filter with a centre frequency of 1kHz and band-width of 100Hz. Take the centre frequency gain to be 2.

6 + 6 = 12

9. (a) Write the SPICE program to find out the node voltage V_1, V_2, V_3 for the circuit shown below.



(b) Write the input file in SPICE to determine the unit step response of a series RC circuit.

6 + 6 = 12

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) When port 1 of a two-port circuit is short-circuited, $I_1=4I_2$ and $V_2=0.25I_2$. Which of the following is true
(a) $Y_{11} = 4$ (b) $Y_{12} = 16$ (c) $Y_{21} = 16$ (d) $Y_{22} = 0.25$.

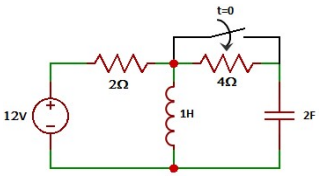
(ii) The average power delivered to an impedance $(4 – j3)\Omega$ by a current $5\cos(100\pi t + 100)$ A is
(a) 44.2W (b) 50W (c) 62.5W (d) 125W.

(iii) 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.

(iv) A two-port is described by the following equations
$V_1 = 50I_1 + 10I_2$
$V_2 = 30I_1 + 20I_2$
Which of the following is not true
(a) $Z_{12} = 10$ (b) $Y_{12} = -0.0143$
(c) $H_{12} = 0.5$ (d) A = 50.

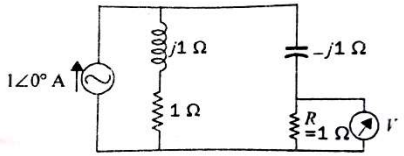
(v) A load is connected to a net work with R_{th} = 10Ω and V_{th} = 40V. The maximum power supplied to the load is
(a) 160W (b) 80W (c) 40W (d) 1W.

(vi) In the given figure the capacitor voltage at t = 0 is
(a) 0V (b) 4V
(c) 8V (d) 12V



(b) To deliver maximum power to any load, show that the load impedance needs to be the complex conjugate of the Thevenin's equivalent impedance of the network.

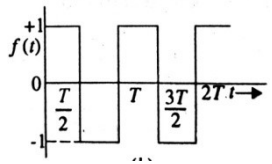
(c) Find the reading of the voltmeter V in the given circuit. Interchange the current source and the voltmeter and verify the Reciprocity theorem.



5 + 3 + 4 = 12

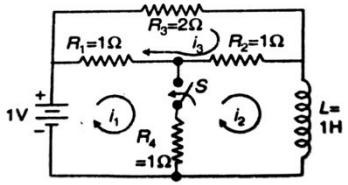
Group – C

4. (a) Find out the Laplace Transform of the given periodic waveform.



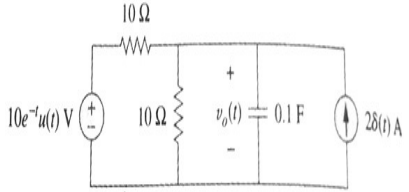
(b) A pulse excitation of height 'V' and width 'a' is applied to a series RC network. Derive the current i(t) in the series circuit for t ≥ 0. Also plot the voltages across the resistor and capacitor against time for t ≥ 0.

(c) The circuit shown below 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.

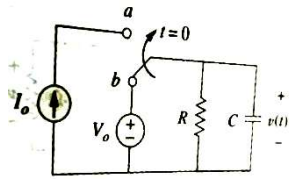


3 + (4 + 1) + 4 = 12

5. (a) Find $V_0(t)$ in the circuit given below. Assume $V_0(0) = 5V$



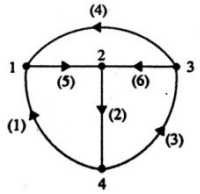
(b) The switch in the given figure has been in position b for a long time. It is moved to position a at t = 0. Determine v(t) for t>0.



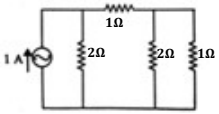
7 + 5 = 12

Group – D

6. (a) Find the reduced incidence and tie-set matrices for the graph given below.

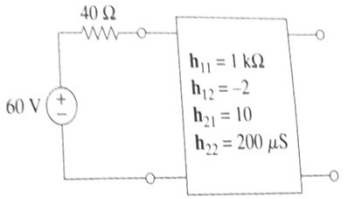


(b) Form the fundamental cut-set matrix for the given network and hence find the matrix form of KCL equations.

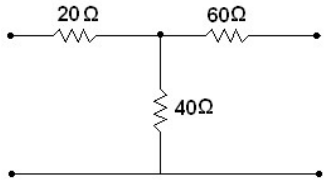


(3 + 3) + 6 = 12

7. (a) Determine the Thevenin's equivalent resistance R_{th} across the output terminals for the given two port network.



(b) Find the Z parameters and hybrid parameters for the circuit given below.



4 + (4 + 4) = 12

Group – E

8. (a) Derive the transfer function of the given circuit and identify the filter type and order.