NETWORK THEORY
(ECE2104)

Time Allotted : 2½ hrs **Full Marks : 60**

Figures out of the right margin indicate full marks.

Candidates are required to answer Group A and any 4 (four) from Group B to E, taking one from each group.

Candidates are required to give answer in their own words as far as practicable.

Group – A

1. Answer any twelve: **12 × 1 = 12**

Choose the correct alternative for the following

(i) If an impedance Z_L is connected across a voltage source V with source impedance Z_S, then for maximum power transfer the load impedance must be equal to
(a) Source impedance ZS (b) complex conjugate of ZS
(c) real part of ZS (d) imaginary part of ZS

(ii) 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) $\Delta\omega + \omega_0$

(iii) 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) $R^2/4L^2 \geq 1/LC$

(iv) Laplace transform of f(t-a) is
(a) e^{-as} F(s) (b) e^{as} F(s)
(c) F(s-a) (d) F(s+a)

(v) The transform impedance of an inductor is
(a) L (b) 1/L (c) sL (d) 1/sL

(vi) The number of twigs in a tree of a graph with *n* nodes and *b* branches is
(a) n-1 (b) n (c) b-n+1 (d) b

(vii) Two two-port networks are connected in series. The z-matrix of the single equivalent network is obtained by
(a) multiplying z-matrices of individual networks (b) adding z- matrices of individual networks
(c) subtracting z- matrices of individual networks (d) multiplying y- matrices of individual networks

(viii) Two two-port to be reciprocal (using z parameters), the condition is
(a) $z_{11}=z_{22}$ (b) $z_{12}=z_{21}$
(c) $z_{11}z_{22}=z_{12}z_{21}$ (d) $z_{11}+z_{22}=z_{12}+z_{21}$

(ix) A low pass filter having cut-off frequency f_1 followed by a high pass filter having cut-off frequency f_2 ($f_2<f_1$) results
(a) band pass filter (b) low pass filter
(c) high pass filter (d) band reject filter

(x) In a source free RC circuit, when the switch is closed the current_____.
(a) does not vary with time (b) decays with time
(c) increases with time (d) first decreases and then increases with time

Fill in the blanks with the correct word

(xi) The Laplace transform of δ(t) is _____.

(xii) For a connected graph with 'n' number of nodes and 'b' number of branches, the number of tie-sets will be always _____.

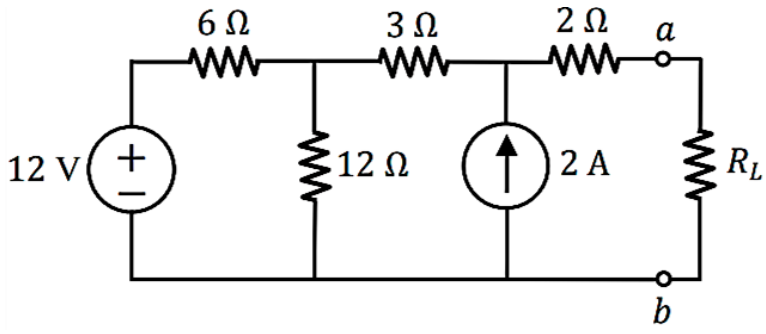
(xiii) The coefficient of coupling, k between the two coils is given by the formula _____.

(xiv) The rank of a graph from a network of five nodes is _____.

(xv) A long time after switching a circuit on with a step, the inductor behaves as a _____.

Group - B

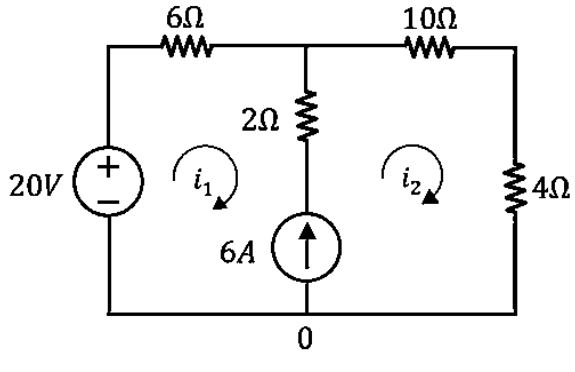
2. (a) Find the value of R_L for maximum power transfer in the circuit. Evaluate the maximum power. *[(CO2)(Analyse/IOCQ)]*



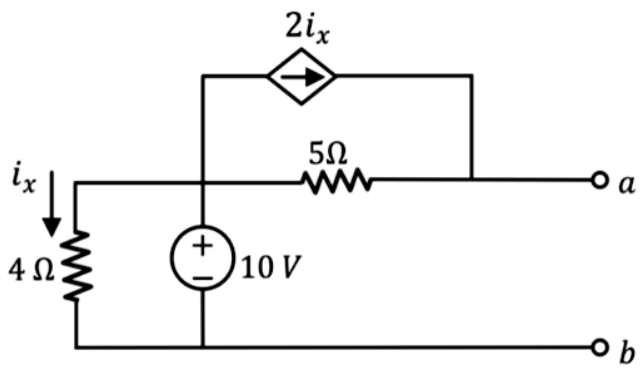
(b) Determine the condition of maximum power transfer to a load having complex impedance by a voltage source having complex impedance. Consider independent tuning of load resistance and load reactance. *[(CO2)(Apply/IOCQ)]*

8 + 4 = 12

3. (a) Find the mesh currents i_1 and i_2 for the given circuit using mesh analysis method. *[(CO1)(Apply/IOCQ)]*



(b) Find the Thevenin equivalent of the circuit shown in the figure, across the terminals a and b. *[(CO2)(Understand/LOCQ)]*

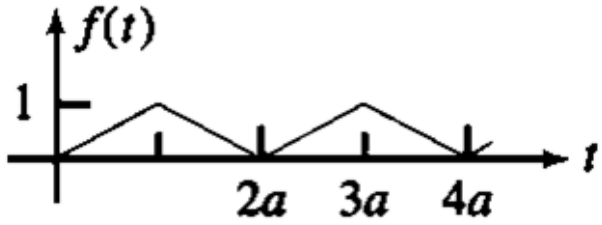


6 + 6 = 12

Group - C

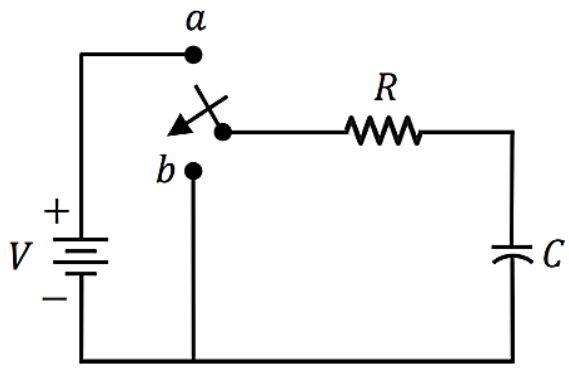
4. (a) Define impulse function. Decipher the response if the impulse function is passed through an integrator circuit. Evaluate the Laplace transform of the response. *[(CO3)(Understand/LOCQ)]*

(b) Evaluate the Laplace transform of the following waveform. *[(CO3)(Understand/LOCQ)]*

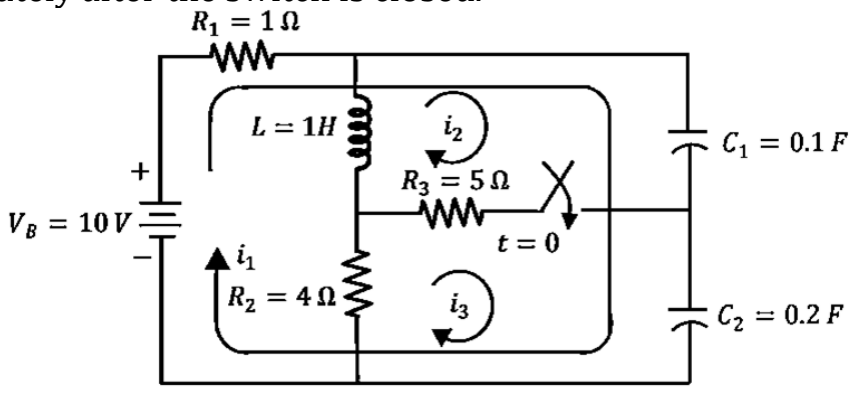


6 + 6 = 12

5. (a) The circuit is in the steady state with switch in position a. The switch is moved from a to b at t=0. Find the current in the resistor. How much energy is dissipated in R during t=0 to t=∞. *[(CO3)(Understand/LOCQ)]*



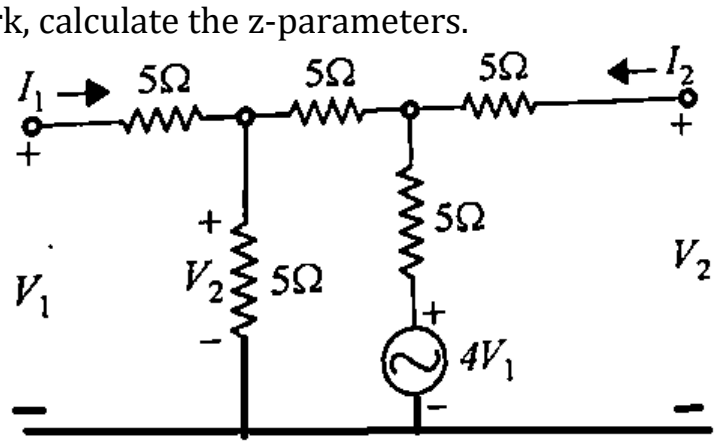
(b) The circuit is in the steady state before t=0 when the switch was open. The switch is now closed at t=0. Determine the mesh currents i_1, i_2 and i_3 immediately after the switch is closed. *[(CO3)(Analyse/IOCQ)]*



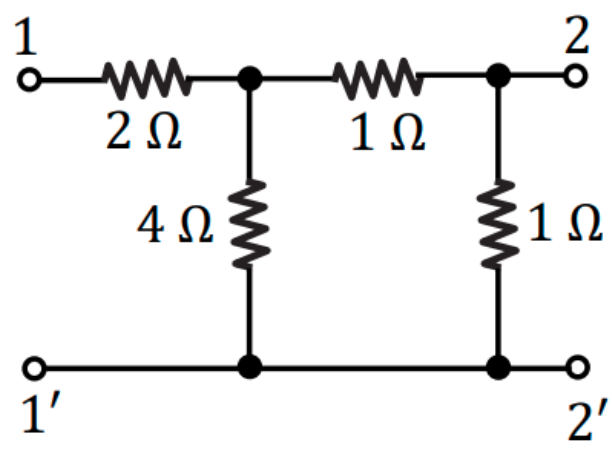
6 + 6 = 12

Group - D

6. (a) For the following 2-port network, calculate the z-parameters. *[(CO5)(Apply/IOCQ)]*

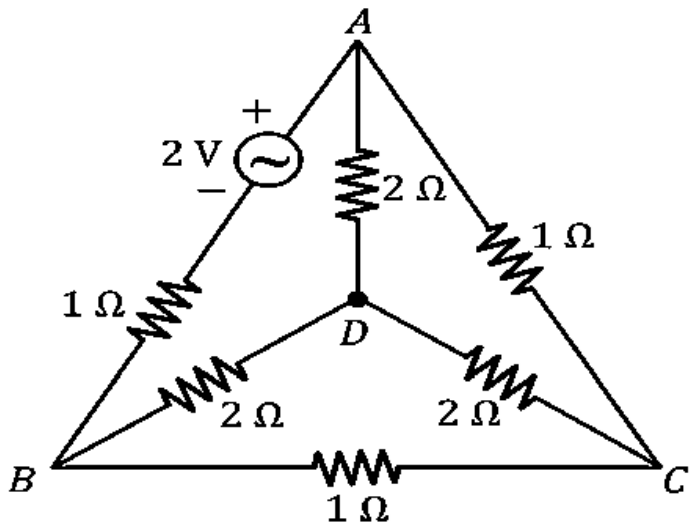


(b) Find the y and z-matrices of the resistive network of the following figure. *[(CO5)(Understand/LOCQ)]*

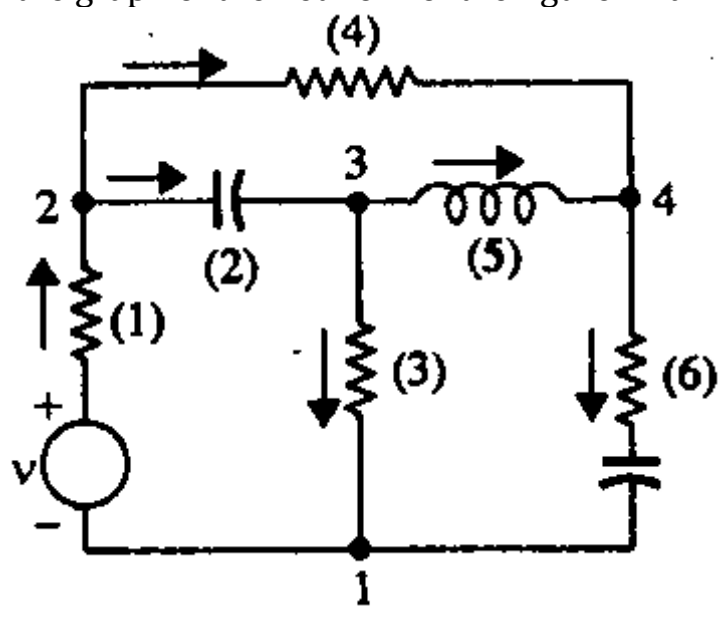


6 + 6 = 12

7. (a) In the following network, write the tie-set matrix and determine the KVL equations. Calculate the loop currents. *[(CO4)(Analyse/IOCQ)]*



(b) How many trees are possible for the graph of the network of the figure. Draw any two of them. *[(CO4)(Apply/IOCQ)]*



6 + 6 = 12

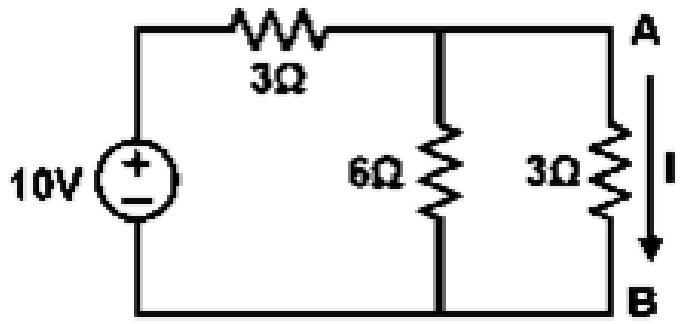
Group - E

8. (a) Design a 2nd order band pass 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)(Design/HOCQ)]*

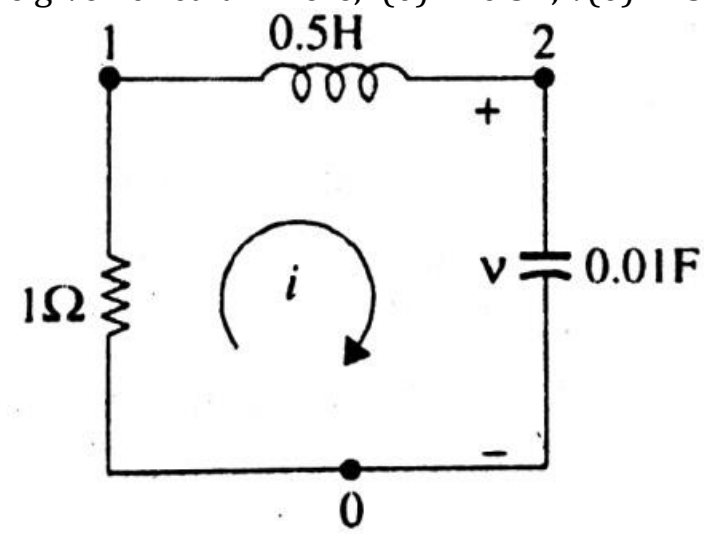
(b) Derive the transfer function of a 1st order low pass active filter. *[(CO6)(Remember/LOCQ)]*

6 + 6 = 12

9. (a) Prove the Compensation theorem by writing a SPICE code and taking a 20% change in the 3Ω resistance through which the current I is flowing. *[(CO6)(Remember/LOCQ)]*



(b) Use SPICE to find i(t) & v(t) in the given circuit. Where, i(0)= −0.5A, v(0)=2.5V. *[(CO6)(Apply/IOCQ)]*



6 + 6 = 12

Cognition Level	LOCQ	IOCQ	HOCQ
Percentage distribution	43.75	50	6.25