

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

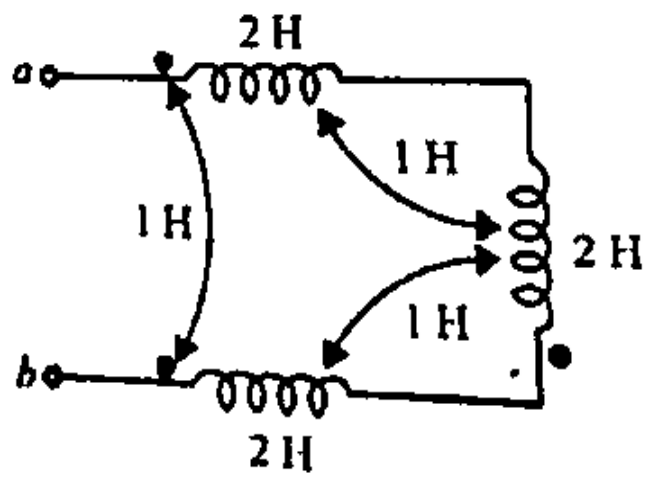
- (i) Reciprocity theorem is not applicable for any circuit having
 (a) independent source (b) dependent source
 (c) capacitor (d) inductor
- (ii) A series RLC circuit has $R=20\Omega$, $X_C=-40\Omega$ and $X_L=80\Omega$. The impedance of the circuit is
 (a) $20 + j120\Omega$ (b) $20 + j40\Omega$ (c) $20 - j120\Omega$ (d) $20 - j40\Omega$
- (iii) In superposition theorem when we consider one voltage source, all the other voltage sources are
 (a) Shorted (b) Removed (c) Undisturbed (d) Opened
- (iv) 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) $R^2/4L^2 \geq 1/LC$
- (v) The inverse Laplace transform of $(1/s+1)$ is
 (a) e^{-t} (b) e^t (c) 1 (d) $\cos t$
- (vi) 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
- (vii) The condition for Reciprocity of any two port network is
 (a) $Y_{11} = Y_{12}$ (b) $Y_{21} = Y_{12}$ (c) $Y_{11} = Y_{22}$ (d) $Y_{22} = Y_{12}$
- (viii) The rank of fundamental cut-set matrix of a connected graph with 'n' number of nodes is
 (a) $n-1$ (b) n (c) $2n+1$ (d) $n+1$
- (ix) The formula for determining the inductance of two coils connected in series is
 (a) $L=L_1+L_2+M$ (b) $L=L_1-L_2+2M$
 (c) $L=L_1+L_2+2M$ (d) $L=L_1+L_2-2M$
- (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) For a connected graph with 'n' number of nodes and 'b' number of branches, the number of tie-sets will be always _____.
- (xii) In two port network analysis, transmission line parameters are also known as _____ parameters.
- (xiii) The Kirchoff's Current Law is based on the conservation of _____.
- (xiv) An ideal current source has _____ input impedance.
- (xv) A long time after switching a circuit on with a step input, the capacitor behaves as a _____.

Group - B

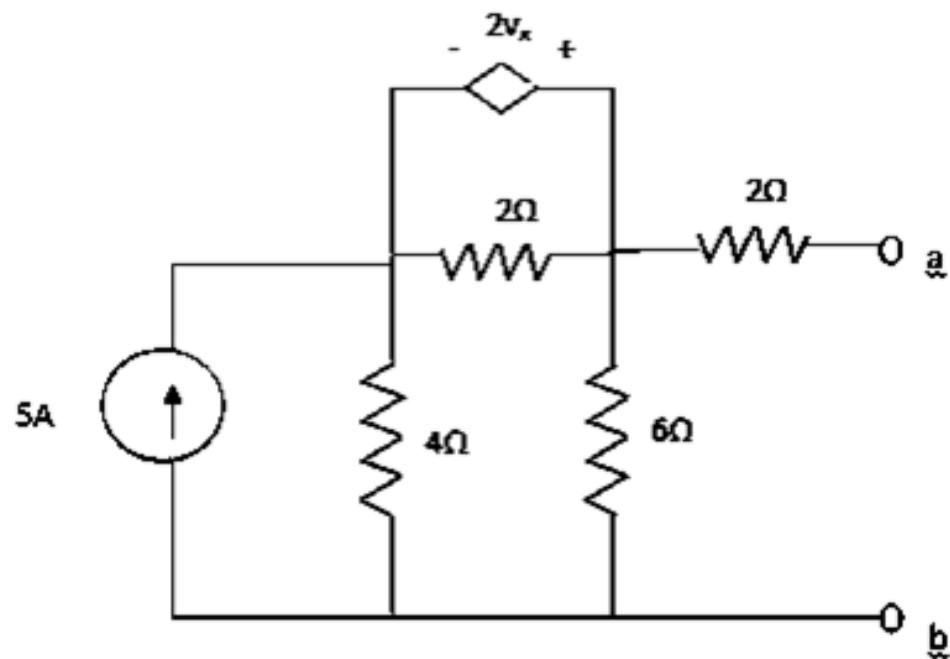
2. (a) Explain the dot convention used in coupled coils. Find the equivalent inductance across the terminals a, b. [[CO1](Analyse/IOCQ)]



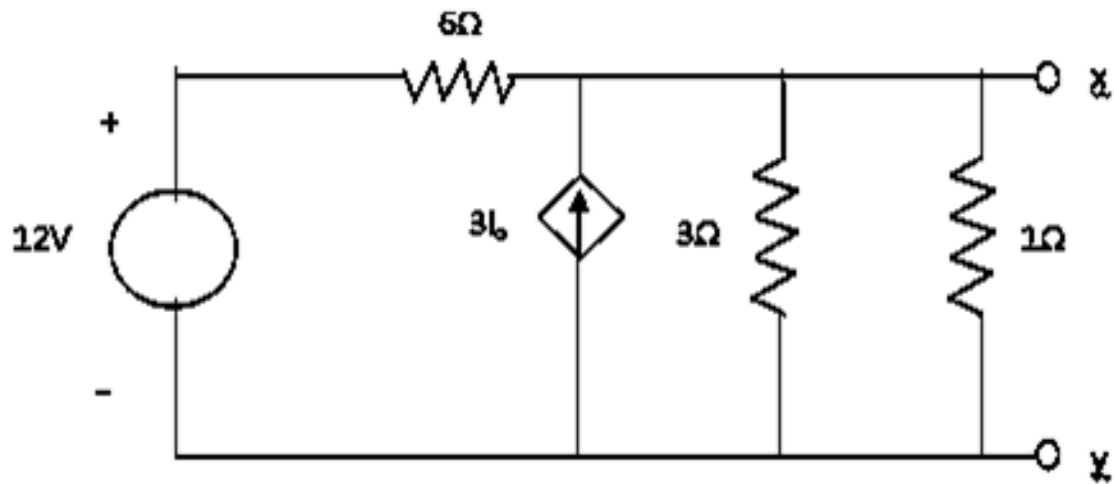
- (b) Calculate the mutual inductances of two coils of self-inductances $100\mu\text{H}$ and $240\mu\text{H}$, which are connected in series to yield a total inductance of $146\mu\text{H}$. [[CO1](Remember/LOCQ)]
- (c) Two perfectly coupled coils each of 1H self-inductance are connected in parallel to each other so as to aid each other. Calculate the effective inductance. [[CO1](Remember/LOCQ)]

$$4 + 4 + 4 = 12$$

3. (a) Evaluate the Thevenin equivalent voltage, V_{th} and resistance, R_{th} of the following circuit. V_x is the voltage across 4 ohm resistor. [[CO2](Analyse/IOCQ)]



- (b) Find the current through load resistance R_L using Norton theorem. i_o is the current through the 6 ohm resistance.

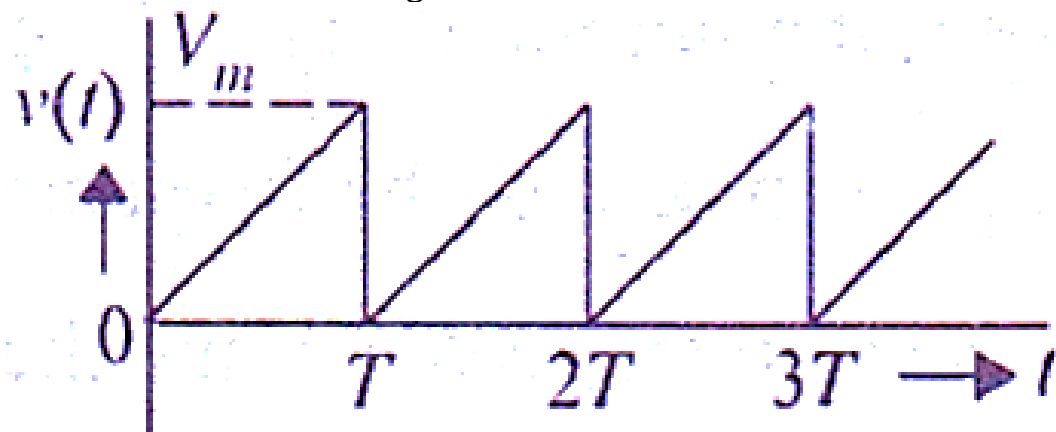


[[CO2](Apply/IOCQ)]

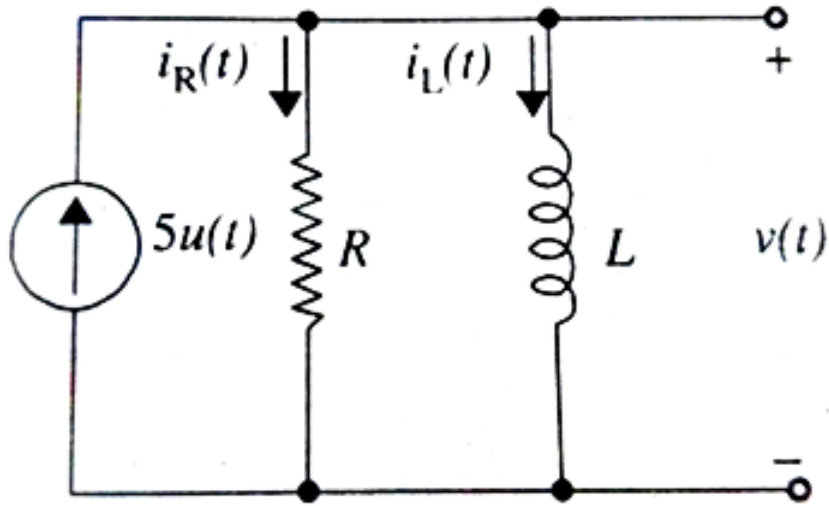
$$6 + 6 = 12$$

Group - C

4. (a) Evaluate the Laplace transform of the following function. [[CO3](Apply/IOCQ)]



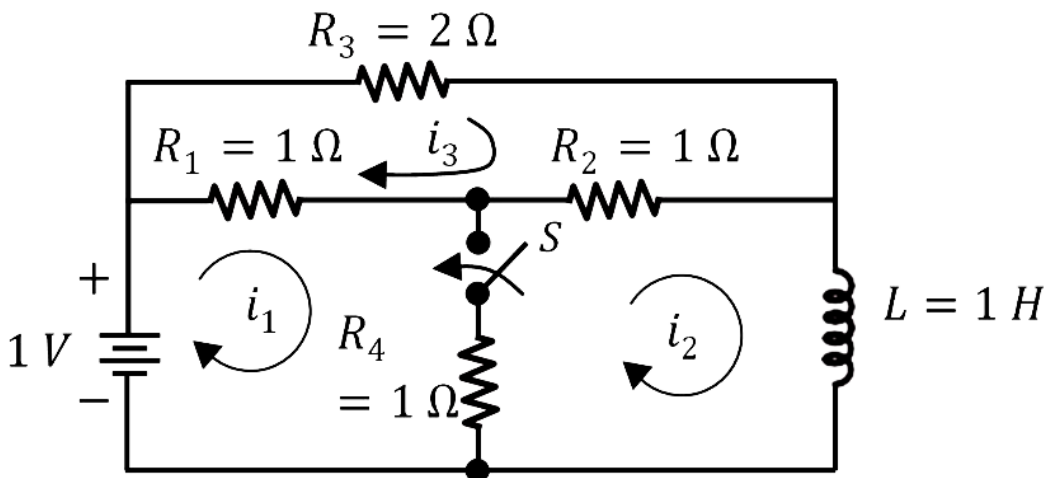
- (b) In the following circuit, determine the voltage $v(t)$ and the currents $i_R(t)$ and $i_L(t)$ for $t > 0$. There is no circulating current at $t = 0$.



[[CO3](Apply/IOCQ)]
6 + 6 = 12

5. (a) The circuit shown in the circuit is initially in the steady state with the switch S open. At $t \geq 0$, the switch S is closed. Obtain the current in the inductor for $t > 0$.

[[CO3](Analyse/IOCQ)]



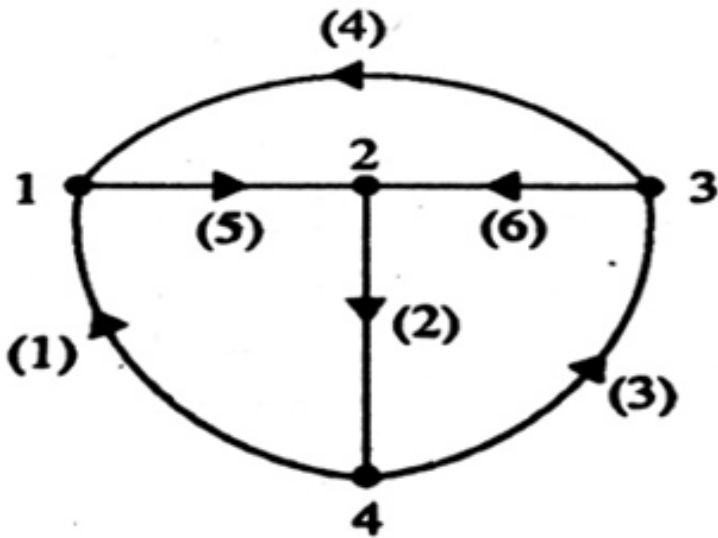
- (b) Considering zero initial condition derive the expression of current in a series R-C circuit excited by a step input. Plot the voltage across the resistor and capacitor.

[[CO3](Remember/LOCQ)]
6 + 6 = 12

Group - D

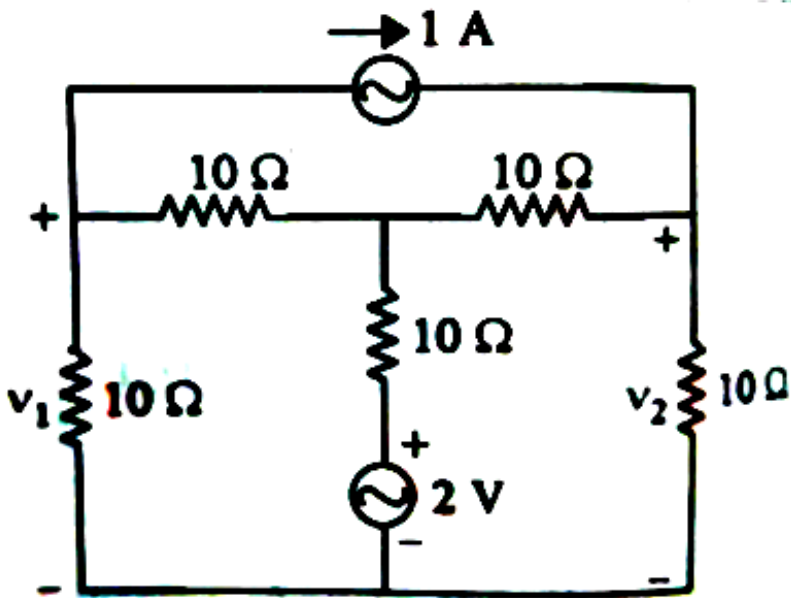
6. (a) Determine the Incident matrix and Tie-set matrix of the given oriented graph.

[[CO4](Analyse/IOCQ)]



- (b) Draw the oriented graph of the network given below. Determine the Incident matrix and use it to find the voltages v_1 and v_2 .

[[CO4](Understand/LOCQ)]



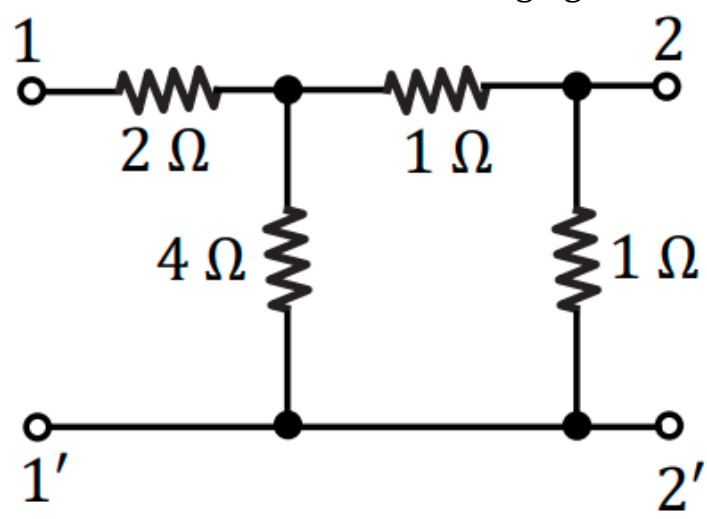
6 + 6 = 12

7.

(a)

Two four terminal networks are connected in parallel, show that the resultant admittance matrix of the overall network is the sum of the individual admittance matrices.
- [[C05](Remember/LOCQ)]
- (b)

Find the y and z-matrices of the resistive network of the following figure.
- [[C05](Understand/LOCQ)]



6 + 6 = 12

Group - E

8.

(a)

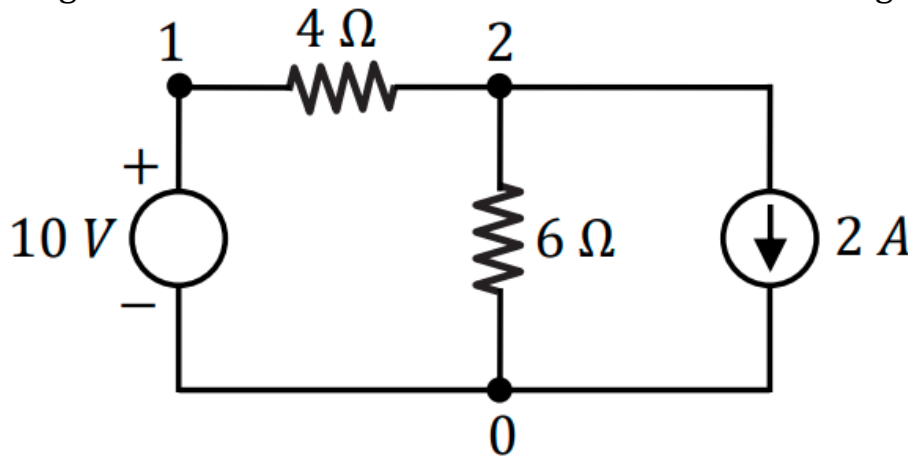
Design a 2nd order band pass filter that has a centre frequency of 1 KHz and a band-width of 100 Hz. Take the centre frequency gain to be 2.
- [[C06](Design/HOCQ)]
- (b)

Derive the transfer function of a 1st order low pass active filter.
- [[C06](Remember/LOCQ)]
- 6 + 6 = 12

9.

(a)

Write down the input file using SPICE code for the circuit to obtain the node voltages.
- [[C06](Analyse/IOCQ)]



- (b)

Write a code in SPICE to get the transient response (current) of a series R-C circuit excited by a dc voltage of 12V. Take R=100Ω and C=2μF.

[[C06](Apply/IOCQ)]

6 + 6 = 12

Cognition Level	LOCQ	IOCQ	HOCQ
Percentage distribution	39.58	54.17	6.25