2022

1st Semester Examination

ELECTRONICS

Paper : ELC 103

(Network Analysis and Synthesis)

Full Marks : 40 Time : Two Hours

The figures in the margin indicate full marks.
Candidates are required to give their answers in their own words as far as practicable.

Answer any ***four*** questions each from Group-A and Group-B; and ***two*** questions from Group-C.

Group - A

Answer any ***four*** questions : 2×4=8

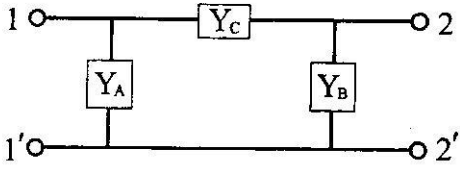
1. State the superposition theorem. 2

2. Define the terms loop, tree, link and twig. ½×4

3. A, π network has the arm impedances $2k\Omega, 3k\Omega$ and $5k\Omega$ respectively. Calculate the arm impedance of the respective T network. 2

P.T.O.

4. Find out the y matrix of the following network. 2



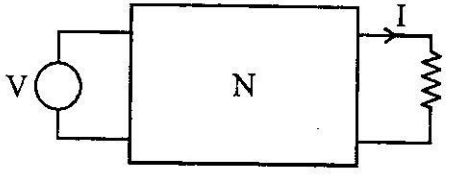
5. Let us consider the identify $P(S) = (S + 1)(S + 2)(S + 3)(S + 4)$, where $P(s)$ is the denominator polynomial of a network function, comment on the stability of the network considering R-H criteria. 2

6. Find out the Laplace transform of $u(t - a)$. 2

Group - B

Answer any ***four*** questions : 4×4=16

7. The network N, contains linear, passive and bilateral elements. When $R_L = 1.5\Omega$. I = 2A and when $R_L = 4\Omega$, I = $1A$, Determine R_L, so that maximum power is dissipated in it. What is the maximum power?



3+1

8. The reduced incidence matrix of an oriented graph is

$$[A] = \begin{bmatrix} 0 & -1 & 1 & 1 & 0 \\ 0 & 0 & -1 & -1 & -1 \\ -1 & 0 & 0 & 0 & 1 \end{bmatrix}$$

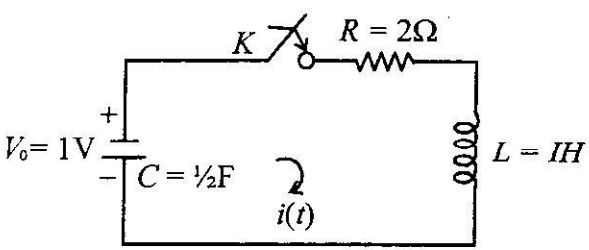
Draw the network graph. 4

9. Prove that for a reciprocal network AD – BC = 1, where A, B, C and D are the transmission parameters of the network. 4

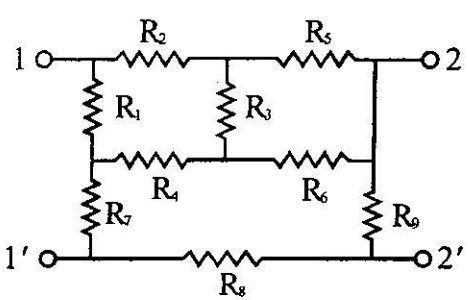
10. Find the first Foster network of the driving point impedance function 4

$$z = j0.1\,w\frac{\left(w^2-4\times10^6\right)\left(w^2-36\times10^6\right)}{w^2\left(w^2-16\times10^6\right)}$$

11. For the following R-L-C circuit, the capacitor initially charged to a voltage v_0. Find expression for the current through resistance R, $i(t)$. 4



12. Reduce the following circuit to an equivalent T network.



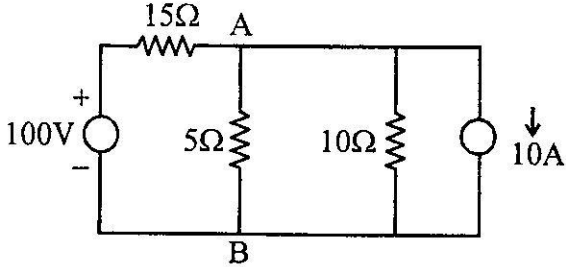
4

P.T.O.

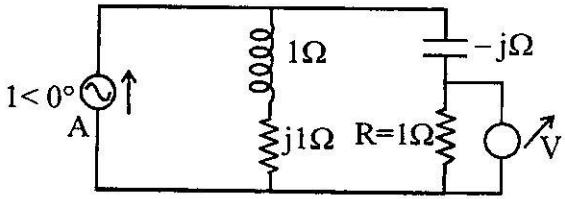
Group - C

Answer any *two* questions. 8×2=16

13. (a) Using Thevenin's theorem determine the current in the branch AB of the following circuit.



(b) In the given circuit, find the reading of the voltmeter *V*. Interchange, the current source and the voltmeter and verify the reciprocity theorem.



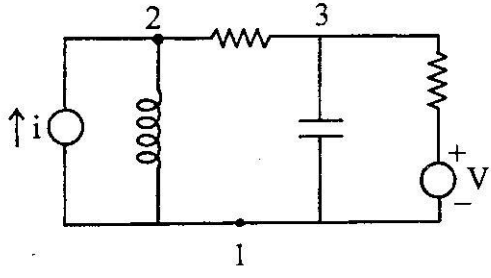
4+4

14. (a) Prove that $\begin{bmatrix} A & B \\ C & D \end{bmatrix} = \begin{bmatrix} A_a & B_a \\ C_a & D_a \end{bmatrix} \begin{bmatrix} A_b & B_b \\ C_b & D_b \end{bmatrix}$

$[A_a, B_a, C_a, D_a]$, $[A_b, B_b, C_b, D_b]$, $[A, B, C, D]$ are the transmission parameters of network N_a, N_b and N respectively and the networks N_a and N_b are in cascade to form network N.

(b) Prove that if N_a and N_b are connected in parallel, the y parameters of the combined network N will be the sum of the respective y parameters of network N_a and N_b. 4+4

15. (a) How many trees are possible for the graph of the network given below :



(b) For a linear, bilateral passive two port network prove that $\Delta z \Delta y = 1$ where Δy and Δz represent the determinant of y and z matrix of the network respectively. 3+5

16. (a) State the Foster reactance theorem.

(b) A reactance function has zero at $\omega_1 = 10^5$ rad/s and infinity. It has poles at $\omega = 0$, and $\omega_2 = 1.1 \times 10^5$ rad/s. The slope of the reactance curve is required to be 0.1Ω rad^{-1}s at $\omega = 10^5$ rad/s. Find a reactance network satisfying this requirement. 2+6
