**PG/IS/ELC-102/19**

# M.Sc. 1st Semester Examination, 2019

## ELECTRONICS

( *Network Analysis and Synthesis* )

PAPER – ELC-102

*Full Marks* : 50

*Time* : 2 hours

*The figures in the right-hand margin indicate marks*

*Candidates are required to give their answers in their own words as far as practicable*

*Illustrate the answers wherever necessary*

1. Answer any *four* questions : $2 \times 4$

   (*a*) State and explain the superposition theorem. 2

   (*b*) What do you mean by critical frequencies of a driving point admittance function ? 2

   (*c*) Write down the drawbacks of constant-*k* type filters. 2

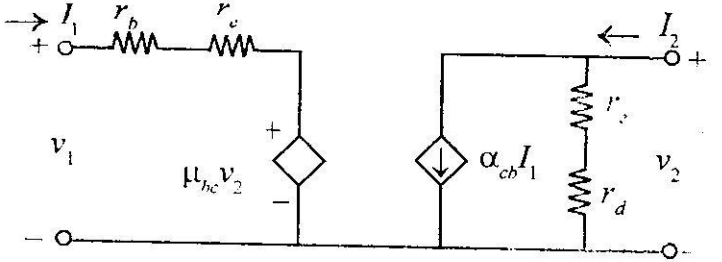
   (*d*) Explain the significance of the Pole-Zero plot of a network function. 2

(*e*) Express the function

$$F(s) = \frac{(s+2)}{(s+1)^2}$$

in a partial fraction expansion. 2

(*f*) Find out the *h*-parameters of the following circuit. 2



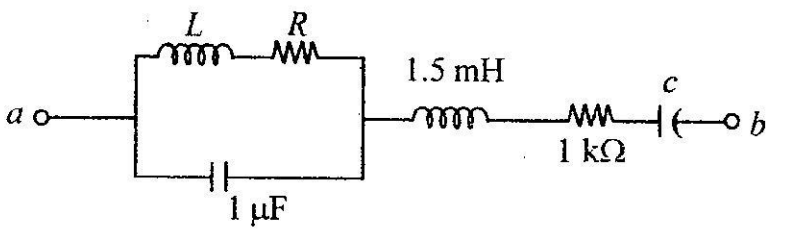

(*g*) Comment of the following function $Z(s)$ could be an impedance function or not ? 2

$$Z(s) = \frac{15(s^3 + 2s^2 + 3s + 2)}{s^4 + 6s^3 + 8s^2}$$

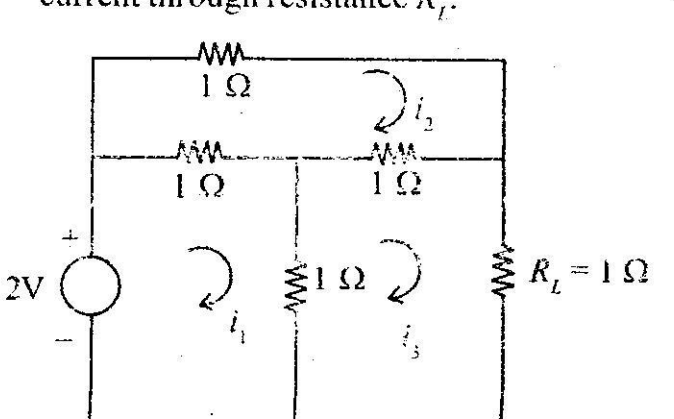
(*h*) If the reduced incidence matrix of a network $[A] = \begin{bmatrix} 1 & 0 & -1 & 1 \\ -1 & 1 & 0 & 0 \end{bmatrix}$. How many trees are possible ? 2

2. Answer any *four* questions : 4 × 4

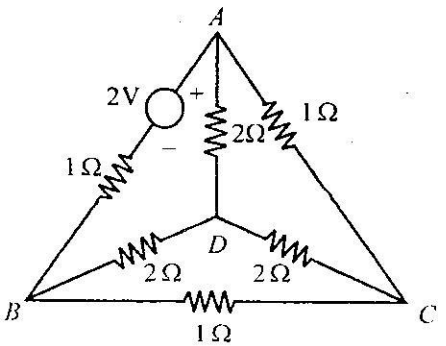
(*a*) The following network is to have a pure resistance of 11kΩ across the terminal *a* and *b* at a frequency of 10 kHz. Determine the values of *R*, *L*, and *C*. 4




(*b*) Apply the mesh methods to find out the current through resistance $R_L$. 4

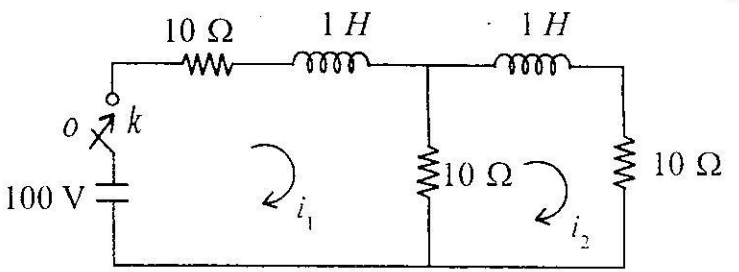


(*c*) For the following network, write down the tie-set matrix and determine the KVL equations. Also calculate the loop currents. 4




(*d*) Prove that for a reciprocal network $AD - BC = 1$. 4

(*e*) Using Laplace transform determine $i_2(t)$ in the following circuit when switch $k$ is closed at $t = 0$. 4





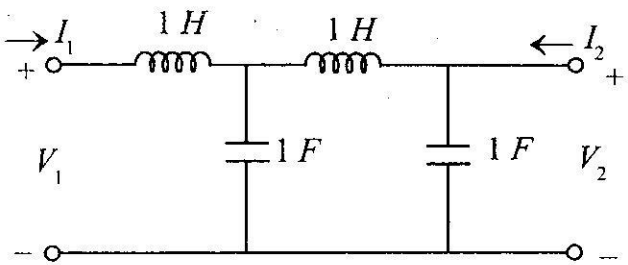

( Continued )

(*f*) Calculate the values of the shunt and the series elements of a high pass π-section filter having a cut-off frequency of 10 kHz. The nominal resistance of the filter is 500 Ω. 4

(*g*) For the given denominator polynomial of a network function, verify the stability of the network using R-H criteria

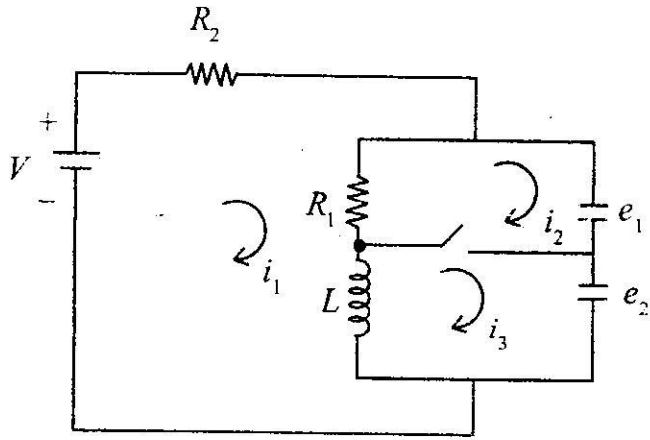
$$Q(s) = s^4 + s^3 + 2s^2 + 2s + 12$$ 4

(*h*) Find out the input impedence of the following network. 4




**3.** Answer any *two* questions : 8 × 2

(*a*) (*i*) Determine $i_1(0+)$, $i_2(0+)$ and $i_3(0+)$ of the following circuit.




(*ii*) Let us consider two Network $N_a$ and $N_b$ are in parallel connection. The $y$-parameters of network $N_a$ and $N_b$ are

$$\begin{bmatrix} y_{11a} & y_{12a} \\ y_{21a} & y_{22a} \end{bmatrix} \quad \text{and} \quad \begin{bmatrix} y_{11b} & y_{12b} \\ y_{21b} & y_{22b} \end{bmatrix}$$

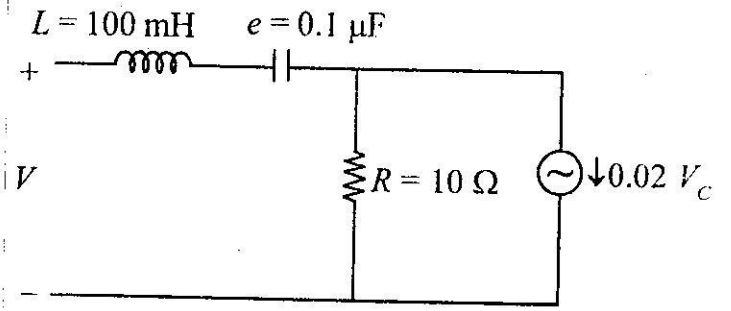
respectively.

Prove that the $y$-parameters of the combined network

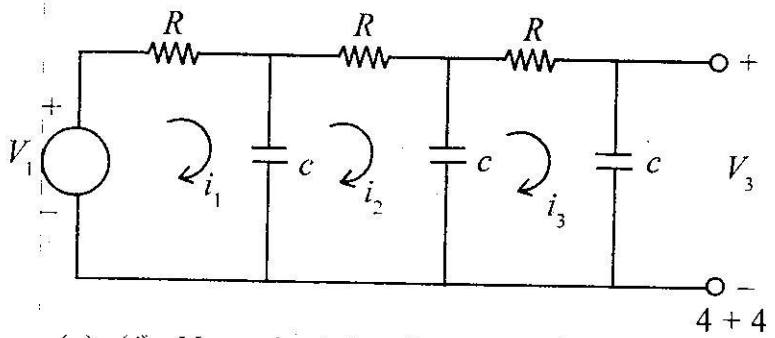
$$\begin{bmatrix} y_{11} & y_{12} \\ y_{21} & y_{22} \end{bmatrix} = \begin{bmatrix} y_{11a} + y_{11b} & y_{12a} + y_{12b} \\ y_{21a} + y_{21b} & y_{22a} + y_{22b} \end{bmatrix}$$

4 + 4

(*b*) (*i*) Determine the resonant frequency, $Q$-factor at resonance and bandwidth of the following circuit.

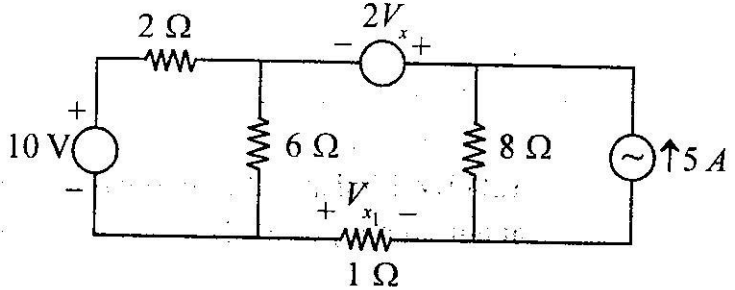



(*ii*) Find the ratio of the voltage $v_3$ to the voltage $v_1$, when phase difference between $v_1$ and $v_3$ is $180^\circ$

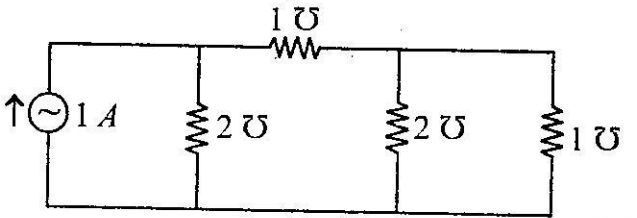



4 + 4

(*c*) (*i*) Use principle of superposition to find the current $I$ in the following circuit.

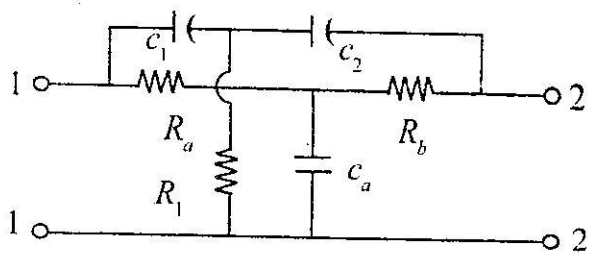



(*ii*) For the following network determine fundamental cut-set matrix and hence find the KCL equation.




4 + 4

(*d*) (*i*) Determine $y_{11}$ of the following Twin-$T$ network.






(*Continued*)

(*ii*) Design a constant-*K* low pass T-section filter with nominal resistance of 50 Ω to produce cut-off at a frequency of 1.2 kHz. Find also the attenuation in dB at a frequency of 2kHz. 4 + 4

[ *Internal Assessment* : 10 Marks]

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