

## B.Tech. 5th Semester Exam., 2013

## NETWORK THEORY

Time : 3 hours

Full Marks : 70

## Instructions :

- (i) All questions carry equal marks.
- (ii) There are NINE questions in this paper.
- (iii) Attempt FIVE questions in all.
- (iv) Question No. 1 is compulsory.

## 1. Choose the correct option (any seven) :

- (a) When switch S in the circuit shown in Fig. 1 is open, steady state is reached. When switch S is closed at  $t = 0$ ,  $i(t)$  for  $t > 0$  is

- (i)  $6 - 4e^{-t}$
- (ii)  $2 - 3e^{-t}$
- (iii)  $3 - e^{-3t}$
- (iv) None of the above

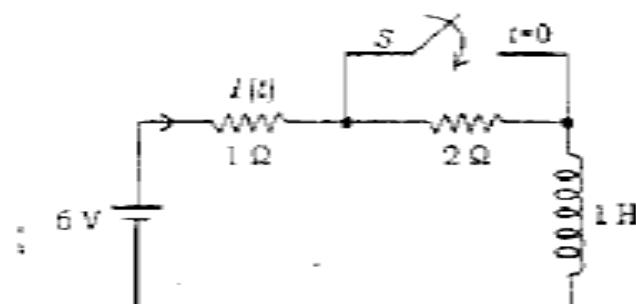


Fig. 1

- (b) The circuit shown in Fig. 2 is in steady state with switch S open. The switch is closed at  $t = 0$ . The value of  $v_c(0^+)$  and  $v_c(\infty)$  will be respectively

(i) 2 V, 0 V

(ii) 0 V, 2 V

(iii) 2 V, 2 V

(iv) 0 V, 0 V

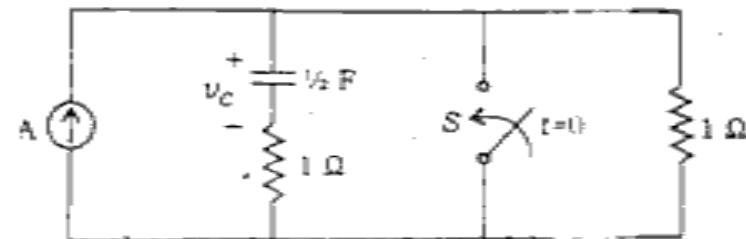


Fig. 2

- (c) The condition for symmetry in ABCD parameter is

(i)  $AD = BC$

(ii)  $\frac{A}{D} = \frac{C}{B}$

(iii)  $AD - BC = 1$

(iv)  $A = D$

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- (d) A two-port network is described by the relations

$$\begin{aligned}V_1 &= 2V_2 + 0.5I_2 \\I_1 &= 2V_2 + I_2\end{aligned}$$

What is the value of  $h_{22}$  parameter of the network?

- (i) 1 mho
- (ii)  $2 \Omega$
- (iii) -2 mho
- (iv)  $4 \Omega$

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- (e) If a transmission line is terminated by its characteristic impedance, the reflection coefficient is

- (i) zero
- (ii) plus one
- (iii) minus one
- (iv) infinity

- (f) The network function

$$F(s) = \frac{(s+2)}{(s+1)(s+3)}$$

represents

- (i) an RC impedance
- (ii) an RL impedance
- (iii) an RC impedance and an RL admittance
- (iv) an RC admittance and an RL impedance

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- (g) The driving point impedance  $Z(s)$  of a network has the pole/zero locations as shown in Fig. 3. If  $Z(0) = 3$ , then  $Z(s)$  is

(i)  $\frac{3(s+3)}{s^2 + 2s + 3}$

$$\frac{2 \pm \sqrt{4-4}}{2} = \frac{2}{2}$$

(ii)  $\frac{2(s+3)}{s^2 + 2s + 2}$

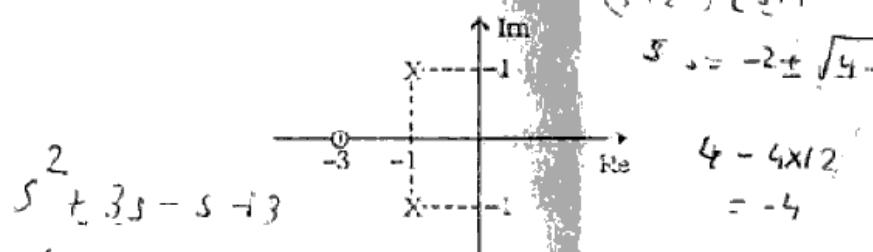
$$\frac{2 \pm \sqrt{4-4}}{2} = \frac{2}{2}$$

(iii)  $\frac{3(s+3)}{s^2 + 3s + 2}$

$$\frac{2 \pm \sqrt{4-4}}{2} = \frac{2}{2}$$

(iv)  $\frac{2(s-3)}{s^2 - 2s - 3}$

$$\frac{2 \pm \sqrt{4-4}}{2} = \frac{2}{2}$$



$$Z(s) = \frac{(s+3)}{(s+1)(s+3)} \cdot \frac{1}{(s-2)} = \frac{1}{(s+1)(s-2)}$$

Fig. 3

- (h) The number of links for a graph having  $n$  nodes and  $b$  branches is

$$b = n-1$$

(i)  $b-n+1$

$$n-1 + b$$

(ii)  $n-b+1$

$$b-(n-1)$$

(iii)  $b+n-1$

(iv)  $b+n$

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(Continued)

- (i) For the reduced incidence matrix  $A$ , which is the set of branches forming a tree?

**Given**

$$A = \begin{bmatrix} 1 & 2 & 3 & 4 & 5 & 6 \\ 1 & -1 & -1 & -1 & 0 & 0 \\ 0 & 1 & 0 & 0 & -1 & 1 \\ 0 & 0 & 1 & 0 & 1 & 0 \end{bmatrix}$$

~~(i)~~ 1, 2, 3

(ii) 2, 4, 6

(iii) 2, 3, 5

(iv) 1, 4, 6

- (i) For the network shown in Fig. 4,  $Z(0) = 3 \Omega$  and  $Z(\infty) = 2 \Omega$ . The value of  $R_1$  and  $R_2$  will be, respectively

(i)  $2\ \Omega$ ,  $1\ \Omega$

(ii)  $1\ \Omega, 2\ \Omega$

(iii)  $3\ \Omega$ ,  $2\ \Omega$

(iv)  $2\Omega$ ,  $3\Omega$

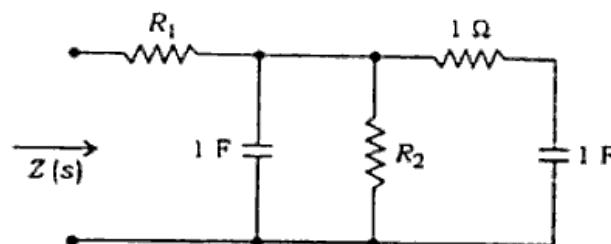


Fig. 4

2. Find  $v_c(t)$  for the circuit shown in Fig. 5, if the switch is moved from position *a* to position *b* at  $t = 0$ .

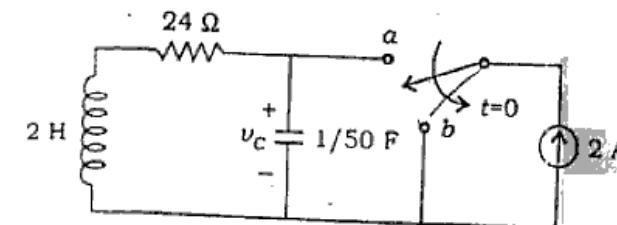


Fig. 5

3. (a) Define (i) network function, (ii) poles and (iii) zeros.

- (b) Determine voltage transfer function,  $G_{12}(s) = \frac{V_2(s)}{V_1(s)}$  for the circuit shown in Fig. 6.

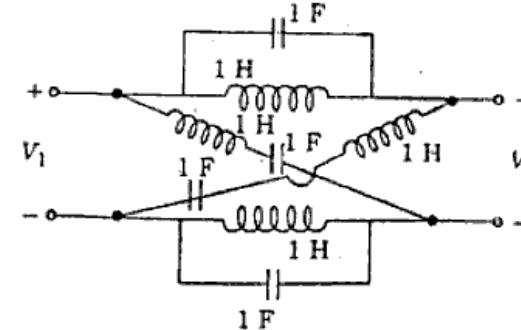


Fig. 6

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4. (a) Find  $h$ -parameters for the circuit shown in Fig. 7.

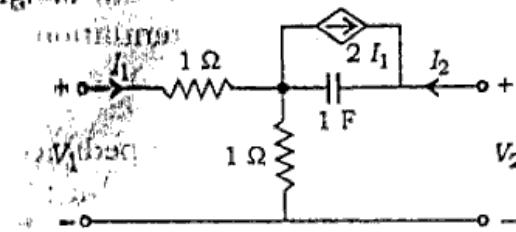


Fig. 7

- (b) Find  $V_1$  and  $V_2$  in the network shown in Fig. 8, if  $y$ -parameters are

$$y_{11} = \frac{3}{2} \text{ U}, y_{22} = \frac{5}{6} \text{ U}, y_{12} = y_{21} = -\frac{1}{2} \text{ U}$$

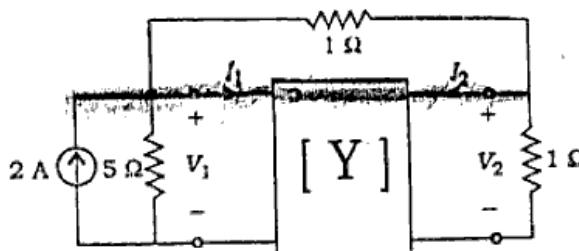


Fig. 8

- ~~Q5~~ For the network shown in Fig. 9, write the tie-set matrix and determine the loop currents and branch currents.

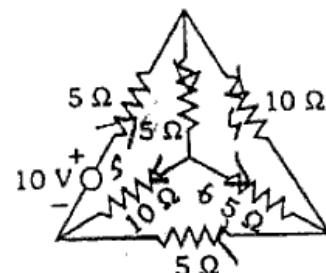


Fig. 9

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6. If an  $m$ -derived high-pass filter has design impedance of  $600 \Omega$  and cut-off frequency of  $3.6 \text{ kHz}$  and infinite attenuation at  $2.5 \text{ kHz}$ , design the filter.
7. Synthesize the following impedance function in Foster I form and Cauer II form

$$Z(s) = \frac{s^4 + 10s^2 + 9}{s^3 + 4s}$$

8. (a) For the circuit shown in Fig. 10, find the voltage  $v(t)$  for  $t > 0$ , if the circuit is in steady state at  $t = 0^-$  and the switch is moved from position 1 to position 2 at  $t = 0$ .

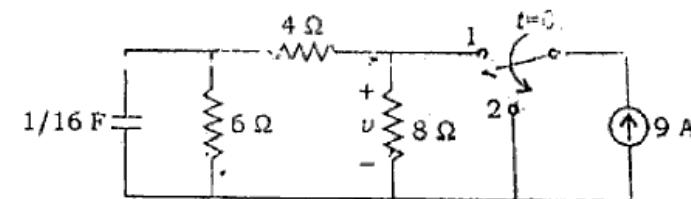


Fig. 10

- (b) Find  $z$ -parameters in terms of  $h$ -parameters.
9. (a) Define the following terms :
- (i) Tree
  - (ii) Cut set
  - (iii) Fundamental loop
  - (iv) Oriented graph
- (b) Write the properties of positive real function.

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