

Code : 031505

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B.Tech 5th Semester Exam., 2017

NETWORK THEORY

Time : 3 hours akubihar.com 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 answer (any seven) :

- (a) In the circuit of Fig. 1 shown below, the voltage $V(t)$ is

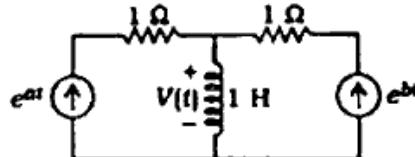


Fig. 1

- (i) $e^{at} - e^{bt}$
- (ii) $e^{at} + e^{bt}$
- (iii) $ae^{at} - be^{bt}$
- (iv) $ae^{at} + be^{bt}$

- (b) When a unit-impulse voltage is applied to an inductor of 1 H, the energy supplied by the source is

(i) ∞

(ii) 1 J

(iii) $\frac{1}{2}$ J

(iv) 0

- (c) The graph of an electrical network has n nodes and b branches. The number of links with respect to the choice of a tree is given by

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(i) $b-n+1$ (ii) $b+n$ (iii) $n-b+1$ (iv) $n-2b-1$

- (d) A system is represented by the transfer function $\frac{10}{(s+1)(s+2)}$. The DC gain of this system is

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(i) 1

(ii) 2

(iii) 5

(iv) 10

(e) For a two-port network to be reciprocal, then

(i) $z_{11} = z_{22}$

~~(ii)~~ $y_{21} = y_{12}$

(iii) $h_{21} = +h_{12}$

(iv) $AD - BC = 0$

(f) The passband of a typical filter network with z_1 and z_2 as the series and shunt-arm impedances is characterized by

(i) $-1 < \frac{z_1}{4z_2} < 0$ akubihar.com

(ii) $-1 < \frac{z_1}{4z_2} < 1$

(iii) $0 < \frac{z_1}{4z_2} < 1$

(iv) None of the above

(g) If $F_1(s)$ and $F_2(s)$ are two positive real functions, then the function which is always positive real, is

(i) $F_1(s)F_2(s)$

~~(ii)~~ $\frac{F_1(s)}{F_2(s)}$

(iii) $\frac{F_1(s)F_2(s)}{F_1(s) + F_2(s)}$

(iv) $F_1(s) - F_2(s)$

(Turn Over)

(h) Each of the two series elements of a T-section low-pass filter consists of an inductor of 60 mH having negligible resistance and a shunt element having a capacitance of $0.2\text{ }\mu\text{F}$. The nominal impedance is

(i) $547.72\text{ k}\Omega$

(ii) $54.72\text{ k}\Omega$

~~(iii)~~ 547.72Ω

(iv) 5.477Ω

(i) For a two-port symmetrical bilateral network, if $A = 3$ and $B = 1$, the value of the parameter C will be

(i) 4 akubihar.com

(ii) 6

~~(iii)~~ 16

~~(iv)~~ 8

(j) The Laplace transform of a unit-ramp function starting at $t = a$ is

(i) $\frac{1}{(s+a)^2}$

(ii) $\frac{e^{-as}}{(s+a)^2}$

~~(iii)~~ $\frac{e^{-as}}{s^2}$

~~(iv)~~ $\frac{a}{s^2}$

(5)

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2. (a) Derive $ABCD$ parameters in terms of y -parameters.
- (b) Determine the y -parameters for the two-port shown in Fig. 2 below :

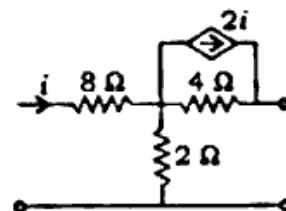


Fig. 2

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3. For the network shown in Fig. 3 below, draw network graph, selecting 2, 4, 5 as tree branches. Obtain loop incidence matrix and loop equations :

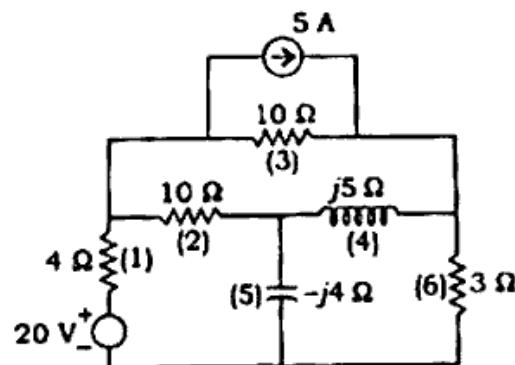


Fig. 3

(6)

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4. In the network shown in Fig. 4 below, the switch is closed at $t = 0$. Find the currents $i_1(t)$ and $i_2(t)$ when initial current through the inductor is zero and initial voltage on the capacitor is 4 V :

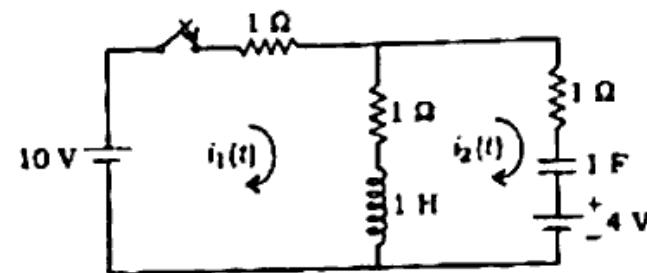


Fig. 4

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5. (a) For the network shown in Fig. 5 below, find $G_{21} = V_2 / V_1$:

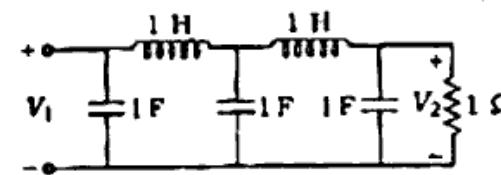


Fig. 5

- (b) Define driving-point functions. Write down driving-point functions for a two-port network.

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6. Derive the following expressions for a constant k high-pass filter :

(a) Nominal impedance

(b) Cut-off frequency

(7)

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- (c) Attenuation constant
- (d) Phase constant
- (e) Characteristic impedance
- (f) Design of filter

7. (a) Realize the Foster form of the following impedance function :

$$Z(s) = \frac{s(s^2 + 4)}{2(s^2 + 1)(s^2 + 9)}$$

(b) Realize the Cauer-II form of the following impedance function :

$$Z(s) = \frac{8(s^2 + 1)(s^2 + 3)}{s(s^2 + 2)(s^2 + 4)}$$

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8. (a) Find the short-circuit and open-circuit impedances of the network shown in Fig. 6 below and hence obtain its π equivalent :

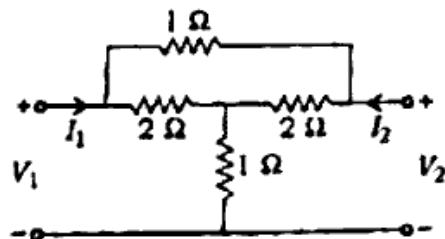


Fig. 6

(8)

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- (b) In the circuit of Fig. 7 below, switch S is closed and steady-state conditions reached. Now at time $t = 0$, switch S is opened. Obtain the expression for the current through the inductor :

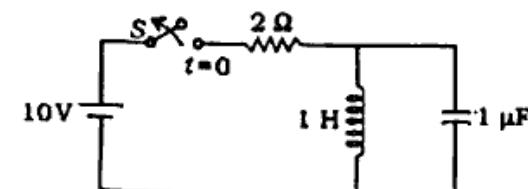


Fig. 7 akubihar.com

9. Write brief notes about the following :

- (a) Incidence matrix
- (b) Loop matrix or circuit matrix
- (c) Transfer functions in two-port network

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