B. E. T. C. E. 2ND YEAR Supplementary Examination 2017

First Semester

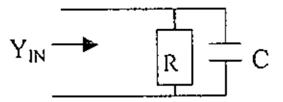
Network Synthesis

Time: 3 hours **Full Marks : 100**

Answer any *five* questions

All questions carry equal marks

1(a) Define PR function? From your definition prove that the input admittance function of the following circuit is PR



10

1(b) If $Z_1(S)$ and $Z_2(S)$ are PR functions then using your definition in part(a) prove that

(i) $Z_1(S) + Z_2(S)$ is a PR function

(ii) $1/Z_1(S)$ is a PR function.

(iii) $Z_1(Z_2(S))$ is a PR function.

10

2(a) If P(S) is a strictly Hurwitz polynomial, show that $P(S)/P'(S)$ is PR, where $P'(S) = dP(S)/dS$ 10

2(b) If P(s) is a Hurwitz polynomial show that $\phi(s) = M(s)/N(S)$ is a PR function where, M(s) is the even part of P(s) and N(s) is the odd part of P(s). 10

3(a) Assume that Z(S) is a PR function and Re[Z(S)] = 0. Show that Z(S) can be expressed either as M(S)/N(S) or as N(S)/M(S) where M(S) and N(S) respectively represent even and odd polynomials in S. 08

3(b) From the result proved in part (a) obtain the general expression for an LC driving point impedance function. Hence derive the Foster I and Foster II realization technique for LC impedance function 06

3(c) Find the Foster I and Foster II realization for the following LC function

$$Z_{LC}(S) = \frac{S(S^2+2)}{(S^2+1)(S^2+3)}$$

06

4 Obtained two Cauer and two Foster realizations for the following RC driving point admittance function.

$$Y(S) = \frac{S(S+3)}{(S+1)(S+4)}$$

5+5+5+5

5(a) Describe a constant K low pass filter. Derive the expression for L and C used in this filter in terms of its cut off frequency and the Z_1Z_2 product. 10

5(b) What are the disadvantages of the above filter? Show how these disadvantages may be overcome in an m-derived filter. Find the expression for m and f_∞ for such filter. 10

6(a) Derive the expression $\sinh\frac{\gamma}{2}=\sqrt{\frac{Z_1}{4Z_2}}$ for a symmetric T network. Assume the usual meanings of the symbols used. 10

6(b) Show how the above expression is used to find the qualitative filter characteristics of a reactive T network. Use a constant K high pass filter as an example to explain your answer. 10

7 Design a state variable low pass filter described by the following voltage transfer function.

$$\frac{V_o(S)}{V_i(S)}=\frac{\omega_0 S}{S^2+a\omega_0 S+\omega_0^2}$$

where, $\omega_0 = 1000$ rad/sec and $a=\sqrt{2}$ 20

8 Find the voltage transfer functions for the circuits shown in Fig 2(a) and 2(b).. Also comment on their applications.

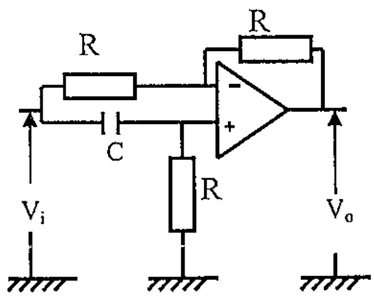


Fig 2(a)

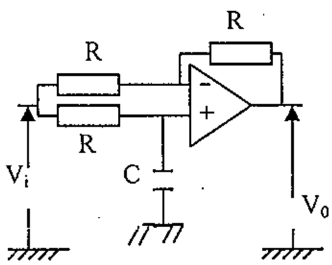


Fig 2(b)

10+10