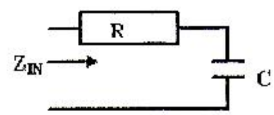
Ref. No. : Ex/ET/T/212/2018(S)

Name of the Examinations: B.E. ELECTRONICS AND TELE-COMMUNICATION ENGINEERING SECOND YEAR FIRST SEMESTER SUPPLEMENTARY EXAM - 2018

Subject : NETWORK SYNTHESIS **Time :** 3 Hours **Full Marks :100**

Answer any five questions All questions carry equal marks

1(a) What is a PR function? From your definition prove that the input impedance 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 $\frac{P(S)}{P'(S)}$ is PR,

where $P'(S) = \frac{dP(S)}{dS}$ 10

2(b) If P(s) is a Hurwitz polynomial show that $\phi(S) = \frac{M(S)}{N(S)}$ 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) Find the voltage transfer function of the circuit shown in Fig 1(a).

10

3(b) Find the input impedance of the circuit shown in Fig 1(b). Find the range of values of C_1 such that the function remains PR.

10

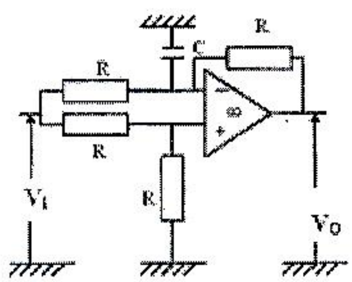


Fig 1(a)

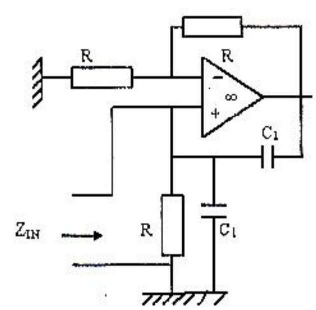


Fig 1(b)

[Turn over

4(a) Assume that Z(S) is a PR function and Re[Z(S)] = 0. Show that Z(S) can be expressed either as $\frac{M(S)}{N(S)}$ or as $\frac{N(S)}{M(S)}$ where M(S) and N(S) respectively represent even and odd polynomials in S.

10

4(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. Find the Foster I and Foster II realization for the following LC function

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

10

5(a) Show how a general expression of $Z_{RC}(S)$ may be derived from the general expression of $Z_{LC}(S)$

10

5(b) Starting from the general expression of $Z_{LC}(s)$ show that $Z_{RC}(S)$ can have a pole at S=0 and cannot have a zero at S = 0.

10

5(c) Obtained two Cauer realizations for the following RC driving point admittance function.

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

10

6(a) Derive the expression for L and C used in a constant K low pass filter in terms of its cut off frequency and the Z_1Z_2 product. Also find the expression for the phase shift in the pass band.

10

6(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

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

10

7(b) Show how the general filter characteristics of a reactance T network may be predicted using the above expression.

8 Design a state variable band pass filter described by the following voltage transfer function

20

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

where, $\omega_o = 1000$ rad/sec and $a = 0.1$