Ref No. Ex/ ET/T/212/2019

B. ETCE 2ND YEAR 1ST SEMESTER EXAMINATION, 2019

Network Synthesis

Time: 3 Hours **Full Marks: 100**

Answer any Five (5) Questions from the followings: 20×5

1. (a) Find the ***voltage transfer function*** of the circuit shown in Fig. 1 (a).
   (b) Find the ***input impedance*** of the circuit shown in Fig. 1(b).

10+10

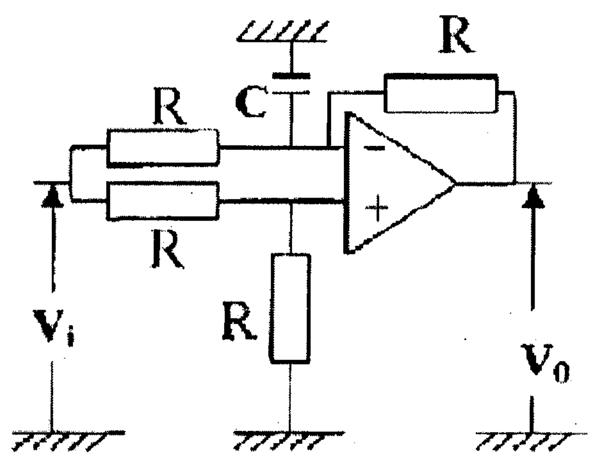

Fig. 1 (a)

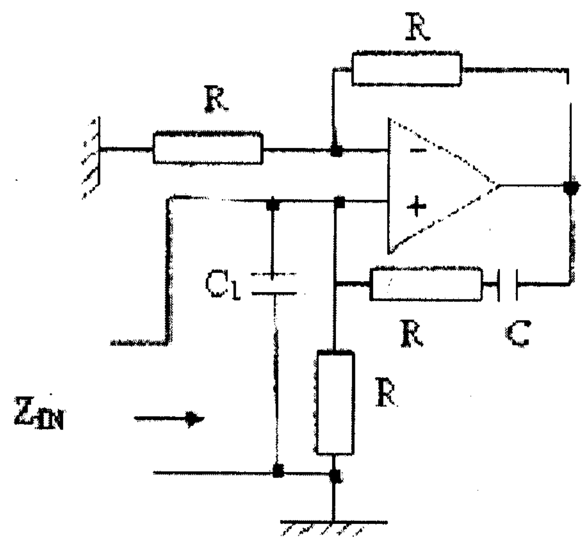

Fig. 1 (b)

2. (a) State the condition (a) and (b) of a ***PR*** function.
   (b) Consider the circuit shown in Fig. 2(a). Using the above conditions prove that if $Z_i(s)$ is PR then the product $V_i(s)\,I_i^*(s)$ is also PR.

[Turn over

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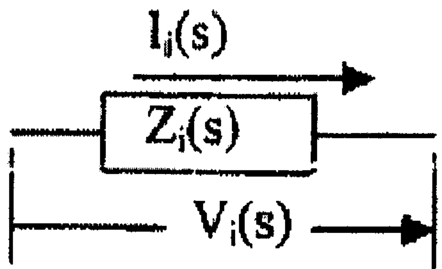

Fig. 2(a)

(c) Assuming ***Z(s) = s-1.*** Find the input impedance of the network shown in Fig. 2 (b). Find the range of ***K*** such that input impedance is ***PR***.

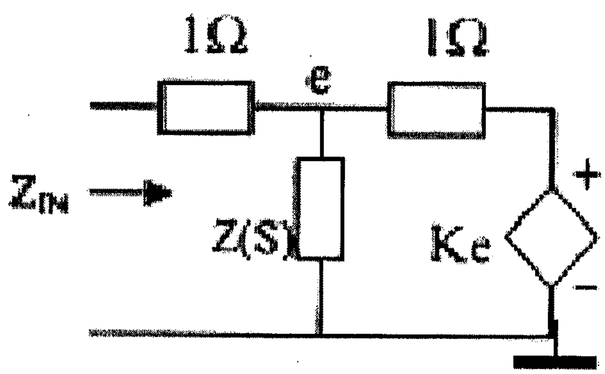

Fig. 2(b)

(d) Using the condition (c′) for the PR function and the fact that is ***Z(s)*** is PR then ***Z(1/s)*** is also ***PR*** show that if

$$Z(S) = \frac{a_0 + a_1 S + \ldots + a_m S^m}{b_0 + b_1 S + \ldots + b_n S^n}$$

is a ***PR*** function then $|(m-n)| \leq 1$

02+05+05+08

3. (a) Assume that ***Z(s)*** is a ***PR*** function and ***Re[Z (s)] = 0***. Show that ***Z(s)*** can have either a **zero** or a **pole** at **s = 0**.

(b) Using the derivation of 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.

(c) Find the ***Foster I*** and ***Foster II*** realization for the following driving point impedance function:

$$Z_{LC}(s) = s(s^2+2)/(s^2+1)(s^2+4)$$

06+06+08

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4. (a) Show that the properties of an ***RC*** driving point impedance function can be obtained from the properties of the ***LC*** driving point impedance function.

   (b) Design ***Foster I*** and ***Foster II*** networks for the ***RC*** impedance function.

   10+10

5. (a) Describe a Constant ***K*** low pass filter. What are the disadvantages of this configuration? Describe how ***m*** derived filter overcome these disadvantages? Show that the cut-off characteristc of a filter can be improved by using an ***m*** derived section:

   (b) calculate the values of the elements of a high-pass filter having a cut-off frequency of 1 KHz and operating into a load resistance of 600 ohms.

   03+03+03+04+07

6. (a) Design an appropriate m derived T section and an appropriate π section for the following specification, design impedance = 400 ohms, cut-off frequency of 5 KHz and a frequency of attenuation (resonant frequency) = 6 KHz.

   (b) Design a composite high pass filter to operate into a load of 600 ohms and have a cut-off frequency of 1.2 KHz. The filter is to have one constant ***K*** section and one ***m*** derived section with infinite frequency of 1.1 KHz and suitable termination half section.

   07+13

7. (a) Make a comparative study between active filter and passive filter.

   (b) Design a second order active BP filter that has a centre frequency of 1 KHz and a band-width of 100 Hz. Take the centre frequency gain to be 2. Derive the necessary relation you use.

   05+15

8. (a) Describe active notch and band pass filter.

   (b) Design an active notch filter having a centre frequency f_0 = 400 Hz and Q = 10, make the centre frequency gain to be 2. Derive the necessary relation you use.

   05+15