

Total No. of Questions : 12]

SEAT No. :

P1382

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T.E. (Electronics & Telecommunication)**Network Synthesis & Filter Design****(2008 Pattern) (Semester - I)***Time : 3 Hours]**[Max. Marks : 100**Instructions to the candidates:*

- 1) *Answer any three questions from each section.*
- 2) *Answers to the two sections should be written in separate answer books.*
- 3) *Figures to the right indicate full marks.*
- 4) *Neat diagrams must be drawn wherever necessary.*
- 5) *Use of electronic pocket calculator is allowed.*
- 6) *Assume suitable data, if necessary.*

SECTION - I

Q1) a) Given : $Z(s) = \frac{s^2 + As}{s^3 + 3s + 2}$ [8]

- i) What are restrictions on 'A' for Z(s) to be a PRF?
 - ii) Find 'A' for Re Z(j ω) to have second order zero at $\omega = 0$.
- b) Define the stability, causality and realizability terms. [3]
- c) What is positive real function? Give necessary and sufficient conditions for a function to be a Positive real function. [5]

OR

- Q2)** a) Explain the significance and effect of poles & zeroes on the system function in network synthesis. [5]
- b) Define a Hurwitz Polynomial. State properties of it. [3]
- c) Test whether following polynomials are Hurwitz : [8]
- i) $s^7 + 2s^6 + 2s^5 + s^4 + 4s^3 + 8s^2 + 8s + 4$
 - ii) $s^7 + 3s^5 + 2s^3 + s$

P.T.O.

- Q3)** a) State the properties of LC driving point impedance function. Obtain the Foster-I form of the network with impedance function : [8]

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

- b) Find Cauer - I and Cauer - II forms of the function : [8]

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

OR

- Q4)** a) Find the Foster-I and Foster-II forms of the following transfer function : [8]

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

- b) An impedance function is given as : [8]

$$Z(s) = \frac{s(s + 2)(s + 5)}{(s + 1)(s + 4)}$$

Find the R-L representation of Cauer I and Cauer II forms.

- Q5)** a) Explain the concept of zeros of transmission (ZOT) with example. State its properties. [6]

- b) Synthesize $Z_{21}(s) = \frac{2}{s^3 + 3s^2 + 4s + 2}$ into LC ladder network with 1Ω termination. [6]

- c) What do you mean by a constant resistance network? Derive the open circuit parameters of a bridge circuit. [6]

OR

- Q6)** a) Find the condition for a lattice network when terminated in 'R', to be a constant resistance network. [6]

- b) Synthesize Z_a and Z_b for a bridge T- network terminated in 1Ω if its transfer function is given as : $\frac{V_2}{V_1} = \frac{s^2 + 3s + 2}{s^3 + 4s^2 + 5s + 2}$. [6]

- c) Synthesize $Z_{21}(s) = \frac{s^3}{s^3 + 3s^2 + 4s + 2}$ into LC ladder network with 1Ω termination. [6]

SECTION - II

- Q7)** a) Explain the necessity of approximation techniques in filter design. Explain in detail the Butterworth approximations and state its properties. [6]
- b) Determine the transfer function for a normalized third order Butterworth LPF. Also determine the cut-off frequency. [6]
- c) Derive the expression for the order 'n' of a typical low pass Butterworth filter. [6]

The specification of a low pass Butterworth filter are;

Passband = 0.2Mrad/sec

Passband loss ≤ 2 dB

Stopband loss ≤ 60 dB at 6 Mrad/sec.

Find the minimum order of the filter.

OR

- Q8)** a) Explain in detail the Chebyshev approximation technique for filter design and state its properties. [6]
- b) The specifications of a chebyshev filter are : [6]
- Passband ripple = 0.5 dB
- Passband = 0 to 2.5 MHz
- Stop band attenuation = 40 dB
- Stopband frequency = 5 MHz
- i) Determine the order 'n' of the filter
- ii) Draw its pole location in s-plane
- c) Explain the need and concept of magnitude and frequency scaling as used in filter designing. [6]

- Q9)** a) Explain the various Active filter design approaches. [8]
 b) Synthesize a second order LPF to have a pole frequency of 2 KHz and a pole Q of 10, using Sallen and key circuit and design 3 i.e. Saraga design. [8]

OR

- Q10)** a) Explain the different biquad feedback topologies used in active filter designing and list the important observations. [8]
 b) Synthesize the following high pass filter function using RC - CR transformation on Sallen and Key low pass filter. [8]

$$H_{hpf}(S) = k \left(\frac{s^2}{s^2 + s + 25} \right)$$

- Q11)** a) Explain the concept of gain sensitivity. Also explain the various factors affecting the gain sensitivity. [8]
 b) What is multielement deviation? Define variability and derive the expression for per unit change in parameter 'P' due to simultaneous variations in all elements. [8]

OR

- Q12)** a) Find the transfer function (V_o/V_{in}) for a series RLC circuit. Compute the sensitivities of k, ω_p , and Q_p to the elements. [8]
 b) Explain the effect of following OPAMP characteristics on the performance of active filters : [8]
 i) Offset voltage and currents.
 ii) Slew rate.
 iii) Dynamic range.
 iv) CMRR.

