[4658] – 83

Seat No.	

T.E. (E&TC) (Semester – I) Examination, 2014
NETWORK SYNTHESIS AND FILTER DESIGN
(2008 Pattern)

Time : 3 Hours Max. Marks : 100

Instructions : *1) Answer Q. **1** or Q. **2**, Q. **3** or Q. **4**, Q. **5** or Q. **6** from Section **I** and Q. **7** or Q. **8**, Q. **9** or Q. **10**, Q. **11** or Q. **12** from Section **II.***
*2) Answers to the **two** Sections should be written in **separate** books.*
*3) **Neat** diagrams must be drawn **wherever** necessary.*
*4) Assume **suitable** data if **necessary**.*

SECTION – I

1. a) Define Network synthesis. State the properties of Network functions. **4**

b) Test whether the following polynomial is Hurwitz **6**

$F(s) = s^4 + s^3 + 5s^2 + 3s + 4$

c) Synthesize the following p.r. impedance function using elementary synthesis procedure. **8**

$$Z(s) = \frac{6s^3 + 3s^2 + 3s + 1}{6s^3 + 3s}$$

OR

2. a) Check whether the following are stable network functions. **4**

i) $\frac{s}{s^2 - 3s + 4}$

ii) $\frac{s - 1}{s^2 + 4}$

b) Which of the following are p.r.f. functions ? Give reasons. **6**

i) $\frac{s + 2}{s^2 + 3s + 2}$

ii) $\frac{3s^2 + 5}{s(s^2 + 1)}$

c) Synthesize the following impedances by successive removals of jω axis poles or by removing min[Re(jω)]. **8**

i) $\frac{s^3 + 4s}{s^2 + 2}$

ii) $\frac{s + 1}{s(s + 2)}$

P.T.O.

3. a) Indicate which of the following functions are either R-C, R-L, or L-C impedance functions. **6**

i) $Z(s)=\dfrac{s^3+2s}{s^4+4s^2+3}$

ii) $Z(s)=\dfrac{s^2+6s+8}{s^2+4s+3}$

iii) $Z(s)=\dfrac{s^2+4s+3}{s^2+6s+8}$

b) Synthesize the following function by continued fractions expansion method. **4**

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

c) Synthesize the following function by Partial Fraction expansion method. **6**

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

OR

4. a) State the properties of R-C driving-point impedances and R-L driving-point impedances. **6**

b) Synthesize the following function by continued fraction expansion method. **4**

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

c) Synthesize the following function by partial fraction expansion method. **6**

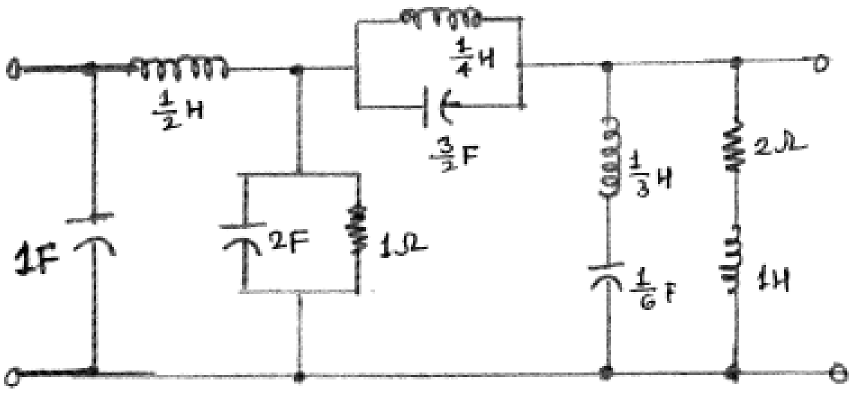
$$Z(s)=\frac{2(s+1)(s+3)}{(s+2)(s+6)}$$

5. a) State the properties of Transfer functions. **4**

b) Synthesize the following function with 1-Ω termination. **6**

$$Z_{21}(s)=\frac{2}{s^3+3s^3+4s+2}$$

c) Identify the zeros of transmission for the given network. **6**



OR

6. a) Synthesize the following voltage ratio with 1-Ω termination using Lattice network. **4**

$$\frac{V_2}{V_9} = \frac{1}{2} \cdot \left(\frac{s-1}{s+1}\right)$$

b) Synthesize the following function with 1-Ω termination. **6**

$$Z_{21}(s) = \frac{s^3}{s^3 + 3s^2 + 4s + 2}$$

c) Synthesize the following voltage ratio with 1-Ω termination using Bridge – T network. **6**

$$\frac{V_2}{V_1} = \frac{s^2 + 1}{s^2 + 2s + 1}$$

SECTION – II

7. a) State the characteristics of Butterworth and Chebyshev approximations. **4**

b) Derive the expression for transfer function of normalized low-pass filter of second-order butterworth filter. **6**

c) Synthesize third-order low-pass Butterworth passive filter for the following specifications : $R_0 = 500\,\Omega$ and $\omega_c = 10^4$ rad/sec. **8**

OR

8. a) Explain frequency scaling and impedance scaling. **6**

b) Transform the third-order Butterworth normalized low-pass passive filter into a high-pass filter with $500\,\Omega$ impedance level with cut-off frequency $\omega_0 = 10^6$ rad/sec. **8**

c) Write a short note on Chebyshev approximations. **4**

9. a) Draw a neat diagram of positive feedback topology. And derive the transfer function of the positive feedback topology assuming an ideal op-amp. **10**

b) Write a short note on RC-CR transformation. **6**

OR

10. Synthesize a second-order Bandpass filter with a centre frequency of 1000 rad/sec and a pole Q of 10. The gain at the centre frequency is required to be 0 dB. **16**

11. a) Define sensitivity. And derive an expression for the sensitivity of ω_p and K (DC gain constant) to the component values R_1, R_2, C_1, C_2, r_1 and r_2 for given transfer function of lowpass sullen and key circuit for n = 2 (order of filter). **8**

$$T(s) = \frac{K / R_1 R_2 C_1 C_2}{s^2 + s\left(\frac{1}{R_1 C_1} + \frac{1}{R_2 C_1} + \frac{1-K}{R_2 C_2}\right) + \frac{1}{R_1 R_2 C_1 C_2}}$$

b) Write a short note on op-amp frequency characteristics and compensation techniques. **8**

OR

12. Write a short note on following : **16**
    i) FDNR
    ii) Gyrator
    iii) NIC
    iv) Multielement deviation.

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