

R1

## INDIAN INSTITUTE OF TECHNOLOGY, KHARAGPUR

Date: ..... FN / AN Time: 2/3 Hrs. Full Marks: 35 No. of Students: 94  
 Autumn / Spring Semester: ..... Deptt.: E & ECE Sub. No.: EC 21005  
 2 Yr. B.Tech. (H) / B.Arch. (H) / M.Sc. Sub. Name: Network Theory  
 Instruction: Answer all questions.

1. What is a positive real function? Show that the driving point impedance function of a circuit made of L, C and R elements is positive real. Show also that poles and zeroes of such a function on the  $s = j\omega$  axis are simple with positive and real residues. (2+3+2)
2. Show that the driving point impedance function  $Z(s) = \frac{2s^3 + 3s^2 + 2s + 3}{s^3 + 3s^2 + 4s + 1}$  is positive real. Synthesize the network with this driving point impedance (3+2)
3. A maximally flat low pass characteristic with power loss ratio  $P_{LR} = 1 + k^2 \left(\frac{\omega}{\omega_c}\right)^4$  is to be designed. Use the insertion loss synthesis method to realize the filter given the source and load impedances are equal  $R_L = R_G$ . Use L and C elements only. (5)
4. a) Calculate the image parameters of a symmetric T and  $\pi$  network. (2+2)  
 b) Use it to design a m-derived T filter with L and C components, given  $\omega_c$  and  $\omega_\infty$  with  $\omega_c = 0.5 \omega_\infty$ . How will the design be modified if you used a  $\pi$  section instead of a T keeping  $\omega_c$  and  $\omega_\infty$  unchanged? Explain the advantages of

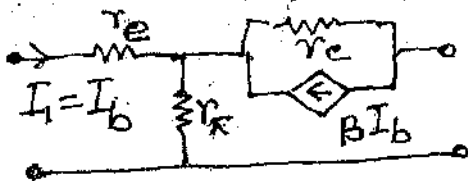
the  $\pi$  over the T section

(2+1+1)

c) Design a low pass Composite filter with a cut off frequency of 2 MHz and impedance of  $75 \Omega$ . Place the infinite attenuation pole at 2.05 MHz. Use L and C components only. (3)

5. Show that a two port network containing only R, L and C elements is reciprocal in nature. (3)

6. Obtain the h parameters of the network shown. (2)



7. Obtain the Bode plot (phase and magnitude) of

$$H(j\omega) = \frac{100(1+j\omega)}{(10+j\omega)(100+j\omega)} \quad \text{from } \omega = 0.01 \text{ to } \omega = 10000$$

$$\omega = 10000$$

(2)