



Reg. No. :

Name :

**First Semester M.Tech. Degree Examination, March 2014
(2013 Scheme)**

ELECTRONICS AND COMMUNICATION

Stream : Signal Processing

TSC 1003 : Digital Filter Design and Applications

Time : 3 Hours

Max. Marks : 60

Instructions : Answer *any two* questions from *each* Module.
All questions carry *equal* marks.

MODULE – I

1. Consider a digital sequence sampled at the rate of 20000 Hz. If we use 8000 point DFT to compute the spectrum, determine
 - a) the frequency resolution
 - b) the folding frequency in the spectrum.

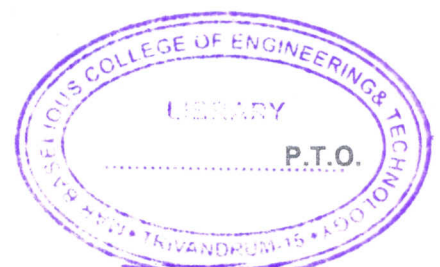
2. Show that group delay of an all pass filter is nonnegative for all ω .

3. a) Find a real-valued causal sequence with $x(0) > 0$ and

$$|x(e^{j\omega})|^2 = 1 + a^2 - 2a \cos \omega.$$

- b) Find the minimum phase system that has a magnitude response given by

$$|H(e^{j\omega})|^2 = \frac{\frac{5}{4} - \cos \omega}{\frac{10}{9} - \frac{2}{3} \cos \omega}$$





MODULE – II

4. Consider the following specifications for a bandpass filter :

$$\begin{aligned} |H(e^{j\omega})| &\leq 0.01; 0 \leq |\omega| \leq 0.2\pi \\ 0.95 \leq |H(e^{j\omega})| &\leq 1.05; 0.3\pi \leq |\omega| \leq 0.7\pi \\ |H(e^{j\omega})| &\leq 0.02; 0.8\pi \leq |\omega| \leq \pi \end{aligned}$$

Design a linear phase FIR filter to meet these specifications using a Hamming window.

5. We would like to design a digital low-pass filter that has a passband cutoff frequency $\omega_p = 0.375\pi$ with $\delta_p = 0.01$ and a stopband cutoff frequency $\omega_s = 0.5\pi$ with $\delta_s = 0.01$. The filter is to be designed using the bilinear transformation. What order Butterworth and Chebyshev filters are necessary to meet the design specifications ?
6. Draw a lattice filter implementation for the all-pole filter

$$H(z) = \frac{1}{1 - 0.2z^{-1} + 0.4z^{-2} + 0.6z^{-3}}$$

and determine the number of multiplications additions and delays required to implement the filter.

MODULE – III

7. Explain briefly, the basic concepts of adaptive noise cancelling. Discuss critically the benefits and limitations of adaptive noise cancelling in a real-time application of your choice and suggest ways of overcoming the limitations.
8. Given a quadratic MSE function for the Wiener filter $J = 10 - 30w + 15w^2$. Use the steepest descent method with an initial guess of $w_0 = 2$ and a convergence factor $\mu = 0.02$ to find the optimal solution for w^* and determine J_{\min} by iterating three times.
9. By using suitable derivations, compare the performance characteristics of Bartlett and Blackman-Tukey methods for power spectrum estimate. **(6×10=60 Marks)**