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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 camal sequence with x(0) > 0 and

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

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

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

P.T.O.

MODULE – II

4. Consider the following specifications for a bandpass filter :

$$\left|H\left(e^{j\omega}\right)\right| \le 0.01;\ 0 \le |\omega| \le 0.2\pi$$

$$0.95 \le \left|H\left(e^{j\omega}\right)\right| \le 1.05\ ;\ 0.3\pi \le |\omega| \le 0.7\pi$$

$$\left|H\left(e^{j\omega}\right)\right| \le 0.02\ ;\ 0.8\pi \le |\omega| \le \pi$$

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)**