EJ – 763

VII Semester B.E. (Electrical & Electronics) Degree Examination, January 2013
(2K6 Scheme)
EE 704 : DIGITAL SIGNAL PROCESSING

Time : 3 Hours Max. Marks : 100

Instruction : *Answer* ***five*** *full questions.*

1. a) Prove that sampling of DTFT results in N-point DFT from which the sequence as well as DTFT can be reconstructed. **10**

   b) Consider the sequence $x(n) = 4\delta(n) + 3\delta(n-1) + 2\delta(n-2) + \delta(n-3)$. Let X (K) be the 6-point DFT of x (n). Find the finite length sequence y (n) that has 6 point DFT $Y(K) = W_6^{4K} X(K)$. **6**

   c) Derive the relationship between N point DFT and Z Transform. **4**

2. a) Let x (n) be a length 'N' real sequence with N-point DFT X(K). Prove that $X(N - K) = X^A(K)$ and X (0) is real. **6**

   b) Determine the N- point circular convolution of x_1 (n) and x_2(n) defined by

   $x_1(n) = \cos\frac{2\pi n}{N}$ $x_2(n) = \sin\frac{2\pi n}{N}$. **6**

   c) Evaluate the following function for a given 12 point seq.

   x (n) = [8, 4, 7, –1, 2, 0, –2, –4, –5, 1, 4, 3] function $\sum_{k=0}^{11} e^{-j\frac{4\pi k}{6}} X(K)$. **8**

3. a) Using DIF FFT, find the 8-point DFT of the sequence x (n) = [1, 1, 1, 1, 1, 1, 1, 1]. **10**

   b) Discuss the computational benefits of DIT algorithm over direct computation of DFT. **5**

   c) Explain with neat contour diagrams the importance and application of Chirp-z transform. **5**

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4. a) Realise the linear phase 7IR filter having the following impulse response

   h (n) = $\{1, \frac{1}{4}, \frac{1}{8}, \frac{1}{4}, 1\}$. **6**

   b) Obtain a direct form II and cascade realisation for the system function

   $$H(z) = \frac{\left(1+z^{-1}\right)}{\left(1-\frac{1}{4}z^{-1}\right)\left(1-z^{-1}+\frac{1}{2}z^{-2}\right)}$$ **6**

   c) Determine the coefficients K_m of lattice filter whose transfer function corresponding to FIR filter described by the transfer function

   $H(z) = 1 + 2z^{-1} + \frac{1}{3}z^{-2}$. Also draw the corresponding lattice structure. **8**

5. a) Derive the expression for poles from the squared magnitude response of Butterworth L.P.F. **10**

   b) Determine the order of a Chebyshev filter to meet the following specifications :

   Passband ripple = – 2db at passband edge frequency 1 rad/sec and 20 db attenuation at shopband edge of 1.3 rad/sec. **10**

6. a) Derive the transformation of IIR filter using approximation of derivatives by backward difference and verify whether it satisfies the sufficient and necessary conditions of mapping. **5**

   b) Convert the following transfer function into digital using impulse invariance method. **5**

   $$H(s) = \frac{s+a}{(s+a)^2 + b^2}$$

   c) Design a digital filter H(z) that when used as A/D – H(z) – D/A structure gives an equivalent analog with the following specifications : **10**

   Passband ripple $\leq$ 3 db

   Passband edge = 500 hz

   Shopband attenuation $\geq$ 15 db

   Shopband edge = 750 Hz

   Sampling rate = 2 KHz

   Use Bilinear transformation on butterworth prototype.

7. a) Derive the frequency response of a symmetric 7 IR low pass filter for both N even and N odd. **10**

   b) Design an ideal low pass filter using Hamming window. The frequency response of the filter is $H_d(e^{j\omega}) = 1 \; -\pi/2 \leq \omega \leq \pi/2$.
   $= 0$ elsewhere

   Select the length of the unit impulse response of FIR filter as 9. **10**

8. Write a brief note on the following :

   1) Frequency sampling design of 7IR filters and its realisation in direct form structure. **5**

   2) Linear convolution for filtering long sequences. **5**

   3) TMS 320 DSP processors. **10**
