EE55

Fifth Semester B.E. Degree Examination, Dec. 07 / Jan. 08
Digital Signal Processing

3 hrs. Max. Marks:100

Note : ***Answer any FIVE full questions.***

1 a. Compute the N- point DFT of $x(n) = a^n$ for $0 \le n \le N-1$ and hence find DFT of the sequence of $x(n) = 0.5^n\, u(n)$; $0 \le n \le 3$. **(10 Marks)**

b. Find the four point DFT of the sequence $x(n) = \{1, 1, -1, -1\}$; hence find x(-2), x(-3), x(5) and x(7). **(05 Marks)**

c. Compute the four point DFT of the sequence $x(n) = \{1, 0, 1, 0\}$. Also find y(n) if $Y(k) = x((k-2))_4$. **(05 Marks)**

2 a. A discrete time signal $x(n) = \{1, 4, 1, 4, 1\}$ is passed through LTI system with impulse response $n(n) = \left\{\frac{1}{2}, \frac{1}{2}\right\}$ to generate y(n). Determine y(n) if DFT based convolution scheme is employed. **(08 Marks)**

b. Let g(n) and h(n) be two finite length sequences of length 5 each, if $y_l(n)$ and $y_c(n)$ denote the linear and 5 point circular convolution of g(n) and h(n) respectively, express $y_c(n)$ in terms of $y_l(n)$. **(12 Marks)**

3 a. Derive and draw the complete decimation–in–frequency flow chart to compute DFT of an 8 – point sequence. Mark all intermediate outputs. **(08 Marks)**

b. If $x_1(n) = \{1, 2, 0, 1\}$ and $x_2(n) = \{1, 3, 3, 1\}$ obtain $x_1(n)$ (n) $x_2(n)$ by DIT – FFT algorithm. Verify your answer by Tabulation method. **(12 Marks)**

4 a. Determine direct form I and II for the second order filter given by

$$y(n) = 2b\cos w_0 y(n-1) - b^2 y(n-2) + x(n) - b\cos w_0 x(n-1)$$ **(08 Marks)**

b. Draw the cascade and parallel realization structure for the system function.

$$H(z) = \frac{5\left(1-\frac{1}{4}z^{-1}\right)\left(1-\frac{2}{3}z^{-1}\right)\left(1+2z^{-1}\right)}{\left(1-\frac{3}{4}z^{-1}\right)\left(1-\frac{1}{8}z^{-1}\right)\left[1-\left(\frac{1}{2}+j\frac{1}{2}\right)z^{-1}\right]\left[1-\left(\frac{1}{2}-j\frac{1}{2}\right)z^{-1}\right]}$$ **(12 Marks)**

5 a. Explain various types of windows used in the design of FIR filters. Write their analytical equations and draw the frequency response characteristics of each window. **(12 Marks)**

b. Design an FIR filter (low pass) using rectangular window with pass band gain of o db, cut off frequency of 200 Hz, sampling frequency of 1 kHz. Assume the length of the impulse response as 7. **(08 Marks)**

6 a. Explain design of FIR filter using windowing technique with approximate expression and sketches. **(08 Marks)**

b. Design a low pass digital filter to be used in a A/D – H(z) – D/A structure that will have a -3db cutoff at 30π rad /sec, and an attenuation of 50 db at 45π rad /sec. The filter is required to have a linear phase and the system will use a sampling rate of 100 samples /sec. **(12 Marks)**

7 a. Explain the bilinear transformation between the 'S' domain and the 'Z' domain. Hence show that the region outside the unit circle in the domain corresponds to the right half of 'S' plane. **(10 Marks)**

b. Design a lowpass 1 rad/sec bandwidth Chebyshef filter of the following characteristics.
   i) Acceptable passband ripple of 2 db
   ii) Cutoff radians frequency of 1 rad /sec
   iii) Stop band attenuation of 20 db or greater beyond 1.3 rad /sec. **(10 Marks)**

8 Write short notes on: a. Overlap and add method. b. Relation between DFT and Z- Transforms. c. D.S.P architecture d. Application of TMS 320 processor. **(10 Marks)**

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