B. Tech Degree VI Semester Examination, April 2010

CS/EI/EE 601 DIGITAL SIGNAL PROCESSING

(2002 Scheme)

Time : 3 Hours Maximum Marks : 100

I. (a) Test the stability, causality and linearity of the following systems :

(i) $y(n) = x(n^2)$

(ii) $y(n) = Cos[x(n)]$ (6)

(b) Find the impulse response of the system described by the difference equation.

$$y(n) - 3y(n-1) - 4y(n-2) = x(n) + 2x(n-1).$$ (7)

(c) Determine the step response of the system whose impulse response is given by $h(n) = a^{-n}u(-n)$ for $0 < a < 1$. (7)

OR

II. (a) Find the inverse z-transform of $X(z) = \dfrac{1}{1 - \frac{3}{2}z^{-1} + \frac{1}{2}z^{-2}}$

when (i) ROC is given by $|z| < 0.5$

(ii) ROC is $|z| > 1.0$. (14)

(b) Determine the response of the system whose input $x(n)$ and impulse response $h(n)$ are given by

$$x(n) = \{\underset{\uparrow}{1}, 2, 3, 1\}$$

$$h(n) = \{1, \underset{\uparrow}{2}, 1, -1\}$$ (6)

III. (a) Calculate the percentage saving in calculations in a 512 point radix 2 FFT when compared to direct FFT. (4)

(b) An 8 point sequence is given by

$$x(n) = \{2, 2, 2, 2, 1, 1, 1, 1\}$$

Compute 8 point DFT of $x(n)$ by radix 2 DIF FFT. Sketch the magnitude and phase spectrum. (16)

OR

IV. (a) State and prove any three properties of DFT. (6)

(b) Compute the 4-point DFT of the sequence $x(n) = \{\underset{\uparrow}{0}, 1, 2, 3\}$. (5)

(c) Explain the decimation-in-time algorithm for computing DFT. (9)

(Turn Over)

V. (a) Realize the following systems with minimum number of multipliers.

(i) $$H(z)=\frac{1}{4}+\frac{1}{2}z^{-1}+\frac{3}{4}z^{-2}+\frac{z^{-3}}{2}+\frac{z^{-4}}{4}$$

(ii) $$H(z)=\left(1+\frac{1}{2}z^{-1}+z^{-2}\right)\left(1+\frac{1}{4}z^{-1}+z^{-2}\right).$$ (12)

(b) What are the advantages and disadvantages of FIR filters? (5)

(c) What is Gibb's oscillations? (3)

OR

VI. Design a highpass filter using Hamming window with cut off frequency of 1.2 radians/sec and N = 9. Obtain the linear phase realization. (20)

VII. (a) Explain the Impulse Invariant transformation method to develop an IIR filter transfer function. (10)

(b) For an analog transfer function $H_a(s)=\frac{2}{(s+1)(s+2)}$ determine $H(z)$ if sampling time period is 0.1 sec, using impulse invariant transformation. (6)

(c) Compare IIR filters and FIR filters. (4)

OR

VIII. (a) Apply Bilinear transformation to the analog transfer function

$$H_a(s)=\frac{2}{(s+1)(s+2)}$$

with sampling period $T=0.1$ sec to obtain $H(z)$. (4)

(b) Realize the following system in parallel and cascade forms.

$$H(z)=\frac{1+\frac{1}{2}z^{-1}}{\left(1-z^{-1}+\frac{1}{4}z^{-2}\right)\left(1-z^{-1}+\frac{1}{2}z^{-2}\right)}.$$ (16)

IX. (a) Explain limit cycle oscillations in recursive systems. (6)

(b) For the system described by the equation $y(n)=0.95y(n-1)+x(n)$ determine the dead band of the system. (10)

(c) Describe any one application of DSP. (4)

OR

X. (a) What is overflow limit cycle? How can it be eliminated? (10)

(b) Explain using a block diagram, the architecture of a typical DSP processor. (10)

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