NEW SCHEME

EE55

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Fifth Semester B.E. Degree Examination, January/February 2005

Electrical & Electronics Engineering

Digital Signal Processing

Time: 3 hrs.] [Max.Marks : 100

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

1. (a) Compute the N - point DFT of the sequences.

i) $x(n) = a^n \quad 0 \leq n < N-1$

ii) $x(n) = 1$ for n even

0 for n odd (10 Marks)

(b) Determine 8 point DFT of the sequence

$x(n) = [1, 1, 1, 1, 1, 1\ 00]$

Sketch its magnitude and phase spectra. (10 Marks)

2. (a) Consider the two four point sequences given below.

$$x(n) = cos\frac{\pi n}{2} \qquad 0 < n < 3$$
$$h(n) = 2^n \qquad 0 < n < 3$$

Calculate $y(n) = x(n)$ ④ $h(n)$. Use matrix method. (8 Marks)

(b) Compute 4 point circular convolution of the sequences given by

$x(n) = [1, 0, 5] h(n) = [0, 5, 1]$

Using DFT and IDFT method. (12 Marks)

3. (a) Given $x(n) = [0, 1, 2, 3, 4, 5, 6, 7]$ find $X(k)$ using DIT-FFT algorithm. (12 Marks)

(b) Compute DFT of the sequence $x(n) = cos\frac{n\pi}{2}$ where $N = 4$ using $DIF-FFT$ algorithm. (8 Marks)

4. (a) A linear time - varient system is described by the following input - output relation.

$2y(n) - y(n-2) - 4y(n-3) = 3x(n-2)$

Realize the system in the following form

i) Direct form I realization

ii) Direct form II realization. (8 Marks)

(b) Obtain a cascade realisation for the system function given below.

$$H(z) = \frac{(1+Z^{-1})^3}{(1-\frac{1}{4}Z^{-1})\,(1-Z^{-1}+\frac{1}{2}Z^{-2})}$$ (6 Marks)

(c) Realize a linear phase FIR filter with the following impulse response

$$h(n) = \delta(n) + \tfrac{1}{2}\delta(n-1) - \tfrac{1}{4}\delta(n-2) + \delta(n-4) + \tfrac{1}{2}\delta(n-3)$$

(6 Marks)

5. (a) Consider an FIR filter having the system function

$H(Z) = 1 + Z^{-1} + Z^{-2} + ...Z^{-(N-1)}$

Deduce a realization for this FIR filter so that there are only two additions and no multiplications but N delay elements. (8 Marks)

(b) Explain the principal features of the Harvard architecture. (6 Marks)

(c) Explain Bilinear transformation method of digital filter design. (6 Marks)

6. (a) A second order analog filter has repeated poles at $s = -a$ transform filter to digital domain, using impulse invariance mapping method. (6 Marks)

(b) Apply impulse variance transformation to the analog transfer function.
$H(s) = \frac{e}{s^2+As+B}$ to digital domain. (8 Marks)

(c) Convert the analog filter with system function $H(s) = \frac{s+a}{(s+a)^2+b^2}$ into digital filter impulse response by the use of the bilinear mapping technique. (6 Marks)

7. Design an IIR filter that when used in the prefilter $A/D-H(z)-D/A$ structure will satisfy the following equivalant analog specifications.

i) LPF with -1 dB cut off at $100\pi\ rad/sec$

ii) Stopband attenuation of $35dB$ at $1000\pi rad/sec$

iii) Monotonic stopband and pass band

iv) Sampling rate of 2000 samples/sec. Use Bilinear transform. (20 Marks)

8. (a) Design a LPF with approximate frequency response given below using rectangular window.

$$H_d(e^{j\omega}) = 1 \quad \omega \le \frac{\pi}{2}$$
$$= 0 \quad \frac{\pi}{2} \le |\omega| \le \pi$$

Take $M = 11$, find the values of $h(n)$. (10 Marks)

(b) The desired frequency response of LPF is

$$H_d(e^{j\omega}) = e^{-j3\omega} \quad -\frac{3\pi}{4} \le \omega \le \frac{3\pi}{4}$$
$$= 0 \quad -\frac{3\pi}{4} \le |\omega| \le \pi$$

Design using Hamming window $M = 7$

Also obtain frequency response. (10 Marks)

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