K 1054

B.E./B.Tech. DEGREE EXAMINATION, NOVEMBER/DECEMBER 2004.

Fifth Semester

Information Technology

IF 351 — DIGITAL SIGNAL PROCESSING

Time : Three hours Maximum : 100 marks

Answer ALL questions.

PART A — ($10 \times 2 = 20$ marks)

1. What is the causality condition for an LTI system?

2. What are the different methods of evaluating inverse Z–transform?

3. What is zero–padding? What are its uses?

4. How many multiplications and additions are required to compute N–point DFT using radix–2 FFT?

5. Draw the direct form realization of FIR system.

6. What is the effect of quantization on pole locations?

7. What are the desirable characteristics of windows?

8. Give the equation specifying Bartlett and Hamming windows.

9. What is an anti–imaging filter?

10. What is a decimator? If the input to the decimator is $x(n) = \{1, 2, -1, 4, 0, 5, 3, 2\}$, what is the output?

PART B — ($5 \times 16 = 80$ marks)

11. (i) Let $X(k)$ denote the N–point DFT of an N–point sequence $x(n)$. If the DFT of $X(k)$ is computed to obtain a sequence $x_1(n)$. Determine $x_1(n)$ in terms of $x(n)$. (10)

(ii) Perform the circular convolution of the following sequences :

$x_1(n) = \{1, 1, 2, 1\}$

$x_2(n) = \{1, 2, 3, 4\}$ (6)

12. (a) (i) Determine whether the following systems are linear, time–invariant (8)

(1) $y(n) = Ax(n) + B$

(2) $y(n) = x(2n)$.

(ii) Find the convolution of the following sequences :

(1) $x(n) = u(n);\ h(n) = u(n-3)$

(2) $x(n) = \{1, 2, -1, \underset{\uparrow}{1}\};\ h(n) = (1, \underset{\uparrow}{0}, 1, 1)$ (4 + 4)

Or

(b) (i) Determine the impulse response of the following causal system

$y(n) - 2\cos\theta\ y(n-1) + y\ (n-2) = x(n)$ (8)

(ii) Determine the z–transform of the following :

(1) $x(n) = n(-1)^n u(n)$

(2) $x(n) = (-1)^n \cos(\pi n/3)\ u\ (n)$. (4 + 4)

13. (a) (i) Obtain the cascade and parallel form realizations for the following system

$y(n) = -0.1\ y(n-1) + 0.2\ y(n-2) + 3x(n) + 3.6\ x(n-1) + 0.6\ x\ (n-2)$. (10)

(ii) Explain in detail about the round–off effects in digital filters. (6)

Or

(b) Compute the 8–point DFT of the sequence :

$x(n) = \{0.5, 0.5, 0.5, 0.5, 0, 0, 0, 0\}$ using the in–place radix–2 DIT algorithm. (16)

14. (a) Design an ideal low pass filter with a frequency response :

$H_d(e^{j\omega}) = 1$ for $\pi/4 \le |\omega| \le \pi$

$= 0$ for $0 \le |\omega| \le \pi/4$

Find the value of $h(n)$ for $N = 11$ using

(i) Hamming window.

(ii) Hanning window. (16)

Or

(b) (i) An analog filter has a transfer function :

$$H(s) = \frac{10}{s^2 + 7s + 10}$$

Design a digital filter equivalent to this using impulse–invariant method. (8)

(ii) Explain in detail about frequency sampling method of designing an FIR filter. (8)

15. (a) Write a detailed note on :

(i) Spectrum of the down sampled signal. (8)

(ii) Multistage implementation of sampling rate converters. (8)

Or

(b) Write applications of multirate signal processing in

(i) Musical sound processing. (8)

(ii) Sub–band coding of speech signal. (8)