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M 2451

B.E./B.Tech. DEGREE EXAMINATION, APRIL/MAY 2008.

Fifth Semester

Computer Science and Engineering

CS 331 — DIGITAL SIGNAL PROCESSING

Time : Three hours   Maximum : 100 marks

Answer ALL questions.

PART A — (10 × 2 = 20 marks)

1.   Define Unit step signal.

2.   Interprete the distributive law of convolution.

3.   Determine the Fourier transform of the signal :

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

4.   Write the Wiener–Khintchine theorem.

5.   Differentiate Lowpass and Highpass filter.

6.   Determine the inverse of the system with impulse response :

      $h(n) = \left(\dfrac{1}{2}\right)^n u(n)$.

7.   Define SNR.

8.   Define FIR filter.

9.   Write about polyphase filter.

10.   What is autocorrelation?

PART B — (5 × 16 = 80 marks)

11. (a) (i) The impulse response of a linear time invariant system is

$h(n) = \{1, 2, 1, -1\}$
    ↑

Determine the response of the system to the input signal.

$x(n) = \{1, 2, 3, 1\}$ (8)
       ↑

(ii) Check whether $y(n) = e^{x(n)}$ is a linear time invariant system.   (8)

Or

(b) (i) Explain the correlation of Discrete-time signals.   (8)

(ii) Discuss the following characteristics of the system, linearity, time invariance, causality, stability.   (8)

12. (a) Determine the Fourier series coefficients and the power density spectrum of the periodic signals as shown in Figure (1).   (16)
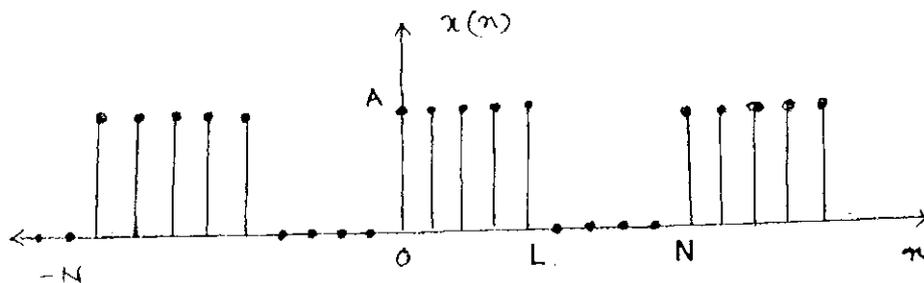

Fig. (1)

Discrete time periodic square-wave signal.

Or

(b) Explain the properties of Fourier Transform for Discrete time signals.(16)

13. (a) (i) Perform the circular convolution of the following sequences :   (8)

$x_1(n) = \{2, 1, 2, 1\}$
       ↑

$x_2(n) = \{1, 2, 3, 4\}$
       ↑

(ii) Write note on the design of FIR filters using window functions.   (8)

Or

(b) Sketch the block diagram for the direct-form realization and the frequency-sampling realization of the $M = 32$, $\alpha = 0$, linear phase (symmetric) FIR filter which has frequency samples.

$$H\left(\frac{2\pi k}{32}\right) = \begin{cases} 1 & ; \ k = 0, 1, 2 \\ 1/2 & ; \ k = 3 \\ 0 & ; \ k = 4, 5, \cdots 15. \end{cases}$$

Compare the computational complexity of these two structures. $(8 + 8)$

14. (a) (i) Discuss the round off effects in Digital filters. (10)

(ii) Compare FIR and IIR filters. (6)

Or

(b) Explain the designing methods of IIR filters from analog filters. (16)

15. (a) (i) How do you estimate the autocorrelation and power spectrum of random signals? (10)

(ii) Explain the use of DFT in power spectrum estimation. (6)

Or

(b) Explain the following sampling rate conversion techniques. (16)

(i) Decimation

(ii) Interpolation.