Reg. No. : | | | | | | | | | | | |

Question Paper Code : Q 2844

B.E./B.Tech. DEGREE EXAMINATION, NOVEMBER/DECEMBER 2009.

Fourth Semester

Information Technology

IT 1252 — DIGITAL SIGNAL PROCESSING

(Regulation 2004)

Time : Three hours Maximum : 100 marks

Answer ALL questions.

PART A — (10 × 2 = 20 marks)

1. Derive the necessary and sufficient conditions for an LTI system to be BIBO stable.

2. What is a Shift Invariant System?

3. List any two properties of Fourier Transform.

4. Draw the basic butterfly diagram for the computation in the radix-2 decimation-in-frequency FFT algorithm.

5. Compare IIR and FIR filters.

6. Convert $H(s) = \frac{1}{s^2+1}$ into a digital filter using approximation of derivatives with T = 0.1 sec.

7. Define Gibb's phenomenon.

8. State the condition satisfied by linear phase FIR filter.

9. Define sampling rate conversion.

10. Define sub-band coding.

PART B — (5 × 16 = 80 marks)

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

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

Determine the response of the system to the input signal

$X(n) = \{1, 2, 3, 1\}$.
$\uparrow$ (12)

(ii) Determine the range of values of the parameter 'a' for which the linear time–invariant system with impulse response $h(n) = a^n u(n)$ is stable. (4)

Or

(b) (i) State and explain the properties of Z-transform. (8)

(ii) Determine the inverse Z-transform of

$X(Z) = 1/(1 - 1.5z^{-1} + 0.5z^{-2})$ if

(1) ROC : $|Z| > 1$

(2) ROC : $|Z| < 0.5$

(3) ROC : $0.5 < |Z| < 1$. (8)

12. (a) (i) Compute 8 point DFT using DIF FFT radix 2 algorithm.

$x(n) = \{0, 1, 2, 3, 4, 5, 6, 7\}$. (8)

(ii) Mention the differences and similarities between DIT and DIF FFT algorithms. (8)

Or

(b) (i) List the steps involved for the radix-2 DIT-FFT algorithm. Explain. (8)

(ii) Using DIT FFT radix 2 algorithm convolve $x(n) = \{1, -1, 2\}$ and $h(n) = \{2, 2\}$. (8)

13. (a) Explain in detail the steps involved in the design of IIR filter using Bilinear transformation. (16)

Or

(b) Determine the cascade and parallel realizations for the system, described by the system function

$$H(Z) = 10(1 - (\tfrac{1}{2})z^{-1})(1 - (2/3)z^{-1})(1 + 2z^{-1})/$$
$$[(1 - (3/4)z^{-1})(1 - (1/8)z^{-1})(1 - (1/2 + j1/2)z^{-1})(1 - (1/2 - j1/2)z^{-1})].$$

(16)

14. (a) Design a FIR low pass filter having following specifications :

$$H_d(e^{j\omega}) = 1 \quad \text{for} \quad -\pi/6 \leq |\omega| \leq \pi/6$$
$$= 0 \quad \text{for} \quad \text{otherwise}$$

and given that $N = 7$ using

(i) Hanning window

(ii) Hamming window

(iii) Blackman window. (16)

Or

(b) Determine the coefficients of a linear phase FIR filter of length $M = 15$ which has a symmetric unit sample response and a frequency response that satisfies the conditions

$$H_r(2\pi k/15) = 1, \quad \text{for } k = 0, 1, 2, 3$$
$$= 0.4 \quad \text{for } k = 4$$
$$= 0 \quad \text{for } k = 5, 6, 7. \quad (16)$$

15. (a) Discuss the effect of finite word length. (16)

Or

(b) Explain Multirate digital signal processing. (16)