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

Fifth Semester

(Regulation 2004)

Electronics and Communication Engineering

EC 1302 — DIGITAL SIGNAL PROCESSING

(Common to B.E. (Part-Time) Fourth Semester Regulation 2005)

Time : Three hours Maximum : 100 marks

Answer ALL questions.

PART A — ($10 \times 2 = 20$ marks)

1. Define the properties of convolution.

2. Draw the basic butterfly diagram of radix – 2 FFT.

3. What are the merits and demerits of FIR filters?

4. What is the relationship between analog and digital frequency in impulse invariant transformation?

5. What are the three types of quantization error occurred in digital systems?

6. What is meant by limit cycle oscillations?

7. What is a periodogram?

8. Determine the frequency resolution of the Bartlett method of power spectrum estimates for a quality factor Q = 15. Assume that the length of the sample sequence is 1500.

9. What is meant by pipelining?

10. What is the principal feature of the Harvard architecture?

PART B — (5 × 16 = 80 marks)

11. (a) (i) Discuss in detail the important properties of the Discrete Fourier Transform. (8)

(ii) Find the 4 point DFT of the sequence (8)

$x(n) = Cos\, n\pi/4$.

Or

(b) (i) Using decimation-in-time draw the butterfly line diagram for 8 point FFT calculation and explain. (8)

(ii) Compute an 8 point DFT using DIF FFT radix 2 algorithm. (8)

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

12. (a) (i) Determine the magnitude response of an FIR filter (M = 11) and show that the phase and group delays are constant (8)

$$H(z) = \sum_{n=0}^{M-1} h(n) z^{-n}$$

(ii) If the desired response of a low-pass filter is

$$H_d(e^{iw}) = e^{-j3w}, \quad -3\pi/4 \le w \le 3\pi/4$$
$$0, \qquad 3\pi/4 < |w| \le \pi$$ (8)

Determine $H(e^{iw})$ for $M = 7$ using a Hamming window.

Or

(b) (i) For the analog transfer function $H(s) = \dfrac{1}{(s+1)(s+2)}$ determine $H(z)$ using impulse invariant technique. Assume $T = 1s$. (6)

(ii) Design a digital Butterworth filter that satisfies the following constraint using bilinear transformation ($T = 1s$) (10)

$$0.9 \le |H(e^{iw})| \le 1 \quad \text{for } 0 \le w \le \pi/2$$
$$|H(e^{iw})| \le 0.2 \quad \text{for } 3\pi/4 \le w \le \pi$$

13. (a) (i) Discuss in detail the Truncation error and Round-off error for sign magnitude and two's complement representation. (8)

(ii) Explain the quantization effects in converting analog signal into digital signal. (8)

Or

(b) (i) A digital system is characterized by the difference equation

$y(n) = 0.9y(n-1) + x(n)$

With $x(n) = 0$ and initial condition $y(-1) = 12$. Determine the dead band of the system. (4)

(ii) What is meant by the co-efficient quantization? Explain. (12)

14. (a) (i) Explain the Barlett method of averaging periodograms. (8)

(ii) What is the relationship between autocorrelation and power spectrum? Prove it. (8)

Or

(b) (i) Derive the mean and variance of the power spectral estimate of the Blackman and Tukey method. (8)

(ii) Obtain the expression for mean and variance of the auto correlation function of random signals. (8)

15. (a) (i) Describe the multiplier and accumulator unit in DSP processors. (6)

(ii) Explain the architecture of TMS 320 C5X DSP processor. (10)

Or

(b) (i) Discuss in detail the four phases of the pipeline techniques. (8)

(ii) Write short notes on :

(1) Parallel logic unit (4)

(2) Circular registers. (4)