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Question Paper Code : 21399

B.E./B.Tech. DEGREE EXAMINATION, NOVEMBER/DECEMBER 2015.

Seventh Semester

Computer Science and Engineering

CS 2403/CS 73 — DIGITAL SIGNAL PROCESSING

(Common to Fifth Semester – Information Technology)

(Regulations 2008)

(Also common to PTCS 2403 – Digital Signal Processing for B.E. (Part-Time)
Sixth Semester – Computer Science and Engineering – Regulations 2009)

Time : Three hours

Maximum : 100 marks

Answer ALL questions.

PART A — (10 × 2 = 20 marks)

1. A discrete-time signal $x(n) = \{-2, -1, 0, 1, -1, 1\}$ is multiplied by $u(-n-2)$.
What is the resulting signal?
2. What is a shift-invariant system? Give an example.
3. Find the circular convolution of two sequences $x_1(n) = \{1, 2, 2, 1\}$ and $x_2(n) = \{1, 2, 3, 1\}$.
4. Calculate the number of multiplications needed in the calculation of DFT using FFT algorithm with 32-point sequence.
5. Compare digital and analog filters.
6. What is meant by impulse invariant method of designing IIR filter?
7. What conditions on the FIR sequence $h(n)$ are to be imposed in order that this filter can be called a linear phase filter?
8. What is the effect of quantization on pole locations?
9. What is the need for anti-imaging filter after up sampling a signal?
10. What is a channel vocoder?

PART B — (5 × 16 = 80 marks)

11. (a) (i) Determine whether each of the following systems below is
(1) Causal (2) Linear (3) Dynamic (4) Time invariant (5) Stable.

(A) $y(n) = e^{-x(n)}$

(B) $y(n) = x(n) \sum_{k=-\infty}^{\infty} \delta(n-2k)$. (8)

- (ii) Explain sampling theorem and reconstruction of the analog signal from its samples. (9)

Or

- (b) (i) Explain the properties of cross correlation and autocorrelation sequences. (8)

- (ii) Find the discrete convolution of the following sequences.

$u(n) * u(n-3)$. (8)

12. (a) (i) Explain any four properties of DFT. (8)

- (ii) Compute the eight-point DFT of the sequence $x(n) = \{0.5, 0.5, 0.5, 0.5, 1, 2, -1, 0\}$ using the in-place-radix-2 DIT algorithm. (8)

Or

- (b) (i) Draw the flowgraph of a two-point radix-2 DIF-FFT algorithm. What is the basic operation of DIF algorithm? (8)

- (ii) Find the IDFT of the sequence

$X(k) = \{4, 1 - j2.414, 0, 1 - j0.414, 0, 1 + j0.414, 0, 1 + j2.414\}$ using DIF algorithm. (8)

13. (a) (i) Design an analog Butterworth filter that has a -2dB passband attenuation at a frequency of 20 rad/sec and atleast -10dB stopband attenuation at 30 rad/sec. (10)

- (ii) Explain the steps of design of digital filters from analog filters. (6)

Or

- (b) (i) Using the bilinear transform, design a high pass filter, monotonic in passband with cutoff frequency of 1000 Hz and down 10 dB at 350 Hz. The sampling frequency is 5000 Hz. (10)

- (ii) Explain the methods of realization of digital filters. (6)

14. (a) (i) Using a rectangular window technique design a low pass filter with passband gain of unity, cut off frequency of 1000 Hz and working at a sampling frequency of 5 KHz. The length of the impulse response should be 7. (10)
- (ii) Compare FIR and IIR filters. (6)

Or

- (b) (i) Obtain the cascade realization of system function
$$H(z) = (1 + 2z^{-1} - z^{-2})(1 + z^{-1} - z^{-2}).$$
 (10)
- (ii) Explain the quantization errors due to finite word length registers in digital filters. (6)
15. (a) (i) Explain aliasing effect in down sampling. (8)
- (ii) Explain subband coding technique used in speech coding. (8)

Or

- (b) (i) Explain digital processing of audio signals. (8)
- (ii) Explain digital signal processing in image enhancement. (8)