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Question Paper Code : 52954

B.E./B.Tech. DEGREE EXAMINATIONS, APRIL/MAY 2019.

Fourth Semester

Electrical And Electronics Engineering

EE 6403 – DISCRETE TIME SYSTEMS AND SIGNAL PROCESSING

(Common to Electronics and Instrumentation Engineering/Instrumentation and Control Engineering)

(Regulation 2013)

Time : Three hours Maximum : 100 marks

Answer ALL questions.

PART A — (10 × 2 = 20 marks)

1. Is the system $y(n) = |x(n)|$ linear and time invariant? Justify your answer.

2. Define unit sample response of a system and state its significance.

3. If $x(n)$ represents the signal and $X(\omega)$ represents the Discrete Time Fourier Transform of $x(n)$, then prove : $x(n-k) \xleftrightarrow{FT} e^{-jwk} X(\omega)$.

4. Obtain the circular convolution of $x_1(n) = \{1, 2, 3\}$ and $x_2(n) = \{-3, 1, -2\}$.

5. Write any two properties of Discrete Fourier Transform.

6. Obtain the IDFT of the sequence $X(k) = \{10, -2 + j2, -2, -2 - j2\}$ using DIT-FFT algorithm.

7. The most straight forward approach to FIR filter design is to truncate the impulse response of an ideal IIR filter. Why this is usually an undesirable approach?

8. Obtain the transfer function for a normalized Butterworth filter of order 2.

9. State how a Digital Signal Processor is different from other processors.

10. Mention any four applications of Digital Signal Processor.

PART B — (5 × 13 = 65 marks)

11. (a) (i) Explain the features of Linear. Time Invariant, Causal and Stable Systems. (7)

(ii) A Digital System is characterized by the difference equation $y(n) = x(n) - 0.5y(n-1) + 0.25x(n-1)$. Check the system for Linearity, Time invariance Causality and Stability. (6)

Or

(b) (i) Explain the process of converting an analog signal to discrete time discrete amplitude signal with necessary diagrams. (7)

(ii) A signal $x(t) = \sin c(50\pi t)$ is sampled at a rate of 20 Hz, 50 Hz and 75 Hz. For each of these three cases, explain if you can recover the signal $x(t)$ from the sampled signal. (6)

12. (a) (i) State and explain any four properties of Z-transform. (8)

(ii) Evaluate the frequency response of the system described by the system function

$$H(z) = \frac{1}{1 - 0.5z^{-1}}. \quad (5)$$

Or

(b) (i) Determine the pole-zero plot for the system described by the difference equation $y(n) - \frac{3}{4}y(n-1) + \frac{1}{8}y(n-2) = x(n) - x(n-1)$. (8)

(ii) Prove that a system having system function $H(z)$ is stable, if and only if all poles of $H(z)$ are inside the unit circle. (5)

13. (a) (i) Compute the 2N point DFT of $y(n)$ in terms of $X(k)$, where $X(k)$ is the N-point DFT of the sequence $x(n)$, $0 \le n \le N-1$. (5)

(ii) Compute the DFT of the three point sequence $x(n) = \{2, 1, 1\}$. (4)

(iii) When $X(k)$ is the DFT of an N-point sequence $h(n)$, prove that $X(k)$ is real and even, when $x(n)$ is real and even. (4)

Or

(b) (i) Compute the DFT sequence for the following sequence using Radix-2 decimation-in-frequency FFT algorithm. (9)

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

(ii) Indicate how inverse DFT can be computed by using FFT Algorithm. (4)

14. (a) (i) Realize the IIR system with difference equation

$$y(n) + \frac{1}{4}y(n-1) - \frac{1}{8}y(n-2) = x(n) - 2x(n-1) + x(n-2)$$ in cascade and parallel form. (7)

(ii) Determine $H(z)$ for Chebyshev filter satisfying the following specifications.

$0.8 \le |H(e^{j\omega})| \le 1$ for $0 \le \omega \le 0.2\pi$

$|H(e^{j\omega})| \le 0.2$ for $0.6\pi \le \omega \le \pi$

Assume $T = 0.1$ sec. Apply bilinear transformation method. (6)

Or

(b) (i) Design a high pass filter using Hamming window with a cut-off frequency of 1.2 radians/sec and $N = 9$. (7)

(ii) Summarize the factors that decide the choice of window in FIR filter design using windowing techniques. Also compare the merits and demerits of windowing techniques. (6)

15. (a) Sketch the block diagram of typical digital signal processor and explain the functional elements. (13)

(b) (i) Illustrate the different addressing formats of a DSP processor with examples. (7)

(ii) Highlight the features of a commercial digital signal processor. (6)

PART C — (1 × 15 = 15 marks)

16. (a) Explain how digital signal processors can be used to implement Biomedical Signal Processing Algorithms with a case study of your choice.

Or

(b) Suggest a DSP Architecture required for a DSP device to implement each of the following

(i) FIR filter

(ii) 8 point DIT FFT.

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