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

Question Paper Code : 20739

B.E./B.Tech. DEGREE EXAMINATION, NOVEMBER/DECEMBER 2018.

Fifth/Sixth Semester

Information Technology

IT 6502 — DIGITAL SIGNAL PROCESSING

(Common to : Computer Science and Engineering/Mechatronics Engineering)

(Regulation 2013)

Time : Three hours

Maximum : 100 marks

Answer ALL questions.

PART A — (10 × 2 = 20 marks)

1. A signal $x(t) = \sin(5\pi t)$ is sampled and what is the minimum sampling frequency is needed to reconstruct the signal without aliasing.

2. Find the system (transfer) function of given difference equation Using z transform $y(n) - 0.5y(n-1) = x(n)$.

3. Compute the DFT of unit impulse signal.

4. Give any two applications of DCT.

5. Why Impulse invariant transformation is not Suitable for the design of high pass filter?

6. Write the transformation which is used for conversion of analog domain to digital domain by using bilinear transformation

7. Write the condition for FIR filter to have linear phase.

8. Give the window function of Hamming window.

9. Perform the addition of the decimal numbers (0.5 and 0.25) using binary fixed point representation.

10. Define deadband. How do calculate the deadband of an IIR system?

PART B — (5 × 13 = 65 marks)

11. (a) Relate Nyquist rate criteria and aliasing effect with sampling process. Discuss how aliasing error can be avoided. (13)

Or

(b) Determine the Region of Convergence of the following signal using z transform :

(i) $x(n) = u(-n)$. (4)

(ii) $x(n) = u(l-n)$. (4)

(iii) $x(n) = (2)^n u(-n)$. (5)

12. (a) (i) Summarize the properties of DFT. (6)

(ii) Determine the circular Convolution of the following system

(1) $x(n) = \{1,2,3\}$ and $h(n) = \{1,2,1\}$. (3)

(2) $x(n) = \{4\ 1\ 2\ -3\}$ and $h(n) = \{1\ -1\ 2\}$. (4)

Or

(b) (i) Compute the DFT of given sequence using DIF-FFT algorithm.

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

(ii) Determine the IDFT of $X(k) = \{6\ -2-2j\ 2\ -2+2j\}$ using DIT algorithm. (5)

13. (a) Compute a Chebyshev analog lowpass filter transfer function by using bilinear transformation technique for the following specification ($T = 1$ sec):

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

$|H(e^{j\omega})| \le 0.2,\ 0.6\pi \le \omega \le \pi$. (13)

Or

(b) Design a Butterworth digital lowpass filter using impulse invariant technique with $T = 1$ sec satisfying the following specification. (13)

$$0.8 \leq \left|H(e^{j\omega})\right| \leq 1 \quad 0 \leq \omega \leq 0.25\pi$$

$$\left|H(e^{j\omega})\right| \leq 0.15 \quad 0.65\pi \leq \omega \leq \pi$$

14. (a) Design an Ideal highpass filter with frequency response using hamming window

$$H_d(e^{j\omega}) = \begin{cases} 0, & -\frac{\pi}{2} \leq \omega \leq \frac{\pi}{2} \\ 1, & \frac{\pi}{2} \leq |\omega| \leq \pi \end{cases}$$

Plot the magnitude response for N = 7. (13)

Or

(b) Design an ideal lowpass filter with frequency response using rectangular window.

$$H_d(e^{j\omega}) = \begin{cases} 1, & -\frac{\pi}{4} \leq \omega \leq \frac{\pi}{4} \\ 1, & \frac{\pi}{4} \leq |\omega| \leq \pi \end{cases}$$ (13)

Plot the magnitude response for N = 11.

15. (a) (i) Define Quantization noise. Derive the quantization noise power. (5)

(ii) Compute the coefficient quantization error of given second order IIR filter system by both direct and cascade form. Assume $b = 3$ bits. (8)

$$H(z) = \frac{1}{(1 - 0.95z^{-1} + 0.255z^{-2})}$$

Or

(b) (i) Determine the limit cycle oscillations and deadband of the following first order IIR filter. Truncated bit $b = 3$. (8)

$$y(n) + 0.95y(n-1) = x(n).$$

Input to the system is

$$x(n) = \begin{cases} 0.875, & n = 0 \\ 0, & \text{otherwise} \end{cases}$$

(ii) Discuss the overflow error signal scaling. (5)

PART C — (1 × 15 = 15 marks)

16. (a) Show that convolution and cross-correlation of the following sequences are same (15)

(i) $x(n) = \{1 \;\; 2 \;\; 1 \;\; 1\}$ and $y(n) = \{1 \;\; 2 \;\; 2 \;\; 1\}$

(ii) $x(n) = \{2 \;\; 0 \;\; 2 \;\; 1\}$ and $y(n) = \{2 \;\; -3 \;\; -3 \;\; 2\}$,

(iii) $x(n) = \{3 \;\; 0 \;\; 3\}$ and $y(n) = \{-3 \;\; 1 \;\; -3\}$

Or

(b) Compute the linear convolution of following sequences by using FFT method $x(n) = \{1 \;\; 3 \;\; 1\}$ and $h(n) = \{-2 \;\; 2\}$. (15)