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

Question Paper Code : 20239

B.E./B.Tech. DEGREE EXAMINATION, MAY/JUNE 2012.

Seventh Semester

Computer Science and Engineering

CS 2403/CS 73 — DIGITAL SIGNAL PROCESSING

(Common to Fifth Semester Information Technology)

(Regulation 2008)

Time : Three hours Maximum : 100 marks

Answer ALL questions.

PART A — (10 × 2 = 20 marks)

1. Determine even and odd components of the signal, $x(n) = \exp\left(j\frac{\pi}{4}n + j\frac{\pi}{2}\right)$. Where $j = \sqrt{-1}$.

2. Compute the autocorrelation of the signal, $x(n) = (0.5)^n u(n)$.

3. Write the formula for Discrete Time Cosine transform. (DCT) pair.

4. What is FFT?

5. What are the limitations of Impulse invariant technique of designing filters?

6. Given the low pass transfer function $H_a(s) = \frac{1}{s+1}$. Find the High pass Transfer function having a cutoff frequency 10 rad/sec.

7. Compare the digital signal processing systems with fixed point and floating point representation.

8. List few applications, where in Linear phase is preferred.

9. Draw the basic building blocks of Adaptive filters.

10. Let $x(n) = \{1.5, \underset{\uparrow}{1}, 0.5, -0.2, 1.5, -7.5\}$: Compute (a) $x\left(\frac{n}{3}\right)$ (b) $x(4n)$.

PART B — (5 × 16 = 80 marks)

11. (a) (i) State sampling theorem and explain aliasing graphically. (8)

(ii) Find the circular convolution of $x(n)*h(n)$ Given that

$$x(n) = \begin{cases} 1. & 0 \le n \le 99 \end{cases}$$

$$h(n) = \begin{cases} (0.5)^n, & 0 \le n \le 49 \\ 0, & 50 \le n \le 99 . \end{cases}$$ (4)

(iii) Find the z-transform of the given sequence $x(n) = 8(n-5) + e^n u(n-2) + u(n)$. (4)

Or

(b) (i) Find the Linear convolution of $x(n)*h(n)$ through circular convolution. Assume the suitable length. M.

$$x(n) = \begin{cases} (0.5)^n, & 0 \le n \le 9 \\ 0 & \text{otherwise} \end{cases}$$

$$h(n) = \begin{cases} (0.8)^n, & 0 \le n \le 19 \\ 0 & \text{otherwise.} \end{cases}$$ (8)

(ii) List all the properties of Analog and Digital frequencies. (4)

(iii) Find the Z-transform of Auto correlation of signal. (4)

12. (a) (i) Let $X(K) = DFT\{x(n)\}$ with n; $K = 0, 1, \cdots, (N-1)$. Determine the relationship between $X(K)$ and the following DFTs.

(1) $DFT\{\text{Re}\, x(n)\}$

(2) $DFT\{x(n-1)\}$. (9)

(ii) State and prove any two properties of DFT. (7)

Or

(b) (i) Compute the DFT of the following sequence :

(1) $x(n) = [1.\ 0, -1, 0]$

(2) $x(n) = Cos(0.25\,\pi n),\ n = 0, 1, 2, \cdots, 7$. (8)

(ii) Write short notes on filtering methods using DFT. (8)

13. (a) (i) An impulse response, $h(t) = \exp(-0.5\,t)\,u(t)$ of certain LTI system. Find the T.F. $H(z)$ use impulse invariant technique. Assume $T = 2$ sec. (8)

(ii) Compare the Analog filters with digital filters. (4)

(iii) Differentiate between Bilinear transformation with frequency translation of filter transfer function. (4)

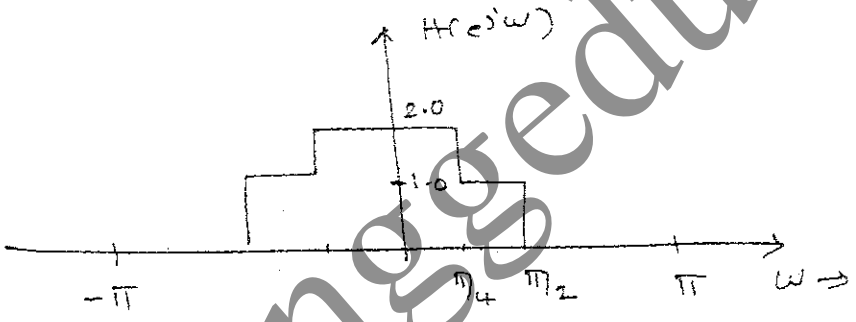
Or

(b) (i) Draw the Ideal Gain Vs frequency characteristics of HPF and BPF and also how the above filters (practically) specified. (8)

(ii) Write short notes on frequency translation in both Analog and Digital domain. (8)

14. (a) The Hamming window is given by $\omega(n) = 0.54 - 0.46\cos\frac{2\pi n}{m-1}, 0 \le n \le m-1$.

Compute the first 10 coefficients using the above window functions having the magnitude response. (16)



Or

(b) (i) Draw the three different structure of $H(z)$.

$$H(z) = \left(1 + 0.5\,z^{-1}\right)\left(1 + 0.75\,z^{-1}\right)^3. \quad (8)$$

(ii) Given $H(z)$, compute the truncated $H'(z)$ with coefficients represented by (1) 4-bit word length (2) 6-bit word length at frequency $\omega = \pi/3$

$$H(z) = \frac{1}{z - 0.752352}. \quad (8)$$

15. (a) (i) Explain the salient features of image enhancement technique. (10)

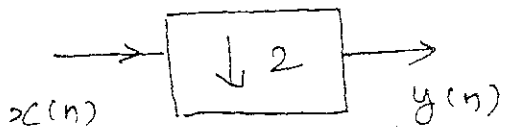
(ii) Write a brief note on speech compression technique. (6)

Or

(b) (i) Determine the output $y(n)$ for each of the given input signal $x(n)$

(1) $x(n) = 8(n-4)$

(2) $x(n) = \exp(j\ 0.2n\ \pi)\ u(n)$. (8)



(ii) Explain the sampling by rational factor by taking an example of your own. Also state its uses in DSP systems. (8)