PMM/KS/15/7051/7061

Faculty of Engineering & Technology

Sixth Semester B.E. (Electronics)/ET/EC (C.B.S) Examination

DIGITAL SIGNAL PROCESSING

Time—Three Hours] [Maximum Marks—80

INSTRUCTIONS TO CANDIDATES

(1) All questions carry marks as indicated.

(2) Solve Question No. **1 OR** Question No.**2**

(3) Solve Question No. **3 OR** Question No.**4**

(4) Solve Question No. **5 OR** Question No.**6**

(5) Solve Question No. **7 OR** Question No.**8**

(6) Solve Question No. **9 OR** Question No.**10**

(7) Solve Question No. **11 OR** Question No.**12**

(8) Assume suitable data whenever necessary.

(9) Illustrate your answers whenever necessary with the help of neat sketches.

(10) Use of non programmable calculator is permitted.

1. (a) Explain advantages and limitations of DSP over ASP. 5

(b) Consider the analog signal :

$x_a(t) = 3 \cos 2000 \pi t + 5 \sin 6000 \pi t + 10 \cos 12000 \pi t$

(i) What is the Nyquist rate for this signal ?

(ii) Assume now that we sample this signal using sampling frequency of 5 kHz. What is the discrete time signal x(n) obtained after sampling ?

(iii) What is the analog signal $y_a(t)$ that we can reconstruct from the samples if we use ideal interpolation ? 9

OR

2. (a) Explain different classifications of DT systems. Examine the following system with respect to different classifications :

$y(n) = x(n)2^{-n}$ 7

(b) Compute the convolution of the following signals graphically or analytically :

$x_1(n) = u(n) - u(n-5)$

$x_2(n) = 2[u(n) - u(n-3)]$ 7

3. (a) Find z-transform of the following signals :

(i) $x(n) = \left(\frac{1}{2}\right)^n u(n+2) + 3^n u(-n-1)$

(ii) $x(n) = \delta(n) + \frac{1}{2}\delta(n-3)$ 7

(b) State and prove any two properties of z-transform. 6

OR

4. (a) Find inverse z-transform of the following using power series expansion method when x(n) is causal and when x(n) is anticausal :

$$X(z) = \frac{1 + z^{-1}}{1 - 2z^{-1} + z^{-2}}$$ 6

(b) Find the step response of the following system using z-transform :

$$y(n) + 3y(n-1) + 2y(n-2) = x(n) - x(n-1)$$ 7

5. Find 8 point DFT of the following sequence using DIT-FFT algorithm

$$x(n) = (-1)^n, \; 0 \le n \le 7$$

Also compute the number of complex additions and multiplications required. 14

OR

6. Compute the circular convolution of the following sequences using DFT and IDFT :

$h(n) = \{1, 2, 3, 4\}$, $x(n) = \{1, 2, 2, 1\}$ 14

7. Design a digital Butterworth filter that satisfies the following constraints using Bilinear transformation. Assume T = 1 sec.

$$0.9 \leq |H(w)| \leq 1, \quad 0 \leq w \leq \frac{\pi}{2}$$

$$|H(w)| \leq 0.2 \quad \frac{3\pi}{4} \leq w \leq \pi$$

13

OR

8. A filter (LTI system) is described by the following difference equation :

$$y(n) = \frac{3}{4}y(n-1) + \frac{1}{8}y(n-2) + x(n) + \frac{1}{3}x(n-1)$$

Implement the system using DF-I, DF-II, cascade and parallel form of structures. 13

9. A lowpass FIR filter is to be designed with following desired frequency response :

$$Hd(w) = \begin{cases} e^{-j2w}, & -\frac{\pi}{4} \leq w \leq \frac{\pi}{4} \\ 0, & \frac{\pi}{4} \leq w \leq \pi \end{cases}$$

Determine the filter coefficients h(n) using rectangular window. Also, determine frequency response H(w).

13

OR

10. Design FIR filter using Hamming Window for a derived response :

$$Hd(w) = \begin{cases} e^{-j3w}, & \frac{-3\pi}{4} \le w \le \frac{3\pi}{4} \\ 0, & \frac{3\pi}{4} \le w \le \pi \end{cases}$$

Also draw the structure of the filter. 13

11. (a) What is multirole signal processing ? Explain applications of multirate signal processing. 6

(b) Given the sequence x(n) :

$$x(n) = \{1, 2, 3, 4, 5, 4, 3, 2, 1\}$$

Find the output sequence y(n) of the system given below :

7

OR

12. (a) Explain the sampling rate conversion by rational factor with the help of block diagram. 5

(b) Explain sub band coding of speech signals with the help of block diagram. 8