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.
 - (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?

OR

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

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

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

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

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

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)
$$x(n) = \delta(n) + \frac{1}{2}\delta(n-3)$$
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(b) State and prove any two properties of z-transform.

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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:

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

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

z-transform:

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

OR

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

$$h(n) = \{1, 2, 3, 4\}, x(n) = \{1, 2, 2, 1\}$$
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 $\frac{3}{7} + 1(K) \leftarrow Contd.$

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Design a digital Butterworth filter that satisfies the following constraints using Bilinear transformation.

Assume T = 1 sec.

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

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

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

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

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

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OR

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

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

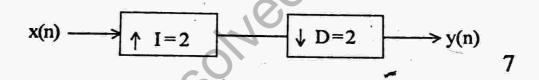
Also draw the structure of the filter.

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



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