B.E. (Information Technology) Seventh Semester (C.B.S.)

Elective - II : Digital Signal Processing

P. Pages : 2 **TKN/KS/16/7593**

Time : Three Hours Max. Marks : 80

Notes :
1. All questions carry marks as indicated.
2. Solve Question 1 OR Questions No. 2.
3. Solve Question 3 OR Questions No. 4.
4. Solve Question 5 OR Questions No. 6.
5. Solve Question 7 OR Questions No. 8.
6. Solve Question 9 OR Questions No. 10.
7. Solve Question 11 OR Questions No. 12.

1. a) Consider the analog signal $x(t) = 3\cos(50\pi t) + 10\sin(300\pi t) - \cos(100\pi t)$. What is the Nyquist rate for this signal. Also calculate folding frequency. **5**

b) If $x(n) = \{1, 4, \underset{\uparrow}{3}, 4, 2\}$ show graphically $x(-n)$ and $x(-n+2)$. **5**

c) Write the advantages of digital signal processing over analog signal processing. **4**

OR

2. a) The input response of a linear time invariant system is $h(n) = \{1, \underset{\uparrow}{2}, 1, -1\}$ determine the response of the system to the input signal $x(n) = \{\underset{\uparrow}{1}, 2, 3, 1\}$ **8**

b) Determine whether the following systems are static/dynamic, linear or nonlinear, time invariant/variant. **6**

i) $y(n) = x(n) - x(n-1)$ ii) $y(n) = \cos[x(n)]$ iii) $y(n) = x(n)\ u(n)$

3. a) Determine the z transform of the following signal **6**

i) $x_1(n) = \{3, 1, 2, \underset{\uparrow}{5}, 7, 0, 1\}$ ii) $x_2(n) = \{2, 4, \underset{\uparrow}{5}, 7, 0, 1, 2\}$

iii) $x_3(n) = \{1, 2, 4, 4, 0, 1\}$ iv) $x_4(n) = \delta(n)$

v) $x_5(n) = \delta(n-2)$ vi) $x_6(n) = a^n \cup(n)$

b) State and derive time shifting and differentiation property of z transform. **7**

OR

4. a) Explain relation of z transform and Laplace transform, z transform and Fourier transform. **6**

b) By Partial fraction expansion method find the inverse z transform of **7**

$$H(z) = \frac{-4 + 8z^{-1}}{1 + 6z^{-1} + 8z^{-2}}$$

5. a) Determine the Fourier transform of the signal $x(n) = a^{|n|} \quad -1 \le a < 1$ **7**

b) State and prove time shifting and time reversal properties of Fourier transform. **6**

OR

6. a) Find the circular convolution of following two sequences using DFT and IDFT where $x_1(n) = \{1, 2, 3, 4\}$ $x_2(n) = \{5, 6, 7, 8\}$ **7**

b) State and prove any three property of DFT. **6**

7. a) Find out H(z) using impulse invariance method at 5Hz sampling frequency from H(s) as **6**

$$H(s) = \frac{2}{(s+1)(s+2)}$$

b) Using bilinear transformation obtain H(z) if $H(s) = \frac{1}{(s+1)^2}$ and T = 0.1 sec. **7**

OR

8. Obtain the Direct form I, Direct form II cascade and parallel structures for **13**

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

9. a) A low pass filter is to be designed with the following desired frequency response **10**

$$H_d(e^{jw}) = \begin{cases} e^{-j2w} & \frac{-\pi}{4} \le w \le \frac{\pi}{4} \\ 0 & \frac{\pi}{4} < |w| \le \pi \end{cases}$$

Determine the filter coefficients $h_d(n)$ if the window function is defined as

$$w(n) = \begin{cases} 1 & 0 \le n \le 4 \\ 0 & \text{otherwise} \end{cases}$$

Also determine the frequency response $H(e^{jw})$ of the designed filter.

b) What are the different design techniques available for the FIR filters. **4**

OR

10. A filter is to be designed with the following desired frequency response **14**

$$H_d(e^{jw}) = \begin{cases} 0 & \frac{-\pi}{4} \le w \le \frac{\pi}{4} \\ e^{-j2w} & \frac{\pi}{4} < |w| \le \pi \end{cases}$$

Determine the filter coefficients $h_d(n)$ if the window function is defined as

$$w(n) = 1 \quad 0 \le n \le 4$$
$$= 0 \quad \text{otherwise}$$

Also determine the frequency response $H(e^{jw})$ of the designed filter.

11. Given x(n) = n + 1 and N = 8, find x(k) using DIF FFT algorithm **13**

i. e. $x(n) = \begin{cases} n+1 & \text{for } 0 \le n \le 7 \\ 0 & \text{otherwise} \end{cases}$

OR

12. Given x(n) = n and N = 8, find x(k) using DIT FFT algorithm **13**

$$x(n) = \begin{cases} n & \text{for } 0 \le n \le 7 \\ 0 & \text{otherwise} \end{cases}$$

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