B.E.Eighth Semester (Electrical Engineering (Electronics & Power)) (C.B.S.)

Elective - II : Digital Signal Processing

P. Pages : 3 **NKT/KS/17/7572**

Time : Three Hours * 0 5 2 8 * 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.
8. Due credit will be given to neatness and adequate dimensions.
9. Assume suitable data whenever necessary.
10. Diagrams and chemical equations should be given whenever necessary.
11. Illustrate your answers whenever necessary with the help of neat sketches.
12. Use of non programmable calculator is permitted.

1. Determine the response of the following systems to the input signal. **7**

$$x(n) = \begin{cases} |n| & , \quad -3 \le n \le 3 \\ 0 & , \quad \text{otherwise} \end{cases}$$

i) $y(n) = x(n)$

ii) $y(n) = x(n-1)$

iii) $y(n) = x(n+1)$

iv) $y(n) = \frac{1}{3}[x(n+1) + x(n) + x(n-1)]$

v) $y(n) = \max[x(n+1),\ x(n),\ x(n-1)]$

vi) $y(n) = \sum_{k=-\infty}^{\infty} x(k)$

vii) $y(n) = x(-n + 4)$

b) Determine the output response y(n) of a LTI system with impulse response **6**
$h(n) = \{4,\ 3,\ \underset{\uparrow}{2},1\}$ for $x(n) = \{1,\ \underset{\uparrow}{2},\ 3\}$ verify the result using tabular method.

OR

2. a) Explain different classifications of DT systems. Examine the following system with respect to different classification : **7**

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

b) Consider the analog signal : **3**

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

i) What is the Nyquist rate for this signal ?

ii) If above signal is sampled at sampling frequency of 5 kHz ; what is the DT signal x(n) obtained after sampling ?

c) Find the autocorrelation of the signal $x(n) = \{1, 2, 3\}$ **3**

3. a) Determine the spectra using discrete time Fourier series (DTFS) of the signal. **6**
$x(n) = \cos \pi n/3.$

b) Determine and sketch the energy density spectrum $S_{xx}(w)$ of the signal **7**
$x(n) = a^n u(n), -1 < a < 1.$

OR

4. a) Determine the discrete time Fourier Transform (DTFT) of the following signals. **6**
Comment first, whether DTFT exists or not.
i) $x_1(n) = u(n)$
ii) $x_2(n) = (-1)^n u(n)$

b) State and prove time shifting and frequency shifting properties of DTFT. What is the significance of frequency shifting property in modulation. **7**

5. a) Find the Z transform of : **8**
i) $\left(\frac{1}{3}\right)^n u(n) - \left(\frac{1}{2}\right)^n u(-n-1)$
ii) $\left(\frac{1}{2}\right)\delta(n) + \delta(n-1) + \frac{1}{3}\delta(n-2)$
Plot ROCs (Region of Convergence) in both cases.

b) Discuss any three properties of Z transform. **6**

OR

6. a) Find the inverse Z transform of the following using partial fraction expansion method **8**
when h(n) is causal and anti causal $H(z) = \frac{3 - 4z^{-1}}{1 - 3.5z^{-1} + 1.5z^{-2}}$

b) Determine the response of the system $y(n) = \frac{5}{6}y(n-1) - \frac{1}{6}y(n-2) + x(n)$ to the input **6**
signal $x(n) = \delta(n) - \frac{1}{3}\delta(n-1)$ using Z transform.

7. a) What do you mean by minimum phase, maximum phase or mixed phase system ? **6**
Determine the zeros for following FIR system and indicate whether the system is minimum phase, maximum phase or mixed phase.
$H_1(z) = 1 + \frac{5}{3}z^{-1} - \frac{2}{3}z^{-2}$
$H_2(z) = 1 - z^{-1} - 6z^{-2}$
$H_3(z) = 1 - 5/2z^{-1} - 3/2z^{-2}$
$H_4(z) = 6 + z^{-1} - z^{-2}$

b) Sketch the block diagram for the frequency sampling realization of M = 32, $\alpha = 0$, linear phase (symmetric) FIR filter which has frequency samples **8**

$$H\left(\frac{2\pi k}{32}\right) = \begin{cases} 1 & , \quad k = 0, 1, 2 \\ ½ & , \quad k = 3 \\ 0 & , \quad k = 4, 5, \ldots .15 \end{cases}$$

what is the computational complexity of this structure ?

OR

8. IIR filter is described by the following difference equation **14**

$$y(n) = -y(n-1) - 4y(n-2) + 2y(n-3) + x(n) - 2x(n-1)$$

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

9. The specifications of desired low pass butterworth filter is **13**

$$0.9 \le |H(w)| \le 1 \, , 0 \le w \le \pi/2$$

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

Design the filter using Bilinear transformation. Assume T = 1 sec.

OR

10. A low pass FIR filter is to be designed with following desired freq. response **13**

$$H_d(e^{jw}) = \begin{cases} e^{-j3w} & , \quad -3\pi/4 \le w \le 3\pi/4 \\ 0 & , \quad 3\pi/4 \le w \le \pi \end{cases}$$

determine the filter coefficients h(n) using Hamming window. Also determine freq. response $H(e^{jw})$.

11. a) State any two properties of DFT. **6**

b) Compute 4 point DFT using DIFFFT algorithm $x(n) = \{\underset{\uparrow}{0}, 1, 2, 3\}$ **7**

OR

12. a) Compute 4 point DFT using DITFFT algorithm $x(n) = \{\underset{\uparrow}{0}, 1, 2, 3\}$ **7**

b) Find 4 pt. circular convolution of following sequences using DFT & IDFT method **6**
$x(n) = \{1, 2, 3\}$ and $h(n) = \{1, 2, 2\}$.

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