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

Elective - I : Digital Signal Processing

P. Pages : 2 **KNT/KW/16/7482**

Time : Three Hours * 0 8 5 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. 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) Show that the necessary and sufficient conditions for stability of LTI system is $\sum_{n=-\infty}^{+\infty} |h(n)| < \infty$. **5**

b) Consider the analog system **9**

$x(t) = 3\cos 100\pi t$

i) Determine the minimum sampling rate required to avoid the aliasing.

ii) Suppose that the signal is sampled at the rate $fs = 200\,Hz$. What is the discrete time signal obtained after sampling.

iii) What is the frequency $0 < F < F_{5/2}$ of the sinusoidal that yields samples indential to obtain in part (ii)

OR

2. a) Explain different types of discrete system with one example. **6**

b) The impulse response of linear time invariant system is $h(n) = \{1, \underset{\uparrow}{2}, 1, -1\}$. Determine the response of the system to the input signal $x(n) = \{1, 2, 3, 1\}$ By using graphical method. **8**

3. a) State and prove any two properties of Z-transform. **6**

b) Determine the Z – transform of the signal $x(n) = (1/2)^n \mu(n)$. Also sketch the Region of convergence (ROC). **7**

OR

4. a) Find the inverse Z – transform of the given function using Long division method when x(n) is causal and when x(n) is anticausal $x(z) = \dfrac{1 + 2z^{-1}}{1 - 2z^{-1} + z^{-2}}$. **6**

b) Determine the unit response of the system. Whose difference equation is $y(n) - 0.7\,y(n-1) + 0.12\,y(n-2) = x(n-1) + x(n-2)$ if $y(-1) = y(-2) = 1$. **7**

5. Determine the sequence y(n) corresponding to the circular convolution of the sequence $x_1(n)$ and $x_2(n)$ where $x_1(n) = \{\underset{\uparrow}{2}, 1, 2, 1\}$ and $x_2(n) = \{\underset{\uparrow}{1}, 2, 3, 4\}$ using DFT and IDFT method. **14**

OR

6. Find 8 point DFT of the following sequence using decimation in frequency (DIF) – FFT algorithm. $x(n) = (-1)^n,\ 0 \le n \le 7$. **14**
Also compute the number of complex addition and multiplication required.

7. A Filter (LTI) system is described by the following difference equation : **13**

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

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

OR

8. Design a digital Butterworth filter that satisfies the following constraints using Bilinear transformation. Assume $T = 1\text{sec}$. **13**

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

$$|H(\omega)| \le 0.2, \quad \frac{3\pi}{4} \le \omega < \pi$$

9. The desired response of a low pass filter is **13**

$$hd\left(e^{j\omega}\right) = \begin{cases} e^{-j3\omega} ; & \frac{-3\pi}{4} \le \omega \le 3\pi/4 \\ 0 ; & 3\pi/4\ \omega \le \pi \end{cases}$$

Design and realise FIR filter for M = 7 using Hamming window.

OR

10. Determine the coefficient of linear phase FIR filter of length M = 15 which has symmetric unit sample response and frequency response that satisfies the conditions. **13**

$$HR\left(\frac{2\pi k}{15}\right) = \begin{cases} 1 & ; k = 0,1,2,3 \\ 0.4 & ; k = 4 \\ 0 & ; k = 5,6,7 \end{cases}$$

11. a) Explain the sampling rate conversion by rational factor with the help of block diagram. **6**

b) Explain sub band coding of speech signal with the help of block diagram. **7**

OR

12. a) What is multirate signal processing? Explain its applications. **6**

b) Given the sequence $x(n)$. **7**
$x(n) = \{1, 2, 3, 4, 5, 6, 7, 8, 9\}$
Find the output sequence $y_1(n)$ and $y_2(n)$ for Multirate structure shown in fig. Q. 12 (b).

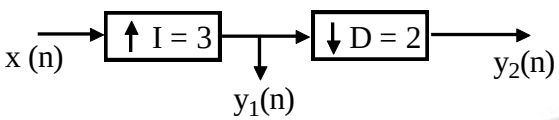

Fig. Q.12 (b)

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