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

Elective - II : Digital Signal Processing

P. Pages : 3 NKT/KS/17/7507

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.
9. Use of non programmable calculator is permitted.

1. a) Explain the following system properties with example. **6**

i) Static system ii) Causal system iii) Time invariant system

b) The impulse response of a liner time invariant system is **7**

$h(n) = \{1, \underset{\uparrow}{2}, 1, -1\}$

Determine the response of the system to the input signal

$x(n) = \{\underset{\uparrow}{1}, 2, 3, 1\}$

OR

2. a) Determine the cross correlation sequence $r_{xy}(\ell)$ of the sequence **7**

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

& $y(n) = \{2, -2, \underset{\uparrow}{4}, 1\}$

b) Determine the response of the following systems to the input signal. **6**

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

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

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

iii) $y(n) = \max\{x(n+1), x(n), x(n-1)\}$

3. a) Determine the z-transform of signal **9**

i) $x(n) = na^n u(n)$ ii) $x(n) = [3(2^n) - 4(3^n)]\,u(n)$

iii) $x(n) = \{2, 4, 5, 7, 0, 1\}$

b) Explain relation of z-transform with Fourier transform. **4**

OR

4. a) Determine the inverse z-transform of **6**

$$x(z) = \frac{1}{1-1.5z^{-1} + 0.5z^{-2}}$$

when

i) ROC : | z | > 1

ii) ROC : | z | < 0.5

b) A linear time-invariant system is characterized by the system function. **7**

$$H(z) = \frac{3-4z^{-1}}{1-3.5z^{-1} + 1.5z^{-2}}$$

Specify the ROC of H(z) & determine h(n) for the following conditions

i) The system is stable

ii) The system is causal

iii) The system is anticausal

5. a) Find the Fourier transform of the following signals. **7**

i) $x(n) = \left(\alpha^n \sin w_o n\right) u(n)$

ii) $x(n) = \left(\frac{1}{4}\right)^n u(n)$

b) Perform circular convolution of two sequence using graphical method. **7**

$$x_1(n) = \{ \underset{\uparrow}{1}, 1, 2, 2 \}$$

$$x_2(n) = \{ \underset{\uparrow}{1}, 2, 3, 4 \}$$

OR

6. a) Find the 4-point DFT of the sequence $x(n) = \cos\frac{n\pi}{4}$ **8**

b) State & prove any three properties of DFT. **6**

7. a) Convert the analog filter with the system function **7**

$$H(S) = \frac{S+0.1}{(S+0.1)^2 + 16}$$

into a digital IIR filter by means of the bilinear transformation. The digital filter is to have a resonant frequency of $w_r = \pi/2$.

b) Convert the analog filter with system function **7**

$$H(S) = \frac{S+0.1}{(S+0.1)^2 + 9}$$

into a digital filter by means of the impulse invariance method.

OR

8. Obtain the direct form I, direct form II, cascade & parallel form realization for the system. **14**

$$y(n) = -0.1y(n-1) + 0.2y(n-2) + 3x(n) + 3.6\,x(n-1) + 0.6\,x(n-2)$$

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

$$H(e^{j\omega}) = \begin{cases} e^{-j3\omega} & , -3\pi/4 \le \omega \le 3\pi/4 \\ 0 & , 3\pi/4 < |\omega| \le \pi \end{cases}$$

Determine $H(e^{jw})$ for M = 7 using humming window function.

$$\omega(n) = \begin{cases} 0.54 - 0.46 \cos \dfrac{2\pi n}{M-1} & , 0 \le n \le M-1 \\ 0 & , \text{otherwise} \end{cases}$$

OR

10. a) List the different weighting function available in window technique. **3**

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

$$H(e^{j\omega}) = \begin{cases} e^{-j2\omega} & , -\pi/4 \le \omega \le \pi/4 \\ 0 & , \pi/4 < |\omega| \le \pi \end{cases}$$

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

$$\omega(n) = \begin{cases} 0.5 - 0.5 \cos \dfrac{2\pi n}{M-1} & , 0 \le n \le M-1 \\ 0 & , \text{otherwise} \end{cases}$$

Use M = 5. Determine the frequency response $H(e^{j\omega})$ of designed filter.

11. Given x(n) = {1, 2, 3, 4, 4, 3, 2, 1} find x(k) using DIT FFT algorithm. **13**

OR

12. Given x(k) = {36, - 4 + j 9.656, –4 + j4, **13**
–4 + j1.656, - 4, –4 – j1.656, –4 – j4,
–4 – j9.656}
Find inverse DFT x(n) using DIF FFT algorithm.

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