5th 17

Exam. Code: 0929
Sub. Code: 6910

1128

B.E. (Electronics and Communication Engineering)
Fifth Semester
EC-502: Digital Signal Processing

Time allowed: 3 Hours **Max. Marks: 50**

NOTE: Attempt five questions in all, including Question No. I which is compulsory and selecting two questions from each Section.

x-x-x

1. (a) With the help of equations, describe how, time-domain sampling shifts the frequency spectrum of a signal.

   (b) Determine the Fourier transform of the signal: $x[n] = a^{|n|}$

   (c) Describe finite wordlength effects in digital filters.

   (d) Perform the polyphase decomposition of IIR filter:

$$H(z) = \left(\frac{1 + 0.6z^{-1}}{1 - 0.9z^{-1}}\right)$$

   (e) Discuss the importance of linear-phase property of digital filters.

(5×2=10)

Section-A

2. (a) Find whether the following systems are Memoryless, Time- Invariant, Linear, Causal, and Stable. Justify your answer. (5)

   i. $y[n] = x[n] \sum_{k=-\infty}^{\infty} \delta[n - 2k]$

   ii. $y[n] = \log_{10}(|x[n]|)$

   (b) Describe Divide and Conquer approach to DFT. Explain radix-2 DIF-FFT algorithm with the help of butterfly diagram. (5)

3. (a) When the input to an LTI system is (5)

$$x(n) = \left(\frac{1}{3}\right)^n u(n) + (2)^n u(-n - 1)$$

   And the corresponding output is

$$y(n) = 5\left(\frac{1}{3}\right)^n u(n) - 5\left(\frac{2}{3}\right)^n u(n)$$

   1. Find system function H(z) and indicate the ROC.
   2. Find the impulse response h(n) of the system
   3. Write the difference equation for the system.
   4. Is the system stable? Is it causal?

   (b) Derive the expressions for Forward and Inverse DCT. Discuss the orthogonality property of DCT. (5)

P.T.O.

4. (a) Discuss the concept of time-frequency analysis. How does Wavelet transform help us perform time-frequency analysis? (5)

(b) Determine the response y(n) of the system (5)

$$y[n] - 4y[n-1] + 4y[n-2] = x[n] - x[n-1]$$

When the input is $x[n] = (-1)^n u[n]$ and the initial conditions are y(-1) = y(-2) = 0.

Section-B

5. (a) A LPF is to be designed with the following desired response (5)

$$H_d(\omega) = \begin{cases} e^{-j3\omega} & 0 \le \omega \le \frac{\pi}{2} \\ 0 & \frac{\pi}{2} \le \omega \le \pi \end{cases}$$

Determine the filter coefficients h(n) for M=7 using bartlett Window.

(b) Obtain the cascade and parallel form structure of system (5)

$$H(z) = \left(\frac{1+z^{-1}}{1-0.6z^{-1}}\right)\left(\frac{1+2z^{-1}+z^{-2}}{1-1.3z^{-1}+0.7z^{-2}}\right)$$

6. Design a digital Chebyshev filter to satisfy the criterion

$$0.86 \le H(\omega) \le 1, \qquad 0 \le \omega \le 0.25\pi$$
$$H(\omega) \le 0.2, \qquad 0.48\pi \le \omega \le \pi$$

Using bilinear transformation. (10)

7. (a) Describe the TMS320CXX architecture and discuss its memory management. (5)

(b) Describe the frequency domain representation of multirate systems with the help of mathematical equations. (5)

x-x-x