Exam.Code:0929
Sub. Code: 6594

2122

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) Determine the Fourier transform of the signal:

$$x[n] = a^{|n|}$$

(b) Determine the lattice coefficients for the FIR filter with the system function

$$H(z) = A_3(z) = 1 + \frac{13}{24}z^{-1} + \frac{5}{8}z^{-2} + \frac{1}{3}z^{-3}$$

(c) Briefly describe JPEG coding.

(d) Perform the polyphase decomposition of IIR filter:

$$H(z) = \left(\frac{1 + 0.7z^{-1}}{1 - 0.9z^{-1}}\right)$$

(e) Discuss the effect of finite wordlength effects in 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. $y[n] = \sum_{k=-\infty}^{n} x[k+2]$

ii. $y[n] = x(n^2)$

(b) Consider the difference equation (5)

$$y[n] + \frac{1}{15}y[n-1] - \frac{2}{5}y[n-2] = x[n]$$

i. Determine the general form of the homogeneous solution to this equation.

ii. Both a causal and an anticausal LTI system are characterized by the given difference equation. Find the impulse response of the two systems.

iii. Show that the causal LTI system is stable and the anticausal LTI system is unstable.

P.T.O.

3. (a) determine the signal with Z-transform (5)

$$X(z) = \frac{3}{\left(1 - \frac{10}{3}z^{-1} + z^{-2}\right)}$$

(b) Describe the Divide and Conquer approach for calculation of DFT. Discuss radix-2 DIT FFT algorithm with the help of butterfly diagram. (5)

4. (a) Compute the N-point DFT of the sequence (5)

$$x[n] = \cos\left(\frac{2\pi}{N}k_0 n\right), \qquad 0 \le n \le N-1$$

(b) Determine the response of the system with impulse response $h(n) = (a)^n u(n)$ to the input signal $x(n) = u(n) - u(n-10)$. (5)

Section-B

5. Design a digital Butterworth filter to satisfy the criterion (10)

$$0.86 \le H(\omega) \le 1, \qquad 0 \le \omega \le 0.28\pi$$
$$H(\omega) \le 0.22, \qquad 0.5\pi \le \omega \le \pi$$

Using impulse invariant transformation.

6. (a) Obtain the cascade and parallel form structure of system (5)

$$H(z) = \left(\frac{1 + z^{-1}}{1 - 0.8z^{-1}}\right)\left(\frac{1 + 2z^{-1} + z^{-2}}{1 - 1.6z^{-1} + 0.8z^{-2}}\right)$$

(b) 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 Blackman Window.

7. (a) Describe the frequency domain representation of down-sampling with the help of mathematical analysis. (5)

(b) Describe the architecture of TMS320C6X processor and discuss memory management. (5)

x-x-x