Exam.Code:0929
Sub. Code: 6594

2123

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) A signal $x(t) = \cos(200\pi t) + 2\cos(320\pi t)$ is ideally sampled at f=300 Hz. If the sampled signal is passed through an ideal low-pass filter with a gain 1/f and cut-off frequency of 250 Hz, what frequency components will appear in the output?

   (b) For an N point sequence, calculate and compare the number of complex multiplications and additions required by DFT and FFT.

   (c) Determine the zero-input response of the system described by the difference equation $y[n] - 3y[n-1] - 4y[n-2] = x[n]$

   (d) Compare the design considerations of FIR filters and IIR filters.

   (e) Describe finite word length effects in digital filters.

   (5×2=10)

Section-A

2. (a) Find whether the following systems are Memory-less, Time- Invariant, Linear, Causal, and Stable. Justify your answer. (5)
   i. $y[n] = x(n) + n.x(n+1)$
   ii. $y[n] = \log_{10}(|x[n]|)$

   (b) Determine the response of the system with impulse response $h(n) = (0.4)^n u(n)$ to the input signal $x(n) = u(n) - u(n-8)$. (5)

3. (a) Determine all possible signals having z-transform (5)

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

   (b) Describe multi-resolution analysis of signals using wavelet transform. (5)

4. (a) Determine the circular convolution of the sequences: $x_1[n] = \{1,2,7,4\}$ and $x_2[n] = \{2,-5,7,1,8\}$. (5)

   (b) Describe radix-2 DIT-FFT algorithm with the help of butterfly diagram. Compute FFT of the sequence $x[n] = 3^n$ for N=8. (5)

P.T.O.

Section-B

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

$$0.81 \leq H(\omega) \leq 1, \qquad 0 \leq \omega \leq 0.31\pi$$
$$H(\omega) \leq 0.17, \qquad 0.51\pi \leq \omega \leq \pi$$

Using impulse invariant transformation. (7)

(b) What is the significance of polyphase representation of multi-rate systems? Perform the polyphase decomposition of IIR filter: (3)

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

6. (a) Derive the expressions for frequency domain representation of Up-sampling and down-sampling. Discuss the effects of these operations on spectrum of signal. (5)

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

$$H(z) = \left(\frac{1 + 7z^{-1}}{1 - 0.36z^{-1}}\right)\left(\frac{1 - 9z^{-1} + z^{-2}}{1 - 2.3z^{-1} + 0.55z^{-2}}\right)$$

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

$$H_d(\omega) = \begin{cases} e^{-3\omega} & 0 \leq \omega \leq \dfrac{2\pi}{3} \\ 0 & \dfrac{2\pi}{3} \leq \omega \leq \pi \end{cases}$$

Determine the filter coefficients h(n) for M=7 using frequency sampling technique.

(b) Describe the architecture of TMS320C6X processor and compare its features with its previous generations. (5)

x-x-x