USN | | | | | | | | | | | **10EE64**

Sixth Semester B.E. Degree Examination, June/July 2017
Digital Signal Processing

Time: 3 hrs. Max. Marks: 100

Note: ***Answer FIVE full questions, selecting at least TWO questions from each part.***

PART – A

1 a. What are the advantages and limitations of digital signal processing over analog signal processing? **(04 Marks)**

b. Consider the sequence $x(n) = 4\delta(n) + 3\delta(n-1) + 2\delta(n-2) + \delta(n-3)$. Find the 6-point DFT of the sequence x(n). Sketch the magnitude and phase spectra. **(08 Marks)**

c. State and prove circular time shift property of DFT. **(04 Marks)**

d. Compute the N-point DFT of the signal,

$x(n) = e^{j\frac{2\pi}{N}K_0 n}$; $0 \le n \le N-1$. **(04 Marks)**

2 a. Compute the 4-point DFT of the following sequences using suitable property of the DFT:
$x_1(n) = (\underset{\uparrow}{1}, 2, 3, 2)$ and $x_2(n) = (\underset{\uparrow}{3}, 2, 1, 2)$ **(06 Marks)**

b. Consider a length-6 sequence $x(n) = \{1, 3, -2, 1, -3, 4\}$ with a 6-point DFT given by X(K). Evaluate $\sum_{K=0}^{5} |X(K)|^2$. **(04 Marks)**

c. Find the 4 point circular convolution of the sequences $x_1(n) = (\underset{\uparrow}{1}, 2, 3, 1)$ and $x_2(n) = (\underset{\uparrow}{4}, 3, 2, 2)$ using the time domain approach based on formula. Verify the result using frequency domain approach. **(10 Marks)**

3 a. Compute the 4-point circular convolution of two sequences given by $x(n) = (\underset{\uparrow}{1}, 2, 3, 4)$ and $h(n) = (\underset{\uparrow}{1}, 2, 2, 1)$ using circular array method. **(04 Marks)**

b. Find the output y(n) of a FIR filter whose impulse response h(n) = (1, 1, 1) and input signal $x(n) = (3, -1, 0, 1, 3, 2, 0, 1, 2, 1)$ using overlap save method. Use 5-point circular convolution in your approach. **(08 Marks)**

c. Find the 8-point DFT of the sequences $x(n) = 2^n$; $0 \le n \le 7$ using Radix-2 DIT-FFT algorithm. **(08 Marks)**

4 a. Given x(n)= n+1; $0 \le n \le 7$. Find X(K) using radix-2 DIF-FFT algorithm. **(10 Marks)**

b. Develop a DIT-FFT algorithm for evaluating the DFT for composite number N = 9. **(10 Marks)**

PART – B

5 a. Explain Bilinear method of transforming an analog filter into digital filter. Also show the mapping from S to Z plane. **(06 Marks)**

b. Convert the following second order analog filter with system transfer function, $H(s) = \frac{(s+a)}{(s+a)^2 + b^2}$ into a digital filter with infinite impulse response by the use of impulse invariance mapping technique. **(06 Marks)**

c. Design an analog filter with maximally flat response in the passband and an acceptable attenuation of -2dB at 20 rad/sec. The attenuation in the stopband should be more than 10 dB beyond 30 rad/sec. **(08 Marks)**

6 a. Determine H(z) for a lowest order butterworth filter satisfying the following constraints:

$$\sqrt{0.5} \leq |H(e^{j\omega})| \leq 1;\ 0 \leq |\omega| \leq \frac{\pi}{2}$$

$$|H(e^{j\omega})| \leq 0.2;\ \frac{3\pi}{4} \leq \omega \leq \pi$$

with T = 1 sec. Apply impulse invariant transformation. **(10 Marks)**

b. Design the digital filter using Chebyshev approximation and Bilinear transformation to meet the following specifications. Passband ripple = 1 dB for $0 \leq \omega \leq 0.15\pi$. Stopband attenuation ≥ 20 dB for $0.45\pi \leq \omega \leq \pi$. **(10 Marks)**

7 a. Design a lowpass digital filter to be used in an $A/D - H(z) - D/A$ structure that will have a -3dB cutoff at 30π rad/sec and an attenuation of 50 dB at 45π rad/sec. The filter is required to have a linear phase and the system will use a sampling rate of 100 samples / second. **(10 Marks)**

b. Design a normalized linear phase FIR filter having the phase delay of Z = 4 & at least 40 dB attenuation in the stopband. Also obtain the magnitude / frequency response of the filter. **(10 Marks)**

8 a. An IIR filter is given by the difference equation,

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

Draw direct form – I and Direct form – II structures. **(10 Marks)**

b. A digital system is given by,

$$H(z) = \frac{1 - \frac{1}{2}z^{-1}}{\left(1 - \frac{1}{3}z^{-1}\right)\left(1 - \frac{1}{4}z^{-1}\right)}$$

. Obtain the parallel form structure. **(05 Marks)**

c. Realize the digital filter with system function given by,

$$H(z) = 1 + \frac{1}{2}z^{-1} + \frac{1}{3}z^{-2} + \frac{1}{7}z^{-3} + \frac{1}{3}z^{-4} + \frac{1}{2}z^{-5} + z^{-6}$$

(05 Marks)

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