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

Sixth Semester B.E. Degree Examination, June/July 2014
Digital Signal Processing

Time: 3 hrs. Max. Marks:100

Note: ***Answer any FIVE full questions, selecting atleast TWO questions from each part.***

Important Note : 1. On completing your answers, compulsorily draw diagonal cross lines on the remaining blank pages.
2. Any revealing of identification, appeal to evaluator and /or equations written eg, 42+8 = 50, will be treated as malpractice.

PART – A

1 a. Compute N-point DFT of x(n) for N = 4, where,

$$x(n)=\begin{cases}1/3; & \text{for } 0 \le n \le 2\\ 0; & \text{otherwise}\end{cases}$$

Draw magnitude and phase spectra. **(10 Marks)**

b. Determine 4-point DFT of x(n) = {0, 1, 2, 3}. Hence verify the result by taking IDFT using linear transformation. **(10 Marks)**

2 a. State and prove the following properties of DFT: i) Periodicity; ii) Linearity. **(08 Marks)**

b. Find the output of LTI system whose impulse response, h(n) = {1, 1, 1} and input signal, x(n) = {3, -1, 0, 1, 3, 2, 0, 1, 2, ...} using overlap add method. Use block length, N = 5. **(12 Marks)**

3 a. Why FFT is needed? What is the speed improvement factor in calculating 64-pt. DFT of a sequence using direct computation and FFT algorithm? **(08 Marks)**

b. What are the differences and similarities between DIT and DIF-FFT algorithms? **(04 Marks)**

c. Compute the 8-pt. DFT of the sequence, x(n) = {0.5, 0.5, 0.5, 0.5, 0, 0, 0, 0}. Using the in place radix-2 DIT algorithm. **(08 Marks)**

4 a. Develop the DIF-FFT algorithm for N = 8. Using the resulting signal flow graph compute the 8-point DFT of the sequence, $x(n)=\sin\left(\frac{\pi}{2}n\right)$, $0 \le n \le 7$. **(11 Marks)**

b. First five points of eight point DFT of a real valued sequence is given by, x(k) = {0, 2 + j2, -j4, 2-j2, 0}. Determine the remaining points. Hence find the sequence x(n) using DIF-FFT algorithm. **(09 Marks)**

PART – B

5 a. Explain impulse invariance method of designing IIR filter. Hence show that mapping results in many-to-one-mapping on unit circle. **(08 Marks)**

b. Determine H(z) of lowest order Butterworth filter that will meet the following specifications:

i) 1 dB ripple in passband; $0 \le w \le 0.15\pi$ rad.

ii) At least 20dB attenuation in stopband; $0.45\pi \le w \le \pi$ rad.

Use bilinear transformation for T = 1sec. **(12 Marks)**

6 a. Design an analog Chebyshev filter that will meet the following specifications:

i) Maximum pass band attenuation = 3dB at 2 rad/sec.

ii) Minimum stop band attenuation = 20dB at 4 rad/sec. **(10 Marks)**

b. Explain transforming an analog normalized LPF into analog LPF, HPF, BPF and BSF filters using frequency transformation methods. **(06 Marks)**

c. Obtain transfer function of IIR digital filter from given $H_a(s)$, using impulse invariance method, $H_a(s) = \frac{0.5(s+4)}{(s+1)(s+2)}$. **(04 Marks)**

7 a. What are the advantages and disadvantages with the design of FIR filters using window function? **(06 Marks)**

b. Deduce the equation for the frequency spectrum for the rectangular window sequence defined by,

$$W_R(n) = \begin{cases} 1; & \text{for } \frac{-(N-1)}{2} \le n \le \frac{(N-1)}{2} \\ 0; & \text{otherwise} \end{cases}.$$

What is the width of main lobe of the spectrum? **(06 Marks)**

c. The frequency response of a filter is given by, $H(e^{jw}) = jw; -\pi \le w \le \pi$. Design the filter, using a rectangular window function. Take N = 7. **(08 Marks)**

8 a. A FIR filter is given by, $y(n) = x(n) + \frac{2}{5}x(n-1) + \frac{3}{4}x(n-2) + \frac{1}{3}x(n-3)$. Draw the Lattice structure. **(06 Marks)**

b. A discrete time system H(z) is expressed as,

$$H(z) = \frac{10\left(1-\frac{1}{2}z^{-1}\right)\left(1-\frac{2}{3}z^{-1}\right)\left(1+2z^{-1}\right)}{\left(1-\frac{3}{4}z^{-1}\right)\left(1-\frac{1}{8}z^{-1}\right)\left[1-\left(\frac{1}{2}+\frac{1}{2}j\right)z^{-1}\right]\left[1-\left(\frac{1}{2}-j\frac{1}{2}\right)z^{-1}\right]}$$

Realize parallel and cascade forms using second order sections. **(14 Marks)**

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