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P.E.S. College of Engineering, Mandya - 571 401

(An Autonomous Institution affiliated to VTU, Belgaum)

Fifth Semester, B.E. - Electronics and Communication Engineering

Semester End Examination; Dec - 2016/Jan - 2017

Digital Signal Processing

Time: 3 hrs *Max. Marks: 100*

***Note**: i) Answer questions from each unit choosing among internal choice.*
ii) Any missing data can be suitably assumed making a clear mention of the same.
iii) Filter tables can be used if required.

UNIT - I

1 a. Compute 4-point DFT and 8-point DFT of causal three sample sequence given by, 10
$x(n) = 1/3 ; \quad 0 \le n \le 2 \quad = \quad 0 \quad ; \quad$ elsewhere

b. Show that Multiplication of two DFTs in frequency domain corresponds to Circular convolution of corresponding sequences in time domain. Provide an example. 10

2 a. X (k) is DFT of 8-point real sequence x(n) whose first few samples are given by [14, 1+2j, 0, -1-3j, 2]. If x(n) is multiplied by $e^{j6\pi n/8}$ to yield x1(n) , determine X1(k). 8

b. Computer linear and circular convolution of two sequences using DFT. 8
x(n) = [1 2]; and h(n) = [2,1]

c. State Parseval's theorem and using the same determine Energy in x(n) = [1,0,1,0] 4

UNIT - II

3 a. A LSI system is characterized by its impulse response h(n) = [0.5, -0.5], a long sequence x(n) = [1, 2,3,2,3,1,2,3,3,3] is applied to this system Using Overlap- Add method determine : (i) DFT length if the input block length is 4 (ii) Input blocks (iii) Output for given input 10

b. Derive the 8-point DIT FFT flow chart starting from basic definition of DFT 10

4 a. Given a 8-point sequence x(n) = [3, 1, 3, 1, 3, -1, 3, -1] , compute the DFT of this sequence using 4-point DIT FFT only once. 10

b. Substantiate the need for Chirp –Z transform with two reasons. 4

c. Compare Butterfly operations of DIT and DIF algorithm for similarities and Dissimilarities 6

UNIT - III

5 a. Design a linear phase FIR highpass filter using hamming window, with a cutoff frequency, $\omega_c = 0.8\pi$ rad/sample and N = 7. Sketch its impulse response. 10

b. Compare FIR and IIR filters on various performance parameters 5

c. Discuss window parameters and their corresponding effect on filter Performance 5

6 a. Determine the coefficients of a linear –phase FIR filter of length N = 15 which has a symmetric impulse response and a frequency response that satisfies the conditions,

$H(2\pi k/15) = 1$; for k = 0,1,2,3 10
$= 0.4$; for k = 4
$= 0$; for k = 5, 6,7

Contd….2

b. Explain the procedure of window based FIR filter design. 5

c. Justify necessity of Linear Phase filters in specific applications 5

UNIT - IV

7 a. Discuss Impulse Invariance and Bilinear Transformation techniques with regard to preserving frequency response characteristics while mapping from analog to digital domain. 10

b. Design a Butterworth digital lowpass filter using Bilinear transformation by taking T = 1 sec, to satisfy the following specifications. 10

$0.6 \leq |H(e^{jw})| \leq 1.0 \quad ; 0 \leq \omega \leq 0.35\pi$

$|H(e^{jw})| \leq 0.1 \quad ; 0.7\pi \leq \omega \leq \pi$

8 a. Determine the poles of Lowpass Butterworth filter for N = 3. Sketch the location of poles on s-plane and hence determine the normalized transfer function of low pass filter. 8

b. Design a Chebyshev digital low pass filter using impulse invariant transformation by taking T = 1 second, to meet the following specifications: 12

$0.9 \leq |H(e^{jw})| \leq 1.0 \; ; 0 \leq \omega \leq 0.25\pi$

$|H(e^{jw})| \leq 0.24 \quad ; 0.5\pi \leq \omega \leq \pi$

9 a. Find the Direct form-II and Parallel realizations for the system described by the difference equation, $y(n) = x(n) + 0.3\,x(n-1) - 0.4x(n-2) - 0.8y(n-1) + 0.7\,y(n-2)$ 10

b. Given that $H(z) = 1/3 + 1/4\,z^{-1} + 3/2\,z^{-2} + 3/2\,z^{-3} + 1/4\,z^{-4} + 1/3\,z^{-5}$

Determine whether the system is FIR or IIR and has Linear –phase or not with suitable justifications, Realize the system with minimum multipliers 10

10.a Realize the given system in cascade and parallel forms. 10

$H(z) = (1 + 0.25\,z^{-1}) / (1 - 2z^{-1} + 0.25z^{-2})(1 - 3z^{-1} + 0.2z^{-2})$.

b. Derive the lattice form realization for a second-order IIR system. 10

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