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

(An Autonomous Institution affiliated to VTU, Belgaum)

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

Semester End Examination; Dec - 2016/Jan - 2017

Digital Signal Processing

Time: 3 hrs *Max. Marks: 100*

***Note**: i) Answer **FIVE** full questions, selecting **ONE** full question from each unit.*
ii) Assume missing data if any.

UNIT - I

1 a. Derive the relationship between N-point DFT and Z-transform. 6

b. Prove that the sampling of Fourier transform of a sequence $x(n)$ results in N-point DFT using which both the sequence and transform can be reconstructed. 10

c. Obtain N-point of, 4
i) $x(n) = \delta(n)$ ii) $x(n) = u(n) - u(n-n_0)$.

2 a. Given $x(n)$ =[1 1 1] obtain the five point DFT, X(K). Use linear transformations. 8

b. Obtain IDFT of $X(K) = \{10, \ (-2+2j), \ -2, \ (-2-2j)\}$ using DFT for, 8
i) N = 4 ii) N = 8. Compare the results.

c. Explain the need of twidle factors in the calculation of computing DFT and IDFT. 4

UNIT - II

3 a. Determine N-point circular convolution of $x_1(n)$ and $x_2(n)$, 6
$x_1(n) = \cos\left(\frac{2\pi n}{N}\right)$ *and* $x_2(n) = \sin\left(\frac{2\pi n}{N}\right)$.

b. State and prove the following properties of DFT, 9
i) Time reversal of a sequence property
ii) Circular frequency shift property
iii) Complex conjugate property.

c. If $x(n)$ is an even length sequence with N-point DFT, $X(K)$, then determine the N-point DFT of $y(n) = x(n) - x\left(n - N/2\right)$. 5

4 a. State and prove Perversal's theorem. 5

b. The even samples of 11-point DFT of length 11 real sequences are given by, 8
$X(0) = 2$, $X(2) = -1-j3$, $X(4) = 1+j4$
$X(6) = 9+j3$, $X(8) = 5$, $X(10) = 2+j2$
Determine the missing odd samples.

c. Explain symmetric properties of DFT. 7

UNIT - III

5 a. What is FFT? Why FFT is needed? 4

b. Compare computational complexity for direct DFT and Radix FFT for,

i) N = 64 6

ii) N = 512. What are the speed improvement factors in each case?

c. Derive Radix-2, DIT-FFT algorithm to compute DFT of N = 8-point sequence and draw complete signal flow graph. 10

6 a. Find the IDFT of sequence X(K) ={4, 1-j2.414, 0, 1-j0.414, 0, 1+j0.414, 0, 1+j2.414} using DIF Algorithm. 10

b. Obtain DFT of sequence *x(n)* = {1 2 3 4 4 3 2 1} using DIT Algorithm. 10

UNIT - IV

7 a. Determine the co-efficient K_m of Lattice FIR filter whose transfer function described by, $H(z) = 1 + 2z^{-1} + \frac{1}{3}z^{-2}$. Also draw corresponding lattice structure. 10

b. Realize the FIR filter whose transfer function is $H(z) = 1 + \frac{3}{4}z^{-1} + \frac{17}{8}z^{-2} + \frac{3}{4}z^{-3} + z^{-4}$ in 10

i) Direct form ii) Cascade form.

8 a. Obtain direct form, cascade and parallel Realization of transfer function,

$$H(z) = \frac{(3+5z^{-1})(0.6+3z^{-1})}{(1-2z^{-1}+z^{2})(1-z^{-1})}$$ 10

b. Convert the following pole zero IIR filter into lattice structure,

$$H(z) = \frac{1+2z^{-1}+2z^{-2}+z^{-3}}{1+\frac{13}{14}z^{-1}+\frac{5}{8}z^{-2}+\frac{1}{3}z^{-3}}$$ 10

UNIT - V

9 a. Derive expression for calculating poles of a Butterworth LPF. 6

b. Compare Butterworth and Chebyshev filters. 4

c. Explain:

i) Bilinear Transformation 10

ii) Impulse invariant Technique or method for Digital filter Design.

10 a. List the steps in the design procedure of a FIR filter using window functions. 10

b. Design a filter $H_d(e^{j\omega}) = \begin{cases} e^{-j3\omega}; -\frac{\pi}{4} \le \omega \le \frac{\pi}{4} \\ 0 \quad ; \frac{\pi}{4} < \omega \le \pi \end{cases}$. Using hamming window with N = 7. 10

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