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

(An Autonomous Institution affiliated to VTU, Belagavi)

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

Semester End Examination; May/June - 2018

Digital Signal Processing

Time: 3 hrs *Max. Marks: 100*

***Note**: Answer **FIVE** full questions, selecting **ONE** full question from each unit.*

UNIT - I

1 a. Derive the relationship between *N*-point DFT and *Z*-transform. 5

b. Obtain *N*-point DFT of; 10

i) $x(n) = a^n$ ii) $x(n) = \cos\left(\frac{2\Pi nko}{N}\right)$

iii) $x(n) = \delta(n - n_o)$ iv) $x(n) = u(n) - u(n - n_o)$

c. Compute DFT of a sequence $(-1)^n$ for $N = 4$ using linear transformations. 5

2 a. Define the terms for *N*-point, DFT and IDFT of a sequence. Explain aliasing effect in sampling. 10

b. Obtain IDFT of *x (k)* = {3, (2+j), 1, (2-j)}, using definition of IDFT. 6

c. What are twiddle factors (W_N)? Explain the need of it in the computation DFT and IDFT. 4

UNIT - II

3 a. Let *X(k)* be 14-point DFT of length 14 real sequences *x(n)*. The first 8 samples of *X(k)* are given by *X* (0) =12; *X* (1) = -1+j3, *X* (2) = 3+j4, *X* (3) = 1-j5, *X* (4) = -2+j2, *X* (5) = 6+j3, *X* (6) = -2-j3, *X* (7) = 10. Determine the missing samples of *X (k)*. 6

b. Find the circular convolution of sequence x_1(n) = {2, 3, -1} and x_2(n) = {1, 4, -2, -3}. Determine the periodic convolution and verify it by Stockham's method. 10

c. State and prove time reversal property of DFT. 4

4 a. State and prove the following properties of DFT : 12

i) Symmetry property ii) Circular time shift property

iii) Parsaval's theorem property

b. Consider finite length sequence, *x (n)* = $\delta(n)+2\delta(n-5)$; 8

i) Find the 10 point DFT *X(k)* ii) Find the sequence *y(n)* that has DFT given by,

$y(k) = [e^{j(\frac{4\Pi k}{10})}].\, X(k)$.

UNIT - III

5 a. Compute IDFT of the sequence, 10

X(k) = {20, (-5.828 - j2.279), 0, (-0.172 – j0.279), 0, (-0.172 + j0.279), 0, (-5.828 - j2.279)} using DIT-algorithm.

b. Explain: i) In place computations ii) Bit reverse order in FFT Algorithm. 6

c. Compare the computational complexity for direct DFT and Radix-2 DFT for N = 32. 4

6 a. Derive Radix-2 DIF-FFT algorithm to compute DFT of N = 8 point sequence and draw complete signal flow graph. 10

b. Compute 8 point DFT of a sequence, $x(n)$ = {1, 1, 0, 0, -1, -1, 0, 0} using DIT-FFT algorithm. 10

UNIT - IV

7 a. Consider a second order LTI system described by the difference equation;

$y(n) = \frac{1}{16} y(n-2) + x(n).$ 10

Determine Direct form-II, Cascade and Parallel form Realizations of the system.

b. Obtain linear phase realization of the impulse response of FIR filter structure,

$h(n) = \delta(n) - \frac{1}{4}\delta(n-1) + \frac{1}{2}\delta(n-2) + \frac{1}{2}\delta(n-3) - \frac{1}{4}\delta(n-1) + \delta(n-5).$ 6

c. Realize FIR filter with impulse response $h(n) = (\frac{1}{2})^n [u(n) - u(n-4)]$ using direct form. 4

8 a. Realize the direct form and linear phase FIR filter having following impulse response :

$h(n) = \{1, \frac{1}{4}, \frac{1}{8}, \frac{1}{4}, 1\}.$ 8

b. Obtain cascade and parallel realization structures of,

$$H(Z) \frac{(1 - Z^{-1})^3}{(1 - \frac{1}{2}Z^{-1})(1 - \frac{1}{8}Z^{-1})}.$$ 12

UNIT - V

9 a. Derive expression for poles from the squared magnitude response of Butterworth LPF. 10

b. Design an ideal low pass filter using Hamming window. The frequency response of the filter is,

$$H_d(e^{jw}) = 1 \qquad -\frac{\Pi}{2} \le w \le \frac{\Pi}{2}$$
$$= 0 \qquad otherwise$$ 10

Select the length of the unit impulse response of FIR filter as 9.

10 a. Drive the expression for order-N of Butterworth analog filter. 10

b. An analog filter has a transfer function,

$$H(S) = \frac{10}{S^2 + 7S + 10}$$ 6

Design a digital filter to realize this using Impulse Invariant method. Take T = 1 sec.

c. List the advantages and disadvantages of Bilinear transformation. 4

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