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

(An Autonomous Institution affiliated to VTU, Belgaum)

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

Semester End Examination; June/July - 2015

Digital Signal Processing

Time: 3 hrs *Max. Marks: 100*

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

UNIT - I

1. a. State and prove the relationship between Z-transform and DFT. 6

b. The first five DFT points of real and even sequence $x(n)$ of length eight are given as $X(k)=\{5,1,0,2,3,.....\}$ Determine remaining three points. 6

c. Compute 4-point DFT of the sequence $x(n)=u(n)-u(n-2)$ sketch the magnitude plot of DFT. 8

2 a. An FIR digital fitter has an unit impulse response $h(n)=\{2,2,1\}$. Determine the output sequence $y(n)$ in response to an input sequence of $x(n)=\{3,0,-2,1,0,-2,-1,0\}$ Use overlap save fast convolution technique. 10

b. Determine IDFT of a 4-point sequence $X(k)=\{4,-j2,0,j2\}$ using DFT. 4

c. If $y(n)=\dfrac{x(n)+x(-n)}{2}$ find $Y(k)$ if $X(k)=\{0.5,\ 2+j,\ 3+j2,\ j,\ 3,-j,3-j2,\ 2-j\}$ 6

UNIT - II

3 a. Classify FFT Algorithms and discuss the advantages of FFT Algorithm. 6

b. Derive DIT-FFT flow graph for N = 4 and hence find the DFT of $x(n)=\{1, 2, 3, 4\}$. 10

c. Explain bit reversal property used in FFT algorithm for N = 16. 4

4. a. Find IDFT of $X(k)=\{36, -4 +j9.7, -4+j4, -4+j1.7, -4, -4 -j1.7, -4-j4, -4-j9.7\}$ using DIF-FFT algorithm. Show clearly all the intermediate results. 10

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

UNIT - III

5. a. Explain the frequency sampling method of designing FIR filters and draw the corresponding block diagram. 8

b. Find an expression for the impulse response $h(n)$ of a linear phase low pass FIR filter using Kaiser window to satisfy the following magnitude response specifications for the equivalent analog filter, stop band attenuation = 40 dB, pass band ripple = 0.01dB, transition width = 1000 πrad/s. Ideal cut off frequency =2400 rad/s, sampling frequency =10 kHz. 12

Contd…2

6. a. Explain the design procedure of FIR filters, using windows concept. 8

b. A low pass filter is to be designed with the following desired frequency response :

$$H_d\left(e^{jw}\right)=\begin{cases} e^{-j2w}, & -\pi/4 \le w \le \pi/4 \\ 0, & \pi/4 < |w| \le \pi \end{cases}$$

Determine the filter coefficients $h_d(n)$ of the window function is defined as: 12

$$w(n)=\begin{cases} 1, & 0 \le n \le 4 \\ 0, & otherwise \end{cases}$$

UNIT - IV

7. a. Explain Bilinear Transformation method. Derive an expression showing mapping from S- plane to Z-plane. Show that there is no aliasing effect in Bi-linear transformation. 8

b. Design a Chebyshev filter to meet the following specifications:

(i) Pass band ripple ≤ 2 dB

(ii) Stop band attenuation ≥ 20 dB

(iii) Pass band edge : 1 rad/s

(iv) Stop band edge : 1.3 rad/s 12

8. a. Distinguish between IIR and FIR filters. 4

b. Derive an expression for order of a low pass butterworth filter. 6

c. Design and realize a digital low pass filter using the bilinear transformation method to satisfy the following characteristics. Take T = 2 sec.

(i) Pass band ripple ≤ 1.25 dB ii) Pass band edge = 200 Hz

(ii) Stop band attenuation = 15 dB iv) Stop band edge = 400 Hz

(iii) Sampling frequency = 2 kHz 10

UNIT -V

9. a. Obtain direct form-I and Lattice structure for the system described by the difference equation

$$y(n)=x(n)+\frac{2}{5}x(n-1)+\frac{3}{4}x(n-2)+\frac{1}{3}x(n-3)$$ 10

b. Obtain the direct form II and cascade realization of

$$H(z)=\frac{(z-1)\left(z^2+5z+6\right)(z-3)}{\left(z^2+6z+5\right)\left(z^2-6z+8\right)}$$ 10

10 a. A FIR filter is given by $y(n)=0.75y(n-1)-0.125y(n-2)+6x(n)+7x(n-1)+x(n-2)$ draw the Direct Form –I and Direct Form –II structure. 8

b. Realize the system with difference equation:

$y(n)=-0.1y(n-1)+0.2y(n-2)+3x(n)+3.6x(n-1)+0.6x(n-2)$ in cascade and parallel form. 12

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