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

(An Autonomous Institution affiliated to VTU, Belagavi)

Fourth Semester, B.E. - Electronics and Communication 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. Find the 4-point DFT of two sequences *g(n)* and *h(n)* using a single 4-point DFT. 6

$g(n) = (1, \underset{\downarrow}{2}, 0, 1)$ and $h(n) = (\downarrow, 1, 0, 2)$

b. *x(n)* and *h(n)* are two frequencies of length 5 each defined as $x(n) = n$ for $0 \le n \le 4$ and *h (n) = u (n) – u(n-2).* Compute the circular convolution between *x(n)* and *h(n)* using frequency domain approach. 8

c. State and prove circular convolution property of DFT. 6

2 a. Consider a FIR filter with impulse response h(n) = {3, 2, 1, 1} . If the input to the filter is {1, 2, 3, 3, 2, 1, -1, -2, -3, 5, 6, -1, 2, 0, 2, 1}, calculate the output response of filter using overlap add method by assuming a block length of 7. 10

b. Find the energy of the 4-point sequence $x(n)=\sin(\frac{2\pi}{N}n)$ 4

c. Find the IDFT of X(K) = {2, 1+j, 0, 1-j}. 6

UNIT - II

3 a. Develop 8 point DIT-FFT radix -2 algorithms and draw the signal flow graph. 10

b. A designer is having number of 8-point FFT chips. Show explicitly how he should interconnect these chips in order to compute a 24-point DFT. 6

Find the 4-point IDFT of the sequence x (k) = {6,-2-2j, 2, -2+2j} using DIF FFT algorithm. 4

4 a. Compute the circular convolution between two sequence x(n) = {1,1,1,1} and h(n) = {1,0,0,1} using DIF FFT algorithm. 10

b. For the sequence x(n)={1,0,1,0}, determine X[2] using Goetzel algorithm 6

c. Assume that a complex multiplication takes 1 µsec and the amount of time taken to compute N-point DFT is determined by amount of time it taken to perform all of Multiplication. 4

i) How much time it taken to compute 64-point DFT directly?

ii) How much time is required if an FFT is used?

UNIT - III

5 a. Design a FIR low pass fitter with cutoff frequency of 1 KHz and sampling frequency of 4 kHz with 11 samples using Fourier series method. 8

b. Design an analog low pass Chebyshev type-I filter that has -3dB cut-off frequency of 2 radians /sec and stop band attenuation of 25 dB or greater for all radian frequencies greater for all radian frequencies greater than 5 radians/s. 12

Contd…2

6 a. A low pass FIR filter is to be designed with the following desired frequency response.

$$H_d(w) = \begin{cases} e^{-j3w} & for\ |w| < \frac{3\pi}{4} \\ 0 & for\ \frac{3\pi}{4} < |w| < \pi \end{cases}$$ 10

Determine FIR filter coefficients using Hamming window approach for a length of N = 7.

b. A fifth order analog low pass Butterworth filter has a pass band edge frequency 2 kHz and maximum pass band attenuation of -2dB. What is the actual attenuation in dB of low pass filter at a frequency 4 kHz? 10

UNIT - IV

7 a. Distinguish between IIR and FIR filter. 4

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

c. Design and realize a digital low pass filter using Bilinear transformation method to satisfy the following characteristics. 10

i) Pass band ripple 1.25 dB; ii) Pass band edge = 200 Hz; iii) stop band attenuation = 15dB; iv) Stop band edge = 400 Hz; v) sampling frequency = 2 kHz . Assuming T = 2 s.

8 a. Design a Chebyshev digital IIR Low pass filter using impulse invariant transformation by taking T = 1 second to satisfy the following specification : 12

$$0.9 \le |H(e^{iw})| \le 1.0 \qquad 0 \le w \le 0.25\pi$$
$$|H(e^{iw})| \le 0.24 \qquad 0.5\pi \le w \le \pi$$

b. The normalized transfer function of an analog fitter is given by,

$$H(S_n) = \frac{1}{S_n^2 + 1.4142 S_n + 1}$$ 8

Convert analog filer to a digital filter with cut off frequency of 0.4π, using bilinear transformation.

UNIT - V

9.a Obtain direct form – I direct form – II and cascade form realization of following function

$$H(Z) = \frac{8Z^3 - 4Z^2 + 11Z - 2}{(z - 0.25)(Z^2 - Z + 0.5)}$$ 12

b. Obtain parallel realization for the system represented by the following system function.

$$H(Z) = \frac{1 + 1/4Z^{-1}}{(1 + \frac{1}{2}Z^{-1})(1 + \frac{1}{2}Z^{-1} + \frac{1}{4}Z^{-2})}$$ 8

10 a. Realize FIR filter with impulse response h(n) given by

$$h(n) = (\tfrac{1}{2})^n [u(n) - u(n-4)]$$ 10

Using direct form – I and direct form – II

b. Given the FIR filter with following difference equations

$$y(n) = x(n) + 3.1x(n-1) + 5.5x(n-2) + 4.2x(n-3) + 2.3x(n-4)$$ 10

Sketch the lattice realization of the filter.

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