U.S.N

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. - 2014

Digital Signal Processing

Time: 3 hrs *Max. Marks: 100*

***Note** :i) Answer any **FIVE** full questions selecting at least **TWO** full questions from each part.*
ii) Assume suitable missing data if any.

PART - A

1. a. Define DTFT of a signal *x(n)*: and inverse DTFT of *X(ω)*. State and prove the frequency shift property of DTFTs. 6

b. Find the N-point DFT of 6

(i) $x(n)=\begin{cases}1....0\le N-1\\ 0......otherwise\end{cases}$; (ii) $x(n)=\begin{cases}a^n....0\le n\le N-1\\ 0......otherwise\end{cases}$

c. Find the four-point DFT of two signals g(n) = {1,2,0,1} and h(n) = {2,2,1,1} by using only one DFT computation. 8

2 a. An 8 point signal *x(n)* has an 8 point DFT *X(k)* = {4,3,2,1,0,1,2,3}. If a 16 point signal *y(n)* is defined as $y(n)=x\left(\frac{n}{2}\right)$ for n even and *y(n)* =0 for n odd, find 16-point DFT *Y(k)*. 8

b. Use Stockham method to find the 4-point circular convolution *y(n)* of *x(n)* = {2,1,2,1} and *h(n)* = {1,2,3,4} 12

3 a. Explain the terms: 8

(i) in-place computation (ii) bit-reversal-order

(iii) Computational complexity of an algorithm (iv) Speedup of FFT algorithm.

b. A long sequence *x(n)* = {1,1,1,1,3,1,1,4,2,1,1,3,1,1,1} is filtered using filter with impulse response *h(n)* = {1,-1} Find the response of the filter using overlap-save method with 5-point convolution. 12

4 a Derive the computational complexity of a DIT - FFT algorithm and find the speed up of the algorithm for N = 2^{10}. 8

b. Compute the 8-point DFT of *x(n)* = {1,1,1,0,0,1,1,1} using DIF-FFT algorithm. Show the results on a SFG. 12

PART - B

5 a. Obtain the direct form-II realization of a third order IIR filter. Then find the transposed form of the same. 8

b. Obtain the direct form –II, cascade and parallel realizations for the IIR filter with

$$\text{TF,}\quad H(z)=\left\{\frac{1+\frac{1}{5}z^{-1}}{\left(1+\frac{1}{4}z^{-1}\right)\left(1-\frac{1}{2}z^{-1}+\frac{1}{3}z^{-2}\right)}\right\}$$ 12

6 a. Discuss the frequency transformation of analog filters. 8

b. Obtain the direct form, cascade form and linear phase form of block diagram representation for the system with the difference equation 12

$$y(n)=\delta(n)+0.75\delta(n-1)+2.1\delta(n-2)+0.75\delta(n-3)+\delta(n-4)$$

7 a. Explain the procedure to design a digital Butterworth IIF filter using bilinear transformation. 8

b. Design a low pass FIR filter using rectangular window with N = 5 for the desired response

$$x_d(t)=\begin{cases}e^{-J2\omega}.....0\le\omega\le\pi/4\\ 0........\pi/4\le\omega\le\pi\end{cases}$$ 12

8 a. Describe the procedure to design an IIR filter using invariant impulse response method. 8

b. Design an analog Butterworth LPF to meet:

(i) pass band gain ≥ -2 dB;

(ii) Pass band edge frequency = 300 π 12

(ii) Gain in attenuation band = - 60 dB and

(iii) Attenuation to start from 4500 π

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