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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. - 2015

## Digital Signal Processing

*Time: 3 hrs* *Max. Marks: 100*

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

### UNIT - I

1 a. Explain the relation between DFT and Z – transform. 6

b. Find the 4 – point DFT of the sequence $x(n) = \cos\left[\frac{n\pi}{4}\right]$. 6

c. The first five points of the 8 – point DFT of a real valued sequence are {0.25, 0.125 – j0.3018, 0, 0.125 – j0.0518, 0}. Determine the remaining three points. 8

2 a. If $y(n) = \frac{\left[x(n) + x(-n)\right]}{2}$ find $Y(k)$; if $x(k) = \{0.5, 2 + j, 3 + j2, j, 3, -j, 3 - j2, 2 - j\}$. 6

b. Explain what is meant by twiddle factors. 6

c. Let $X(k)$ denotes the N – point DFT of the N – point sequence $x(n)$,

i) Show that if $x(n)$ satisfies the relation $x(n) = -x(N - 1 - n)$ then $X(0) = 0$.

ii) Show that with N even and if $x(n) = x(N - 1 - n)$ then $x(\frac{N}{2}) = 0$. 8

### UNIT - II

3 a. A four point sequence $x(n) = \{1, 2, 3, 4\}$ has DFT $X(k)$, $0 \le k \le 3$ without performing DFT or IDFT, determine the signal values which has DFT $X(k - 1)$. 8

b. Given a real finite length sequence $x(n) = \{4, 3, 2, 1, 0, 0, 1, 1\}$,

i) $y(n)$ is a sequence relates to $x(n)$ such that $Y(k) = W_8^{+nk} X(k)$ where $X(k)$ is 8 point DFT of $x(n)$, obtain $y(n)$.

ii) Also obtain finite length sequence $q(n)$ related to $x(n)$ such that its 8 point DFT is $Q(k) = Re\{X(k)\}$. 12

4 a. State and prove the:

i) Circular time shift of a sequence ii) Circular frequency shift of a sequence. 8

b. Given the sequence $x_1(n)$ and $x_2(n)$ compute;

(i) The Circular convolution of $x_1(n)$ (N) $x_2(n)$ for N = 6

(ii) The linear convolution $x_1(n) * x_2(n)$ 12

Contd….2

(iii) What value of N is necessary so that linear and circular convolution are the same on the N-point interval.

(iv) Determine the non zero lengths of $x_1(n)$ and $x_2(n)$ and how the results in part (iii) could be obtained without performing calculations. Given:

$x_1(n) = \{2, 1, 1, 2\}$ and $x_2(n) = \{1, -1, -1, 1\}$.

## UNIT - III

5 a. Use the 8-point radix-2 input bit reserved, DIT-FFT algorithm to find the DFT of the sequence, $x(n)= \{0.707, 1, 0.707, 0, -0.707, -1, -0.707, 0\}$. 10

b. What is FFT? Develop an 8-point DIF-FFT. Determine DFT of the following 8-point sequence, $x(n) = \left(\frac{1}{4}\right)^n, 0 \le n \le 7$ Using FFT flow graph, Show all the intermediate results. 10

6 a. The DFT, $X(k)$ of sequence is given as,

$$X(k) = \left\{\underset{\uparrow}{0}, 2\sqrt{2}(1-j), 0, 0, 0, 0, 0, 2\sqrt{2}(1+j1)\right\}$$ 10

Determine the corresponding time sequence *x(n)* and write its signal flow graph.

b. A complex sequence *z(n)* with *DFT, Z(k)* is formed *as z(n) = x(n) + jy(n)* where *x(n)* and *y(n)* are real valued sequence with corresponding *DFT's X(K)* and *Y(k)* respectively. Express *X(k) and* Y(k) in terms of *Z(k).* Given Z*(k) = { 12+j12, 1.414+j3.414, 0, (-0.5858+j1.414), 0, -1.414+j05858, 0, -3.414- j1.414}.* Compute *X(k)* and *Y(k)* using above relations without computing any DFT. 10

## UNIT - IV

7 a. Obtain linear phase realization of $H(z) = 1 + \frac{Z^{-1}}{4} + \frac{Z^{-2}}{4} + Z^{-3}$. 6

b. Realise the following system function in (i) Direct from (ii) Cascade form,

$$H(z) = 1 + \frac{3}{4}z^{-1} + \frac{17}{8}z^{-2} + \frac{3}{4}z^{-3} + z^{-4}$$ 10

c. Obtain the cascade realization of system function $H(z) = 1 + \frac{5}{2}z^{-1} + 2z^{-2} + 2z^{-3}$ 4

8 a. A system is represented by the T.F. $H(z) = 3 + \frac{4z}{z-\frac{1}{2}} - \frac{2}{z-\frac{1}{4}}$

(i) Does this H(z) represents FIR or IIR filter? Why?

(ii) Give a difference equations realization of this system using direct form - I 12

(iii) Draw the block diagram for the direct form – II canonic realization, and give the governing equations for implementations.

Contd….3

b. The Transfer function of a discrete casual system is given by $H(z)=\frac{1-z^{-1}}{1-0.2z^{-1}-0.15z^{-2}}$. 8

Draw cascade and parallel realization.

**UNIT - V**

9 a. Design a second order band pass digital butterworth filter with pass band of 200 Hz to 300 Hz and sampling frequency of 2000 Hz using bilinear transformations. 10

b. Design a second order high pass digital filter for following specifications. Ripple in the pass band = 1 db, pass band edge frequency =100 Hz, Sampling frequency = 400 Hz, Monotic response in the stop band. Use $S \rightarrow \frac{2}{j}\left[\frac{1-z^{-1}}{1+z^{-1}}\right]$ type of mapping. 10

10. Design the symmetric FIR low pass filter whose desired frequency response is given as

$H_d(w)\begin{cases} e^{-jwc} & for\,|w| \le w_c \\ 0 & otherwise \end{cases}$ .The length of the filter should be 7 and $w_c$ = 1 rad/sec. 20

Use (i) Rectangular window (ii) Hanning window.

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