# Fifth Semester B.E. Degree Examination, Dec.2017/Jan.2018
## Digital Signal Processing

Time: 3 hrs. Max. Marks: 80

**Note: Answer any FIVE full questions, choosing ONE full question from each module.**

### Module-1

1 a. Define DFT and IDFT of a signal obtain the relationship between of DFT and z – transform. **(06 Marks)**

b. Compute circular convolution using DFT and IDFT for the following sequences, $x_1(n) = \{2, 3, 1, 1\}$ and $x_2(n) = \{1, 3, 5, 3\}$. **(10 Marks)**

**OR**

2 a. The first five samples of the 8 – point DFT x(k) are given as follows : $x(0) = 0.25$, $x(1) = 0.125 - j0.3018$, $x(4) = x(6) = 0$, $x(5) = 0.125 - j0.0518$. Determine the remaining samples, if the x(n) is real valued sequence. **(04 Marks)**

b. State and prove the circular time shift and circular frequency shift properties. **(06 Marks)**

c. If $x(n) = \{1, 2, 0, 3, -2, 4, 7, 5\}$, evaluate the following :

i) x(0) ii) x(4) iii) $\sum_{n=0}^{7} x(k)$. **(06 Marks)**

### Module-2

3 a. State and prove the following properties of phase factor $\omega_N$.
i) periodicity
ii) symmetry. **(04 Marks)**

b. Find the output y(n) of a filter whose impulse suppose $h(n) = \{1, 2, 3, 4\}$ and input signal to the filter is $x(n) = \{1, 2, 1, -1, 3, 0, 5, 6, 2, -2, -5, -6, 7, 1, 2, 0, 1\}$ using overlap – add method with 6-point circular convolution. **(12 Marks)**

**OR**

4 a. In the direct computation of N-point DFT of x(n), how many :
i) Complex additions
ii) Complex multiplications
iii) Real multiplication
iv) Real additions
v) Trigonometric functions
Evaluations are required? **(06 Marks)**

b. Explain the linear filtering of long data sequences using overlap – save method. **(10 Marks)**

### Module-3

5 a. Given $x(n) = \{1, 0, 1, 0\}$, find x(2) using Goertzel algorithm. **(06 Marks)**

b. Find the 8-point DFT of the sequence $x(n) = \{1, 2, 3, 4, 4, 3, 2, 1\}$ using DIT – FFT radix – 2 algorithm. **(10 Marks)**

OR

6 a. What is chirp–z transform? Mention its applications? (06 Marks)

b. Find the 4-point circular convolution of x(n) and h(n) give below, using radix–2. DIF–FFT algorithm.

$x(n) = \{1, 1, 1, 1\}$

$h(x) = \{1, 0, 1, 0\}$. (10 Marks)

## Module-4

7 a. Derive an expression for the order, cut of frequency and poles of the low pass Butterworth filter. (08 Marks)

b. A Butterworth low pass filter has to meet the following s specifications.

i) Pass band gain, $k_p = -1dB$ at $\Omega_p = 4$ rad/sec

ii) Step band alternations greater than or equal to 20dB at $\Omega_s = 8$rad/sec

Determine the transfer function $H_a(s)$ of the Butterworth filter to meet the above specifications. (08 Marks)

OR

8 a. A third –order Butterworth low pass filter has the transfer function :

$$H(s) = \frac{1}{(s+1)(s^2+s+1)}$$

Design H(z) using impulse invariant technique. (10 Marks)

b. List the advantages and disadvantages of IIR filters. (06 Marks)

## Module-5

9 a. A linear time – invariant digital IIR filter is specified by the following transfer function :

$$H(z) = \frac{(z-1)(z-2)(z+1)z}{\left[z-\left(\tfrac{1}{2}+\tfrac{1}{2}j\right)\right]\left[z-\left(\tfrac{1}{2}-j\tfrac{1}{2}\right)\right]\left[z-j\tfrac{1}{4}\right]\left[z+j\tfrac{1}{4}\right]}$$

Realize the system in the following forms : i) direct form – I ii) Direct form –II. (12 Marks)

b. Obtain a cascade realization for the system function given below :

$$H(z) = \frac{\left(1+z^{-1}\right)^3}{\left(1-\tfrac{1}{4}z^{-1}\right)\left(1-z^{-1}+\tfrac{1}{2}z^{-2}\right)}.$$ (04 Marks)

OR

10 a. Explain the following terms :

i) Rectangular window

ii) Bartlett window

iii) Hamming window. (08 Marks)

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

$$H_d(\omega) = \begin{cases} 0, & -\pi/4 < \omega < \pi/4 \\ e^{-j2\omega}, & \pi/4 < |\omega| < \pi \end{cases}$$

Find the frequency response of the FIR filter designed using rectangular window defined below :

$$\omega_R(n) = \begin{cases} 1, & 0 \le n \le 4 \\ 0, & \text{otherwise} \end{cases}.$$ (08 Marks)

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