Student Exam No.:_____

# GANPAT UNIVERSITY

## B. TECH. SEMESTER: VII (EC) REGULAR EXAMINATION NOV/DEC -2015

## 2EC702: DIGITAL SIGNAL PROCESSING

**Time: 3 Hours ]** **[Total Marks: 70**

**Instructions:**

1. Attempt all questions.
2. Answers to the two sections must be written in separate answer books.
3. Figures to the right indicate full marks.

## SECTION-I

1 (A) Obtain following structure of given system described by difference equation 6
(i) Direct form-I (ii) Direct form-II

$$y(n) + 2y(n-1) + 3y(n-2) = 4x(n) + 5x(n-1) + 6x(n-2)$$

(B) Obtain the following structures of given system transfer function 6
(i) Cascade form via the first order sections (ii) Parallel form via the first order sections

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

**OR**

1 (A) Obtain the following structures of given system transfer function 12
(i) Direct form-I and Direct form-II block diagram
(ii) Direct form-I and Direct form-II Signal flow graph
(iii) Signal flow graph of Direct form-I and Direct form-II
(iv) Transposed form of Direct form-II
(v) Find number of multipliers, adders and memory require in direct form-I and direct form- II.
(vi) Which one is Canonic and Noncanonic structure? Why?

$$H(Z) = \frac{1 - \frac{7}{6}Z^{-1} + \frac{1}{6}Z^{-2}}{1 + Z^{-1} + \frac{1}{2}Z^{-2}}$$

2 (A) A low pass filter is designed with the following desired frequency response specifications 6

$$H(e^{j\omega}) = \begin{cases} e^{-2j\omega} ; -\frac{\pi}{4} \le \omega \le \frac{\pi}{4} \\ 0 \quad ; \ otherwise \end{cases}$$

Determine the filter coefficient and transfer function if the window function is defined as

$$W(n) = \begin{cases} 1 \ ; 0 \le n \le 4 \\ 0 \ ; otherwise \end{cases}$$

(B) Design a second order digital lowpass Butterworth filter with a cutoff frequency of 3.4kHz at a sampling frequency of 8kHz. 5

**OR**

2 (A) Design Highpass FIR filter using Fourier transform method for the following specifications. Sampling frequency=2kHz, Cut off frequency=0.5kHz, Order of filter=6. 6

(B) The normalized low pass filter with a cut off frequency of 1 rad/sec is given as $H_P(s) = \frac{1}{s+1}$. Use the given $H_p(s)$ and the Bilinear transformation method to design a corresponding digital IIR highpass filter with cutoff frequency of 15 Hz and a sampling rate of 90Hz. 5

3 (A) Obtain direct form structure of given FIR system 3
$y(n) = 4x(n) + 5x(n-1) + 6x(n-2) + 2x(n-3) + 3x(n-4)$

(B) Give the comparisons of IIR filter and FIR Filter characteristics. 3

(C) Consider the following Laplace transfer function $H(s) = \frac{2}{s+2}$ 6
Determine filter transfer function H(z) using the impulse invariant method if the sampling rate = 10Hz .

## SECTION-II

4 (A) Obtain DTFT of following : 6
(i) unit impulse
(ii) unit step
(iii) $a^n u(n)$

(B) Determine the length-4 sequence from its DFT. 4
X(k) = { 4, 1-j, -2, 1+j}

(C) What is DFT? Give the Definition of DFT. 2

**OR**

4 (A) Explain and prove following property of DFT: 4
(i) Linearity
(ii) Time reversal of sequence

(B) Obtain the DFT of following: 4
(i) $\delta(n - n_o)$
(ii) $a^n u(n)$

(C) Find the linear convolution of the following sequences using DFT 5
x(n)={1,-2,4} h(n)={2,1,2,1}

5 (A) Find the circular convolution using graphical method 6
x(n) = {1, 2, 3, 1} h(n) = {4, 3, 2, 2}

(B) Explain radix-2 decimation in frequency FFT algorithm. 8

**OR**

5 (A) Do as directed:
(i) Find linear convolution and circular convolution using matrix method
x(n) = {1, 2, 3, 1} h(n) = {4, 3, 2, 2}
(ii)Why the result of circular and linear convolution is not same?
(iii) How to obtain same result from linear and circular convolution? 3

(B) How the mathematical complexity is reduced in DIF FFT algorithm?

6 (A) Draw internal architectures of TMSC62x DSP processors and explain functional units and its operations. 7

(B) Derive the impulse response formula of FIR Kaiser Window used for FIR lowpass filter design with the following specifications: 5
$\omega_p = 0.35\pi$ , $\omega_s = 0.5\pi$ , $\delta_1 = \delta_2 = \delta = 0.021$

**END OF PAPER**