Student Exam No.________________

GANPAT UNIVERSITY

B. Tech. Semester: VII Electronics and Communication Engineering

Regular Examination Nov.-Dec. 2016

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.
4. Assume suitable data, if necessary.

SECTION-I

1 (A) Obtain Direct form-I and Direct form-II structures of given system transfer function. 6

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

(B) Obtain Cascade form via the first order sections structure of given system described by difference equation. 6

$$y(n) = -0.1y(n-1) + 0.72y(n-2) + 0.7x(n) - 0.25x(n-2)$$

OR

1 (A) Obtain Signal flow graph of Direct form-I and Direct form-II structures of given system transfer function. Also find number of multipliers, adders and delay elements require in direct form-I and Direct form- II. 7

$$H(Z) = \frac{1+2Z^{-1}}{1-1.5Z^{-1}+0.9Z^{-2}}$$

(B) Obtain Parallel form via the first order sections structure of given system transfer function. 5

$$H(z) = \frac{1-Z^{-1}}{1+0.2Z^{-1}-0.15Z^{-2}}$$

2 (A) Determine the transfer function and difference equation of 5-tap FIR bandpass filter design using the Fourier transform method with a lower cutoff frequency of 2,000 Hz and an upper cutoff frequency of 2,400 Hz at a sampling rate of 8,000 Hz. 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 30 Hz and a sampling rate of 200Hz. 5

OR

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

$$H(e^{j\omega}) = \begin{cases} e^{-3j\omega} ; -\frac{\pi}{2} \le \omega \le \frac{\pi}{2} \\ 0 \quad ; \; otherwise \end{cases}$$

Determine the filter coefficient and transfer function if the window function is defined as $W(n) = \begin{cases} 1 \; ; 0 \le n \le 6 \\ 0 \; ; otherwise \end{cases}$

(B) Determine the transfer function and difference equation of a first order digital lowpass Butterworth filter with a cutoff frequency of 1500 Hz and a passband ripple of 3dB at a sampling frequency of 8000 Hz. 5

3 (A) Draw architectures of TMSC6000 DSP processors and explain functional units and its operations. 6

(B) Compare the main lobe width and peak amplitude of side lobe for rectangular, Bartlett, hanning, hamming and blackman window function. 3

(C) Explain Impulse Invariant Method to design Digital IIR filter in brief. 3

SECTION-II

4 (A) Obtain the DFT of $x(n)$ if, $x(n) = \begin{cases} 1, 0 \leqslant n \leqslant 3 \\ 0, \text{otherwise} \end{cases}$ 4

(B) Explain the overlap save method and overlap add method for linear filtering of long data sequence. 6

(C) How to obtain same result for linear and circular convolution? 2

OR

4 (A) Explain and prove following property of DFT. 6

(i) Periodicity

(ii) Circular time shift of sequence

(B) Determine the length-4 sequence from its DFT. 4

$x(k) = \{4, 1-j, -2, 1+j\}$.

(C) Explain the relation between DTFT and DFT with its equation. 2

5 (A) Find circular convolution of x(n) and h(n) using graphical method. 5

$x(n) = \{1, 2, 3, 4\} \quad h(n) = \{1, 1, 1\}$

(B) Prove following relationship. 6

$(i)\ W_N^K = W_N^{K+N}$

$(ii)\ W_N^2 = W_{N/2}$

OR

5 (A) Explain radix-2 decimation in time FFT algorithm. 5

(B) Compute the DFT of the following sequence using DIF FFT algorithm. 6

$X(n) = \{0.5, 0.5, 0.5, 0.5, 0, 0, 0, 0\}$

6 (A) Obtain Direct form-I structure of IIR system given by following transfer function. Also find number of multipliers, adders and delay elements require in it. 6

$$H(z) = \frac{\sum_{k=0}^{M} b_k z^{-k}}{1 + \sum_{k=1}^{N} a_k z^{-k}}$$

(B) Obtain and draw the Lattice structure of FIR filter. 6

END OF PAPER