Registration No. : | | | | | | | | | | |

Total number of printed pages – 3

B. Tech

FECS6401

Seventh Semester Examination – 2013

INTRODUCTION TO DIGITAL SIGNAL PROCESSING

BRANCH : IT, CSE

QUESTION CODE : C- 213

Full Marks – 70

Time : 3 Hours

*Answer Question No. **1** which is compulsory and any **five** from the rest.*
The figures in the right-hand margin indicate marks.

1. Answer the following questions : 2×10

   (a) Find the Niquist rate of sampling of the mixed signal given below :

   $$10\sin(300\pi t) + 3\cos(50\pi t) - \cos(100\pi t)$$

   (b) Establish the relation between correlation and convolution.

   (c) What is condition of stability of a LTI system in Z-domain?

   (d) What is even and odd signal ? Express a signal X (n) in terms of even and odd component.

   (e) How many real multiplication and addition is required for computation of N-point DFT ?

   (f) Draw the basic structure of 1st order digital IIR filter.

   (g) Express the signal U (–n–3) in sequential representation, when U (n) is a unit step function.

   (h) Give the mapping of S-plane to Z-plane using bilinear transformation technique.

P.T.O.

(i) Find the impulse response of the system which is described by the difference equation.

$$Y(n) = 0.75\,x(n-2) + x(n)$$

(j) Why IIR filters does not have Linear phase characteristics ?

2. (a) Find the inverse Z-transform of the following casual system. Then find its stability region. 5

$$h(z) = \frac{1}{1 - az^{-1} + bz^{-2}}$$

(b) Determine the steady state response of the system described by

$$h(n) = 0.5\,y(n-1) + y(n-2) + 0.25\,x(n-1)$$

When a unit step function is applied to the system. 5

3. (a) Find the circular convolution of the following two sequence : 5

$$X_1(n) = \{1, 2, 3, 4\},$$

$$X_2(n) = \{2, 1, 2, 1\}$$

(b) Find inverse Z-transform of 5

$$X(z) = \log\,(1 + az^{-1}) \quad |z| > |a|$$

4.. Convert the analog filter with system function

$$H(s) = \frac{s + 0.1}{(s + 0.1)^2 - 9}$$

Into a digital IIR filter using impulse invariance and bilinear transformation method. The digital filter is to have resonant frequency of $\frac{\pi}{2}$. 10

5. (a) Consider the casual system

$$Y(n) = 0.9\,y(n-1) - 0.08\,y(n-2) + x(n) + 0.3\,x(n-1)$$

Obtain Form-I and Form-II structure of the system. 5

(b) Explain the Design of linear phase FIR filter using windows. 5

6. (a) Determine the impulse response for the two cascaded LTI system having impulse responses. 5

$$h1(n) = 0.5^n u(n)$$

$$h2(n) = 0.25^n u(n)$$

(b) Find the range of values a and b for which the LTI system with impulse response

$$h(n) = a^n \quad n \geq 0$$
$$= b^n \quad n < 0$$

Is stable ? 5

7. (a) Explain Decimation in time FFT algorithm. 5

(b) Find 4-pont IDFT of the signal, $X(k) = \{1, 1, 0, 1\}$ and sketch magnitude response. 5

8. Write short notes on any two 5×2

(a) Overlap add filtering using DFT method

(b) Casually and its implication

(c) Circular convolution

(d) Use of DFT in linear filtering.