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

Total number of printed pages – 2

B. Tech

FECS 6401

Seventh Semester Back Examination – 2014

INTRODUCTION TO DIGITAL SIGNAL PROCESSING

BRANCH (S) : CSE, IT

QUESTION CODE : L186

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) Define a unit impulse signal. How the unit impulse signal is used as test signal in digital signal processing ?
   (b) Write the transfer function of a delay element in Z-domain. Explain its importance in digital signal processing.
   (c) State the conditions of stability for causal LTI system in Z-domain.
   (d) State the time shifting property of the z transforms.
   (e) State the two conditions that must be satisfied for which the system will obey the linearity property ?
   (f) Why aliasing occurs most of the time when mapping of s-plane to z-plane is done using impulse invariance sampling method ?
   (g) Find the impulse response the LTI system shown below.
   $$Y(n) = 0.25y(n-1) + x(n)$$
   (h) How many real multiplication and real additions are required to compute 16 point DFT ?
   (i) What is difference between FIR and IIR filter ?
   (j) What are different bands in a digital filter ? At which band an ideal filter is distortion less?
2. (a) What is energy and power signal ? With example justify that a energy signal may or may not be a power signal. 5
   (b) Differentiate between : 5
      (i) Static and dynamic
      (ii) Time variant and Time invariant.

P.T.O.

3. Determine the coefficient of linear phase FIR filter length M = 15, which has a symmetric unit sample response and frequency response that satisfies the condition 10

$$Hr\left(\frac{2\pi K}{15}\right) = 1 \qquad K = 0, 1, 2, 3$$

$$= 0.4 \qquad K = 4$$

$$= 0 \qquad K = 5, 6, 7$$

4. (a) The impulse response of LTI system is expressed as

$$h(n) = 0.2^n u(n)$$

Find the value of A such that $h(n) - A\,h(n-1) = \delta(n)$. 5

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

$$x(n) = y(n-1) + 2y(n-2)$$

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

5. (a) Find inverse Z-transform of the casual signal x(n) whose Z-transform is given as 5

$$X(z) = \frac{1}{1 - 1.5z^{-1} - 0.5z^{-2}}.$$

(b) Prove that convolution of two signals in discrete time domain is equal to multiplication in discrete frequency domain. 5

6. (a) Convert the analog filter with the system function

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

Into a digital IIR filter using impulse invariance transformation method. 5

(b) Bring out mapping between ω and Ω. Where it is used ? 5

7. (a) The DFT of $x(n)$ is described as $X(k) = \{1, -1 + 2f, -1, 1 + 2f\}$. Find the DFT of $x^2(n)$. 5

(b) Explain the design procedure for IIR filter using bilinear transformation method. 5

8. Write short notes on any **two** : 5×2

(a) Casual and non-casual system

(b) Stability of discrete system in Z-domain

(c) FIR filters using window technique

(d) Mapping of S-plane into Z-plane.