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

Total number of printed pages – 2

B. Tech

PCEC 4304

Sixth Semester Regular Examination – 2014

DIGITAL SIGNAL PROCESSING

BRANCH(S) : EC, ETC

QUESTION CODE : F 215

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) The following analog signal is sampled at 8,000 samples per second :

$$x(t) = \sin(1250\,t) + 2\cos(1000\,\pi t)$$

What is corresponding discrete time signal after sampling?

(b) State the time shifting properties of Z-transform.

(c) What is approximate transition width of main lobe in the rectangular window ? What happens to it if you double the filter length ?

(d) State the magnitude response of the system described by

$$y(n) = 0.2Y(n-2) + X(n).$$

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

(f) What do you mean by linear phase characteristics of FIR filter ? Why IIR filters does not have linear phase characteristics ?

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

(h) State the limitations of impulse invariance method for realizing IIR filter.

(i) State circular frequency shifting property of DFT.

(j) Establish the relation between DFT and Z-transform.

P.T.O.

2. (a) Find the Z-transform of the following signal : 6

(i) $x(n) = a^n u(n)$

(ii) $x(n) = n^2 u(n-1)$

(b) Using convolution property, determine Z-transform of the signal 4

$x(n) = (n+1)\, u(n)$

3. (a) Explain various windows used for design of linear phase FIR filter. 5

(b) Find the impulse response of LTI system whose frequency response is described as 5

$H(e^{jw}) = 1$ For $|w| < \pi/4$

$= 0$ otherwise

4. (a) Compare the merits and limitations of impulse invariance and bilinear transformation methods of IIR filter design. 5

(b) Design a single pole low-pass digital filter with 3-dB bandwidth of 0.2π, using bilinear transformation applied to the analog filter.

$$H(s) = \frac{\Omega}{s + \Omega}$$

Where Ω is the 3-dB bandwidth of an analog filter. 5

5. (a) Consider the casual system 5

$Y(n) = 0.75\, y(n-1) - 0.125\, y(n-2) + x(n) + 0.3x(n-1)$

Obtain direct form-I and form-II structure.

(b) Explain linear phase and stability property of FIR and IIR filters. 5

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

(b) Explain how DFT can be used in linear filtering the discrete signal. 5

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

(b) What is N in N-point DFT ? Find 4-pont DFT of the discrete signal, $X(n) = \{0, 1, 2, 3\}$. 5

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

(a) Linear phase FIR filter by frequency sampling method

(b) Stability of LTI system

(c) Symmetric FIR filter

(d) Use of DFT in linear filtering.