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

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B. Tech

PCEC 4304

Sixth Semester Regular Examination – 2014

DIGITAL SIGNAL PROCESSING

BRANCH(S) : AEIE, EIE, IEE

QUESTION CODE : F 233

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 impulse response of the LTI system which is described by the difference equation

$$Y(n) = 0.5x(n-1) + 2x(n)$$

(b) State the conditions that must be fulfilled for FIR filter to be linear phase.

(c) Why FIR filters are inherently stable ?

(d) Express Unit step function U (n) in terms of in terms of impulse functions $\delta(n)$.

(e) Compare no. of complex multiplication and addition is required for computation of 32-point DFT when computed directly and then computed using decimation in time (DIT) algorithm.

(f) What are the properties of IIR filter ?

(g) Express a discrete unit step functions in terms of discrete unit impulse functions.

(h) State the limitations of the method bilinear transformation technique when used for realization of IIR filter.

(i) State the properties of region of convergence (ROC) of Z-transform.

(j) When DFT x(k) of a sequence x (n) is real ?

P.T.O.

2. (a) The impulse response of LTI system is expressed as 5

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

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

(b) Determine the steady state response of the system described by 5

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

When a unit step function is applied to the system.

3. (a) Consider the LTI system described by the equation 5

$$x(n) = a^n u(n) - b^n u(-n-1)$$

What conditions must hold on a and b for Z-transform to exist ?

(b) Find inverse Z-transform of 5

$$X(z) = \log(1 - z^{-1}) \qquad |z| > 0.5$$

4. Design a high-pass filter, monotonic in pass band with cutoff frequency of 1000 Hz and down 10 dB at 350 Hz. The sampling frequency is 5000 Hz. Determine the order and poles of a high-pass filter. Sketch the poles of proposed filfer transfer functions. 10

5. (a) Consider the casual system

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

Justify whether the filter is FIR or IIR. Then find direct realization of the system. 5

(b) Explain the Design of linear phase FIR filter using frequency sampling method. 5

6. (a) Explain the design procedure for IIR filter using impulse invariance transformation method. 5

(b) Convert the analog filter with system function 5

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

Into a digital IIR filter using impulse invariance transformation method. The digital filter is to have resonant frequency of $\pi/2$.

7. (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 the Decimation in time FFT algorithm. 5

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

(a) Different windows used for FIR filters

(b) Symmetric properties of FIR filter

(c) Overlap add filtering using DFT method

(d) Use of DFT in linear filtering.