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Total number of printed pages – 3

B. Tech
PCEC 4304

Sixth Semester Regular Examination – 2014

DIGITAL SIGNAL PROCESSING

BRANCH : EEE

QUESTION CODE : F 253

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) Determine the ROC of the signal given by

$$x(n] = (0.5)^n u(n) - (0.8)^{-n} u(-n - 1)$$

(b) State and prove the differentiation property of z-transform.

(c) What are the properties of Twiddle factor ?

(d) What is the basic difference between DTFT and DFT ?

(e) What is the speed of improvement factor in calculation 64 point DFT of a sequence using direct computation and computation with FFT algorithm ?

(f) What is zero padding? What are its uses ?

(g) Why the result of circular and linear convolution is not the same ? Explain with an example.

(h) Sketch the mapping of s-plane to z-plane in bilinear transformation method.

(i) What is the necessary and sufficient condition for the linear phase characteristics of an FIR filter? Draw the direct form realization of linear phase filter for even number of samples.

(j) Differentiate between linear filters and adaptive filters.

P.T.O.

2. (a) Determine all possible signals $x(n]$ associated with the z-transform 6

$$X(z) = \frac{5z^{-1}}{3-7z^{-1} + 2z^{-2}}$$

- (b) By first differentiating $X(z)$ and then using appropriate properties of the z-transform, determine $x(n]$ for the following transform : 4

$$X(z) = \log(1 - 2z) \quad |z| < \frac{1}{2}$$

3. (a) What is sectioned convolution any why is it required ? Describe the structural difference between overlap save and overlap add method. 3

- (b) Compute the convolution of a long data sequence using overlap save method for the given sequences. 7

$$x(n) = \{1, -1, 2, 3, -4, 1, 2, 8, 3, 1, 7, 8, 2, 0, 0, 1, 5, 4\}$$

$$h(n) = \{1, 2, 3, -1\}$$

4. Design an FIR digital filter approximating the ideal low frequency response. 10

$$H_d(\omega) = \begin{cases} 1, & |\omega| \leq \frac{\pi}{6} \\ 0, & \frac{\pi}{6} \leq |\omega| \leq \pi \end{cases}$$

- (a) Determine the co-efficients of 15 tap filter based on window method with rectangular window.

- (b) Realize the filter using Direct Form structure.

5. Determine the DFT of the following 8-point sequence with appropriate butterfly diagram using DIF-FFT method : 10

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

6. Design and realize a digital low-pass filter using bilinear transformation to satisfy the following requirements : 10

- (a) Monotonic stop band and pass band

- (b) -3 dB cut-off frequency at 0.6 radians and

- (c) Magnitude down at 16 dB at 0.75π radians.



7. (a) What is DCT ? How does it differ from DFT ? Derive an expression for Forward and Inverse type II DCT. 6
- (b) Prove that DCT is an orthogonal transform. 4
8. Write short notes on any **two** : 5x2
- (a) System Identification
 - (b) DFT as a linear transformation
 - (c) Impulse invariance method of IIR filter design
 - (d) Adaptive Line Enhancer.

