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B. Tech PCEC 4304

## Sixth Semester Regular Examination – 2014

## DIGITAL SIGNAL PROCESSING

**BRANCH: EEE** 

**QUESTION CODE: F253** 

Full Marks - 70

Time: 3 Hours

ENTRA

Answer Question No. 1 which is compulsory and any five from the rest.

The figures in the right-hand margin indicate marks.

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.
- Differentiate between linear filters and adaptive filters.

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

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

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

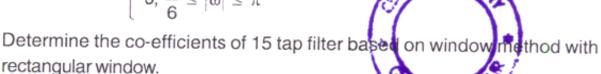
$$X(z) = \log (1 - 2z)$$
  $|z| < \frac{1}{2}$ 

- (a) What is sectioned convolution any why is it required? Describe the structural difference between overlap save and overlap add method.
  - (b) Compute the convolution of a long data sequence using overlap save method for the given sequences.

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

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

$$H_{d}(\varpi) = \begin{cases} 1, \ |\varpi| \le \frac{\pi}{6} \\ 0, \ \frac{\pi}{6} \le |\varpi| \le \pi \end{cases}$$



- (b) Realize the filter using Direct Form structure.
- Determine the DFT of the following 8-point sequence with appropriate butterfly diagram using DIF-FFT method:

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

- Design and realize a digital low-pass filter using bilinear transformation to satisfy the following requirements:
  - (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  $0.75 \pi$  radians.

(a)

(a) What is DCT? How does it differ from DFT? Derive an expression for 7. 6

Forward and Inverse type II DCT.

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(b) Prove that DCT is an orthogonal transform.

5×2

- Write short notes on any two: 8.
  - (a) System Identification
  - (b) DFT as a linear transformation
  - Impulse invariance method of IIR filter design (c)
  - (d) Adaptive Line Enhancer.