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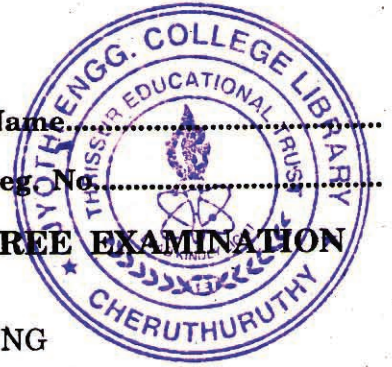
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Name: .....

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**SIXTH SEMESTER B.TECH. (ENGINEERING) DEGREE EXAMINATION  
MAY 2013**

**AI 09 601—DIGITAL SIGNAL PROCESSING  
(2009 admission onwards)**



Time : Three Hours

Maximum : 70 Marks

**Part A**

*Answer all questions.*

1. Show that, for symmetric  $x(n)$ ,  $n = 0, 1, \dots, N - 1$ , the DFT  $X(k) = 0$  for  $k = N/2$ .
2. Obtain the circular convolution of  $x[n] = \{1, 2, 1\}$  with  $y[n] = \{1, -1\}$ .
3. Draw the lattice structure realization of the FIR filter  $H(z) = 1 + \frac{1}{2}z^{-1}$ .
4. Write the transformation equation to convert a digital low-pass filter into a digital high-pass filter.
5. What are the different buses in TMS 320 C 54 processor ?

(5 × 2 = 10 marks)

**Part B**

*Answer any four questions.*

6. Show that 8-point DFT can be expressed in terms of two 4-point DFTs.
7. Let N-point DFT of  $x(n)$  is  $X(k)$ . Express DFT of  $x^*(n)$  and  $e^{-j4\pi mn/N}x(n)$  in terms of  $X(k)$ .
8. What is overflow error ? How it is prevented ?
9. Prove that a stable analog filter will be mapped to a stable digital filter through impulse invariant transform.
10. Convert the analog filter having transfer function  $H(s) = \frac{1}{s^2 + 3s + 2}$  into digital IIR filter using impulse invariant method.
11. With an example explain how a specific DSP hardware will increase the processing speed of a DSP algorithm implementation.

(4 × 5 = 20 marks)

**Part C**

*Answer any one question from each module.*

**Module I**

12. (a) (i) State and prove convolution property of DFT. (5 marks)  
(ii) Show that DFT of even part of a signal  $x(n)$  is equal to the real part of the DFT of  $x(n)$ .

(5 marks)

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- (b) (i) Show that DFT of two real sequences of length  $N$  can be computed using one  $N$ -point DFT.

(6 marks)

- (ii) State and prove time shifting property of DFT.

(4 marks)

## Module II

13. (a) Draw the direct form and lattice-ladder form realizations of the IIR filter :

$$H(z) = \frac{1 + 2z^{-1} + 3z^{-2} + 2z^{-3}}{1 + 0.9z^{-1} - 0.8z^{-2} + 0.5z^{-3}}$$

(10 marks)

- (b) Explain the limit cycle oscillations of a digital filter with respect the system described by the difference equation  $y[n] = 0.95y[n-1] + x[n]$ . Also determine the dead band of the filter.

(10 marks)

## Module III

14. (a) Design an FIR linear phase filter using Hamming window approximating the ideal frequency response :

$$H(\omega) = \begin{cases} 1, & \text{for } |\omega| \leq \frac{\pi}{4}, \\ 0, & \text{for } \frac{\pi}{4} < |\omega| \leq \pi \end{cases}$$

Assume filter length  $L = 13$ . Draw the filter structure in Direct Form.

(10 marks)

- (b) Design an digital IIR filter with the following specifications :

pass band = 0 – 12 kHz, stop band = 12.6 – 16 kHz, pass band ripple < 0.1 dB, stop band attenuation > 30 dB, sampling frequency = 32 kHz. Draw the filter structure for the filter.

(10 marks)

## Module IV

15. (a) Describe the function of on chip peripherals of TMS 320 series processors. (10 marks)

- (b) What are the DSP specific processing units and instructions present in a typical digital signal processor ? Explain with appropriate examples.

(10 marks)

[4 × 10 = 40 marks]