

B. Tech Degree VI Semester Examination, April 2010**CS/EE 602 DIGITAL SIGNAL PROCESSING**

(2006 Scheme)

Time : 3 Hours

Maximum Marks : 100

PART – A(Answer ALL questions)

(8 x 5 = 40)

- I. (a) Show that for a discrete LTI system with zero initial conditions, the o/p is $y[n] = x[n] * h[n]$, $x[n]$ and $h[n]$ the i/p and impulse response respectively.
- (b) Find the stability of the system given by the impulse response $h[n] = 0.5^n u[n] + 1.5^n u[n]$. Plot its ROC.
- (c) Show that for a periodic sequence $x_p[n]$ with DFS $X_p[k]$, DFS of $x_p * [n] = X_p * [-k]$, and DFS of $x_p * [-n] = X_p * [k]$ where * represents complex conjugation.
- (d) Find the circular convolution of the two sequences $x_1[n] = [1 \ 2 \ 1]$ and $x_2[n] = [1 \ 4 \ 2]$, so that it gives the same result as linear convolution. Verify that both convolutions give the same result.
- (e) Write a short note on the rectangular window method for FIR filter design. What is its disadvantage?
- (f) What is the impulse invariant method for designing IIR filters? Using this transformation, transform the following filter into its discrete equivalent $H_a(s) = \frac{1}{(s+1)(s-1)}$.
- (g) If the quantization step size is IV and the number of bits used for quantization $m = 3$, find the RMS quantization error. How will it be reduced if m is increased to 8? Calculate the percentage reduction in the RMS quantization error in the second case.
- (h) Enumerate some features that distinguish DSP processors from general purpose processors.

PART – B

(4 x 15 = 60)

- II. (a) For the impulse response below, determine if the systems are causal and stable.

(i) $h[n] = 2^n u[-n]$

(ii) $h[n] = \text{Sin}\left(\frac{n\pi}{2}\right)$

(iii) $h[n] = \delta[n] + \text{Sin } \pi n$

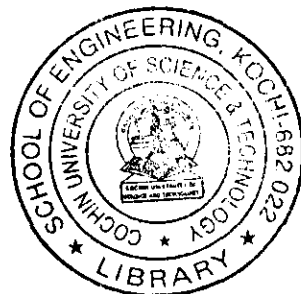
(iv) $h[n] = e^{2n} u[n-1]$. (8)

- (b) For the systems given by

(i) $y[n] = \text{Cos}(x[n])$

(ii) $y[n] = Ax[n] + B$,

check whether the systems are linear. (7)

OR

(Turn Over)

III. (a) Find the inverse Z transform of $X(Z) = \frac{1}{2z^{-2} + 2z^{-1} + 1}$. (7)

(b) Determine the causal signal $x[n]$ having the Z transform

$$X(Z) = \frac{1}{(1 - 2z^{-1})(1 - z^{-1})^2}. \quad (8)$$

IV. Show how the 8 point Radix - 2 Signal flow graph may be used to compute the DFTs of $x_1[n] = [1 \ 4 \ 3 \ 2 \ 2 \ 3 \ 2 \ 2]$ and $x_2[n] = [1 \ 4 \ 1 \ 2 \ 2 \ 3 \ 4 \ 2]$, simultaneously, using the signal flow graph only once. Hence, compute $X_1[k]$ and $X_2[k]$. (15)

OR

V. (a) What is the improvement in speed in terms of number of complex additions and multiplications in calculating the 64 point DFT of a sequence using Direct Computation and FFT algorithm? (5)

(b) Derive the 8 point D.I.F FFT Signal Flow graph. (10)

VI. (a) Design a Low Pass FIR filter for the following specifications :
 Cut off frequency = 500 Hz
 Sampling frequency = 2kHz
 Order of the filter = 10, and use the rectangular window for truncating the impulse response. (8)

(b) For the given FIR filter with $H(z) = 1 + 2z^{-1} + 3z^{-2} + 4z^{-4} + 3z^{-5} + 2z^{-2} + z^{-6}$, implement the filter using least number of delay elements. Will the filter have linear phase? (7)

OR

VII. (a) Consider the recursive relation given by $y[n] = 3y[n-1] + y[n-2] + 5x[n] + 2x[n-1]$. Obtain its
 (i) Direct Form - 1
 (ii) Direct Form - 2 implementations. (6)

(b) Obtain the linear constant coefficient difference equation of the discrete filter obtained by discretising the analog filter $H(s) = \frac{s+1}{(s+3)(s+5)}$. (9)

VIII. (a) Write notes on :
 Limit cycle oscillations in a First Order FIR System. Hence calculate the dead band amplitude if the quantization step size is 0.5 volt and 3 bits are used for binary encoding the quantization levels. (8)

(b) Describe using a suitable diagram an application of a DSP to image processing. (7)

OR

IX. With a neat block diagram explain the architecture of the Texas Instruments TMS 320C - 54 X fixed point processor. (15)