B.Tech. Degree VII Semester (Supplementary) Examination in Electronics and Communication Engineering, March 2003

EC 701 DIGITAL SIGNAL PROCESSING

(1995 Admissions)

Time: 3 Hours Maximum Marks: 100

I. (a) Prove that the convolution of two sequences in the time domain is equivalent to the product of their Fourier transforms in the frequency domain. (10)

(b) Explain how the prediction of the o/p of a system can be done, given its impulse response. Also explain how the impulse response can be used to predict the stability of the system. (10)

OR

II. (a) Define Discrete Fourier Transform (DFT) pair. State any two properties of DFT. Explain the difference between Discrete Fourier Series (DFS) and DFT. (10)

(b) By direct evaluation of the convolution sum determine the step response of a linear shift-invariant whose unit sample response $h(n)$ is given by

$$h(n) = a^{-n}u(-n), \qquad 0 < a < 1. \tag{10}$$

III. (a) Let $h\min(n)$ denote a minimum-phase sequence with Z-transform $H\min(Z)$. If $h(n)$ is a Causal, non-minimum phase sequence whose Fourier Transform magnitude is equal to $\left|H\min(e^{jw})\right|$, show that $\left|h(0)\right| < \left|h\min(0)\right|$. (10)

(b) Define causality and separability with reference to 2D – systems. (10)

OR

IV. (a) Derive an integral expression for H(z) inside the unit circle in terms $\mathrm{Re}\left[H(e^{jw})\right]$, When $h(n)$ is a real, stable sequence such that $h(n) = 0$ for $n > 0$. (10)

(b) Find the inverse discrete Fourier transform of the sequence

$$X(k) = \{6,\ -2 - j_2,\ 2,\ -2 + j_2\} \tag{10}$$

V. (a) What do you mean by 'in-place' computation in FFT algorithms. What is its significance? (10)

(b) Describe the DIT FFT algorithm. Explain how the same algorithm can be used to find inverse DFT. (10)

OR

VI. (a) Develop a decimation in time algorithm for evaluating the DFT for N = 9 using radix – 3 algorithm. (12)

(b) Show how the ordering of input data for N = 8 is done using bit reversal to achieve in-place computation of FFT. (8)

VII. (a) Compare IIR and FIR filters. (10)

(b) Explain the Fourier series method of FIR filter implementation. (10)

OR

VIII. (a) Discuss the digital filter design using the impulse invariance technique. (10)

(b) Realize the digital filter in

(i) Direct form (ii) Cascade form

$h(n) = 2n$.....for $0 \le n \le 4$

Given that $= n^2$.....for $5 \le n \le 7$ (10)

$= 0$.....*otherwise*

IX. (a) The difference equation of a first order system is given by $y(n) = a \cdot y(n-1) + x(n)$, where $a = \frac{1}{2}$. Only finite length registers of 4 bits are available for storage. Calculate the impulse response of the system and explain the effect of the finite length register. (12)

(b) What are limit cycles? Explain. (8)

OR

X. Explain in detail the effect of finite word length in digital filter implementation. (20)

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