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SEVENTH SEMESTER B.TECH. (ENGINEERING) DEGREE EXAMINATION, DECEMBER 2005

EE 2K 702—DIGITAL SIGNAL PROCESSING

Time : Three Hours Maximum : 100 Marks

Answer **all** *questions.*

I. (a) What is causality ? Derive the condition for causality of an LTI system.

(b) State and prove time delay property of z-transform.

(c) Find the discrete Fourier series representation of a 4-point periodic sequence

$x(n) = \{1, 0, -1, 0\}$.

(d) What is FFT algorithm ? Why is it required ?

(e) Determine the direct form FIR structure corresponding to the following lattice parameter :

$K_1 = 0.5, K_2 = 0.25, K_3 = \frac{1}{3}$.

(f) Explain about coefficient quantization in FIR filter.

(g) Explain FIR filter design procedure using window function.

(h) Explain about bilinear transformation.

(8 × 5 = 40 marks)

II. (a) (i) State and prove symmetry property of Fourier transform. (8 marks)

(ii) Derive the necessary and sufficient condition for the BIBO stability of an LTI system. (7 marks)

Or

(b) (i) Find the *z*-transform of :

1 $x(n) = \left(\frac{1}{2}\right)^n + \left(\frac{1}{2}\right)^{-n} \quad n \geq 0$

$= 0 \quad n < 0$

2 $x(n) = n\left(\frac{1}{2}\right)^n \sin(w_0 n) \quad n \geq 0$

$= 0 \quad n < 0$

(8 marks)

(ii) Determine the inverse *z*–transform $X(z) = \frac{1}{1 - 0.5z^{-1} + 0.6z^{-2}}$. (7 marks)

Turn over

III. (a) (i) State and prove any *two* properties of DFT. (8 marks)

(ii) Find the 4-point DFT of $x(n) = \{1, 2, 3, 4\}$. (7 marks)

Or

(b) (i) Find the linear convolution of $x(n) = \{1, 2, 3\}$ with $h(n) = \{-2, 1\}$ using decimation in time FFT algorithm. (8 marks)

(ii) Find the inverse DFT of $X(K) = \{2, 1 + 2j, 0, 1 - 2j\}$ using FFT algorithm. (7 marks)

IV. (a) (i) Determine the state-space model for the system described by $y(n) = y(n-1) + 0.11\, y(n-2) + x(n)$ and sketch the type I and type II state-space realizations. (8 marks)

(ii) Obtain cascade realization of the system having difference equation :

$$y(n) = \frac{3}{4} y(n-1) - \frac{1}{8} y(n-2) + x(n) + \frac{1}{3} x(n-1).$$

(7 marks)

Or

(b) (i) Sketch the lattice-ladder structure for the system :

$$H(z) = \frac{1 - 0.8\, z^{-1} + 0.15 z^{-2}}{1 + 0.1\, z^{-1} - 0.72 z^{-2}}.$$

(9 marks)

(ii) Draw the block diagram of architecture of fixed point DSP processor TMS320 C50. (6 marks)

V. (a) (i) Derive bilinear transformation mapping technique used for IIR filter design. (7 marks)

(ii) Convert the following analog system function into digital using impulse invariant technique

$$H(s) = \frac{1}{(s + 0.1)^2 + 9}$$

Assume T = 1 sec.

(8 marks)

Or

(b) (i) Design a band-pass digital FIR filter of band 0.5 π rad/sec to 0.7 π rad/sec with impulse response length N = 7 using Hanning window. (8 marks)

(ii) Explain limit cycle oscillations in digital system. (7 marks)

[4 × 15 = 60 marks]