Seat No.: _____ Enrolment No._____

GUJARAT TECHNOLOGICAL UNIVERSITY

B. E. - SEMESTER – VII • EXAMINATION – WINTER 2012

Subject code: 171003 Date: 01/01/2013

Subject Name: Digital Signal Processing

Time: 10.30 am - 01.00 pm Total Marks: 70

Instructions:

1. **Attempt any five questions.**
2. **Make suitable assumptions wherever necessary.**
3. **Figures to the right indicate full marks.**

Q.1 **(a)** Define the following with respect to discrete time systems: **04**
(i) Linear Shift Variant System (ii) Recursive system (iii)Stable System(iv) Causal system

(b) Find the Z Transform of : **06**

(i) $x(n) = \left(\frac{1}{4}\right)^n u(n) - \left(\frac{1}{2}\right)^n u(n-1)$

(ii) $x(n) = \left(\frac{1}{3}\right)^{n-1} u(n-1)$

(iii) $x(n) = r^n (\cos \omega_0 n) u(n)$

© Check for the shift invariance and stability of an accumulator **04**

Q.2 **(a)** Justify the following statements with respect to discrete time systems. (any TWO) **04**
(i)An impulse input to an accumulator yields a unit step output
(ii) For a causal LTI system impulse response h(n)=0 for n<0
(iii) The convolution operation satisfies the commutative property.

(b) Define Z transform . Explain the following properties of Z transform: **05**
(i) Multiplication of an exponential Sequence
(ii) Differentiation of X(Z)

OR

(b) Prove $Z[x_1(n) * x_2(n)] = X_1(Z) + X_2(Z)$ **05**

Prove $F[nx(n)] = j\frac{dX(e^{j\omega})}{d(\omega)}$

(c) Define region of Convergence of Z transform. Explain right sided and left sided discrete time sequences and discuss the region of convergence with suitable illustrations and sketches. **05**

Q.3 **(a)** Explain the Concept of Sampling and alising in Sampled data System **03**

(b) Explain the symmetry property of the Fourier Transform for real, real-odd and real-even discrete time signals. **04**

(b) Find y(n) using linear Convolution property of Z transform **07**
for x(n)={2,1,0,0,5 }, h(n)={2,2,1,1) Also verify by the graphical method

OR

Q.3 **(a)** List the applications of DSP **02**

(b) Explain the design of IIR filter using Bilinear transformation method and discuss its advantages over other design methods Discuss the stability aspects and frequency warping **06**

(c) Determine the inverse Z transform of the following: **06**

(i) $X(z) = \dfrac{(1+3z^{-1})}{(1+3Z^{-1}+2Z^{-2})}$ (Long Division Method) for x(n) causal and x(n) anticausal

(ii) $X(z) = \dfrac{(5z^{-1})}{(1-2Z^{-1})(3-2Z^{-1})}$ (Partial Fraction Method)

Q.4 **(a)** Explain the window functions used in FIR filter design. **04**

(b) Obtain the system function H(Z) for the system described by the difference equation, **08**

$y(n) - 3y(n-1) + 2y(n-2) = x(n) - x(n-1)$

Realize the filter using (i) Direct Form I (ii) Direct Form II (iii)Cascade form (iv) Parallel Form for all cases, draw the structures neatly with system equations at different points.

(c) Determine the frequency spectrum of the signal **02**

$x(n) = \left(\frac{1}{3}\right)^n u(n-5)$

OR

Q.4 **(a)** Compute the circular convolution of the sequences **06**
$x_1=\{1,2,2,1\}$ and $x_2=\{1,2,3,1)$ showing the steps in detail

(b) Discuss two properties of DFT. **04**

(c) Find the IDFT of Y(K)={1,0,1,0} **04**

Q.5 **(a)** Define (i)DTFT(ii)DFT and (iii)IDFT of a discrete time sequence with mathematical representation **03**

(b) Find 4 point DFT of x(n) and h(n) for the given sequences **07**
x(n)={2,0,0,1) and h(n)={4,3,2,1). Compute Y(K)=X(K).H(K)

(c) Find the DFT of the sequence x(n)={1,0,0,1} using DIF algorithm **04**

OR

Q.5 **(a)** Compute the 8 point DFT of the sequence **08**
x(n)={1,1,1,1,1,1,1,1} using DIT FFT and draw the flow diagram. Compute the values at the output of all stages and indicate them in the table.

(b) Explain any <u>one</u> of the following: **06**
(i)Decimation in frequency FFT algorithms
(ii) Architecture of DSP Processor
(iii) Impulse Invariance method for IIR filter design.

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