Seat No.: ________ Enrolment No.___________

GUJARAT TECHNOLOGICAL UNIVERSITY

BE - SEMESTER–VII • EXAMINATION – WINTER • 2014

Subject Code: 171003 **Date: 04-12-2014**

Subject Name: Digital Signal Processing

Time: 10:30 am - 01:00 pm **Total Marks: 70**

Instructions:

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

Q.1 **(a)** Draw the block diagram of a typical Digital Signal Processing system and explain. **07**

(b) A discrete –time signal x(n) is given below : **07**

$x(n) = \{ 1, 1, \underset{\uparrow}{1}, 1, 1, \frac{1}{2} \}$

Sketch and label carefully each of the following signals:

(i) $x(n-2)$ (ii) $x(4-n)$ (iii) $x(2n)$

(iv) $x(n)u(2-n)$ (v) $x(n-1)\delta(n-3)$

Q.2 **(a)** Perform the linear convolution of the following sequences : **07**

$x_1(n) = \{1, \underset{\uparrow}{2}, 3, 4, 5 \}$, $x_2(n) = \{ -1, 0, \underset{\uparrow}{1} \}$

(b) (i) For the following system, determine whether the system is stable,causal,linear,time-invariant,memoryless: **05**

$$T\{x(n)\} = \sum_{k=n_0}^{n} x(k)$$

(ii) What are the advantages of digital signal processing over analog signal processing? **02**

OR

(b) Let $X(e^{jw})$ denote the fourier transform of the signal x(n) .Perform the following calculations without explicitly evaluating $X(e^{jw})$: **07**

$x(n)=\{-1, 0, 1, \underset{\uparrow}{2}, 1, 0, 1, 2, 1, 0, -1 \}$

(i) Evaluate $X(e^{jw}) \big|_{w=0}$

(ii) Evaluate $X(e^{jw}) \big|_{w=\pi}$

(iii) Find $\Theta(X(e^{jw}))$

(iv) Evaluate $\int_{-\pi}^{\pi} X(e^{jw})\, dw$

(v) Determine and sketch the signal whose fourier transform is $X(e^{-jw})$

(vi) Determine and sketch the signal whose fourier transform is $Re\{X(e^{jw})\}$

Q.3 **(a)** Determine the z-transform of the following sequences. Sketch ROC and pole zero plot : **07**

(i) $x_1(n) = \alpha^{|n|}$, $0 < |\alpha| < 1$

(ii) $x_2(n) = (-1/3)^n u(n) – (1/2)^n u(-n-1)$

(b) Suppose the z-transform of x(n) is **07**

$$X(z) = \frac{z^{10}}{(z-(1/2))\,(z-(3/2))^{10}\,(z + (3/2))^2\,(z + (5/2))\,(z + (7/2))}$$

It is also known that x(n) is a stable sequence.

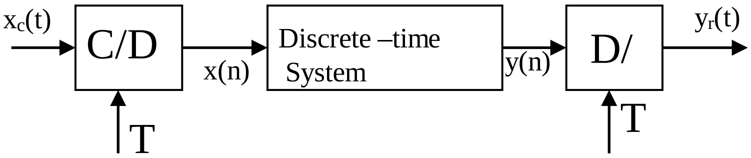
(i) Determine the region of convergence of X(z).

(ii) Determine x(n) at n = -8.

OR

Q.3 **(a)** Consider the discrete time system with an ideal low pass filter with cutoff **07**

frequency $\pi/8$ radian/s.



(i)If $x_c(t)$ is bandlimited to 5 kHz , what is the maximum value of T that will avoid aliasing?
(ii)If 1/T = 10 kHz , what will the cutoff frequency of the continuous –time filter be?
(iii) Repeat part(ii) for 1/T=20kHz.

(b) Draw the structures of the following discrete time system: **07**

$$H(z) = \frac{(1 + z^{-1})^2}{1 - 0.75 z^{-1} + 0.125 z^{-2}}$$

(i)Direct form – I
(ii)Direct Form – II
(iii)Cascade form
(iv)Parallel form

Q.4 **(a)** Discuss the following transformation methods to design digital filters: **07**
(i)Impulse invariance (ii)Bilinear transformation

(b) Find the circular convolution of the following sequences: **07**
$x_1(n) = \{ 1, 2, 3, 4\}$ $\quad\quad$ $x_2(n) = \{ 2, 1, 2, 1\}$
↑ $\quad\quad$ ↑

OR

Q.4 **(a)** Design a Digital low pass FIR filter using Kaiser window to meet the following specifications: **07**
$0.99 \le |H(e^{jw})| \le 1.01 \quad , 0 \le w \le 0.4\pi$
$|H(e^{jw})| \le 0.001 \quad , 0.6\,\pi \le w \le \pi$

(b) Consider the real finite-length sequence x(n). **07**
$x(n) = \{ 4, 3 , 2, 1\}$
↑
(i)Sketch the finite length sequence y(n) whose six-point DFT is $Y(k) = W_6^{4k} X(k)$, Where X(k) is the six-point DFT of x(n).
(ii) Sketch the finite length sequence w(n) whose six-point DFT is $W(k) = \mathrm{Re}\{ X(k) \}$
(iii) Sketch the finite length sequence q(n) whose three-point DFT is $Q(k) = X(2k)$, k=0,1,2

Q.5 **(a)** Explain the Decimation in Time FFT algorithm **07**
(b) Discuss the applications of digital signal processing with suitable examples. **07**

OR

Q.5 **(a)** Discuss the key features of the architecture of DSP Processors. **07**
(b) Write a short note on coefficient quantization in IIR filters. **07**

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