

GUJARAT TECHNOLOGICAL UNIVERSITY
BE - SEMESTER-VII • EXAMINATION – SUMMER 2013

Subject Code: 171003**Date: 28-05-2013****Subject Name: Digital Signal Processing****Time: 02.30 pm - 05.00 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) Find if following systems are linear, causal, stable, time-invariant and memoryless **07**

(i) $T[x_1(n)] = \sum_{k=-\infty}^{\infty} x(k)$ **(03)**

(ii) $T[x_2(n)] = x(n - n_0)$ **(02)**

(iii) $T[x_3(n)] = x(n) + n(n+1)$ **(02)**

(b) A discrete-time signal is defined as **07**

$$x(n) = \begin{cases} 1 + n/3, & -3 \leq n \leq -1 \\ 1, & 0 \leq n \leq 3 \\ 0, & \text{otherwise} \end{cases}$$

(i) Find the values of $x(n)$ and sketch the sequence **(03)**

(ii) Find $x(-n+4)$ and sketch **(02)**

(iii) Find $x(n-4)$ and sketch **(02)**

Q.2 (a) Find the convolution of following pairs of discrete sequences **07**

(i) $x_1(n) = \underset{\uparrow}{0}, 1, 2, 3, 4, 5$ $h_1(n) = \underset{\uparrow}{0}, 1, 2, 3, 4, 5$ **(04)**

(ii) $x_2(n) = \underset{\uparrow}{1}, 1, 1, 1, 1, 1$ $h_2(n) = 1, 2, 3, \underset{\uparrow}{4}, 3, 2, 1$ **(03)**

(b) An LTI system has the system function given below **07**

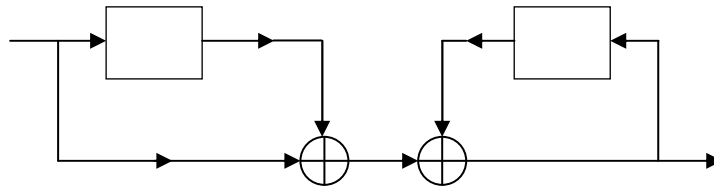
$$H(z) = \frac{1 + 2z^{-1} - 3z^{-2}}{1 - 0.75z^{-1} + 0.5z^{-3}}$$

(i) Write the difference equation for this system **(04)**

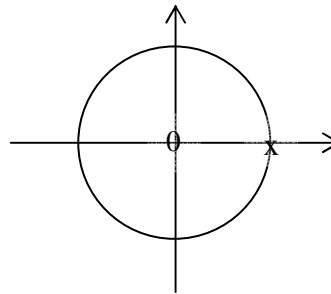
(ii) Draw the block diagram **(03)**

OR

- (b) For the discrete-time system shown below 07
 (i) Write the difference equation (04)
 (ii) Find the poles and zeros (03)



- Q.3** (a) The pole zero plot of a sequence is shown in the z-plane. 07
 (i) Write the z-transform $X(z)$ (03)
 (ii) Find the sequence $x(n)$, and (02)
 (iii) Sketch the sequence (02)



- (b) Find the z-transform of following sequence 07

$$x(n) = \begin{cases} 2^n & 0 \leq n \leq 5 \\ 0 & \text{otherwise} \end{cases}$$

OR

- Q.3** (a) Find the sequence for which the z-transform is given below 07

$$X(z) = \frac{1}{1 - 5z^{-1} + 6z^{-2}}, \text{ for ROC } |z| > 2 \text{ and } |z| > 3$$

- (b) Draw the block diagram of a digital signal processor with Harvard architecture and describe the important differences with Von-Neumann architecture. 07

- Q.4** (a) Describe the difference between Fourier transform, Fourier series, Discrete time Fourier transform and Discrete Fourier transform and their corresponding time-domain signals. 07
 (b) A continuous time signal is sampled at regular intervals of 0.1ms and DFT coefficients are obtained for segments of 100 samples. What is the frequency separation (resolution) between the DFT coefficients? 07

OR

- Q.4** (a) Describe the properties of discrete Fourier transform 07
Q.4 (b) A discrete sequence is given by 07

$$x(n) = 1, 1, 0, 0$$

 Find the DFT coefficients of this sequence.

- Q.5 (a)** State if following statements are True or False **07**
1. Convolution of two sequences is equivalent to the convolution of their Z transforms
 2. Multiplying the z transform of a sequence by z^{-5} advances the sequence by 5 samples
 3. A two sided sequence can be causal or anticausal
 4. If the ROC of a z-transform is outside of the unit circle, all the poles lie inside the circle
 5. For group delay to be constant phase response should be linear with frequency
 6. When two LTI systems with impulse responses $h_1(n)$ and $h_2(n)$ are cascaded the resulting impulse response is obtained by multiplying $h_1(n)$ and $h_2(n)$
 7. The frequency response of a discrete-time linear filter is periodic
- (b)** Describe the advantages and disadvantages of FIR filter over IIR filter **07**
- OR**
- Q.5 (a)** Find the number of complex multiplications and complex additions required in the direct computation of 1024 point DFT. How many complex multiplications and complex additions will be required using FFT algorithm? **07**
- (b)** Describe the following terms in the context of FFT **07**
1. Twiddle factor
 2. Butterfly operation
 3. Decimation in time and decimation in frequency
