GUJARAT TECHNOLOGICAL UNIVERSITY
BE - SEMESTER– VII (New) EXAMINATION – WINTER 2019

Subject Code: 2171708   **Date: 26/11/2019**
Subject Name: Digital Signal Processing
Time: 10:30 AM TO 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)** How Digital signal processing is better than Analog signal processing? Explain in brief.   **03**

(b) A discrete time signal is given by   **04**
$$x(n)= \{ 2, 1, 1, 2, 1 \}$$
$$\uparrow$$
sketch the following signal:
(1) $x(n+1)$ (2) $x(n-2)$
(2) $x(n) u(n-1)$ (4) $x(n-1) \delta(n-1)$

(c) A Digital communication link carries binary coded words representing samples of an input signal   **07**
$$x_a(t) = 3 \cos600\pi t + 2 \cos1800\pi t$$
The link is operated at 10000 bits/sec and each input sample is quantized into 1024 different voltage level.
(a) What is the sampling frequency & folding frequency?
(b) What is the Nyquist rate for the signal $x_a(t)$?
(c) What are the frequencies in the resulting discrete time signal $x(n)$?
(d) What is the resolution Δ?

Q.2 **(a)** Determine the autocorrelation of the sequence   **03**
$$x(n) = \{1,5,1,2\}$$
$$\uparrow$$

(b) Obtain the linear convolution of   **04**
$$x(n) = \{1,2,2,1\} \qquad h(n) = \{1,2,1\}$$

(c) Determine the response of the system   **07**
$$y(n) = 5/6 \, y(n-1) - 1/6 \, y(n-2) + x(n) \quad \text{to the input signal}$$
$$x(n) = \delta(n)$$

OR

(c) Prove that LTI system is stable if its impulse response is absolutely summable. Test the stability of a system where impulse is   **07**
$$h(n) = a^n u(n).$$

Q.3 **(a)** Prove that LTI system is causal if its impulse response   **03**
$$h(n)= 0 \text{ for } n < 0$$

(b) Determine if the following discrete time systems are   **04**
(1) Causal or non causal
(2) Linear or non linear

(a) $y(n) = \cos x(n)$
(b) $y(n) = x(n^2)$

(c) Determine the inverse Z transform of the following using partial fraction expansion method.   **07**
$$X(z) = z^3/(z-1)(z-1/2)^2 \qquad |z| > 1$$

OR

Q.3 **(a)** Find the Z transform and sketch ROC of   **03**
$x(n) = a^n u(n) + \delta(n-3)$

(b) State & prove differentiation property of Z transform.   **04**

(c) Find the inverse Z transform of the following using long division method.   **07**
(1) $X(z) = z / z-1$ $|z| > 1$
(2) $X(z) = z / z-a$ if $|z| < |a|$

Q.4 **(a)** Describe the relationship between DFT & Z- transform.   **03**
(b) Explain linearity & periodicity properties of DFT.   **04**
(c) The transfer function of a causal LTI system is   **07**
$H(z) = (1 - z^{-1}) / (1 + 3/4\ z^{-1})$

(1) Find the impulse response of the system.
(2) Find the output of the system to the input
$x(n) = (1/3)^n u(n) + u(-n-1)$
(3) Is the system stable?

OR

Q.4 **(a)** Compute the DFT of the following: **03**
(1) $x(n) = \delta(n)$
(2) $x(n) = \delta(n - n_0)$

(b) Find the circular convolution of the following sequences: **04**
$x(n) = \{1,2,3,4\}$ $h(n) = \{2,1,1,2\}$

(c) Consider the LTI system initially at rest, described by the difference equation,   **07**
$y(n) = 1/4\ y(n-2) + x(n)$
(1) determine h(n) of the system
(2) Determine direct form –II, parallel form & cascade form realization of this system.

Q.5 **(a)** Explain frequency Aliasing.   **03**
(b) Write the properties of   **04**
(a) humming window
(b) hanning window

(c) Explain bilinear transformation method of designing IIR filter.   **07**

OR

Q.5 **(a)** Find inverse DFT of $X(K) = \{1,2,3,4\}$ **03**
(b) The transfer function of analog filter is   **04**
$H(s) = 3 / (s+2)(s+3)$ with $T_s = 0.1$ sec
Design IIR filters using bilinear transformation.

(c) Explain Radix-2 decimation in frequency FFT algorithm.   **07**

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