Seat No.: _____ Enrolment No.

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) δ (n -1)

(c) A Digital communication link carries binary coded words representing samples of an input signal **07**

$x_a(t) = 3 \cos 600\pi t + 2 \cos 1800\pi t$

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**

$x(n) = \{1,2,2,1\}$ $h(n) = \{1,2,1\}$

(c) Determine the response of the system **07**

$y(n) = 5/6\, y(n-1) - 1/6\, y(n-2) + x(n)$ 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**

$h(n) = 0$ 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**

$X(z) = z^3/(z-1)(z-1/2)^2 \quad |z| > 1$

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) $X(z) = z / z-1 \quad |z| > 1$

(2) $X(z) = z / z-a \quad \text{if} \quad |z| < |a|$

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**

$x(n) = \{1,2,3,4\} \qquad h(n) = \{2,1,1,2\}$

(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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