

Enrollment No./Seat No.:

GUJARAT TECHNOLOGICAL UNIVERSITY

Bachelor of Engineering - SEMESTER - VII EXAMINATION - WINTER 2025

Subject Code: 2171003

Date: 13-11-2025

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.
4. Simple and non-programmable scientific calculators are allowed.

	Marks
Q.1 (a) Explain the basic blocks used in the digital signal processing system.	03
(b) What is the significance of ROC in Z-transforms? Explain by using suitable example.	04
(c) Classify following systems as: (a) Static or Dynamic; (b) Linear or Nonlinear; (c) Shift Invariant or Shift Variant; (d) Casual or Non-casual; (e) Stable or Unstable. (i) $y_1(n) = x(n) + nx(n+1)$ (ii) $y_2(n) = \cos[x(n)]$	07
Q.2 (a) Define: (a) Time Invariant System (b) Static System (c) Casual System	03
(b) Describe the relationship between Fourier Transform & Z-transform.	04
(c) Consider a casual LTI system, whose system function is $H(z) = \frac{1 - a^{-1}z^{-1}}{1 - az^{-1}}$ Where a is real. i) For what range of values of a is the system stable. ii) Show that the system is an all pass system i.e., the magnitude of the frequency response is a constant. Also specify the value of the constant.	07
OR	
(c) A difference equation describing a filter is given below:	07
$y(n) - \frac{3}{4}y(n-1) + \frac{1}{8}y(n-2) = x(n) + \frac{1}{2}x(n-1)$ Draw direct form-I and direct form-II structures.	
Q.3 (a) What is Gibbs phenomenon?	03
(b) List the properties of Butterworth low-pass filters.	04
(c) Compare FIR and IIR filters in detail.	07
OR	
(a) Explain Minimum Phase System in brief.	03

- (b) State formulas for Discrete Time Fourier Transform (DTFT) Z-transform of discrete time signal $x(n)$. Prove relationship between Z-transform and DTFT. 04
- (c) State the properties of Z-transform and derive any three properties. 07
- Q.4** (a) What is up sampling and down sampling? Give one application of that. 03
- (b) What do you mean by frequency wrapping? 04
- (c) Discuss 8-point Radix-2 Decimation-in-time FFT algorithm. 07

OR

- (a) What is meant by quantization error? How to avoid it? 03
- (b) State and prove, the property “Differentiation in frequency domain” for Fourier Transform of discrete time signals. 04
- (c) Compute circular convolution of the given two sequences: $x(n) = \{1, 0.5\}$ and $h(n) = \{0.5, 1\}$ 07
- Q.5** (a) What is bilinear transformation for filter design. 03
- (b) Compute DFT of the given sequence. $x(n) = \{0, 1, 2, 3\}$ 04
- (c) Explain the following in context of DSP processor architecture: (a) MAC (b) Pipelining 07

OR

- (a) Write a short critical note on Harvard architecture of DSP processor. 03
- (b) Explain the following with reference to the multirate signal processing: Decimation, Interpolation. 04
- (c) What is windowing? Explain in detail the process of converting IIR system in to FIR system using rectangular window. 07
