

GUJARAT TECHNOLOGICAL UNIVERSITY
BACHELOR OF ENGINEERING – SEMESTER 7 – EXAMINATION – SUMMER 2026

Subject Code: 3171714

Date: 03/06/2026

Subject Name: Advance Control Theory

Time: 02:30 PM TO 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.**
- 4. Simple and non-programmable scientific calculators are allowed.**

- Q.1**
- (a) Explain any two z-transform properties and analyze their effect on system output. **03**
 - (b) Explain the stability criterion by the Jury test and analyze how it determines the stability of a discrete-time system. **04**
 - (c) Explain singular points in details **07**
- Q.2**
- (a) Explain why the sampling theorem is fundamental for digital control systems. **03**
 - (b) Explain initial value theorem for Z-transform of system. **04**
 - (c) Explain the relationship between s and z domain. **07**
- OR
- Q.2**
- (c) Explain how a PID controller can be implemented in a digital system. **07**
- Q.3**
- (a) List the methods of inverse z-transform and demonstrate the use of any one method to analyze the output of a discrete-time system. **03**
 - (b) Illustrate the difference between stability and asymptotic stability using a diagram. **04**
 - (c) Derive the transfer function of a zero-order hold. **07**
- OR
- Q.3**
- (a) Analyze the stability of a nonlinear system when it experiences jump resonance. **03**
 - (b) How the LTI discrete system can be represented in state space? **04**
 - (c) Draw and explain the block diagram of a discrete-time system including a zero-order hold and sampler in the feedback loop. **07**
- Q.4**
- (a) Analyze the behavior of a system near a singular point and distinguish between stable and unstable nodes. **03**
 - (b) Discuss on stability aspect in state space domain for the discrete system. **04**
 - (c) explain the describing function of relay with hysteresis type of nonlinearity. **07**
- OR
- Q.4**
- (a) Compare the block diagram of a multivariable system to that of a single-input single-output system **03**
 - (b) Compare a two-degree-of-freedom controller with a single-degree-of-freedom controller and analyze their differences using an example. **04**
 - (c) Evaluate the stability of a nonlinear system using Lyapunov's direct method and compare it to other stability criteria **07**

- Q.5**
- (a)** Evaluate why the RGA is considered a fundamental tool for analyzing input-output pairing in multi-variable systems. **03**
 - (b)** Evaluate the significance of phase plane, phase trajectory, and phase portrait in analyzing the behavior of nonlinear systems. **04**
 - (c)** Evaluate the role of describing function in designing controllers for nonlinear systems with dead-zone nonlinearities. **07**

OR

- Q.5**
- (a)** Assess the advantages and limitations of digital PID controllers compared to continuous-time PID controllers. **03**
 - (b)** Assess the importance of root-locus analysis in determining stability of discrete-time systems. **04**
 - (c)** Evaluate the advantages and limitations of full-order versus reduced-order observers. **07**
