

Seat No./Enrollment No.: _____

GUJARAT TECHNOLOGICAL UNIVERSITY
BACHELOR OF ENGINEERING – SEMESTER 5 – EXAMINATION – SUMMER 2026

Subject Code: 3154102

Date: 06/06/2026

Subject Name: Principles of Robotics

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) List the components involved in developing the dynamic model of a 2 DOF manipulator. **03**
 - (b) Define degrees of freedom and explain its significance in robot kinematics. **04**
 - (c) How are robots classified based on their applications and capabilities? **07**
- Q.2**
- (a) Differentiate between direct and inverse kinematics with suitable examples. **03**
 - (b) List and describe different types of robot joints with examples. **04**
 - (c) What are SCARA robots? Draw a neat sketch and explain how are they different from other robot configurations? **07**
- OR**
- Q.2**
- (c) Illustrate the representation of robotic joints using Denavit-Hartenberg parameters. **07**
- Q.3**
- (a) Define path planning in robotics. **03**
 - (b) Describe work cell in robotics. **04**
 - (c) Justify the use of cubic polynomial trajectory generation in robotic systems with examples from real-world applications. **07**
- OR**
- Q.3**
- (a) List different types of paths used in Cartesian space planning. **03**
 - (b) What are sensors in robotics? Classify them and explain their importance in robotic operations. **04**
 - (c) Review and evaluate different methods of position and orientation planning used in robotic manipulators. **07**
- Q.4**
- (a) Differentiate between prismatic and rotary joints with suitable examples. **03**
 - (b) Define and explain linear and angular velocities in robotic manipulators with suitable examples. **04**
 - (c) Derive the Jacobian matrix for a simple 2-DOF planar manipulator. **07**
- OR**
- Q.4**
- (a) Illustrate the method of force and moment balance in robotic manipulators. **03**
 - (b) List and explain different types of joints used in robotic manipulators with symbols. **04**
 - (c) Discuss how arm singularity affects the motion and control of a robot manipulator. **07**
- Q.5**
- (a) Define the manipulator control problem. **03**

- (b) What is the Lagrange-Euler formulation? State its advantages in robotic modeling. **04**
(c) Differentiate between kinematic and dynamic control in robotic manipulators. **07**

OR

- Q.5** (a) What is force control in robotic manipulators? **03**
(b) Describe the structure of a typical linear control scheme used in robotic systems. **04**
(c) Compare PID control with force control in robotic manipulators. **07**
