Reg No.:_____ Name:_____

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

B.Tech Degree S5 (S,FE) Examinations June 2026 (2019 Scheme)

Course Code: RAT301
Course Name: INTRODUCTION TO ROBOTICS

Max. Marks: 100 Duration: 3 Hours

PART A

(Answer all questions; each question carries 3 marks) Marks

1	Differentiate between Degrees of Freedom and Workspace of a robot.	(3)
2	Explain 3R concurrent wrist.	(3)
3	Write the three rotation matrixes about x, y, z axis.	(3)
4	Explain three kinematic parameters used in robotic manipulators.	(3)
5	Explain cartesian space trajectory planning.	(3)
6	Explain the principle behind cubic polynomial trajectory planning	(3)
7	Draw the schematic diagram of a PID robot control system.	(3)
8	Write down the equations for force and torque in terms of the Lagrangian.	(3)
9	Explain the working principle of accelerometer with a diagram.	(3)
10	Describe any three non-industrial applications of robots	(3)

PART B

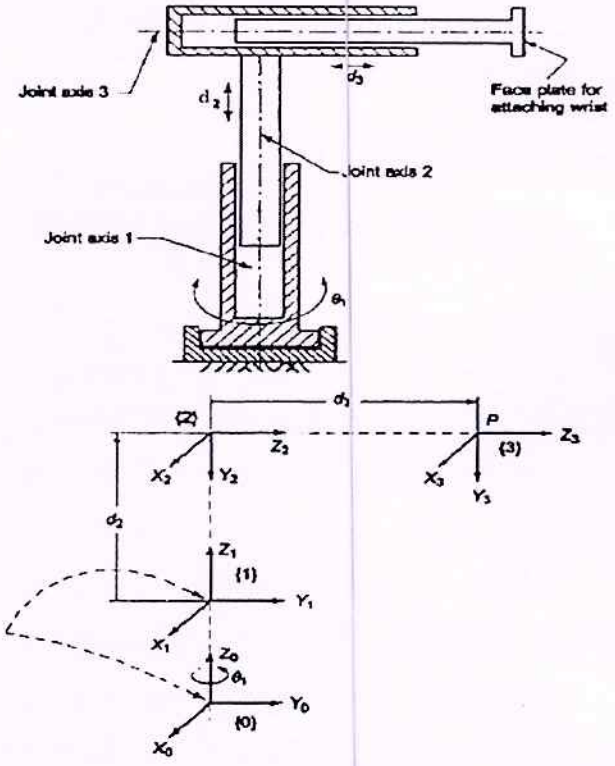
(Answer one full question from each module, each question carries 14 marks)

Module -1

11	a)	Describe SCARA and PUMA robots with neat diagrams.	(10)
	b)	Describe with a diagram a gripper that can be used to handle large flat objects of any non-porous material.	(4)
12	a)	Classify robots based on drive technologies.	(6)
	b)	Describe mechanical grippers and magnetic grippers with neat diagrams.	(8)

Module -2

13	a)	For the following cylindrical robot arm, compute the position and orientation of the tool tip.	(10)



b) Explain the screw transformation with necessary equations. (4)

14 a) A mobile frame {B} is rotated $\pi/3$ radians about the Z-axis of the fixed frame {A} and translated 2 units along the X-axis. If the coordinates of a point P in frame {B} are (3, 0, 1), determine the homogeneous transformation matrix and the coordinates of P in frame {A} (7)

b) Derive the relation between joint and end effector velocities in terms of the tool configuration Jacobian. (7)

Module -3

15 a) Describe the Artificial potential field algorithm with a suitable example. (9)

b) Explain with a diagram trajectory planning using via points. (5)

16 a) Explain with figure how Linear Trajectory with Parabolic Blends can overcome the disadvantage of straight-line trajectory planning in joint space. (6)

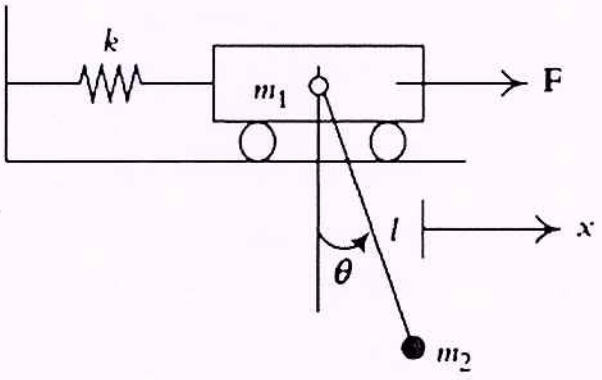
b) It is required for the second joint of a 6-axis robotic manipulator to move from an initial angle of 30° to a final angle of 120° in 5 seconds. Develop a cubic polynomial trajectory for this motion and sketch the corresponding displacement, velocity, and acceleration profiles. (8)

Module -4

17 a) Describe PD gravity control with necessary equations and block diagrams. (7)

b) Explain generalized force in dynamic modelling of robots. (7)

18 a) Develop the dynamic model of a 2DOF cart pendulum system shown in the figure below. (10)

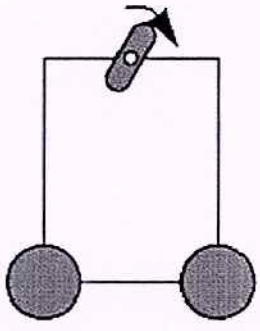


b) Draw the block diagram of a Computed Torque Control system for a robotic manipulator and explain (4)

Module -5

19 a) Explain the applications of robots in material handling and welding with specification of the robots used for these applications. (8)

b) Determine the degree of mobility, degree of steerability and degree of maneuverability of the robot shown in the figure below. (6)



20 a) Explain the terms dynamic range, resolution and linearity with reference to sensors. (6)

b) Explain the working of Heading sensors and vision sensors. (8)

***