A

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Reg No.:_____ Name:_____

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

B.Tech Degree S5 (R,S) Examination November 2025 (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		Outline any three considerations to be taken while choosing a gripper for an application.	3
2		Explain degrees of freedom with an example.	3
3		Summarize any three DH parameters used in forward kinematics of manipulators.	3
4		Represent rotation and position in a 4 x 4 homogeneous matrix with simple example.	3
5		Distinguish between Point to Point and Continuous Path planning.	3
6		Explain the three costs associated with A* algorithm.	3
7		Explain the use of Lagrangian mechanics in dynamic modelling of robots.	3
8		Draw the schematic diagram of a robot control system.	3
9		Distinguish between holonomic and non-holonomic robots.	3
10		Explain the working principle of a speed sensor.	3

PART B

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

Module -1

11	a)	Describe with the help of neat diagrams the various joints used in robotic manipulators.	10
	b)	Explain the SCARA configuration robot with a diagram.	4

OR

12	a)	Describe the four basic robot configurations with diagrams of structure and workspace.	10
	b)	Distinguish between active and passive grippers.	4

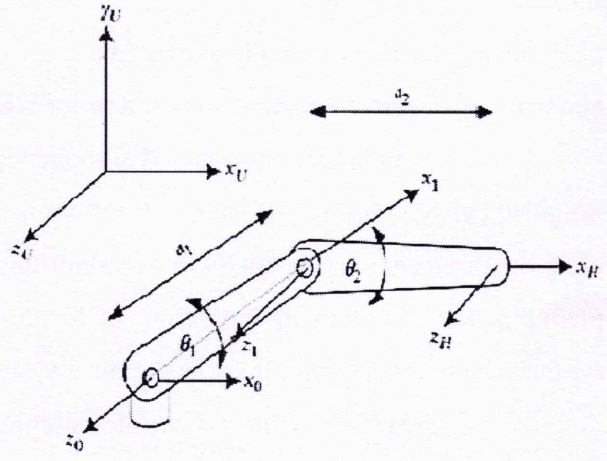
Module -2

13 a) Suppose the mobile coordinate frame M is rotated about the fixed coordinate frame F by π about f^3 axis and then translated by 3 units along f^2 axis. Obtain the coordinates with reference to the fixed frame of a point whose coordinates in the mobile frame are $p = [3\ 0\ -1\ 1]^T$. 7

b) Explain the Tool Configuration Jacobian and the relation between joint and end effector velocities 7

OR

14 a) Derive the forward kinematics transformation matrix for the given robotic configuration. 8



b) Determine the inverse of the transformation matrix given below. 6

$$T = \begin{bmatrix} 0.5 & 0 & 0.866 & 3 \\ 0.866 & 0 & -0.5 & 2 \\ 0 & 1 & 0 & 5 \\ 0 & 0 & 0 & 1 \end{bmatrix}$$

Module -3

15 a) The fourth joint of a robotic manipulator must move from 75^0 to 105^0 in 3 sec. Find the coefficients of the cubic polynomial to interpolate a smooth trajectory. Also obtain the position, velocity, and acceleration profiles. 8

b) Explain with necessary diagrams, the significance of the trapezoidal velocity profile used in LSPB trajectory planning. 6

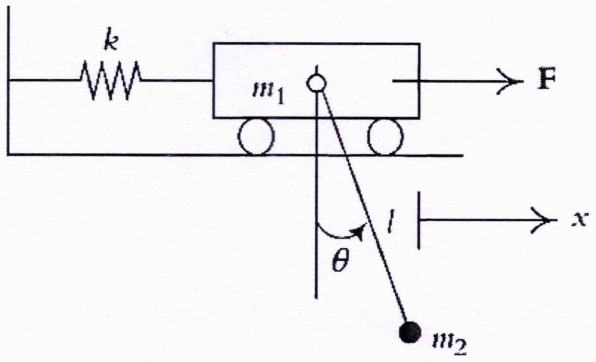
OR

16 a) Describe the potential field technique for path planning of robots in the presence of obstacles. 8

b) Explain how straight line and circular trajectories are planned in Cartesian space. 6

Module -4

17 a) Develop the dynamic model of the 2 DOF system shown in the figure below. 9



b) Describe Computed torque control with a neat block diagram. 5

OR

18 a) Explain the working of a single axis PID controller with derivation of closed loop transfer function and block diagram. 7

b) Derive the expression for the residual forces acting on a robotic arm once the inertial forces and gravitational forces have been removed. 7

Module -5

19 a) Describe any three industrial applications of robots. 6

b) Explain the working of IMU and Accelerometers. 8

OR

20 a) Explain repeatability, work volume, stroke and reach of robots with necessary diagrams. 8

b) Describe open loop type of kinematic controller in wheeled mobile robots with a diagram. 6

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