

Reg No.: _____

Name: _____

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY
SIXTH SEMESTER B.TECH DEGREE EXAMINATION(R&S), MAY 2019

Course Code: EC368

Course Name: Robotics

Max. Marks: 100

Duration: 3 Hours

PART A

Answer any two full questions, each carries 15 marks

Marks

- 1 a) Draw and explain the components and structure of robotic arm. (5)
- b) Explain the working of linear and rotary types of hydraulic actuators with the help of neat diagrams. (10)
- 2 a) Describe the characteristics of sensors. Explain various sensors with the help of neat diagrams. (7)
- b) Briefly explain the speed control and direction control of electric motors. (8)
- 3 a) Explain the principle of operation of stepper motors and brushless DC motors. List their advantages and disadvantages. (8)
- b) Explain the common kinematic arrangements of robots based on various coordinate systems. (7)

PART B

Answer any two full questions, each carries 15 marks

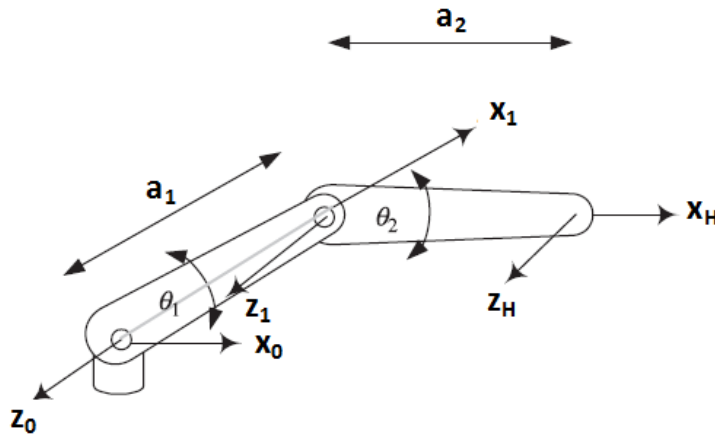
- 4 a) Discuss various image processing techniques used in robotics. (10)
- b) Calculate the inverse of the following transformation matrix. (5)

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

- 5 a) A frame B was rotated about the x-axis 90°, then, it was translated about the current a-axis 3 inches before it was rotated about z-axis 90°. Finally, it was translated about current o-axis 5 inches. (8)
 - a) Write an equation that describes the motion.
 - b) Find the final location of a point P (1, 5, 4)^T attached to the frame relative to the reference frame.
- b) Derive the matrix representing the orientation change with Euler angles. Which are (7)

the fundamental rotations involved in this?

- 6 a) For a simple 2-axis robot shown in figure, (8)
- Assign appropriate frames for DH representation.
 - Fill out parameters table.
 - Derive the forward kinematic equations for the robot.

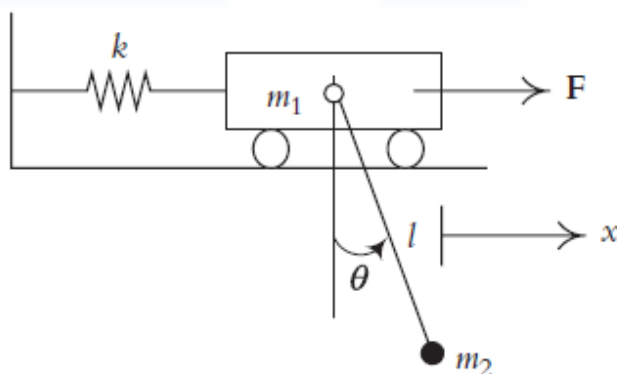


- b) Write homogeneous transformation matrix for translation in cylindrical coordinate system. Which are the three transformations involved? (7)

PART C

Answer any two full questions, each carries 20 marks

- 7 a) Derive the equations of motion for 2 DOF system shown in figure. (10)



- b) Explain the structure of robot programming language. (10)
- 8 a) Derive the Jacobian operator for linear and angular velocity of end-effector. (10)
- b) Distinguish between textual programming and lead through programming. (5)
- c) Write VAL commands for controlling end-effector motion of a robot. (5)
- 9 a) What is the role of inverse Jacobian operator in velocity kinematics? Also, explain the significance of singularities in the same. (10)
- b) Describe the state-of-art of robotics. What are mobile robots? (10)
