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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   (10) neat diagrams.

2 a) Describe the characteristics of sensors. Explain various sensors with the help of neat   (7) diagrams.

   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   (8) their advantages and disadvantages.

   b) Explain the common kinematic arrangements of robots based on various coordinate   (7) systems.

PART B

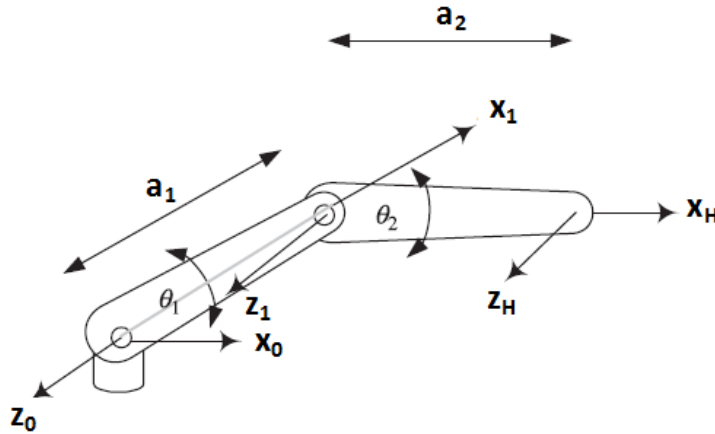*Answer any two full questions, each carries 15 marks*

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   (8) a-axis 3 inches before it was rotated about z-axis 90°. Finally, it was translated about current o-axis 5 inches.

     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)

i) Assign appropriate frames for DH representation.

ii) Fill out parameters table.

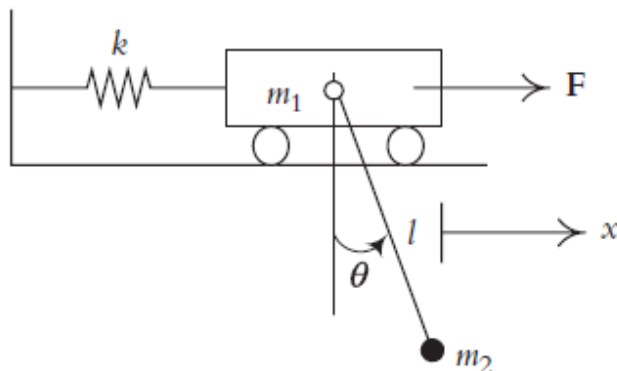iii) Derive the forward kinematic equations for the robot.

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

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 (10)
the significance of singularities in the same.

b) Describe the state-of-art of robotics. What are mobile robots?   (10)

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