



DEPARTMENT OF COMPUTER SCIENCE & ENGINEERING
UNIVERSITY OF BARISAL

Final Examination 2022
Course Title: Robotics and Automation
Course Code: CSE-4101
4th year 1st Semester
Session: 2021-22 (Admission: 2018-19)

Time: 3 hour

Marks: 60

Answer any five Questions from the followings.

1. a) Define actuator. What are different types of actuators? Explain. [4]
b) Why, where and how electric actuators are used in robotics? [8]
2. a) Explain the basic implementation of an electric motors in robotic control. [5]
b) Draw the internal construction of a DC motor and explain its operations and principles of control. [7]
3. a) Explain the process of coordinates' transformations. [6]
b) Using appropriate diagram and matrices, discuss, how robot rotates. [6]
4. a) Define composite rotations and Yaw-Pitch-Roll transformation matrix. [4]
b) Suppose we rotate tool about the fixed axes, starting with Yaw of $\pi/2$, followed by Pitch of $-\pi/2$ and finally, a Roll of $\pi/2$, what is the resulting composite rotation matrix? [4]
c) Let a point P at the tool tip has mobile coordinate $[P]M = [0,0,6]^T$, Find $[P]F$ following YPR transformation of 45, 60 and 90 degree respectively. [4]
5. a) Classify the robot end-effector from the view point of control. Sketch and explain a cam actuated gripper used for robots. [6]
b) For a planar 2 DOF, 2R manipulator as shown in Fig.5 (b), find out the Jacobian matrix. [6]

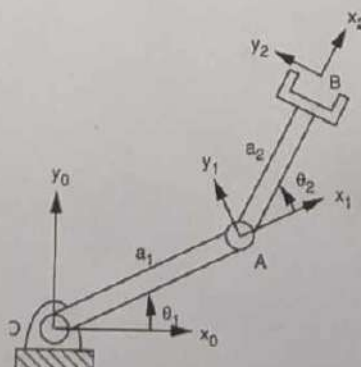


Fig. 5 (b)

6. a) What is degree of freedom in robotics point of view? [2]

- b) Explain the anatomy and architecture of an industrial robot with appropriate figures. [4]
- c) Define and mention important characteristics of, [6]
- i) Polar robot ii) Cylindrical robot iii) Cartesian robot
- iv) Angular robot v) SCARA robot

7. a) Discuss on joint and link parameters in robotics point of view. [4]
- b) Define direct Kinematics and its problem. [2]
- c) Write DH algorithm for assignment of Coordinate frames (use suitable figures). [6]
8. a) Describe with a suitable diagram how a non-servo control robot system works. [4]
- b) Fig. 8 (b) shows two matrices. [8]

$$\mathbf{H}_1 = \begin{bmatrix} \cos \theta & \sin \theta & 0 & a \\ -\sin \theta & \cos \theta & 0 & b \\ 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 1 \end{bmatrix} \quad \mathbf{H}_2 = \begin{bmatrix} \cos \theta & 0 & \sin \theta & 0 \\ 0 & 1 & 0 & 0 \\ -\sin \theta & 0 & \cos \theta & c \\ 0 & 0 & 0 & 1 \end{bmatrix}$$

Fig. 8 (b)

Describe what is happening to an object undergoing $H = H_1 H_2$. Be very specific and include any applicable reference frames. Draw the initial body frame, any intermediate frames and the final body frame.