DEPARTMENT OF COMPUTER SCIENCE & ENGINEERING

UNIVERSITY OF BARISAL

Final Examination 2023

Course Title: Robotics and Automation

Course Code: CSE-4101

4th year 1st Semester

Session: 2022-23 (Admission: 2019-20)

Time: 3 hour **Marks:** 60

Answer any five Questions from the followings.

1. a) Define software robots with examples. [2]

   b) Explain at least 5 different types of robots mentioning their construction, deployment and applications. [10]

2. Elaborate the concept of coordinate frames. How it helps to describe the location and motion of a robot. [12]
   Use appropriate figures, equations and matrices to explain.

3. a) How robot rotates. Explain different types of rotations using appropriate examples. [9]

   b) Write an algorithm for composite rotation. [3]

4. a) What do you understand by homogeneous coordinates. How homogeneous transformation matrix is used to change coordinate frame in robotics? [5]

   b) Elaborate your concept on inverse homogeneous transformation. [3]

   c) Explain degrees of freedom of a robot using appropriate figures. [4]

5. a) Explain robot architecture considering five common body and arm configurations. [5]

   b) How a robot can locate itself and navigate through an environment? What are the types of non-verbal interaction? Briefly explain each of them. [7]

6. 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]

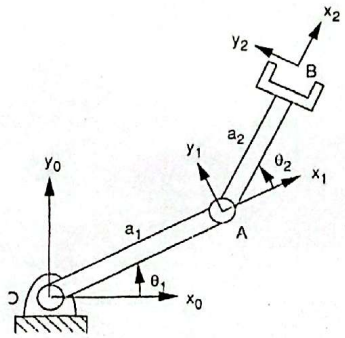

Fig. 5 (b)

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]

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

Fig. 8 (b)

Describe what is happening to an object undergoing $H = H_1H_2$. Be very specific and include any applicable reference frames. Draw the initial body frame, any intermediate frames and the final body frame.