Programme	B.Tech.	Semester	WINTER SEMESTER 2023 - 24
Course Title	ROBOTICS AND AUTOMATION	Course Code	BECE312L
Faculty Name	Prof. Velmathi G	Slot	F1+TF1
		Class Nbr	CH20232240502751
Time	3 Hours	Max. Marks	100

General Instructions:

- Write only Register Number in the Question Paper where space is provided (right-side at the top) & do not write any other details.
- PART A consists of 2 questions each 10 marks.
- PART B consists of 4 questions each 15 marks.
- PART C consists of 1 question each 20 marks.

Section - I
Answer all questions (2 X 10 Marks = 20 Marks)

01. (a) Define ROS (Robot Operating System). Discuss the key differences between ROS1 and ROS2, highlighting their respective advantages and disadvantages. [5marks]   [10]

(b) What is Adams and how is it used in the field of robotics? Discuss its features and capabilities for simulating and analyzing mechanical systems. [5marks]

02. (a) Analyze the role of industrial robots in enhancing efficiency and safety in welding assembly processes within manufacturing industries. How do robotic systems contribute to quality control and production optimization in these tasks? [5marks]   [10]

(b) Examine the challenges and opportunities in the development of underwater robots for marine exploration and infrastructure maintenance. How do underwater robots address the unique environmental and operational constraints of underwater environments? [5marks]

Section - II
Answer all questions (4 X 15 Marks = 60 Marks)

03. (a) In a bustling airport, a humanoid robot named ARIA (Airport Robotic Information Assistant) is deployed to assist travelers with navigation, flight information, and other inquiries. During a busy period, ARIA encounters a scenario where a visually impaired passenger approaches and seeks assistance in locating their departure gate.   [15]

Recommend a series of operations that ARIA should perform to effectively communicate with and assist the visually impaired passenger, ensuring a seamless and inclusive interaction while considering factors such as accessibility, privacy, and maintaining the passenger's independence and dignity throughout the assistance process. [8 marks]

(b) For the given industrial robotics structure in Fig.1, determine number of links, joints and the Degree of Freedom. [7 marks]
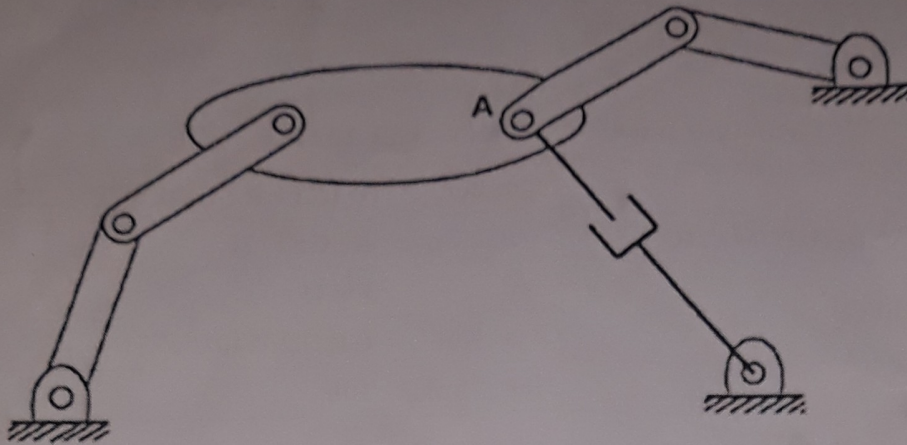

Fig. 1.

04. (a) You're part of a team developing a robotic camera gimbal system for capturing stabilized footage in dynamic environments. The system relies on specific type of motor to adjust the camera's orientation and maintain stability during movement. While filming a fast-paced outdoor event, such as a sports competition, the system encounters a scenario where sudden changes in terrain cause unexpected vibrations and disturbances to the camera's stability. [15]
Identify the type of motor used in this scenario and explain in detail how this motor system should adapt its control sequence to compensate for the unexpected vibrations and maintain optimal stability of the camera gimbal, ensuring high-quality footage without sacrificing smoothness or clarity. [8 marks]

(b) A hydraulic press has an input cylinder 2 inch in diameter and an output cylinder 7 inches in diameter. Assuming 100% efficiency, determine the force exerted by the output piston when a force of 12 pounds is applied to the input piston. Also, If the input piston is moved through 6 inches, how far is the output piston moved? [7 marks]

05. You oversee the development of an automated car equipped with a full suite of sensors. During a test drive in an urban setting, the car faces a situation where unexpected roadwork leads to lane closures and diversions. The automated car needs to travel along with the pedestrians and cyclists navigating while crossing the road work constructional area. [15]
Create a strategic sequence of sensing and actuations, detailing how the car's sensor integration system should interpret live sensor data to navigate safely through the construction site, detect and react to dynamic obstacles like pedestrians and cyclists, and make decisions to identify the alternate path for the vehicle in an efficient way to ensure passenger safety also to ensure proper traffic rules and regulations for maintaining smooth travel. [15 marks]

06. (a) A single-link robot with a rotary joint as in Fig.2, is motionless at $\Theta=25$ degrees. It is desired to move the joint in a smooth manner to $\Theta=60$ degrees in 5 seconds. Find the coefficients of a cubic trajectory expression that accomplishes this motion and brings the manipulator to rest at the goal. [7 marks] [15]
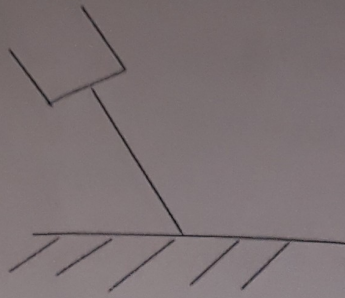Plot the displacement and velocity of the joint as a function of time. [3 marks]

Fig. 2.

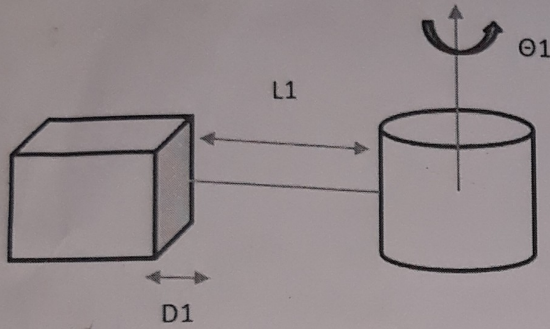(b) For the given kinematic chain in Fig. 3, find the joint angles and distances. [5 marks]

Fig. 3.

Section - III

Answer all questions (1 X 20 Marks = 20 Marks)

[20]

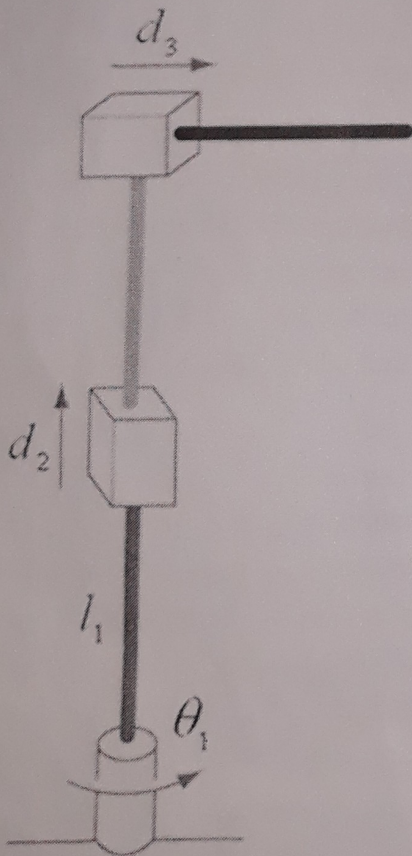07. For the given robotic structure in Fig. 4,

Fig.4.

Identify and draw appropriate frames for the Denavit-Hartenberg representation. [5 marks]

Identify and explain the types of joints, links and fill out the D-H parameter table. [6 marks]

Link$_i$	q_i	d_i	a_i	a_i	

Deduce the forward kinematic transformation matrix using the D-H parameters. [9 marks]

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