

# Final Assessment Test(FAT) - Nov/Dec 2024

Programme	B.Tech.	Semester	Fall Semester 2024-25
Course Code	BECE312L	Faculty Name	Prof. Ganala Santoshi
Course Title	Robotics and Automation	Slot	B1+TB1
Time	3 hours	Class Nbr	CH2024250101229
		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.

## Course Outcomes

1. Classify robots and summaries their role in diverse applications
2. Infer the working of basic electric, electronic, and other types of drives required in robots.
3. Distinguish and interpret the sensors for various applications in robotics and automation.
4. Determine the mathematical model of robotic systems and analyze their kinematic behavior.
5. Design robots for varied working environments encompassing all types of motions across different paths and diverse trajectories.
6. Apply the ideas in performing various robotic tasks for contemporary industry standards using suitable programming skills

## Section - I

Answer all Questions (4 × 10 Marks)

\*M - Marks

Q.No	Question	*M - Marks		
		*M	CO	BL
01.	In a robotics laboratory, acoustic sensors are integrated into autonomous mobile robots for warehouse management. These sensors enable the robots to navigate by detecting obstacles and monitoring the noise levels of machinery. a) Analyze the working principle of acoustic sensors in autonomous mobile robots. Examine how these sensors detect sound waves and convert them into useful data that supports navigation and obstacle detection. [5 Marks] b) Evaluate two specific applications of acoustic sensors in robotic systems within the warehouse environment. Discuss how these applications enhance operational efficiency and safety. [5 Marks]	10	3	3
02.	A company specialized in developing robots for automobile manufacturing industry to carry out assembly of critical components. The company seeks to improve the characteristics to ensure the reliability of their manufacturing process. a) Identify suitable metrics of the assembly robots in the automotive industry, providing five valid characteristics for your choice. [5 marks] b) Illustrate how external factors such as calibration errors or environmental conditions might impact the performance characteristics, provide a relevant example. [5 marks]	10	1	2



03. A robotics company is evaluating the effectiveness of different robot software platforms in their laboratory, where they are developing a robot to assist in assembling critical automobile components. The company is utilizing ROS (Robot Operating System) and needs to compare its communication mechanisms with other potential platforms. Based on the scenario answer the following query's:

- Compare and contrast the message communication between the nodes in ROS (Robot Operating System) with a suitable diagram. [5 marks]
- Highlight five important characteristics of ROS (Robot Operating System), when compared with similar kind of robot software platforms. [5 marks]

04. Underwater robots and drones are equipped with advanced sensors and imaging technologies to gather critical data and execute tasks in challenging, human-inaccessible environments during disasters.

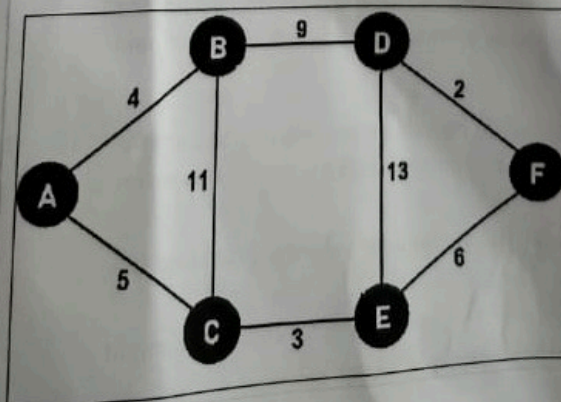
- Analyze the operational mechanisms of underwater robots, focusing on the types of sensors employed for navigation and data collection in these environments. Evaluate how these sensors contribute to successful mission outcomes. [5 Marks]
- Assess two specific applications of underwater robots in marine research or environmental monitoring, and justify their importance in advancing scientific knowledge or conservation efforts. [3 Marks]
- Examine two ways in which drones can be deployed in disaster response scenarios, providing examples of their impact on recovery and rescue operations. [2 Marks]

#### Section - II

Answer all Questions (3 × 20 Marks)

\*M - Marks

Q.No	Question	*M	CO	BL
05.	<p>Imagine a mobile robot is tasked with exploring a cluttered room filled with furniture and other obstacles. The robot's objective is to navigate from a designated starting point to a specific target location while avoiding collisions with the obstacles in its path.</p> <p>a) Illustrate how the bug algorithm can be employed by the robot to achieve its navigation goal. What are the main phases of the algorithm, and how does it guide the robot's movement? [10 Marks]</p> <p>b) Consider the graph shown below, where the vertices and the edges represent the above scenario. Use Dijkstra's Algorithm to find the shortest path from A to F in the graph given below. [10 Marks]</p>	20	6	5





06. In a large packaging facility, hydraulic or pneumatic actuators play a critical role in powering conveyor systems and automated packaging machines. These actuators must provide both linear and rotary motions for precise positioning of packages, which can adjust the conveyor height, sealing operation and proper labelling using the machines.

a) Analyze the role of hydraulic actuators in this packaging facility. Examine their working principle, particularly focusing on how hydraulic energy is transformed into mechanical motion. [6 Marks]

b) Design a circuit diagram of the hydraulic drive system both linear and rotary used in this application, ensuring key components such as the pump, valves, actuators, and reservoir are clearly labeled. [7 Marks]

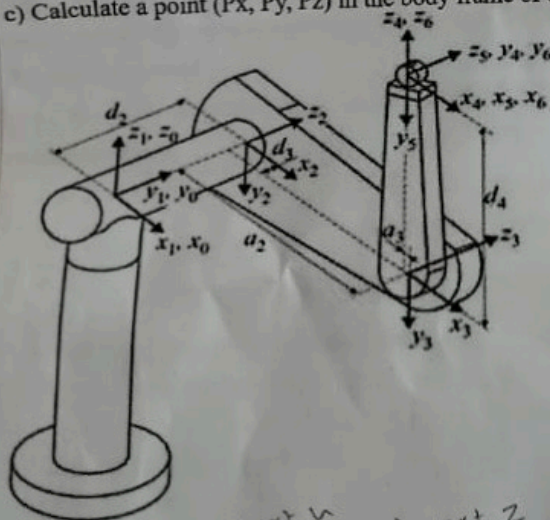
c) Justify how pneumatic drives differ from hydraulic drives in terms of operation, power, and efficiency, and assess the suitability of pneumatic drives for specific tasks in the packaging facility with necessary diagrams and explanation. [7 Marks]

07. The Puma 560 is shown in the following figure along with the DH parameters and body frames for each link in the chain. Note that in the given problem,  $a_3$  and  $d_3$  are negative, as they represent signed displacements.

a) Write all the intermediate matrices for the given PUMA 560. Show separate matrices along the axes and about the axes, wherever is applicable. [8 marks]

b) Write a matrix to calculate end effector position and hand to achieve a desired orientation. [7 marks]

c) Calculate a point  $(P_x, P_y, P_z)$  in the body frame of the last link [5 marks]



Matrix	$\alpha_{i-1}$	$a_{i-1}$	$\theta_i$	$d_i$
$T_1(\theta_1)$	0	0	$\theta_1$	0
$T_2(\theta_2)$	$-\pi/2$	0	$\theta_2$	$d_2$
$T_3(\theta_3)$	0	$a_2$	$\theta_3$	$d_3$
$T_4(\theta_4)$	$\pi/2$	$a_3$	$\theta_4$	$d_4$
$T_5(\theta_5)$	$-\pi/2$	0	$\theta_5$	0
$T_6(\theta_6)$	$\pi/2$	0	$\theta_6$	0