Reg. Number:	

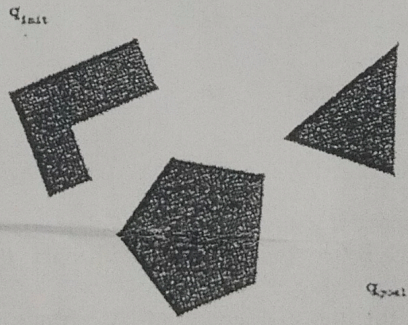
VIT
Vellore Institute of Technology
(Deemed to be University under section 3 of UGC Act, 1956)
CHENNAI

Continuous Assessment Test (CAT) – II - October 2024

Programme	:	**B.Tech ECE**	Semester	:	**Fall Sem. 2024-25**
Course Code & Course Title	:	**BECE312L & Robotics and Automation**	Class Number	:	**CH2024250101238 CH2024250101240 CH2024250101235**
Faculty	:	**Dr. R. Priyadarshini / 52200 Dr. S. Abinaya / 52232 Dr. Suguna M / 52215**	Slot	:	**B2+TB2**
Duration	:	**1½ Hours**	Max. Mark		**50**

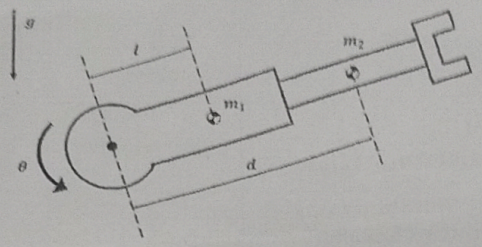
General Instructions:
- Write only your registration number on the question paper in the box provided and do not write other information.
- Only non-programmable calculator without storage is permitted

Answer all questions

Q. No	Sub Sec.	Description	Marks
1		A robot in an automated warehouse sorts packages. It uses a camera to scan shelves and identify packages by their shape, size, and color. Its job is to pick up blue square-shaped boxes and place them on a conveyor belt for processing. The robot uses feature extraction to detect shape and color and an object recognition algorithm to find the correct boxes. The robot has been trained on images of different package shapes (squares, circles, triangles) and colors (blue, red, green). Its performance is being evaluated based on how accurately it identifies and picks up the blue square-shaped boxes. (a) What is feature extraction, and how does the robot use it to identify blue square-shaped boxes from the camera feed? [5 marks] (b) How does the robot use an object recognition algorithm to identify the blue square-shaped boxes based on the features extracted? [5 marks]	10
2		A robot is placed in a large warehouse that contains several storage racks and aisles. The warehouse is represented as a configuration space as in Fig 1. The robot needs to navigate through the space that starts at a given position denoted as q_{init} and reaches to a specified destination q_{goal} in Fig 1.  Fig 1. Configuration Space of Warehouse a) Construct a connectivity graph using exact cell decomposition method to represent this warehouse environment. [3 marks]	10

b) Apply Dijkstra's algorithm to perform a graph search in order to find the shortest path between the robot's start node q_{init} and the destination node q_{goal}, ensuring that obstacles are avoided. [7 marks]

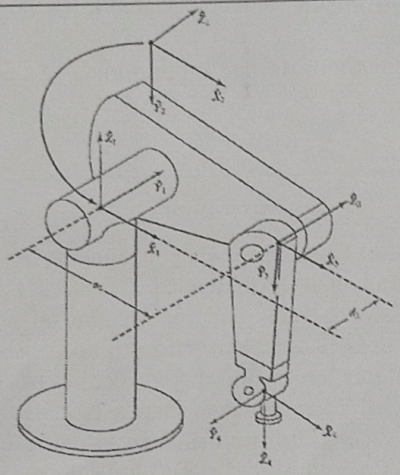
3



15

Derive the Lagrangian dynamics to determine the equation of motion for the above given manipulator [15 marks]

4



$Link_i$	α_{i-1}	a_{i-1}	d_i	θ_i
1	0	0	0	θ_1
2	−90	0	0	θ_2
3	0	a_2	d_3	θ_3
4	−90	a_3	d_4	θ_4
5	90	0	0	θ_5
6	−90	0	0	θ_6

15

Link parameters, kinematic parameters and frame assignments for the PUMA 560 manipulator are given along with DH table. Using this information derive the following

(a) All the transformation matrices from base frame to final frame [9 marks]

(b) Derive equations for end effector position (Px, Py and Pz) [6 marks]