Reg. No.: 20BCE1707

Name :

VIT

Vellore Institute of Technology

(Deemed to be University under section 3 of UGC Act, 1956)

Continuous Assessment Test-I – Jan 2023

Programme	:	**B.Tech (CSE)**	Semester	:	**WINTER 2023**
Course	:	**Robotics and its Applications**	Code	:	**CSE3011**
Faculty	:	**Dr. Rajesh R**	Slot(s)	:	**D2**
			Class Nbr(s)	:	**CH2022235000630**
Time	:	**1½ Hours**	Max. Marks	:	**50**

Answer ALLQuestions

1.	Consider a Robot which is designed for controlling conveyor belt in manufacturing applications. The conveyor belts are connected with rotor to make movements with respect to the wheel rotation of motor. The motor has to be designed for this conveyor system with four pair of coil winding in stator and two pair of permanent magnet at inner rotor. Motor should take 1.8 degree step angle movement when the coil is energized.	[10]
2.	Assume that you want to design a robot for palletizing operation and spray painting applications. Can the close loop control mechanism support these applications? Outline the various servo control mechanisms which can be used for spray painting and palletizing operation with robots.	[10]
3.	Robotics research lab needs a robot for pick and place operation. Assume that robots have 3 joints, 2 links and an end effector. The robot you are going to design should perform linear and rotational motion. Also, explain the functionalities of mentioned joints and links considered for your robot model.	[10]
4.	In an industry assembly line the end products that are placed on the conveyor belt must be counted by sensors. Sensor used for counting the end products must use light signal for detection and counting. Also, sensor should measure the exact position of the disk at any time, without the need for a starting position. Summarize and explain the sensors used for the above mentioned applications.	[10]
5.	In your robotics lab you need to develop robots for multiple applications like medical, measurement of geographical conditions, indoor environment monitoring and industrial applications. Elaborate in detail the various robots you will use for the above mentioned applications.	[10]
	Total Marks	**[50]**

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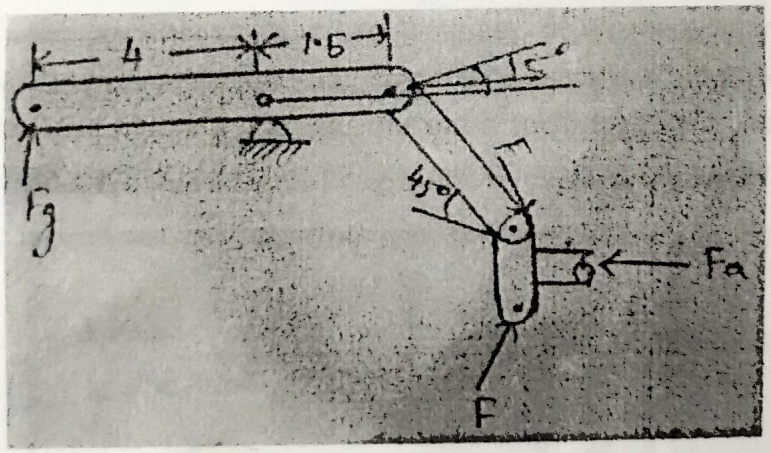
Continuous Assessment Test-II – Mar 2023

Programme	:	**B. Tech (CSE)**	Semester	:	**WINTER 2023**
Course	:	**Robotics and its Applications**	Code	:	**CSE3011**
Faculty	:	**Dr. Rajesh R**	Slot(s)	:	**D2**
			Class Nbr(s)	:	**CH2022235000630**
Time	:	**1½ Hours**	Max. Marks	:	**50**

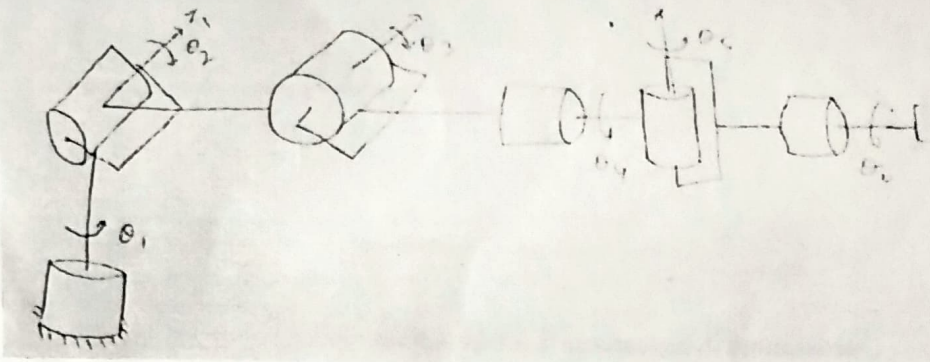
Answer **ALL** Questions

1. a) A 5kg circular block is gripped in the three finger gripper and lifted vertically at a velocity of 1 m/s with acceleration of 27.5 m/s^2. What can be the value of coefficient of friction if the gripper jaw is made up of plastic material and circular block is of steel material? Calculate the minimum force that would prevent slippage. (5 Marks) **[10]**

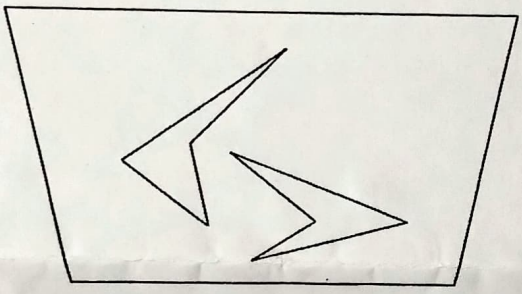
b) The diagram shows the linkage mechanism and dimensions of a gripper used to handle a work piece for a machining operation. Suppose it has been determined that the gripper force is to be 25 Kgf. What is required to compute the actuating force to deliver this force of 25 Kgf. Total moment obtained along the single arm of the pivot gripper is $25(4\cos15^0) = F\ Sin45^0(1.5\ cos15^0)+F\ Cos\ 45^0(1.5\ sin15^0)$. Calculate Fa, which is double the value of force obtained from total momentum and $Cos45^0$. (5 Marks)



2. Assume that you want to design a robot for the robotics lab that has an arm with prismatic and rotational joints as shown in below Figure. Add suitable frames for the robot from the base to the end effector. Obtain the DH parameter table and write the procedure to get the table. **[10]**

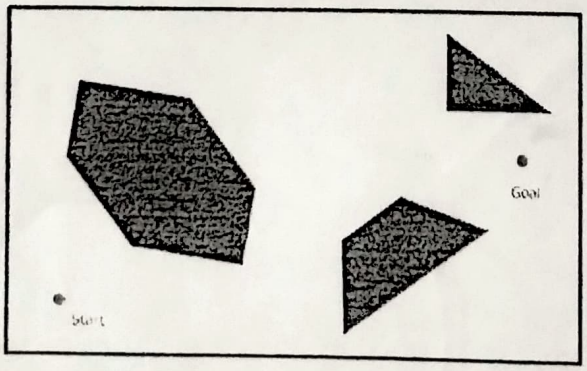


Consider a robot in your robotics lab that has to decompose the given cell area into multiple small trapezoidal cells for path planning. Identify the multiple paths your robot can take to reach its final goal from its initial position. Also create the list for each event (every vertex) that occurs in every plane sweep from left to right in order to identify the edges through which your robot can traverse to reach its target location. Find the total number of events (vertices) that occur in this polygonal cell and the list of edges it can use at events 3 and 7. **[10]**

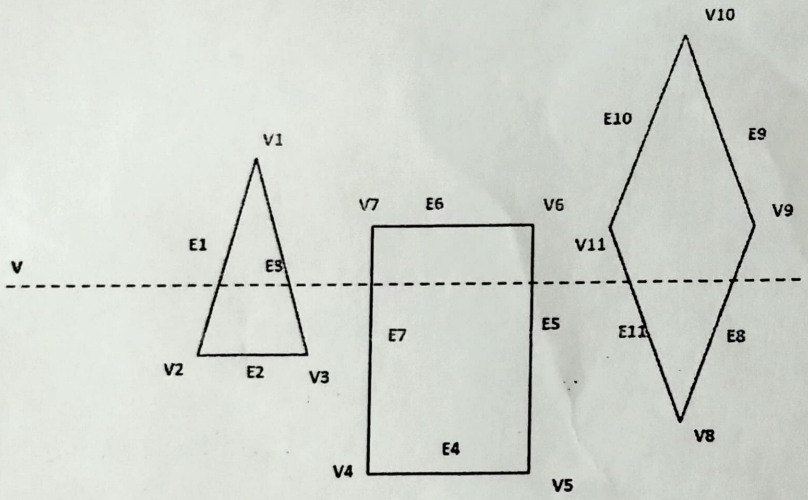


Note: Event starts from 1 to N (left to right).

a) Construct a reduced-visibility graph whose vertices are considered from the start, goal as well as all obstacle vertices, and the edges consist of all possible collision-free line segments and obstacle edges. Use a motion planning method to identify a path from start to goal by considering the edges and vertices of obstacles in the given diagram. **[10]**



b) Consider a humanoid robot that has to move from one location to another by avoiding obstacles. The robot has to identify the visible edges in the given graph to reach its final destination. Identify the sorted vertex list with respect to angles and find the active edge list. Create the edge list for each vertex. What will be the edge list and visible vertex list at angles V4 and V10?



5. Consider an image processing application where an analog light image input is converted into digital pixels. Using an analog-to-digital converter, a continuous voltage is converted to its digital counterpart. The maximum voltage range is 0 to 25 V. The A/D converter has a 16-bit capacity range. Determine the number of quantization levels, resolution, spacing of each quantization level, and voltage value for a grey image with a pixel value 16. **[10]**

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Final Assessment Test (FAT) - APRIL/MAY 2023

Programme	**B.Tech**	Semester	**Winter Semester 2022-23**
Course Title	**ROBOTICS AND ITS APPLICATIONS**	Course Code	**CSE3011**
Faculty Name	**Prof. Rajesh R**	Slot	**D2+TD2**
		Class Nbr	**CH2022235000630**
Time	**3 Hours**	Max. Marks	**100**

PART-A (10 X 10 Marks)
Answer All questions

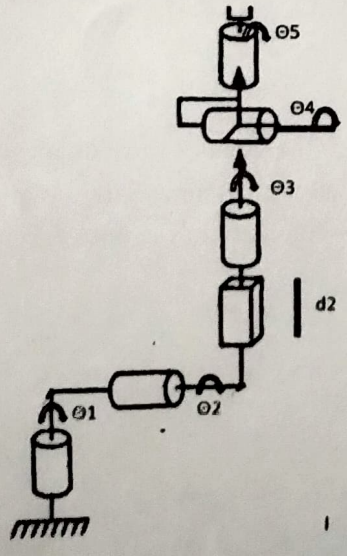
01. Consider an industrial robotic manipulator with various body-and-arm configurations. The robotics arms should support two or more joints with multiple degrees of freedom. With a diagrammatic representation, explain the various coordinate systems supported by a robotic manipulator. **[10]**

02. Derive the mathematical model of a DC motor with electrical equations and mechanical equations. Use the electromechanical relationships to obtain the transfer function from the input voltage source applied to the motor's armature to the output of the rotational speed of the shaft. Represent the transfer function for the given physical parameters: **[10]**

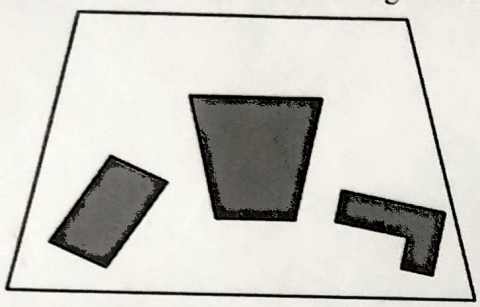
(J) moment of inertia of the rotor 0.01 kg.m^2
(B) motor viscous friction constant 0.1 N.m.s
(Kb) electromotive force constant 0.01 V/rad/sec
(Kt) motor torque constant 0.01 N.m/Amp
(R) electric resistance 1 Ohm
(L) electric inductance 0.5 H

03. Assume that your robot is moving in a straight line. How will it identify the presence of an obstacle without touching an object? Enumerate the different modalities of non-contact sensing methods for object detection in detail. **[10]**

04. Assume that you want to design a robot for the robotics lab that has an arm with prismatic and rotational joints as shown in below figure. Add suitable frames for the robot from the base to the end effector. Obtain the DH parameter table and write the procedure to get the table. **[10]**



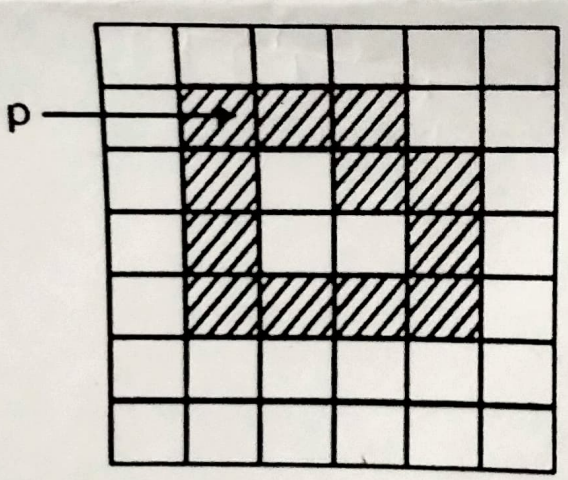
05. Consider a robot in your robotics lab that has to decompose the given cell area into multiple small trapezoidal cells for path planning. Identify the multiple paths your robot can take to reach its final goal from its initial position. Also create the list for each event (every vertex) that occurs in every plane sweep from left to right in order to identify the edges through which your robot can traverse to reach its target location. Find the total number of events that occur in this polygonal cell and the list of edges it can use at events 5 and 9. **[10]**



06. a) Assume that you want to develop a four-finger gripper made of aluminum to hold a 15-kg steel object in a vertical direction. What can be considered the coefficient of friction if an acceleration of 30 m/s^2? Calculate the minimum force that would prevent slippage. **[10]**

b) A 1kg load is to be handled as shown in figure 1 with a coefficient of friction $\mu = 0.1$. The gripper, Gimatic MG-0050, moves upward with an acceleration $a=4m/s^2$. Verify that the safety factor is at least S=1.5.

07. Robot machine vision system use an image compression techniques to store the compressed image in robot controller. Apply the image compression techniques to find the compressed value and shape number for the given image with 4 and 8 chain codes. **[10]**



08. Consider an image processing application where you have to identify the edges of the images from the given image pixels. Use any filter technique to get the edges. Assume your own threshold to get the output matrix filter and identify the changes in the intensity of the boundary pixels. **[10]**

111	222	163	230	234
225	32	110	215	187
49	92	184	97	161
194	233	127	202	29
166	141	164	173	237

09. Products to be palletized are fed into the robotic cell area via the infeed conveyor system. A pallet has to be deposited into the pallet loading area by the palletizing robot. The robot picks one or multiple products at a time and accurately places them on a pallet. Write a VAL program to perform palletizing operations for the aforementioned applications and explain the robot palletizing operation. **[10]**

10. Consider that you have to assemble an electric motor with a single-station robot assembly system. All the motor assembly parts are sequentially presented to the robot, which has a gripper and screw driver to produce the final end product. Elaborate about the various assembly operations that can be performed and write the sequential procedure to assemble the electric motor. **[10]**