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Daffodil International University

Department of Software Engineering

Faculty of Science & Information Technology

Final Examination, Fall 2024

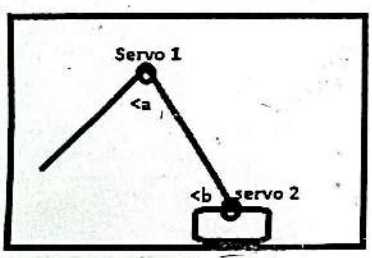
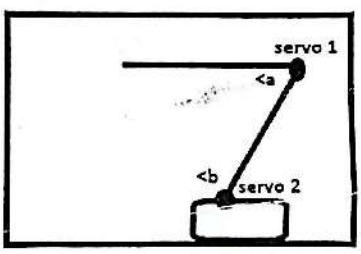
Course Code: SE532; Course Title: Introduction to Robotics

Sections & Teachers: 40(A,B,C,D)-HI; 40(E,F,G,H)-MT; 40(I)- MS

Time: 2:00 Hrs **Marks: 40**

Answer ALL Questions

[The figures in the right margin indicate the full marks and corresponding course outcomes. All portions of each question must be answered sequentially.]

1.	a)	In the given robotic manipulator, there are 2 servo motors labelled as servo 1 and servo 2. Initially, angle a of the manipulator was 30 degree and angle b was 45 degree. After some action, angle a was still 30 degree but angle b has become 120 degree. Draw the circuit and write the arduino **code** for this servo motor action.  	[Marks-5]	CLO-2 *Level-3*
	b)	Suppose, you are designing a robotic arm for an assembly line that requires: Precise movement for placing small components, Variable speed for different tasks and Ability to lift objects up to 2 kg. Choose between a servo motor, DC motor, or stepper motor for this design. Justify your choice by **showing** proper explanations.	[Marks-5]	
	c)	**Explore** the concept of Pulse Width Modulation (PWM) and describe how varying the duty cycle affects the output voltage and the behavior of a connected device, such as a motor.	[Marks-3]	

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	d)	i. A frame F and undergoes the following transformations. **Compute** the coordinates of the frame at the conclusion of transformations. F_{old}= $\begin{bmatrix} 0.866 & -0.5 & 0 & 2.5 \\ 0.5 & 0.866 & 0 & -1.25 \\ 0 & 0 & 1 & 3.75 \\ 0 & 0 & 0 & 1 \end{bmatrix}$ 1. Rotation of 90∘ about the z-axis, 2. Followed by a rotation of 180∘ about the y-axis. --- ii. A frame, F is positioned in a 3D coordinate system. F_{old}= $\begin{bmatrix} 1 & 0 & 0 & 3 \\ 0 & 0 & -1 & 4 \\ 0 & 1 & 0 & 2 \\ 0 & 0 & 0 & 1 \end{bmatrix}$ The frame undergoes the following sequence of transformations: The frame is first rotated by 180∘ about the z-axis. Then, the resulting frame is rotated by 90∘ x-axis, Finally, the frame is translated by [0,−7,5], shifting its position in the space. **Determine** the final coordinates of the frame after applying all these transformations.	[Marks-5+7 =12]	
2.	a)	You are tasked with designing a robot that will serve various purposes in an agricultural farm. One of its functions is **"Obstacle Avoiding"**. Focus on the obstacle avoiding function and **decide** the answers to the following questions in order to design this robot: i. List the components required to design this robot. ii. Draw and label the circuit diagram for this robot. iii. Describe the programming logic or code needed to make the robot avoid obstacles.	[Marks-8]	CLO-3 *Level-5*
	b)	If the robot were to have limbs (hands and legs) to assist in farming, **recommend** the robot design steps required to build this enhanced robot.	[Marks-4]	
	c)	To make this robot navigate in a smarter way using mapping and 3D visualization, we can use Gazebo in combination with ROS (Robot Operating System) to simulate and design a robot that navigates using mapping techniques. **Explain** the functions of Gazebo simulator.	[Marks-3]	

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