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Daffodil International University

Faculty of Science & Information Technology

Department of Software Engineering

Final Examination, Spring 2025

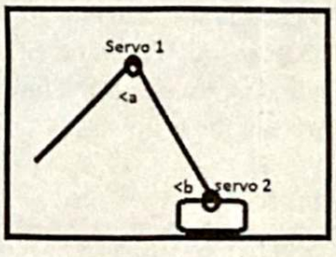
Course Code: SE532; Course Title: Introduction to Robotics

Sections & Teachers: 41(A,B,C,K,L)-MT; 41(D,E,F,M,N)-HI; 41(G,H,I,J)- MBM

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 two servo motors labelled as servo 1 and servo 2. Initially, the manipulator's servo 1 is at an angle of 60 degrees, and servo 2 is at 90 degrees. After performing a certain action, servo 1 moves to 120 degrees, while servo 2 moves to 45 degrees. Draw the circuit and write the arduino **code** for this servo motor action. 	[Marks-5]	CLO-2 *Level-3*
	b)	You are tasked with controlling a DC motor using an L298N motor driver and an Arduino microcontroller. The motor should perform the following sequence of actions when the program is run: a. Start the motor and run it in the forward direction at full speed for 5 seconds, b. Stop the motor for 2 seconds, c. Run the motor in the reverse direction at half speed for 3 seconds, d. Stop the motor. Draw the circuit and write the arduino **code** for this motor action.	[Marks-5]	
	c)	**Explore** the concept of ADC and Pulse Width Modulation (PWM). Describe how varying the duty cycle affects the output voltage and the behavior of a connected device, such as a motor in PWM.	[Marks-5]	

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	d)	i. A vector is described as P=5i+2j-9k. **Compute** its matrix form if it were to describe a direction as a unit vector. ii. A frame, F is positioned in a 3D coordinate system. $F_{old}=$ $\begin{bmatrix} 0 & -1 & 0 & 2 \\ 1 & 0 & 0 & -3 \\ 0 & 0 & 1 & 1 \\ 0 & 0 & 0 & 1 \end{bmatrix} * \begin{bmatrix} 4 \times 4 \end{bmatrix}$ The frame undergoes the following sequence of transformations: The frame is first rotated by 90∘ about the z-axis. Then, the resulting frame is rotated by 90∘ by y-axis. Finally, the frame is translated by [4,0,-2], shifting its position in the space. **Determine** the final coordinates of the frame after applying all these transformations.	[Marks-3+7 =10]	
2.	*a)*	You are tasked to design and implement an "Automated Delivery Robot" for an indoor environment, such as an office or factory floor. The robot should be able to follow a predefined line path to deliver items between different stations. Along the path, if any obstacle appears (such as a person or object), the robot must detect it and either stop or navigate around it safely before continuing to follow the line to complete its delivery task. **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-10]	CLO-3 *Level-5*
	b)	**Explain** your design choices, sensor integration, challenges faced while designing this robot.	[Marks-2]	
	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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