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Daffodil International University

Faculty of Science & Information Technology

Department of Software Engineering

Final Examination, Summer 2026

Course Code: SE 532; Course Title: Introduction to Robotics

Sections & Teachers: MTE (A, B), HI (C, D, J), SCS (E, F, G, H), FF(I)

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)*	A point $p(5,5,5)^T$ is attached to a rotating frame. The frame rotates 90^0 about the z-axis of the reference frame. **Compute** the coordinates of the point relative to the reference frame after the rotation, and sketch the result graphically.	[Marks-5]	CLO-2 *Level-3*
	b)	A frame F_{noa} is located in the position P. After the following transformation the frame position has changed to $Q[2,5,7]^T$. A rotation along Z axis by anti-clock 30 degree but before that a translation along all axis by [2,3,5]. After those two, another rotation along Y axis by 45 degrees followed by a translation along all axis by [3,-5,3]. **Calculate** the position P with respect to Q.	[Marks-10]	
	c)	An H-bridge is an electronic circuit made of four switches that lets a motor driver run a DC motor forward, backwards, and stop quickly. **Sketch** the H-bridge circuit and the truth table to describe its functionality.	[Marks-5]	
	d)	In a robotic arm system, there is one servo motor labelled as servo-1. Initially, servo-1 = 90°. When the program starts, the robotic arm should perform the following sequence: Rotate servo-1 by 30°, Wait for 2 seconds, Rotate servo-1 by 45°, Wait for 2 seconds, Finally, return the servo motor to its initial positions. **Build** the circuit and code the Arduino program for this servo motor action.	[Marks-5]	
2.	*a)*	An agro-tech startup is deploying an Autonomous Crop Monitoring Rover to optimize large-scale farming efficiency. The rover operates independently in outdoor crop fields to navigate rows, monitor environmental conditions, and transmit data without human intervention. Rover Specifications & Features are: • **Field Navigation:** Moves through uneven crop rows using a motorized chassis.	[Marks-10]	CLO-3 *Level-5*

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		• **Obstacle Avoidance:** Detects and bypasses obstacles like rocks, animals, or fences. • **Soil Monitoring:** Identifies dry soil patches requiring immediate irrigation. • **Weather Detection:** Senses sudden rainfall to protect its electronics or alter behavior. • **Data Transmission:** Sends real-time field data wirelessly to a central farm dashboard. • **Local Alerts:** Activates a visual strobe and audible buzzer during critical events. • **Power Management:** Operates for extended periods using a battery and solar charging system. **Collaborate** 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 detect dry soil and rainfall while also avoiding obstacles.		
	b)	In ROS, different parts of a robot can communicate with each other using nodes, topics, and messages. **Explain** these concepts with a simple example of a robot system.	**[Marks-5]**	