Faculty Name: IT
Qualification Name: Programming Foundation
Module Name: Robotics Development
Module Code: RD412

Formative Assessment 3 Paper

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Formative Assessment 3 Paper

Faculty Name:	Information Technology
Qualification Name:	IT Certificate in Programming Foundation
Module Name:	Robotics Development Semester 2
Module Code:	RD412
Hand Out:	20– 09 – 2024
Hand In:	04 – 10 – 2024
Total Marks:	80
Examiner:	Mr Thabang Mashile
Resources Required:	None

Section A: Application-based Question(s)	40 Marks
Section B: Scenario-based Question(s)	40 Marks

Instruction(s) to Students

1. Read all instructions carefully before beginning the assessment.
2. Use only the materials provided to you, including supporting materials if necessary.
3. Read each question carefully and make sure you understand what is being asked.
4. Manage your time carefully and pace yourself throughout the hand-in and hand-out dates.
5. Show all your work and clearly label your answers.
6. All Formatives are due by 23:30 p.m.
7. Use correct terminology, grammar, spelling, and punctuation.
8. When you have finished the assessment, check your work to make sure you have answered all questions to the best of your ability.
9. This assessment is a group activity, list all group members on the answer sheet.
10. All members of this group activity must submit on campus online.

Section A

Application-based Question(s) 40 Marks

Question 1

Devise ladder programs for systems that will carry out the following Internal Relay tasks:

1.1 Switch on an output 5 s after receiving an input and keep it on for the duration of that input, according to Allen Bradley. (10 Marks)

1.2 Switch on an output for the duration of the input and then keep it on for a further 5 s, using TON. (10 Marks)

1.3 Switch on an output for 5 s after the start of an input signal, using an off-delay timer. (10 Marks)

1.4 Start a machine if switch B is closed within 0.5 s of switch A being closed; otherwise the machine is not switched on. (10 Marks)

[Total = 40 Marks]

End of Section A

Section B

Scenario-based Question(s) 40 Marks

Study the scenario and complete the question(s) that follow:

Tailoring a solution

In the year 2023, a robotics organization named "RoboCrafters Inc." has been contracted to develop an advanced automated warehouse system. The objective is to use an array of robotic arms and autonomous vehicles to handle everything from inventory management to order fulfillment. In order to develop a highly efficient, reliable, and scalable system, RoboCrafters Inc. opts for a blend of IL (Instruction Lists), SFC (Sequential Function Charts), and ST (Structured Text) programming methods to control different aspects of their robotic operations.

Instruction Lists (IL): This low-level programming method is used for real-time control of the robotic arms. Engineers find it useful for defining quick and precise movements, capturing the detail-oriented tasks like picking up an item, rotating it, and placing it in a designated area.

Sequential Function Charts (SFC): The SFC method is implemented to control the workflow of the entire warehouse operation. It helps the engineers to visualize, design, and manage the sequence of operations like receiving inventory, storing it, and shipping out orders. The SFC method allows for easy debugging and updating.

Structured Text (ST): This high-level, script-like programming method is used for complex calculations and logic control, like optimal route planning for autonomous vehicles inside the warehouse. Structured Text enables the organization to create complex decision-making algorithms and integrate them seamlessly.

RoboCrafters Inc. has used the following Instruction Lists (IL) for a warehouse robot arm task.

Variables:

H_POS: Current horizontal position
V_POS: Current vertical position
DEST: Destination point
GRIP_STATUS: Whether gripper is holding a package (1 for holding, 0 for empty)
Initial State:

H_POS := 0 (Initialize horizontal position)
V_POS := 0 (Initialize vertical position)
GRIP_STATUS := 0 (Initialize gripper status)
Instructions:

START: (Start of Instruction List)

CHECK_GRIP: (Check gripper status)

IF GRIP_STATUS == 0 GOTO PICKUP
PICKUP: (Pick up a package)

MOVE_TO_A
GRIP_ON
GRIP_STATUS := 1
MOVE_TO_B: (Move to point B horizontally)

```
DEST := B
WHILE H_POS < DEST
H_POS++ (Increment horizontal position)
END_WHILE
MOVE_TO_D: (Move to point D vertically)

DEST := D
WHILE V_POS < DEST
V_POS++ (Increment vertical position)
END_WHILE
DROP: (Drop the package)

GRIP_OFF
GRIP_STATUS := 0
RETURN_TO_START:

H_POS := 0
V_POS := 0
GOTO START
Subroutines:

MOVE_TO_A: (Move to point A horizontally)

DEST := A
WHILE H_POS > DEST
H_POS-- (Decrement horizontal position)
END_WHILE
GRIP_ON: (Activate gripper)

ACTIVATE_GRIPPER
GRIP_OFF: (Deactivate gripper)

DEACTIVATE_GRIPPER
```

Source: Mashile., T (2023).

Question 2

You are tasked with programming an automated bartender robot capable of making different cocktails. The robot has an arm for mixing and serving the drinks, and it needs to operate in a two-dimensional plane: horizontally to reach for various drink ingredients and vertically to pour them into a glass. Using IL (Instruction Lists), and ST (Structured Text), how would you program the robot to make a "Mojito" cocktail that involves grabbing mint leaves, adding lime juice, pouring rum, and topping it off with soda water?

The robotic arm must move between four points:

Point A: Where the mint leaves are located (lower left corner)
Point B: Where the lime juice is located (lower right corner)
Point C: Where the rum is located (upper left corner)
Point D: Where the soda water is located (upper right corner)

The robot should start from a neutral position (Point N), pick one ingredient at a time, mix them in the correct sequence, and return to the neutral position after making the cocktail.

Below is a Sequential Function Charts (SFC)
Workflow Steps:
Start from Neutral Position (N)
Pick Mint Leaves (Point A)
Add Lime Juice (Point B)
Pour Rum (Point C)
Top with Soda Water (Point D)
Return to Neutral Position (N)

(40 Marks)
[Total = 40 Marks]

End of Section B

Rubric

Criteria	Max. Marks	Allocated Marks
Instruction List (IL) for Robotic Arm Movement and Actions		
Logical Flow and Sequence	10	
Proper Initialization of Variables	5	
Correct use of Movement Instructions (e.g., MOVE_TO_X)	10	
Correct Activation and Use of Tools (e.g., GRIPPER, POURER)	5	
Total:		
Structured Text (ST) for Decision Making and Logic		
Logical Structure and Flow	5	
Correct Variable Initialization and Use	3	
Error Handling and Exception Cases	2	
Total:		