Instructions to Candidates:

- Answer all questions.
- The report has to be submitted in both hard and soft format(PDF file)
- All tasks have to be demonstrated
- The assignment should be submitted using the Moodle drop box
- Use CAD software for all drawings.
- Include all working and calculations as an appendix.
- Use a professional layout for the report.

Declaration:

I, …… declare that, to the best of my knowledge, no part of this assessment has been copied from any other student's work. I further declare that no part of this assessment has been prepared and/or written for me by any other person

Name: ……

Signature:..... Date:.....

Practical task 1

Operating a charge and discharge process

Charge and discharge of a reservoir is a common process in industry as well as a need for mixing two or more substances. By using automated valves this process can be completely automated. Let's say that fluid used in the example is water, and that a reservoir has to be filled up and emptied four times.

Functional Description.

When you push T1 on the operating panel, valve V1 opens and a reservoir starts filling up with water. At the same time, motor M of the mixer starts working.

When the reservoir fills up, water level goes up and reaches the level set by a sensor S1. V1 valve closes and motor of the mixer stops. Valve V2 opens and the reservoir starts emptying. When water level falls below the level set by a sensor S2, valve V2 closes.

By repeating the same cycle four times, lamp (END) that indicates end of a cycle is activated.

Pressing T1 key will start a new cycle.

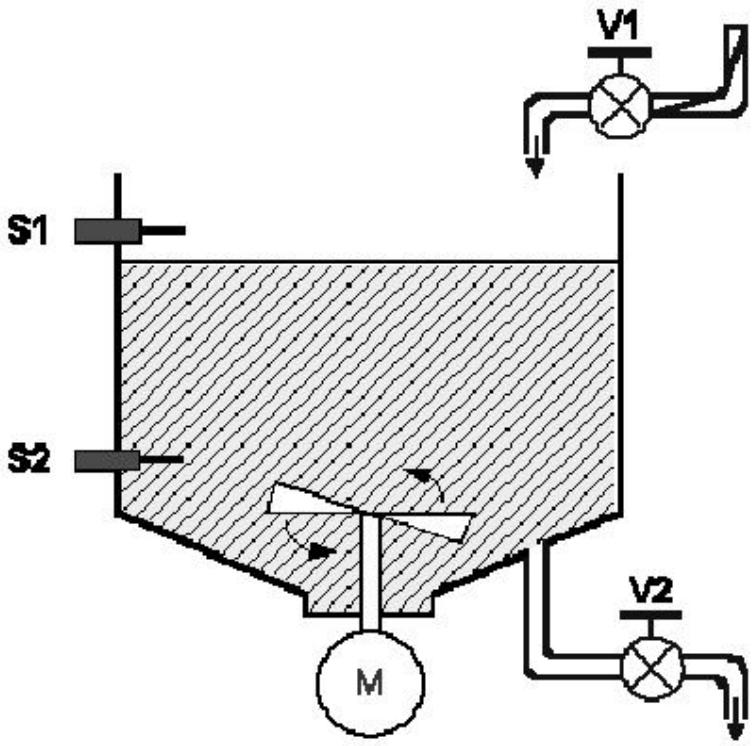

Figure 1

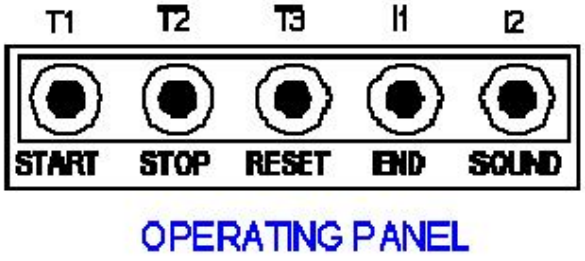

Figure 2

Level S1 and S2 sensors provide information on whether fluid level goes beyond a specified value.

(a) Draw a state sequence diagram for one cycle of filling and discharging. Make the first state an idle state on power Up. [1 Mark]

(b) Briefly explain what causes the move transition from state 2 to state 3 in your diagram above. [1 Mark]

(c) Using one of the following methods, ladder logic, function block diagram, sequential function charts or structured text produce a program for the idle state. The transition state to move out of the idle state is operation of the START button. [3 Mark]

Practical task 2
Trafic light control and coordination

"The normal function of traffic lights requires sophisticated control and coordination to ensure that traffic moves as smoothly and safely as possible and that pedestrians are protected when they cross the roads. A variety of different control systems are used to accomplish this, ranging from simple clockwork mechanisms to sophisticated computerized control and coordination systems that self-adjust to minimize delay to people using the road."[Wikipedia free encyclopedia]

Functional Description.

A M340 PLC is responsible to control a junctions for a fixed control stages.

Table 1 Traffic Board 1and 2 default timing

Phase	Directions	Delay Disengaged sensor	Delay Engaged sensor
1	North / South = On Turn = Off South / East = Off	6s	9s
2	North / South = Off Turn = Off South / East = On	6s	9s
3	North / South = Off Turn = On South / East = Off	3s	5s

Note: Green to Red transients (Amber) is 1s in all situations.

The operator screen will need to have force control which will safely and hold the given direction.

Figure 3

A M340 PLC is responsible to control the process. However a HMI system (similar to Figure 4) is responsible to control and monitor the process. The operator can see status of traffic lights on the computer screen and may force directions by pushing

direction arrows. The control system is also responsible to count number of cars moving in each direction.

Do the following assignments to perform the task

a) Develop a ladder program to perform the direct control of all traffic lights [4 Mark]

b) Write down a structure text program to count number of cars in each direction [2 Mark]

c) Set up an Ethernet network to establish a sustainable communication between PLC and the HMI system. [2 Mark]

d) Develop a proper HMI system to perform the described supervisory tasks [3 Mark]

e) Debug and document the project [3 Mark]

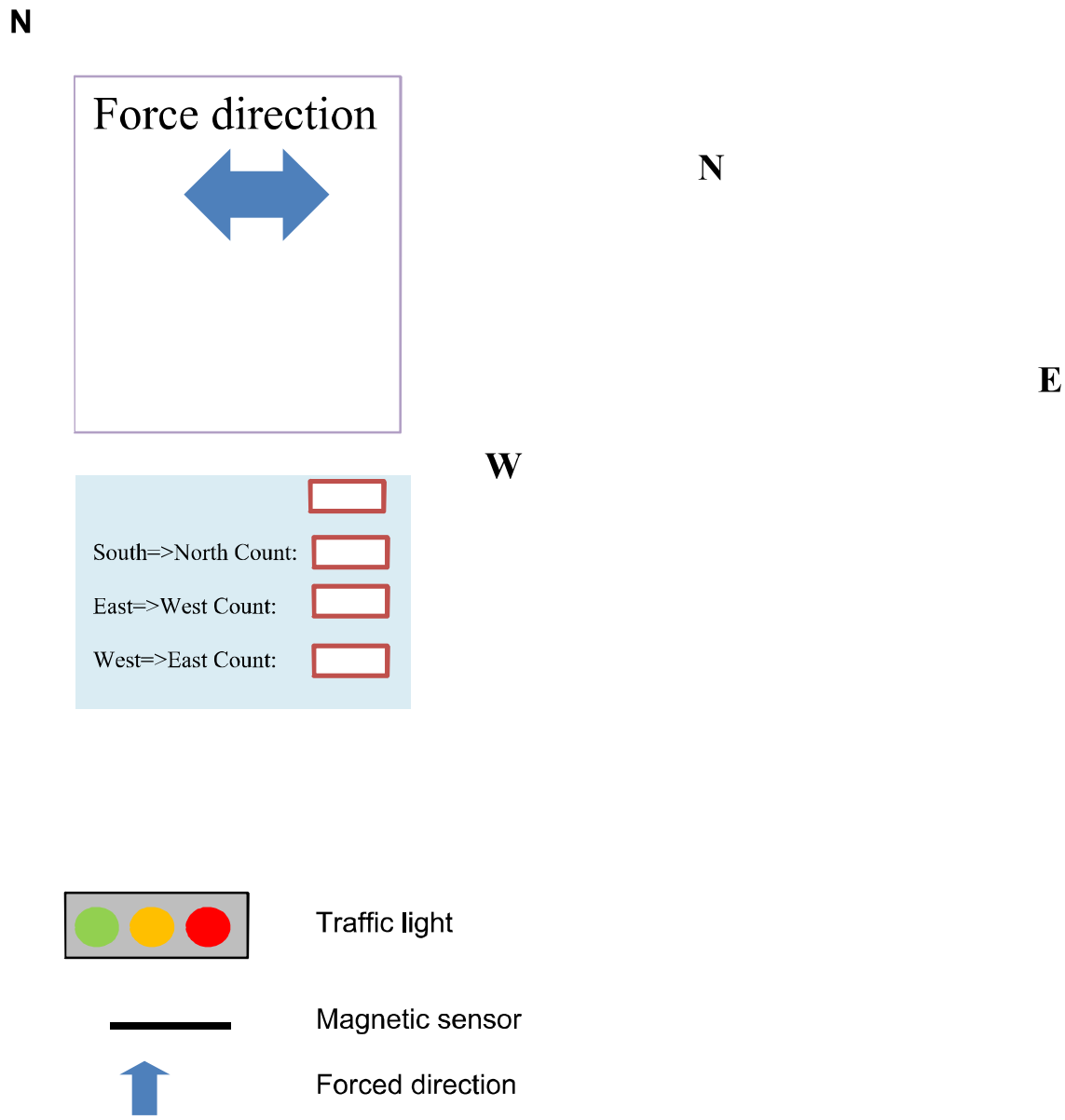
N
Force direction
N
E
W
South=>North Count:
East=>West Count:
West=>East Count:
Traffic light
Magnetic sensor
Forced direction

Figure 4

Here are the inputs and out puts for the traffic light boards.

Input	Address	Comments
Lain1	%I0.1.0	Push button to show there is a car in lain one.
Lain2	%I0.1.1	Push button to show there is a car in lain two.
Lain3`	%I0.1.2	Push button to show there is a car in lain three.

Outputs	Address	Comments
NSredLight	%Q0.1.16	The red light for the north south road.
NSyellowLight	%Q0.1.17	The yellow light for the north south road.
NSgreenLight	%Q0.1.18	The green light for the north south road.
NSturnLight	%Q0.1.19	The turn light for the north south road.
EWredLight	%Q0.1.20	The red light for the east west road.
EWyellowLight	%Q0.1.21	The yellow light for the east west road.
EWgreenLight	%Q0.1.22	The green light for the east west road.

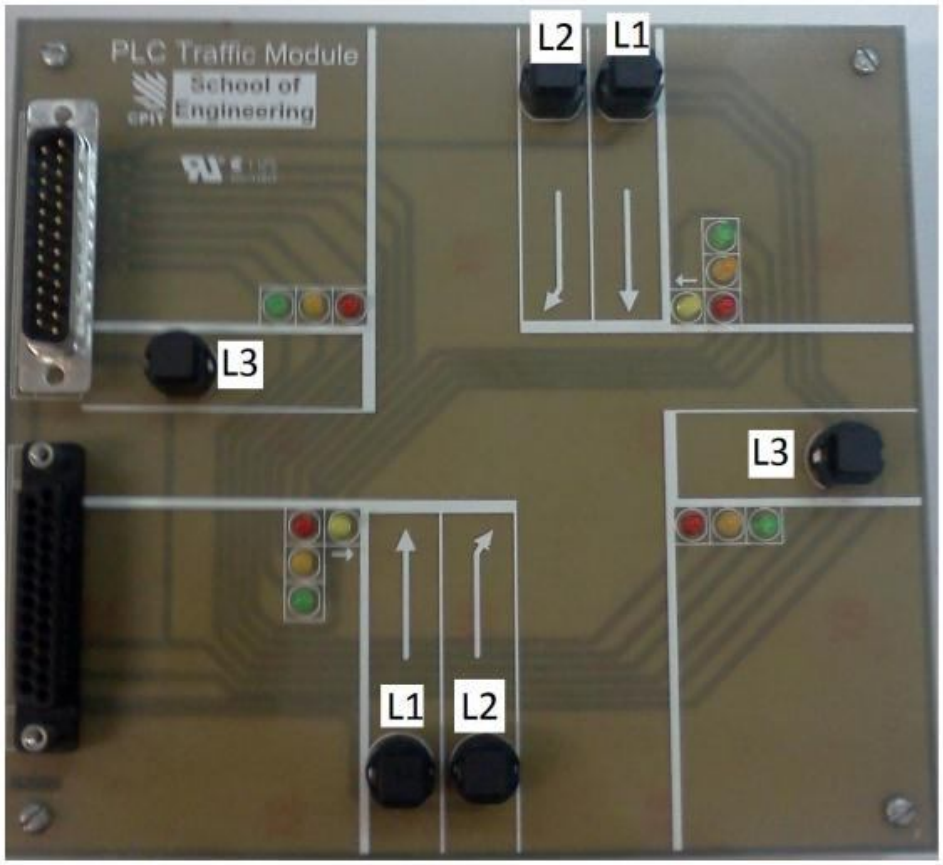

Figure 5

Practical Task 3

The FESTO conveyer consists of 600mm belt driven by a 24V D.Sc. A relay on the FESTO panel controls the motor operation and is wired for source operation.
A block on the conveyer can be directed down one of four shoots, the first 3 are an air operated ram. If no gates are operated the block will move to the end and down the last shoot.
In figure 3, the block enters the conveyer at the top of the picture and is detected by the EntryPE. Located next is the GateOnePE, if GateOne is closed, the block will be directed down the first shoot.

The position of GateOne arm is detected by GateOneArmPE.
The process is repeated for each of the other two gates. The fourth shoot directs the block down the shoot, the presence of a block can be detected by GateFourPE

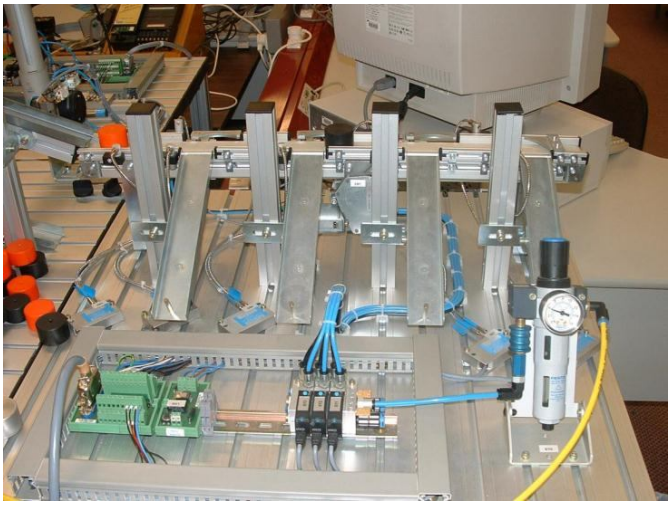

Figure 6

List of IOs are as following:

Table 2

GateOneArmPE	I0
GateTwoArmPE	I1
GateThreeArmPE	I2
EntryPE	I3
GateOnePE	I4
GateTwoPE	I5
GateThreePE	I6
GateFourPE	I7
Conveyer Motor	Q0
Gate One solenoid	Q1
Gate Two solenoid	Q2
Gate Three solenoid	Q3
Error output	Q4

The FESTO transducers provide source 24V outputs and the inputs on the FESTO are setup for 24V source operation.

Functional Description:

When the PLC is in the RUN mode it will switch ON the conveyer so it will run continuously.

a) Detect block on entry, close first arm, check that arm is in the driven position by checking GateOneArmPE status, ie is active. Block is validated by GateOnePE pulsing active as the block passes the PE. Block will be directed down shoot 1, as there is no PE to detect that block has gone down the shoot, a timer must be used to release GateOne arm. Use GateOnePE to trigger the **timer.**

b) Repeat the process for each gate and link them together so that the gate cycle swaps from one shoot to the next for each new block. Use memory to do shoot sequence control.

c) In the case of two blocks arriving together, ie EntryPE going active again before a cycle is completed, open all gates and allow the block to be rejected down shoot four, cycle is not incremented and all latched PE bits reset by blocks passing the GateFourPE. Use a counter to count two blocks.

d) **Two** output:

I. If two blocks are placed on the conveyer, alarm output is solid ON and is cleared when GateFourPE detects both blocks.

II. If any gate arm when driven is not validated by its arm PE, (no air supply) operate the alarm output by pulsing at a one second rate. Alarm is cleared by the block passing the GateFourPE

Table 3

Assessment details Function	Marks
Part A	2
Part B	2
Part C	2
Part D	2
Well-designed and documented program	3
Total	11