

MARKING CRITERIA AND STUDENT FEEDBACK

This section details the assessment criteria. The extent to which these are demonstrated by you determines your mark. The marks available for each criterion are shown. Lecturers will use the space provided to comment on the achievement of the task(s), including those areas in which you have performed well and areas that would benefit from development/improvement.

Common Assessment Criteria Applied	Marks available	Marks awarded
1. Research-informed Literature Extent of research and/or own reading, selection of credible sources, application of appropriate referencing conventions	10	4
SATISFACTORY. SEE COMING CRITERIA.		
2. Knowledge and Understanding of Subject Extent of knowledge and understanding of concepts and underlying principles associated with the discipline.	25	14
VE GOOD		
3. Analysis Analysis, evaluation and synthesis; logic, argument and judgement; analytical reflection; organisation of ideas and evidence	25	12
SATISFACTORY		
4. Practical Application and Deployment Deployment of methods, materials, tools and techniques; application of concepts; formulation of innovative and creative solutions to solve problems.	30	24
EXCEPTIONAL		
5. Skills for Professional Practice Attributes in professional practice: individual and collaborative working; deployment of appropriate media; presentation and organisation.	10	5
GOOD		

Assignment Mark (Assessment marks are subject to ratification at the Exam Board. These comments and marks are to give feedback on module work and are for guidance only until they are confirmed.)	Late Submission Penalties (tick if appropriate)		59 %
	Up to four weeks late		
	First Attempt?	✓	

FdSc & HN COMMON ASSESSMENT AND MARKING CRITERIA

Assessment Criteria	OUTRIGHT FAIL	UNSATISFACTORY	SATISFACTORY	GOOD	VERY GOOD	EXCELLENT	EXCEPTIONAL
	REFER (equivalent to 0-29%)	REFER (equivalent to 30-39%*)	PASS (equivalent to 40-49%)	PASS (equivalent to 50-59%)	MERIT (equivalent to 60-69%)	DISTINCTION (equivalent to 70-79%)	DISTINCTION (equivalent to 80-100%)
1. Research-informed Literature Extent of research and/or own reading, selection of credible sources, application of appropriate referencing conventions	Little or no evidence of reading. Views and findings unsupported and non-authoritative. Referencing conventions largely ignored.	Poor evidence of reading and/or of reliance on inappropriate sources, and/or indiscriminate use of sources. Referencing conventions used inconsistently.	References to a limited range of mostly relevant sources. Some omissions and minor errors. Referencing conventions evident though not always applied consistently.	Inclusion of a range of research-informed literature, including sources retrieved independently. Referencing conventions mostly consistently applied.	Inclusion of a wide range of research-informed literature, including sources retrieved independently. Selection of relevant and credible sources. Very good use of referencing conventions, consistently applied.	A comprehensive range of research-informed literature embedded in the work. Excellent selection of relevant and credible sources. High-level referencing skills, consistently applied.	Outstanding knowledge of research-informed literature embedded in the work. Outstanding selection of relevant and credible sources. High-level referencing skills consistently and professionally applied.
2. Knowledge and Understanding of Subject Extent of knowledge and understanding of concepts and underlying principles associated with the discipline.	Major gaps in knowledge and understanding of material at this level. Substantial inaccuracies.	Gaps in knowledge, with only superficial understanding. Some significant inaccuracies.	Evidence of basic knowledge and understanding of the relevant concepts and underlying principles.	Knowledge is accurate with a good understanding of the field of study.	Knowledge is extensive. Exhibits understanding of the breadth and depth of established views.	Excellent knowledge and understanding of the main concepts and key theories. Clear awareness of challenges to established views and the limitations of the knowledge base.	Highly detailed knowledge and understanding of the main theories/concepts, and a critical awareness of the ambiguities and limitations of knowledge.
3. Analysis Analysis, evaluation and synthesis; logic, argument and judgement; analytical reflection; organisation of ideas and evidence	Unsubstantiated generalisations, made without use of any credible evidence. Lack of logic, leading to unsupported/missing conclusions. Lack of any attempt to analyse, synthesise or evaluate.	Some evidence of analytical intellectual skills, but for the most part descriptive. Ideas/findings sometimes illogical and contradictory. Generalised statements made with scant evidence. Conclusions lack relevance.	Evidence of some logical, analytical thinking and some attempts to synthesise, albeit with some weaknesses. Some evidence to support findings/views, but evidence not consistently interpreted. Some relevant conclusions and recommendations, where relevant	Evidence of some logical, analytical thinking and synthesis. Can analyse new and/or abstract data and situations without guidance. An emerging awareness of different stances and ability to use evidence to support the argument. Valid conclusions and recommendations, where relevant	Sound, logical, analytical thinking; synthesis and evaluation. Ability to devise and sustain persuasive arguments, and to review the reliability, validity & significance of evidence. Ability to communicate ideas and evidence accurately and convincingly. Sound, convincing conclusions / recommendations.	Thoroughly logical work, supported by evaluated evidence. High quality analysis, developed independently or through effective collaboration. Ability to investigate contradictory information and identify reasons for contradictions. Strong, persuasive, conclusions, justifiable recommendations.	Exceptional work; judiciously selected and evaluated evidence. Very high quality analysis, developed independently or through effective collaboration. Ability to investigate contradictory information and identify reasons for contradictions. Highly persuasive conclusions
4. Practical Application and Deployment Effective deployment of appropriate methods, materials, tools and techniques; extent of skill demonstrated in the application of concepts to a variety of processes and/or contexts; formulation of innovative and creative solutions to solve problems.	Limited or no use of methods, materials, tools and/or techniques. Little or no appreciation of the context of the application.	Rudimentary application of methods, materials, tools and/or techniques but without consideration and competence. Flawed appreciation of the context of the application.	An adequate awareness and mostly appropriate application of well-established methods, materials, tools and/or techniques. Basic appreciation of the context of the application.	A good and appropriate application of standard methods, materials, tools and/or techniques. Good appreciation of the context of the application, with some use of examples, where relevant.	A very good application of a range of methods, materials, tools and/or techniques. Very good consideration of the context of the application, with perceptive use of examples, where relevant. Evidence of some innovation and creativity.	An advanced application of a range of methods, materials, tools and/or techniques. The context of the application is well considered, with extensive use of relevant examples. Application and deployment extend beyond established conventions. Innovation and creativity evident throughout.	Outstanding levels of application and deployment skills. Assimilation and development of cutting edge processes and techniques.
5. Skills for Professional Practice Demonstrates attributes expected in professional practice including: individual initiative and collaborative working; deployment of appropriate media to communicate (including written and oral); clarity and effectiveness in presentation and organisation.	Communication media is inappropriate or misapplied. Little or no evidence of autonomy in the completion of tasks. Work is poorly structured and/or largely incoherent.	Media is poorly designed and/or not suitable for the audience. Poor independent or collaborative initiative. Work lacks structure, organisation, and/or coherence	Can communicate in a suitable format but with some room for improvement. Can work as part of a team, but with limited involvement in group activities. Work lacks coherence in places and could be better structured.	Can communicate effectively in a suitable format, but may have minor errors. Can work effectively as part of a team, with clear contribution to group activities. Mostly coherent work and is in a suitable structure.	Can communicate well, confidently and consistently in a suitable format. Can work very well as part of a team, with very good contribution to group activities. Work is coherent and fluent and is well structured and organised.	Can communicate professionally and, confidently in a suitable format. Can work professionally within a team, showing leadership skills as appropriate, managing conflict and meeting obligations. Work is coherent, very fluent and is presented professionally.	Can communicate with an exceptionally high level of professionalism. Can work exceptionally well and professionally within a team, showing advanced leadership skills. Work is exceptionally coherent, very fluent and is presented professionally.

PLC Program design using FBD



By Harry Owen



REFERENCES

PLC cover photo for front cover assignment sheet – <http://www.vectorautomationinc.com/wp-content/uploads/2013/09/PLC.jpg>

PLC components picture. Available at -
<https://i.pinimg.com/originals/62/e6/5d/62e65d7fe9c09e7a2a3aa97d8fc51f3c.jpg>

Academo. 2014. Logic Gate Simulator. Available at: <https://academo.org/demos/logic-gate-simulator/> [Accessed: 2nd December 2017].

PLC Dev Tools For Learning. 2016. How PLCs Work. Available at:
http://www.plcdev.com/how_plcs_work [Accessed: 1st December 2017]. PlcTutor. 2013. PLC components. Available at: <http://www.plctutor.com/plc-components.html> [Accessed: 1st December 2017].

Toolstation. Fused Spur 13A Switched Neon. Available at:
<https://www.toolstation.com/shop/Electrical/d190/White+Wiring+Accessories/sd2633/Fused+Spur+13A/p95225> [Accessed: 9th December 2017].

Websparky. Schneider Electric Easy9 16A Single Pole Type B MCB (8890P). Available at:
<http://www.websparky.co.uk/acatalog/EZ9F16132-HiRes.jpg> [Accessed: 9th December 2017].



Introduction to assignment

Introduction

Programmable Logic Controllers are available in three design types, which are termed:

- Unitary PLC
- Modular PLC
- Rack mounted PLC

Each PLC type has been developed to meet specific applications with respect to operational Characteristics, system capacity, I/O functionality and potential expansion.

Task 1 – Programmable Logic Controller types

a)

PLC

First of all it is best to discuss what a PLC is. A PLC stands for a Programmable Logic Controller and are used widely around the world in many different industries. A PLC is a way of instructing and monitoring inputs and outputs going to and from electrical components and machinery. Before PLCs, relays were used to control these signals which was tricky and time consuming considering there could have been hundreds of relays in one panel.

PLC's are smaller and more compact than earlier technology it replaced as well as being smarter with some new PLC's automatically monitoring systems and making due adjustments when faults occur whereas before the only way to do this is by rewiring the system manually.

PLCs are constructed from central processors as well as memories which can be facilitated with battery backups allowing the PLC to keep storing and controlling systems in event of a main power loss. Different PLC's allow different number inputs/outputs, monitoring programmes, controlling programs, housekeeping programmes (which can clean up old unused history to allow more space for new storage) and different sizes.



Unitary PLC

A unitary Programmable Logic Controller (PLC) can be seen as the simplest out of the three different PLC types. A unitary PLC is small and compact with basic inputs and outputs. They are the cheapest out of the different PLC types and are portable. Unitary PLC's are mounted directly onto the system or machine they are controlling.

Unlike other PLC types, a unitary PLC does not allow for expansion meaning the amount of inputs and outputs that the PLC comes with is all you can use. This is why they are mostly used for controlling small and simple systems with not many inputs and outputs. Because of their simplicity any faults that occur with the PLC cannot be fixed individually and so the whole PLC would have to be replaced.

Unitary PLCs would be used in examples such as automatic door systems or carpark barrier systems. If a user is looking for a cheap and simple way of controlling a basic system, a unitary PLC is the best PLC to use.

Modular PLC

A modular Programmable Logic Controller (PLC) is different to a unitary PLC mainly because each component of the PLC such as the power supply, central process unit (CPU), controller and input/outputs are separate and not all encased together. This allows the user to change individual parts that can become faulty. Another benefit of a modular PLC is the addition of extra inputs and outputs, this allows a system to become more complex allowing it to control additional components and machinery.

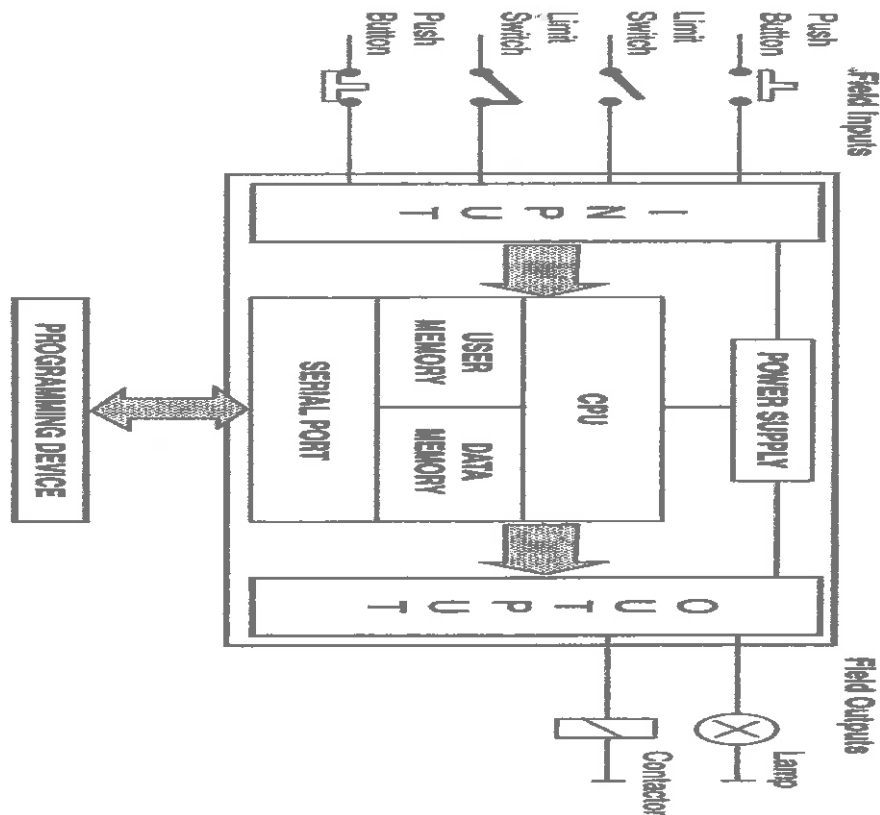
These added benefits of a modular PLC come at a cost meaning they tend to be more expensive than a unitary PLC. But if there is a more complex system that require multiple inputs and outputs or a person prefers to have the option of replacing an individual components of the PLC, a modular PLC is better than a unitary PLC.

Modular PLCs would be used in examples such as a manufacturing company or a refinery. If a user is looking for a PLC that is complex where the addition of multiple inputs/outputs would be needed or memory capacity could be increased, a modular PLC is a good choice.

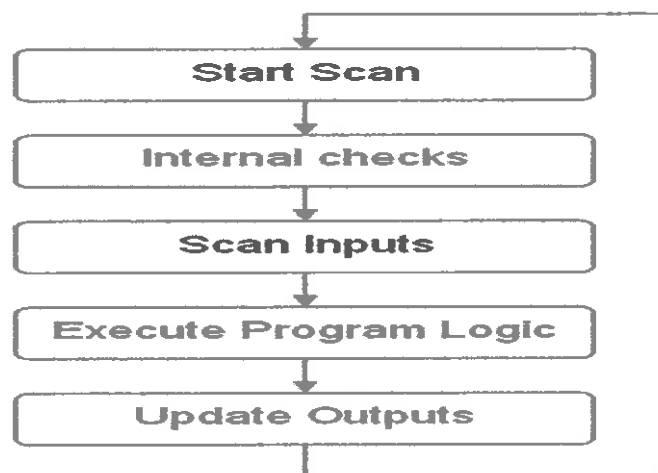
Rack Mounted PLC

A rack mounted Programmable Logic Controller (PLC) is very similar to a modular PLC but different in the way it is organized and mounted. Where the modular PLC components and extras all connect onto each other, a rack mounted PLC connects into a standard connect sort in the rack, this means that instead of the extras slotted into each other 'Piggy backing' as it is on a modular PLC, each module or connection rack is connected into a central network bar.

B)



CPU Operating Cycle



PLC components

With a wide range of PLCs with a lot designed to do a wide range of jobs there can be different components for the different PLCs, but most PLCs have six basic components.

Power Supply - Every PLC will need a power supply. Power is needed for the PLC to work. Different PLCs will require different voltages, such as Alternating Current, Direct current, 120VAC, 12VDC, 24VDC, etc.

Central Processing Unit (CPU) - The CPU module (Central Processing Unit) is the brain of the PLC. This module is usually found next to the power supply unit. The CPU consists of a microprocessor, memory chip and other integrated circuits to control logic, monitoring and communications. The CPU accepts the designed program made to control the inputs and outputs of the PLC and runs the program. The memory associated with the CPU stores and monitors the program and status of the inputs and outputs.

The CPU system goes through a cycle upon start up and regularly throughout being online. "One cycle through the program is called a scan time and involves reading the inputs from the other modules, executing the logic based on these inputs and then updated the outputs accordingly. The scan time happens very quickly (in the range of 1/1000th of a second)."

The rack - Found in modular and Rack mounted PLCs, the rack mount is base plate for the PLC that anchors the modules that make up the PLC. The Power supply unit plugs into the rack, supplying it with power so that the other modules that connect into the rack are supplied with power.

The Input/output module - This module is where the input signal comes into the PLC and where the PLC control sends the signal out to the instruments or system. They can come in two main forms, analogue and digital. Analogue is where it uses the binary change, On/off yes/no. Digital is where the signal is always adjusting, this can be from a constant monitor of voltage, current etc.

Memory – The PLC memory storage simply stores the input program from the programmer and can also store the input and outputs condition as well as their previous history log.

The Programmer - This is the system used to create the program that you want to be installed and used by the PLC. There are many different systems to create a PLC program on, but all allow you to set up the program so that you can control what happens to in the inputs and how they are controlled when going to the equipment or system from the PLC.

/JDP

Task 2 – Logic diagrams and truth tables

There are many control situations that require actions to be initiated when a certain combination of conditions are realised. Such situations can involve the use of logic gates to produce an output when certain input conditions are met.

a) Assuming two inputs (A & B) and one output (Q), produce truth tables for each of the following

logic gates:

- AND
- OR
- NAND
- NOR
- XOR

	A	B	Q
AND	0	0	0
	0	1	0
	1	0	0
	1	1	1
OR	0	0	0
	0	1	1
	1	0	1
	1	1	1
NAND	0	0	1
	0	1	1
	1	0	1
	1	1	0
NOR	0	0	1
	0	1	0
	1	0	0
	1	1	0
XOR	0	0	0
	0	1	1
	1	0	1
	1	1	0

- a) Produce a truth table for the logic circuit shown below (figure 1). Comment on the circuit output with respect to the inputs, noting any issues that may arise when using this configuration of logic gates.

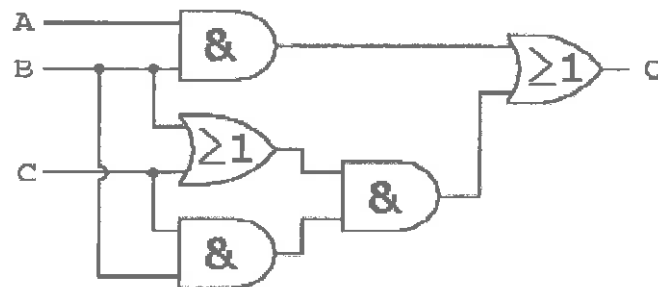


Figure 1. Logic Gate Circuit

	THE LOGIC CIRCUIT							
A	0	0	0	1	1	1	0	1
B	0	1	0	0	1	0	1	1
C	0	0	1	0	0	1	1	1
Q	0	0	0	0	1	0	1	1

Task 3 - Timers and Counters

Timers are used widely in PLC programs for many different purposes. An On-Delay Timer allows a countdown of a specified time to start once it has received a signal say from a control voltage. The timer will delay the output signal from occurring until the timer has finished. On-Delay Timers are used in many various programs but can be used in a traffic light program where signals to different lights must be delayed and staggered.

An Off-Delay Timer will continue the signal to the output circuit on the PLC even after loss from the input signal until the specified time has counted down. These timers are often used in lighting circuits where for example a light may continue to be on even after a loss of input from a motion sensor, this may be to allow for someone to completely leave an area before loss out light even after they have gone out of the motion sensor range.

Pulse timers are different to On and Off delay timers by allowing switching to multistate. This means they are able to give an output signal for a specified time and then switch back after the timer has counted down. They can be on to off pulse timers meaning when they have a signal to start they switch off not allowing an output signal until the timer counts down where they go back to their original state. Off to On do the opposite giving a signal output for a duration of time before returning to their off state. On to Off and Off to On pulse timers allow switching either way no matter what state they are originally in.

Timers

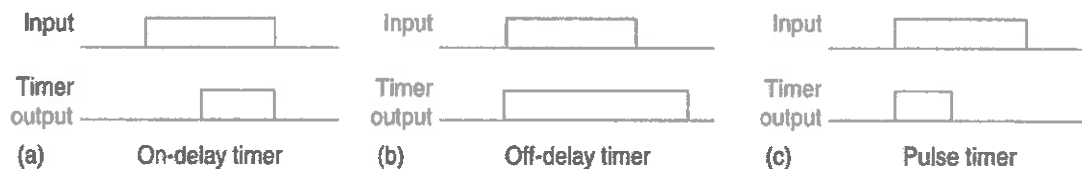


Figure 12.2: Timers: (a) on-delay (b) off-delay (c) pulse

B- Up Counters – Up counters receive signals and hold how many times they receive the signal until it receives the desired amount before allowing the output signal. Most of these counters can be wired to a reset to allow the circuit to start again but don't allow for individual signals to be taken away from the input signal total. For example an airport detection system may count how many people pass through a gate departure onto the plane, because they don't need to register people getting off but only getting on they could use an Up counter so that when they reach the aircrafts maximum seating an output of a light or alarm could flag.

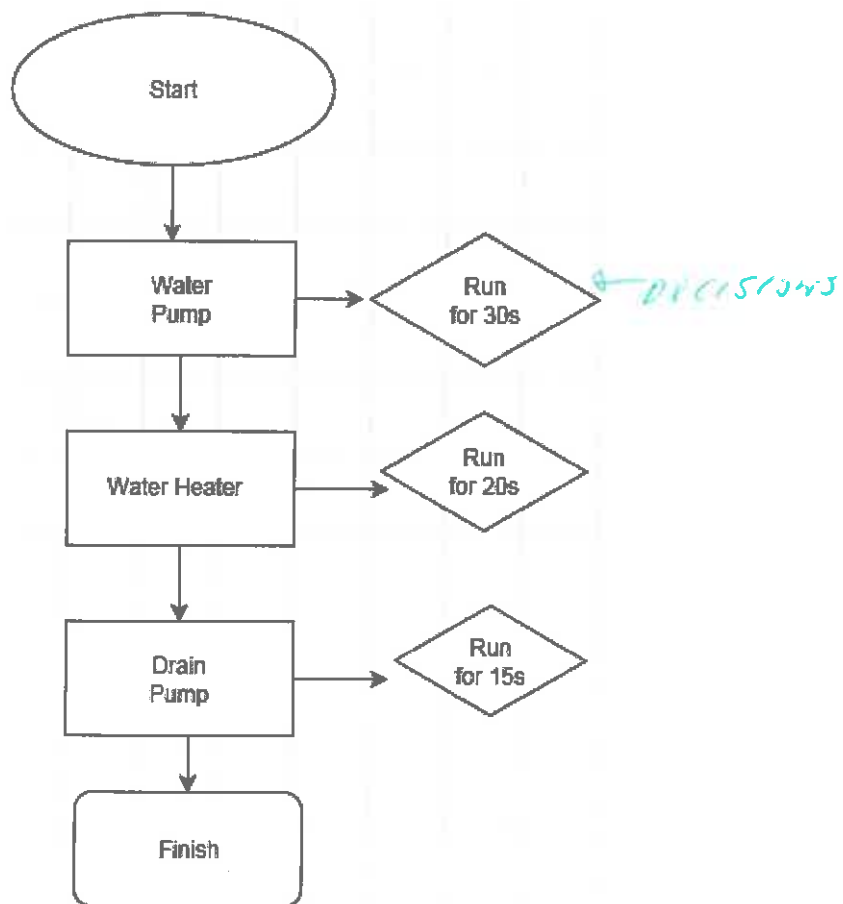
Up/Down Counters – This counter can do the same as the Up counter but will also allow for signals to be taken away. For example, a shop may have a limit of customers they are allowed in a shop at one time. An Up/Down counter can monitor and record how many customers have entered and left the shop and allow for an output signal of a light or alarm when the shop has reached its maximum number of people.



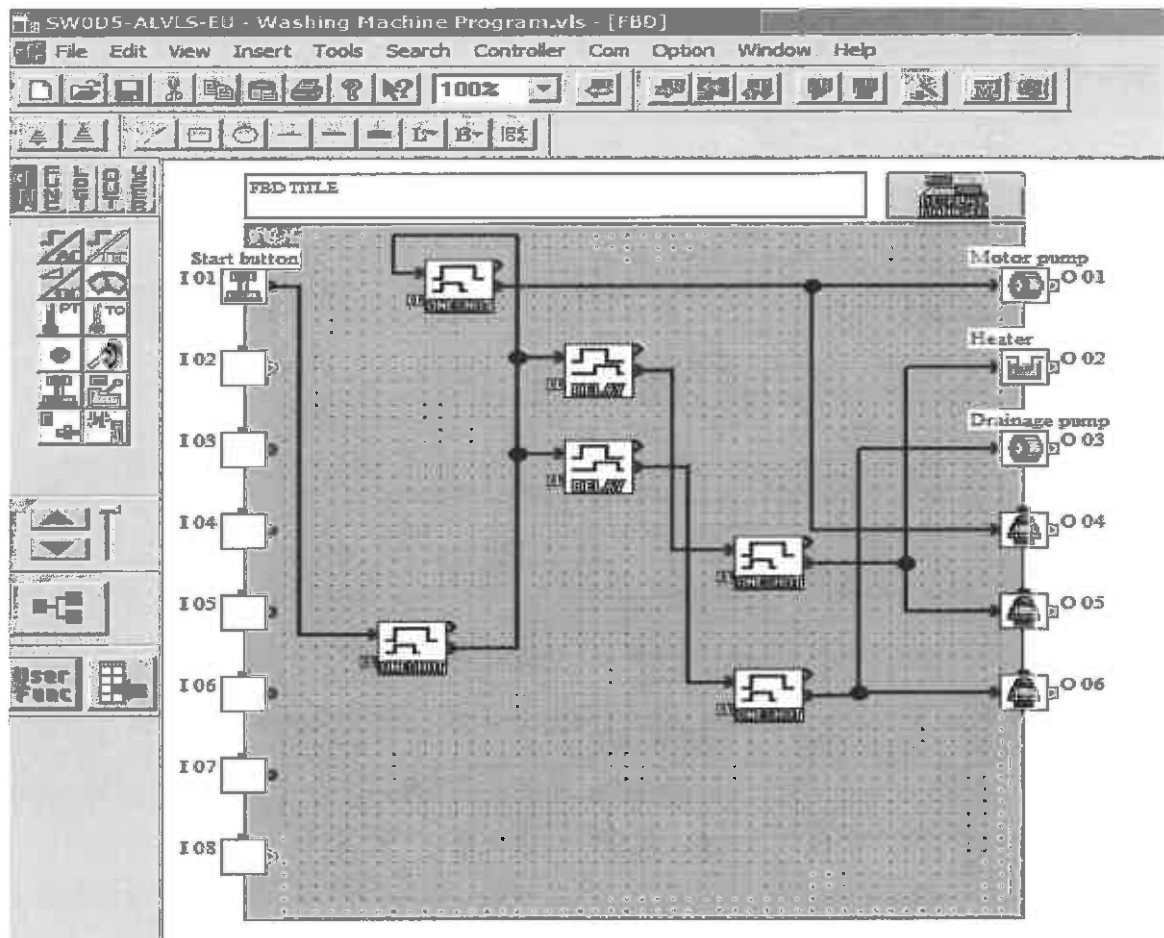
Part B Introduction

Task 4 – Programming problems

Use the Mitsubishi Alpha software to develop programs to meet the following sequential operations:

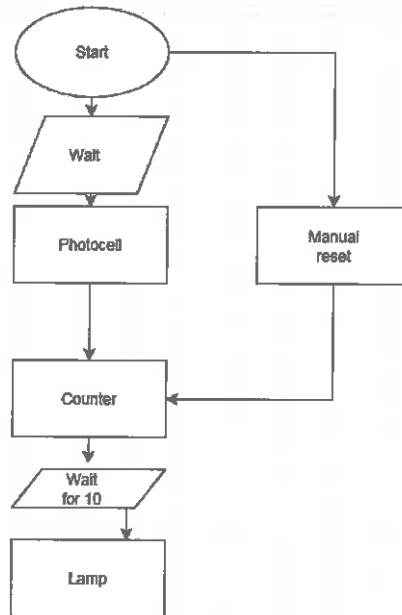


MODULE CODE/ COD Y MODIWL: PDSE4005 - PROGRAMMABLE LOGIC CONTROLLERS

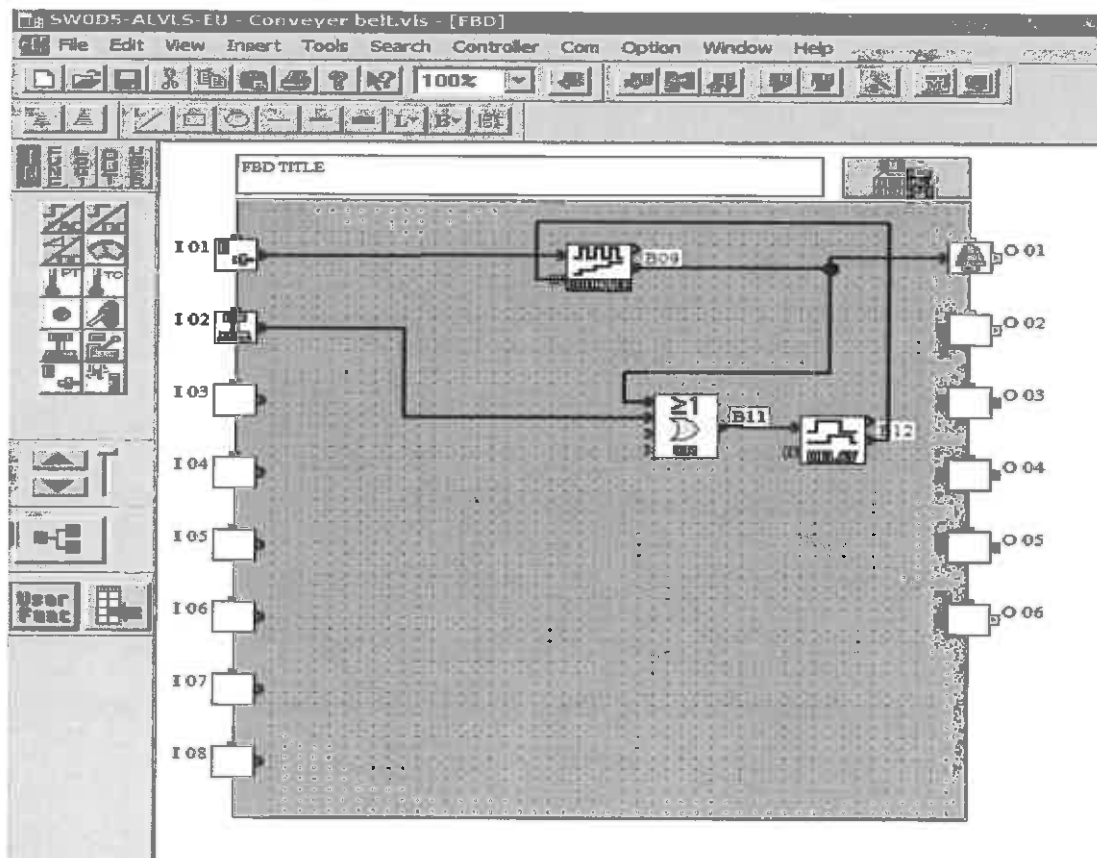


This is the Program made for the washing machine cycle. It starts with an input signal of a start button. Sends a signal to a one shot function allowing a output signal to go to a motor pump but for only 50 seconds. It also goes to a delay so that the signal is blocked from going to the heater until the pump has finished pumping in the water. Once the 50 second delay has finished it goes to a one shot logic allowing a signal for 20 seconds to the output of the heater. Another delay is in line with the first one shot disrupting the signal to the drain pump until the filling pump and heater has finished running their part of the cycle. Once that delay has finished of 70 seconds the signal goes to a one shot logic to give the output drain pump on the PLC as run for 15 seconds. A running light is tapped of each leg going to the output so that a visual aid can assist in knowing each step of the cycle.

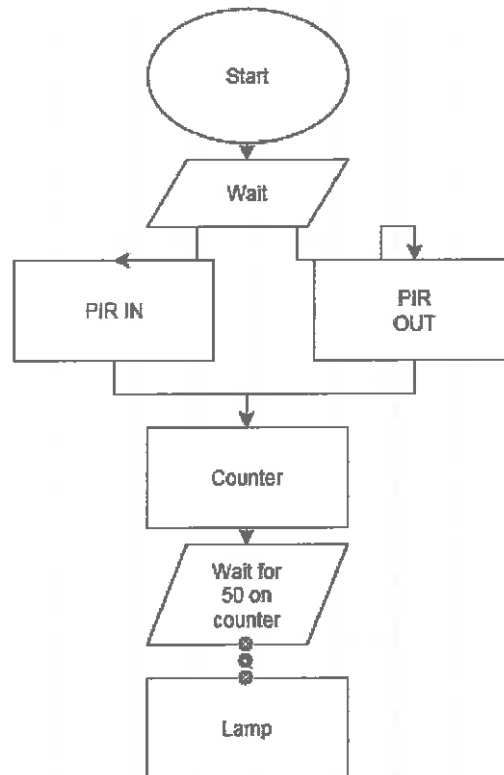
a) Conveyer belt



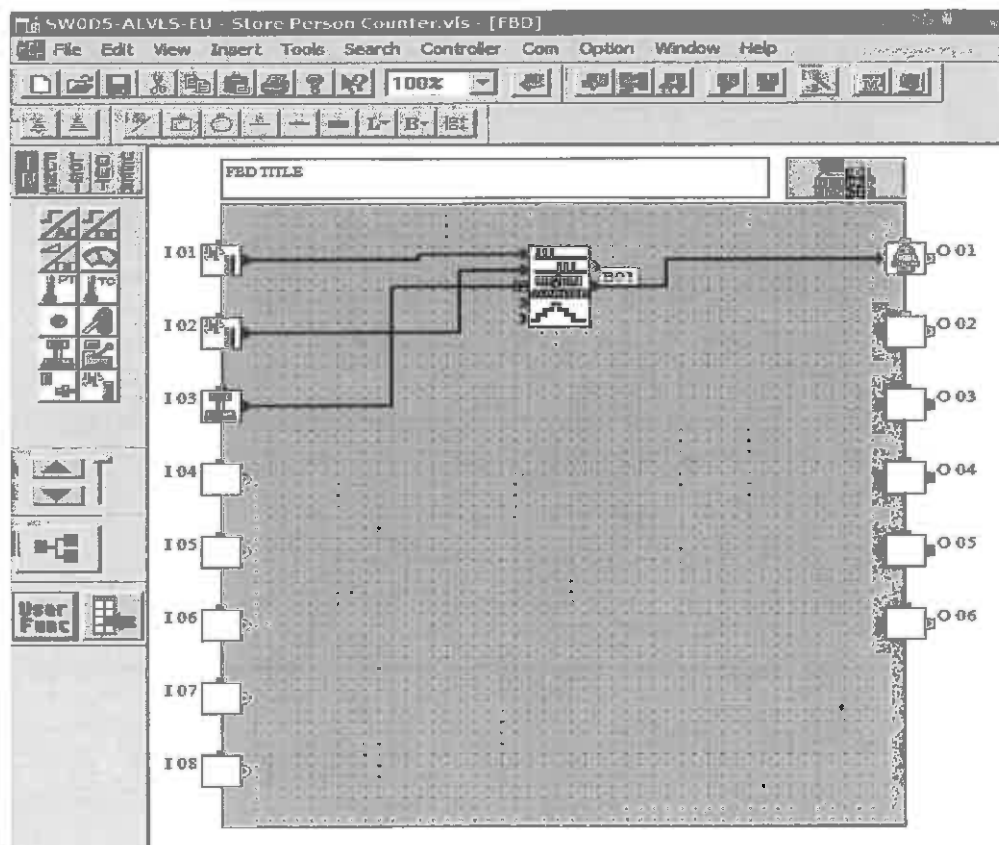
This program is for the conveyor belt system. It starts by a photocell detector sending a signal to a counter, the counter records the amount of times it has received a signal and after 10 input signals it gives a signal to an indication light output. It can be manually reset from a push button but also automatically resets once the 11th signal has been given.



c- Store Person Counter



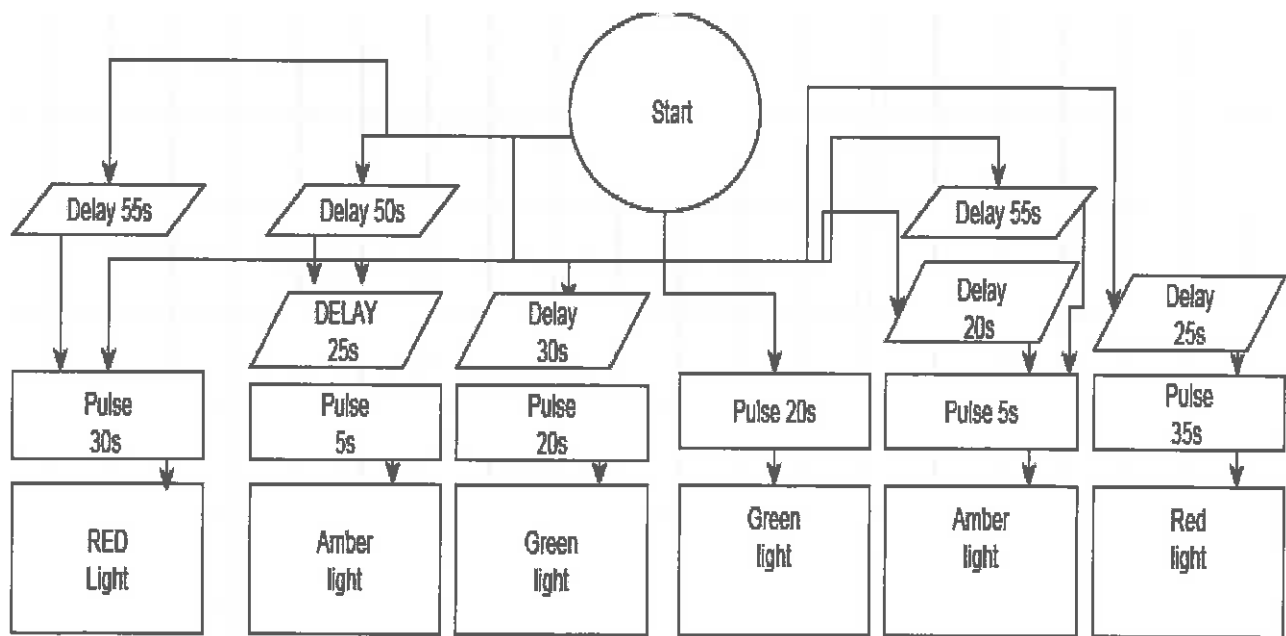
This program is for the store counter program. It starts by a movement sensor detecting movement either in or out the shop. This then sends a signal to an up and down counter that records the amount of times they have received a signal from the inputs. If the counter reads 50 then a signal is send to an indication lamp. The counter can be reset by a push button as well.



Task 5

Table 1

Timing (s)		5	10	15	20	25	30	35	40	45	50	55	60	RETURN
North / South Traffic Light Set Sequence														
Set 1	Red													
	Amber													
	Green													
East / West Traffic Light Set Sequence														
Set 2	Red													
	Amber													
	Green													



MODULE CODE/ COD Y MODIWL: PDSE4005 - PROGRAMMABLE LOGIC CONTROLLERS

This program is the traffic light program. It starts off with a start signal from a push button and then goes to a set/reset component. It then breaks off to go to every light. Each light dependent on what time specified above will go through a delay to stop the lights from coming on all at the same time and then a pulse to make sure there lights only come on for a specified time.

