

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	5
GOOD		
2. Knowledge and Understanding of Subject Extent of knowledge and understanding of concepts and underlying principles associated with the discipline	25	15
VERY GOOD.		
3. Analysis Analysis, evaluation and synthesis; logic, argument and judgement; analytical reflection; organisation of ideas and evidence	25	15
VERY GOOD.		
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	25
EXCEPTIONAL.		
5. Skills for Professional Practice Attributes in professional practice: individual and collaborative working; deployment of appropriate media; presentation and organisation	10	7
EXCELLENT		

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)		67 %
	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 unsupportable/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.

Assignment 2 PLC's

Task 1 Basic Ladder Diagram

a) Produce a table to show the ladder diagram for the following logic gates:

i) AND ii) OR iii) NAND iv) NOR v) XOR

b) Add another column to the table stating the instruction list for each gate.

Task a+b) i)

Figure 1 illustrates an **AND** logic gate which was created in ladder logic, this gate works by having the input to the first contact (**X001**), this contact will then close, meaning it has been switched on, the second contact (**X002**), will then be closed, which will complete the circuit and allow power to the coil (**Y001**).



Figure 1, an **AND** logic gate created in MELSOFT series GX Developer.

The instruction list for this **AND** gate:

STEP	INSTRUCTION	ELEMENT
1	Close N/O Contact (LD)	LD 001
2	Close N/O Contact (AND)	AND 002
3	Energise Coil (OUT)	OUT 001

Task a+b) ii)

Figure 2 illustrates an **OR** logic gate which was created in ladder logic, this gate works by having 2 inputs which are linked together that connect to the coil. The two inputs which are linked are **(X001)** and **(X002)**, if either of these contacts are closed it will cause the coil **(Y002)** to become energised.



Figure 2, an **OR** logic gate created in MELSOFT series GX Developer.

STEP	INSTRUCTION	ELEMENT
1	Close N/O Parallel Contact (LD)	LD 001 OR 002
2	Close N/O Parallel Contact (OR)	OR 001 OR 002
3	Energise Coil (OUT)	OUT 002

Task a+b) iii)

Figure 3 illustrates an **NAND** logic gate which was created in ladder logic, this gate works in reverse action to a **AND** gate, the contacts **(X001)** and **(X002)** are normally closed, this allows the coil **(Y003)** to be powered at all times unless either one of the contacts are powered which will cause them to open and break the circuit

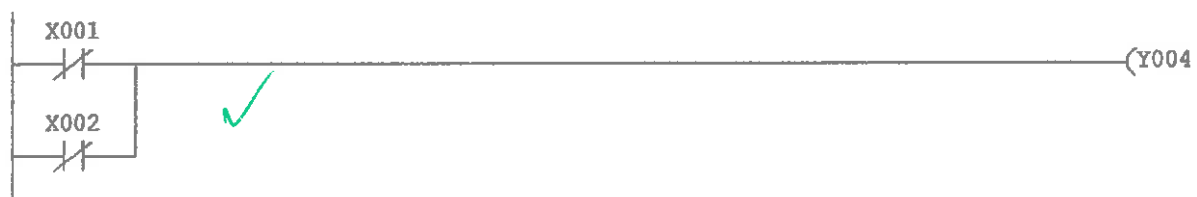


Figure 3, an **NAND** logic gate created in MELSOFT series GX Developer.

STEP	INSTRUCTION	ELEMENT
1	Open N/C Contact (LDI)	LDI 001 ✓
2	Open N/C Contact (ORI)	ANI 002 ✗
3	De-energise Coil (OUT)	OUT 003

Task a+b) iv)

Figure 4 illustrates a **NOR** logic gate which was created in ladder logic, this gate works in reverse action to a **OR** gate, the contacts (**X001**) and (**X002**) are normally closed which means the circuit is constantly made unless an input is put through one of the contacts, this will then cause the contact to open therefore breaking the circuit to the coil (**Y004**).



Figure 4, an **NOR** logic gate created in MELSOFT series GX Developer.

STEP	INSTRUCTION	ELEMENT
1	Open N/C Parallel Contact (LDI)	LDI 001 ✓
2	Open N/C Parallel Contact (ORI)	ORI 002 ✗
3	De-energise Coil (OUT)	OUT 004

Task 5 a+b) v)

Figure 5 illustrates an **XOR** logic gate created in ladder logic, this gate works by having four contacts. (**X001**) and (**X004**) being the normally open contacts, and (**X002**) and (**X003**) both being the normally closed contacts. This gate will only work when the number of contacts which are closed are odd, if (**X001**) became closed it was create a circuit to energise the coil (**Y001**), can work in a similar way as an **AND** gate and an **OR** gate combined.

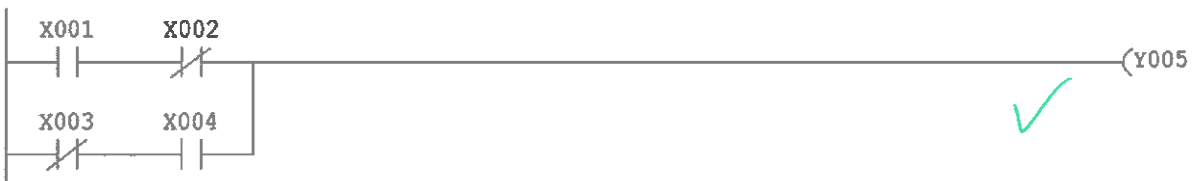
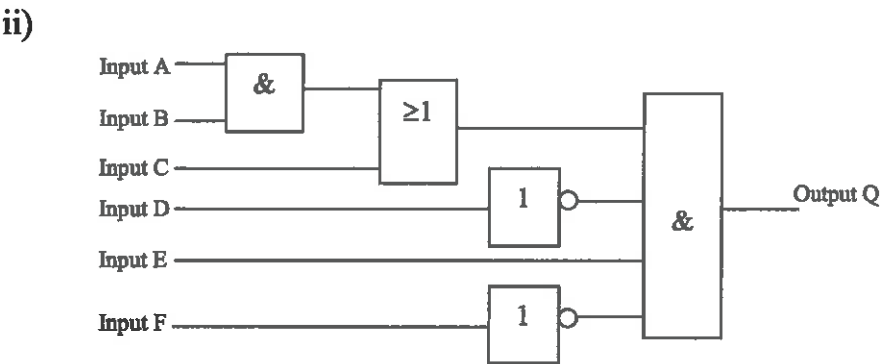
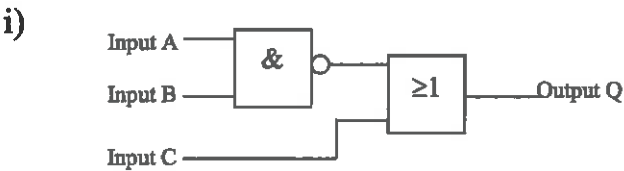


Figure 5, an **XOR** logic gate created in MELSOFT series GX Developer.

STEP	INSTRUCTION	ELEMENT
1	Close N/O Contact (LD)	LD 001 ✓
2	Open N/C Contact (AND)	ANI 002 ✓
3	Open N/C Contact (LDI)	LDI 003 ✓
4	Close N/O Contact (AND)	AND 004 ✓
5	Energise Coil (OUT)	OUT 005 ✓

Task 2 – Function Block Diagrams and Instruction Lists

a) For each of the function block diagrams below produce a ladder logic diagram and an instruction list:



Task 2 a) i)

Figure 6 illustrates the function block diagram (i), which has been converted into ladder logic using MELSOFT series GX Developer.



Figure 6

STEP	INSTRUCTION
1	LDI
2	ANI
3	OR
4	OUT

Figure 7, the instruction list for the program

Task 2 a) ii)

Figure 8 illustrates a function block diagram (ii), which has been converted into ladder logic using MELSOFT series GX Developer.

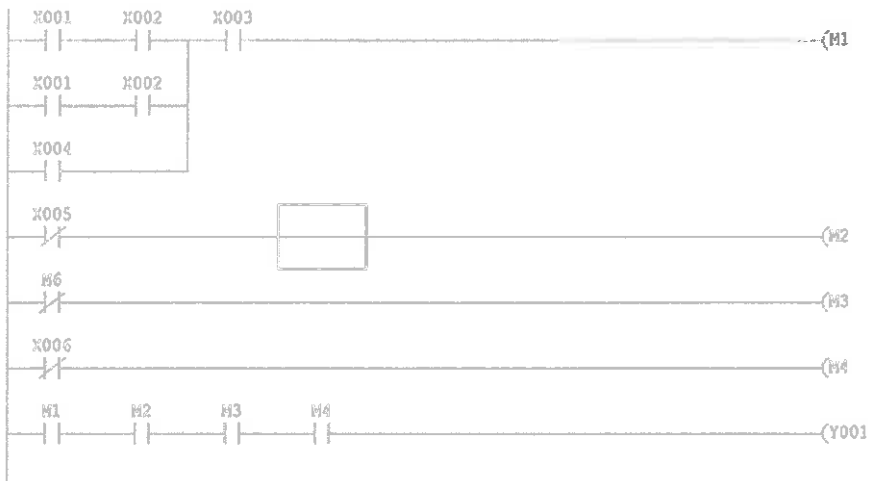


Figure 8

Figure 9, the instruction list for the program.

STEP	INSTURCTION
1	LD
2	AND
3	AND
4	OR
5	LDI
6	LDI
7	LDI
8	LD
9	AND
10	AND
11	AND
12	OUT

Figure 9

b) For each of the instruction lists below produce a ladder logic diagram and a function block diagram:

- | | | | | | |
|----|-----|------|-----|-----|------|
| i) | LD | X400 | ii) | LD | X400 |
| | ANI | X401 | | ANI | X401 |
| | LDI | X400 | | OUT | Y430 |
| | AND | X401 | | LDI | X402 |
| | OUT | Y430 | | AND | X403 |
| | | | | OUT | Y431 |
| | | | | LD | X404 |
| | | | | ORI | X405 |
| | | | | OUT | Y432 |

Task 2b) i)

Figure 10 illustrates the ladder logic which was created using the instruction list (i).



Figure 10.

Figure 11 illustrates the function block which was created from using the instruction list (ii)

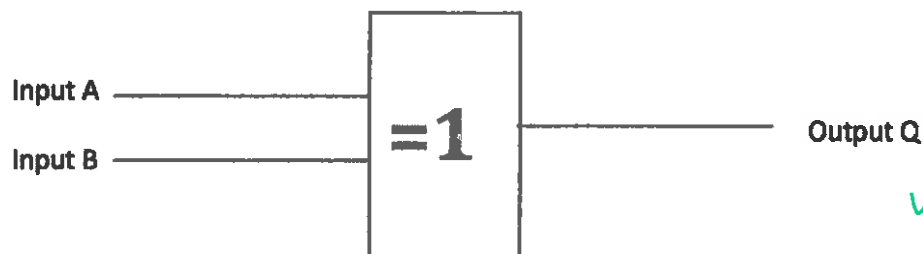


Figure 11

Task 2b) ii)

Figure 12 illustrates the ladder logic which was created using the instruction list (ii).

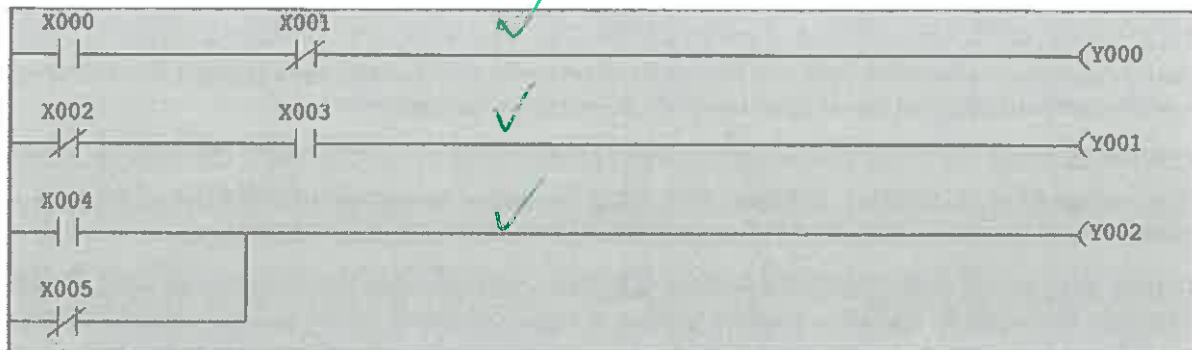


Figure 12

Figure 13 illustrates the function block which was created using the instruction list (ii).

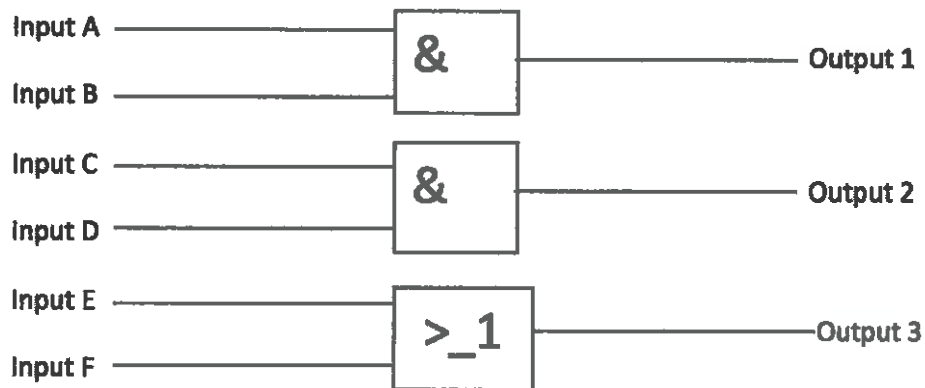


Figure 13

Task 3 – Programming problems

Use the Ladder Logic design software to develop programs to meet the following sequential operations:

- For part of a washing machine cycle a water supply pump is required to run for 50 seconds. It is then to be switched off and a heater switched on for 20 seconds. The heater should then be turned off and a drain pump run for 15 seconds to remove the water. The cycle should be started using a momentary 'on' switch, run automatically and terminated once the drain pump has stopped.
- A photocell sensor is being used to detect objects moving on a conveyor belt. The system is required to give an output after receiving a 10 pulse input from the sensor as a result of detecting 10 objects passing in front of it. The system should have a manual and automatic counter reset.
- A pneumatic power press requires a control system to start and stop the drive motor through the use of momentary switches. In addition, a safety system is required where the drive motor should not start if any one of three interlock switches are not made. The control system should be fully fail safe in case switches or wiring become open circuit.

Task 3a)

Figure 14 shows the ladder logic program which was created to run on a washing machine. The first step to this program is the set/reset, this is so the signal can be latched, the contacts (X001, M1 and T3), T3 is a closed contact and once the timer on T3 has ran out this allows the timer to time out stopping the operation. The timer T1 is for the water supply pump, the water supply pump will run for 50 seconds, after the 50 seconds has finished the T1 contact will become closed and this will allow the signal to go through to the water heater and allow it to start, the water heater is T2, and will run for 20 seconds, once the 20 seconds is up this will close the T2 contact and this will allow the signal to go through to the T3 timer which is for the drain pump, this will run for 15 seconds, the timer will then run out and for the N/C T3 contact at the start of the program to open which will terminate the program.

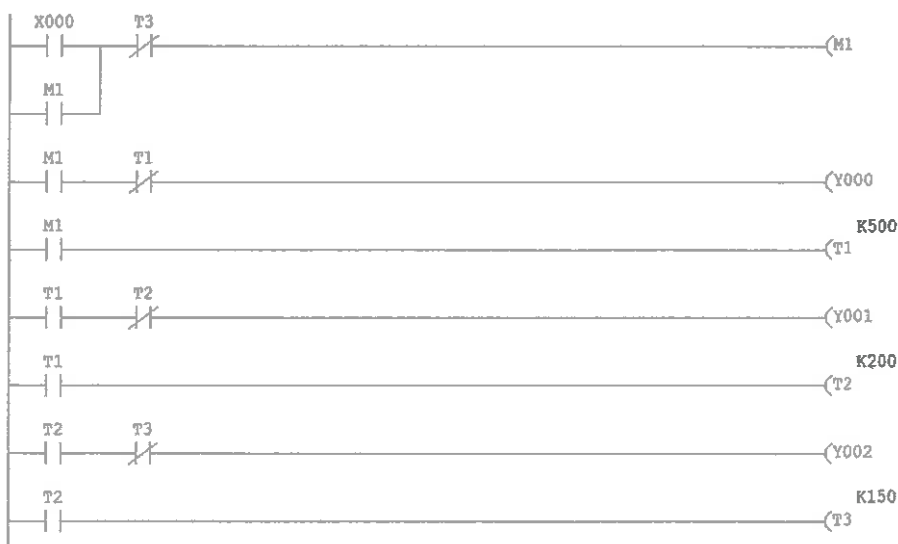


Figure 14 illustrates the program which was created to run a washing machine.

Figure 15 illustrates the instruction list for the washing machine program.

STEP	INSTRUCTION	ELEMENT
0	LD	400
1	OR	401
2	LDI	403
3	OUT	430
4	LD	404
5	ANI	405
6	OUT	431
7	LD	406
8	OUT	432
9	LD	407
10	ANI	408
11	OUT	432
12	LD	409
13	OUT	433
14	LD	410
15	ANI	411
16	OUT	434
17	LD	412
18	OUT	435

Figure 15

Task 3b)

Figure 16 illustrates the program used to detect objects moving on a conveyer belt, the counter was added first with the manual reset, this allows the counter to be manually reset by the user, the contacts (**X000** and **X001**) are the contacts which connect to the counter (**C1**) with a manual reset. The counter has a limit of 10 counts, this means when the counter has reached its limit it will send a signal to the (**C1**) contact, this will close the contact and allow the timer (**T1**) to begin its cycle of 10 seconds. This will then close the (**T1**) contact which will cause the program to automatically reset by allow a signal to the counter reset which is illustrated as (**RST C1**), this allows the program to reset and the operation will be repeated.

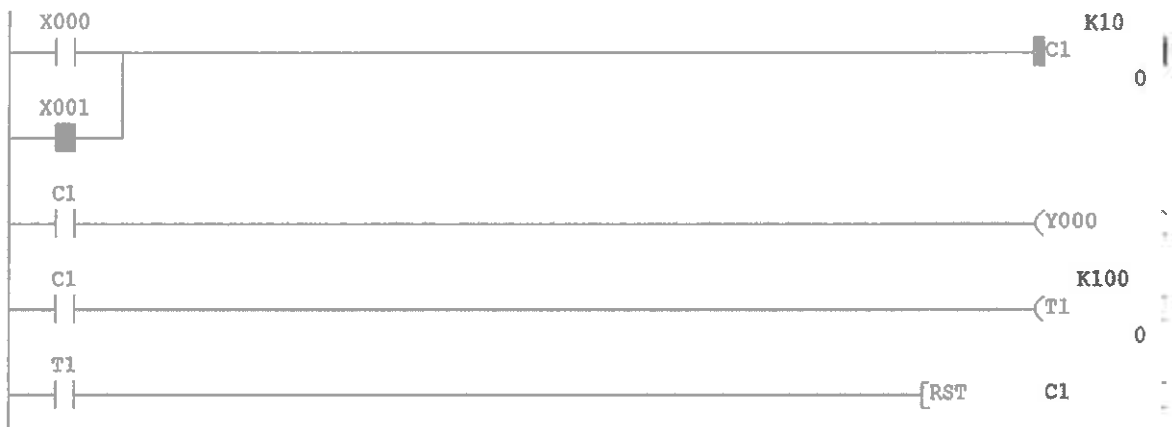


Figure 16, the program which was created to the count objects on a conveyer belt.

STEP	INSTRUCTION	ELEMENT
1	LD	400
1	OR	401
2	OUT	430
3	LD	402
4	OUT	431
5	LD	403
6	OUT	432
7	LD	404
8	OUT	433

Figure 17, the instruction list for the program.

Task 3c)

Figure 18 illustrates a program that was created to operate a pneumatic power press. The first thing added into the program was the latching system for the switch, this allows the signal to be constant giving a signal to the output at all times, the contacts which illustrate this are **(X000)**, this is also the start button, the stop is the contacts **(X100)**, this is a normally closed contact which means when the stop button is pressed it will break the circuit causing the program to terminate. The contacts **(X002)** and **(X003)** are used as a safety system when operating the pneumatic power press, both contacts must be closed for the pneumatic press to operate, therefore if these contacts were connected to a mechanical guard, and the guard was not in place, the contacts would not be made which means the press would not operate.

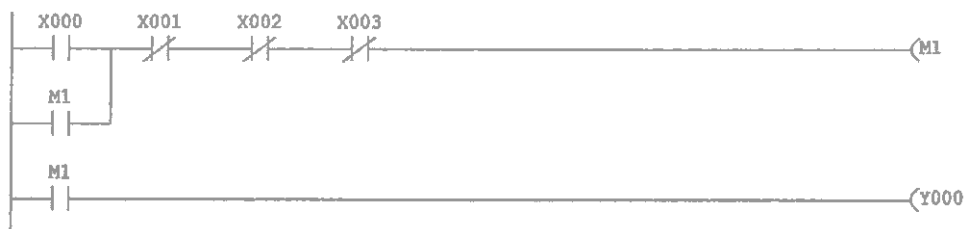


Figure 18, the program which was created to run a pneumatic power press.

STEP	INSTRUCTION	ELEMENT
1	LD	400
2	OR	401
3	LDI	402
4	ANI	403
5	ANI	404
6	OUT	430
7	LD	405
8	OUT	431

Figure 19, the instruction list for the program used to run the pneumatic power press.

/SDP

Task 4 – Conveyor belt component sorting system

To complete this task you are required to develop a PLC program using the Mitsubishi FX development software that will operate a conveyor belt component sorting system. Carefully study the control system specification to determine what is required to meet the application. You are required to control the operation of the conveyor belt and the component sorting process. Using the Mitsubishi FX PLC development software construct and test your design to prove it meets the specification. Once completed and tested the program will be downloaded to the conveyor belt PLC simulator to ensure that it operates correctly.

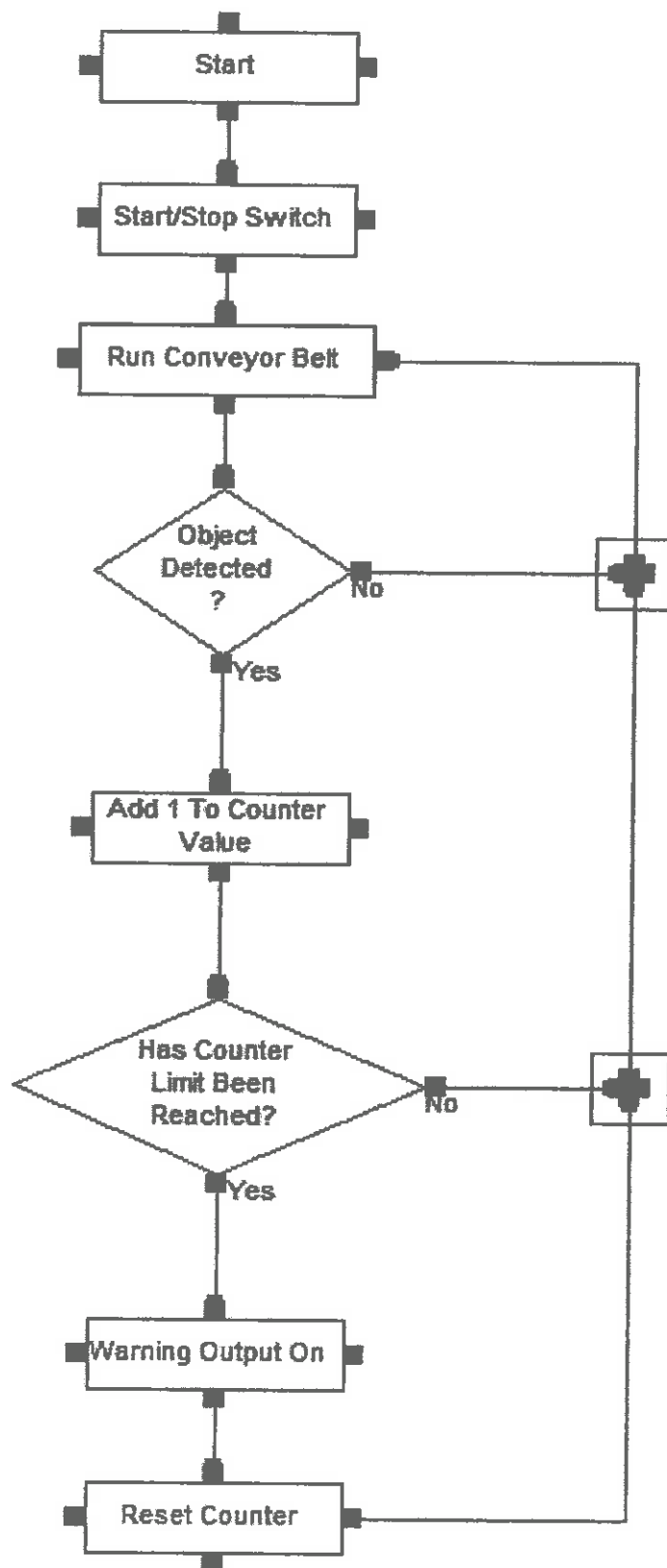
Task 4)

Figure 20 illustrates the program which was created to run a conveyer belt component sorting system. The first part of the system to be added was the power light, this light would be powered when the contact (M1), it will create a connection to the output (Y002) which will cause the light to turn on. A start/stop was then added to the program, the open contact (X000) was the start button, and the (X001) was the stop button as this contact was normally closed. The coil (M1) is then powered and this closes the (M1) N/O contact to keep the signal. Once the start button is pressed the N/C contact (M1) on line 0 of the program will become open turning the power light off, then N/O (M1) contact will become closed allowing the green running light (Y001) on line 7 of the program to become active showing the system is running.

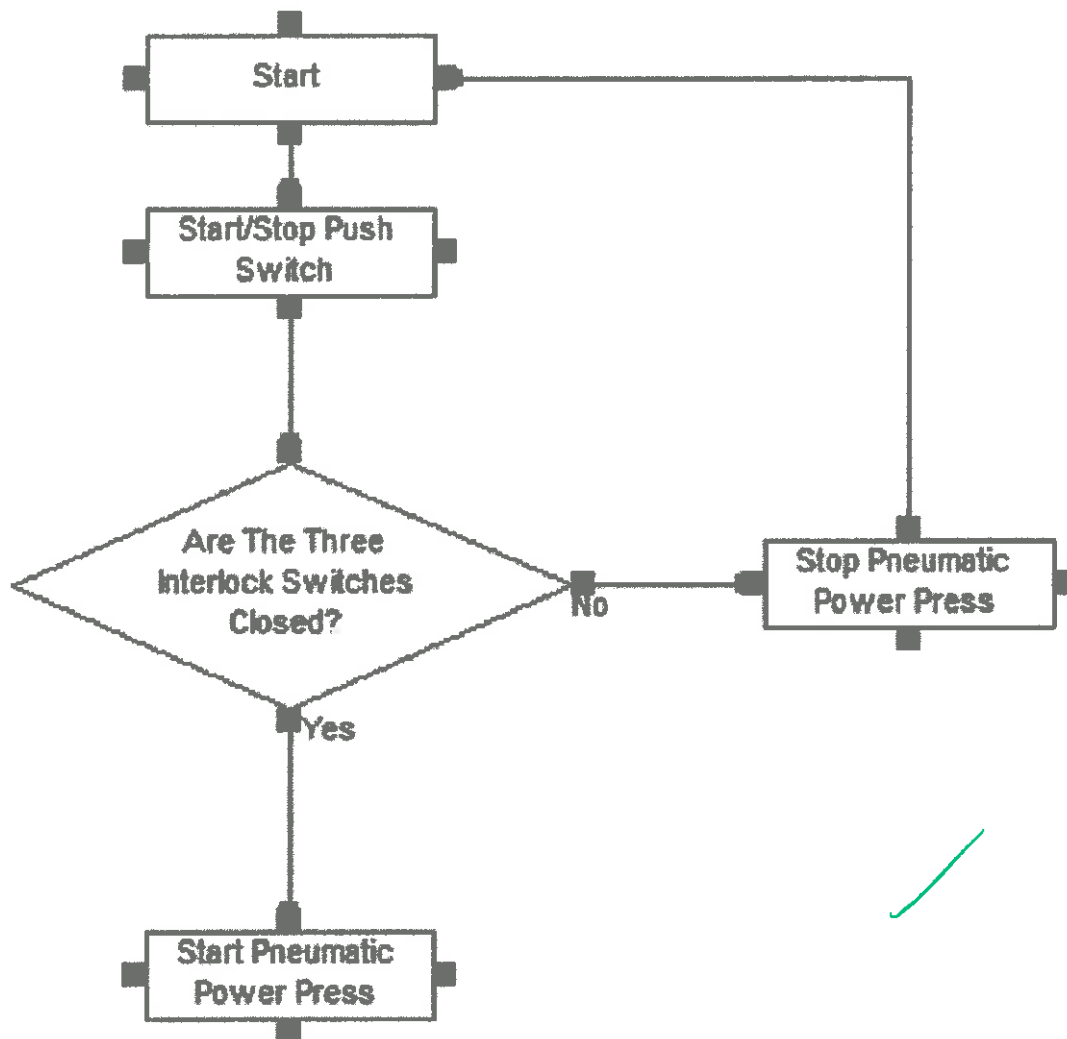
Once any objects over the height limit on the light sensor go through, it causes the (T1) timer to start, it has a 4 seconds' timer and as it reaches the value it causes the (Y003) output to have a connection, which will activate the pneumatic piston to push the object off the conveyer belt. As any object below the light sensor go through, it will activate (C1) counter, this has a value of 5 seconds. When this counter reaches its limit, the conveyer belt will stop, this is cause by the (T3) timer becoming operational which will close the (T3) N/O contact, and this will then activate the reset which is (RST C1).

/BDP

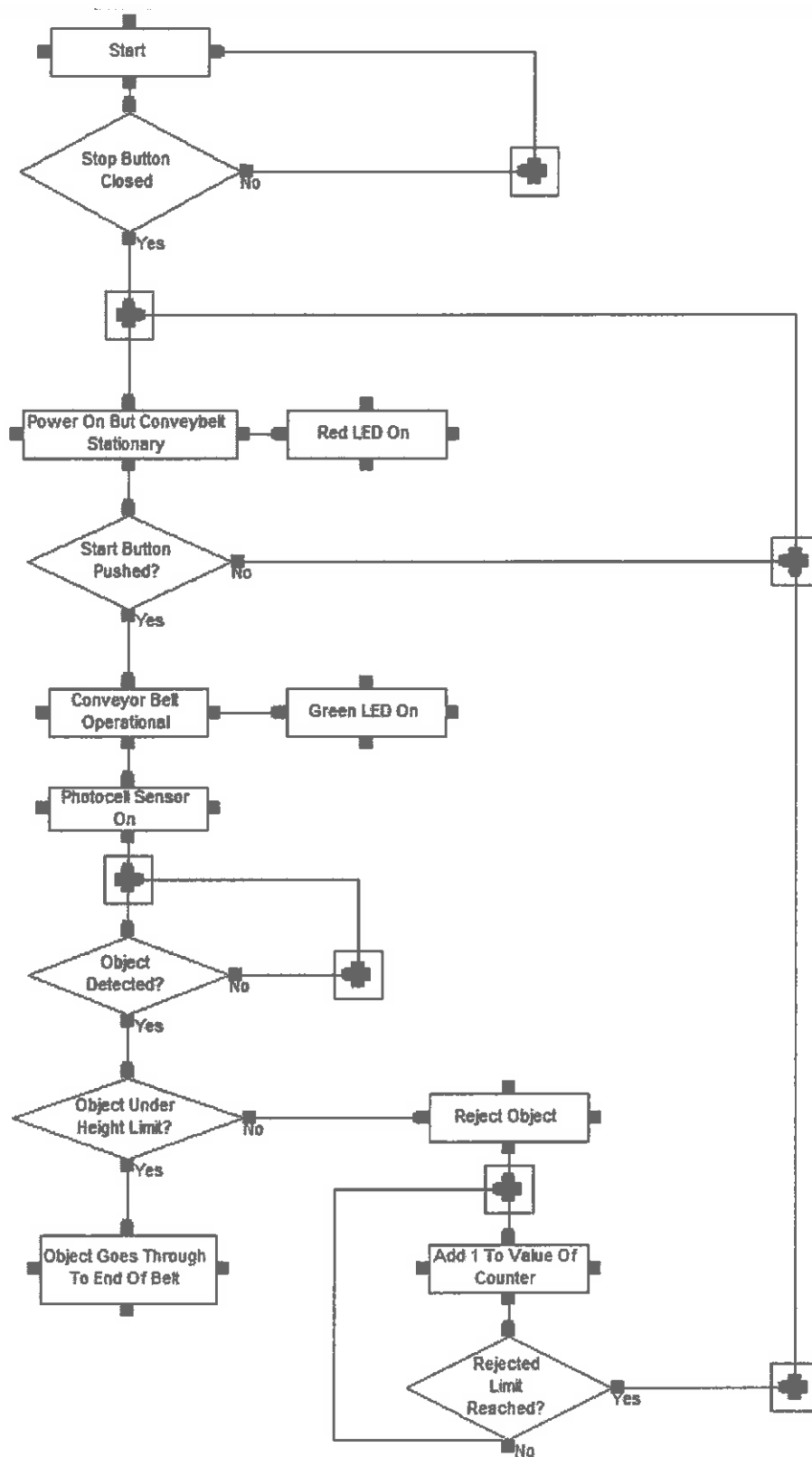
Flow Diagram for Task 3b (Conveyer Belt Counter)



Flow Diagram for Task 3c (Pneumatic Power Press)



Flow Diagram for Task 4 (Conveyer Belt Component Sorting System)



References:

- MELSOFT series GX Developer for creating the programs.
 - FireWorks for creating the flow diagrams.
 - Moodle (PLC Ladder Logic Listings)
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Figure 20, the program which was created to run the conveyer belt component sorting system.

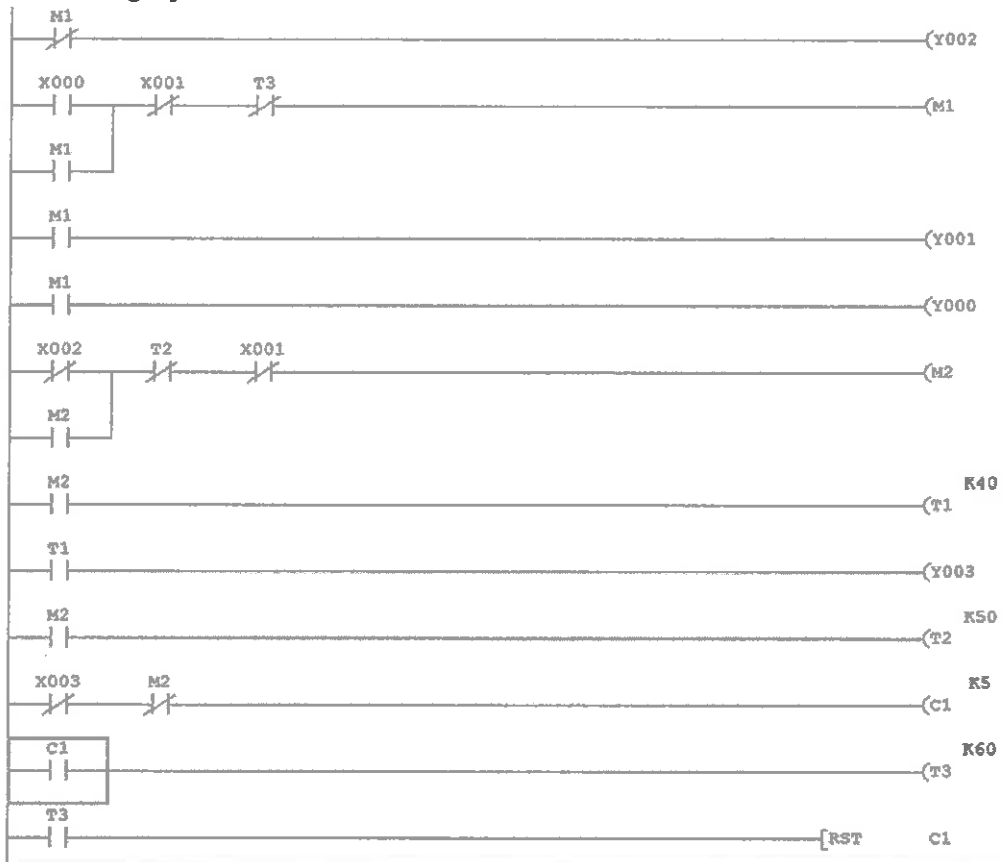


Figure 20.

Flow Diagram for Task 3a (Washing Machine)

