

## 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 |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------|---------------|
| <b>1. Research-informed Literature</b><br>Extent of research and/or own reading, selection of credible sources, application of appropriate referencing conventions.                                    | 10              | 5             |
| Good.                                                                                                                                                                                                  |                 |               |
| <b>2. Knowledge and Understanding of Subject</b><br>Extent of knowledge and understanding of concepts and underlying principles associated with the discipline.                                        | 25              | 15            |
| Very good.                                                                                                                                                                                             |                 |               |
| <b>3. Analysis</b><br>Analysis, evaluation and synthesis; logic, argument and judgement; analytical reflection; organisation of ideas and evidence                                                     | 25              | 12            |
| Satisfactory.                                                                                                                                                                                          |                 |               |
| <b>4. Practical Application and Deployment</b><br>Deployment of methods, materials, tools and techniques; application of concepts; formulation of innovative and creative solutions to solve problems. | 30              | 20            |
| Very good.                                                                                                                                                                                             |                 |               |
| <b>5. Skills for Professional Practice</b><br>Attributes in professional practice: individual and collaborative working; deployment of appropriate media; presentation and organisation.               | 10              | 5             |
| Good.                                                                                                                                                                                                  |                 |               |

|                                                                                                                                                                                                           |                                                        |   |      |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------|---|------|
| <b>Assignment Mark</b> (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.) | <b>Late Submission Penalties (tick if appropriate)</b> |   | 57 % |
|                                                                                                                                                                                                           | Up to one week late                                    |   |      |
|                                                                                                                                                                                                           | First Attempt?                                         | ✓ |      |

## GUIDANCE FOR STUDENTS IN THE COMPLETION OF TASKS

- 1. Research-informed Literature:** You must provide evidence of individual research with respect to PLC and systems theory and operation, and provide relevant referencing.
- 2. Knowledge and Understanding of Subject:** Your report should show you gained knowledge of the PLCs and associated systems used in this assignment.
- 3. Analysis:** The report should show analysis of the research and experimental programming work.
- 4. Practical Application and Deployment:** Verify program design and operation against expected theoretical and calculated outcomes. Although the practical exercises may be completed as part of a group exercise the resulting report and analysis of data must be an independent piece of work. You will need a verified copy of your program design (screen shot) to confirm the PLC program has been demonstrated and witnessed.
- 5. Skills for Professional Practice:** Your work should be well organised and presented in a professional manner.

## Task 1

- a. A start "shown in figure 1" button could be connected to a plc and this would act a safety feature because the whole PLC would not run unless the start button was pressed. The switch would be programmed within the PLC to latch which would make the program constantly run until either the stop button is pressed or something trips and stops the program which over writes the latch.

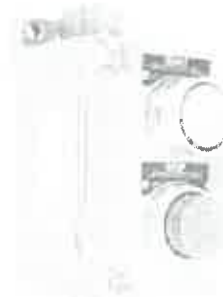


Figure 1



A pressure transmitter "shown in figure 2" can be implemented into the PLC because if it is on a piece of equipment such as a compressor if the operator starts the compressor then they would want to know the pressures inside for safety reasons, within the transmitter programming into the PLC there can be a high or low trip point. What this does is when the trip point is reached then it will send an output and send a signal to the plc which will stop the compressor.

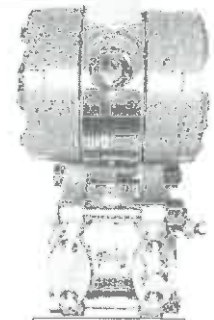


Figure 2

*Only with analog input.*

A relay "shown in figure 3" can be connected in to give a signal into the PLC which will be used with a normally closed or normally open contact on the PLC so when the relay changes signal then it will change the contact and either prevent something starting or will stop something so that it will stop anything getting damaged even more.



Figure 3



An RTD "shown in figure 4" can be used because it a very accurate temperature measuring device and can be used to measure process through pipes so that it doesn't get too hot or cold because this can be very dangerous because if it is too hot there is a risk of the process spontaneously combusting which can be disastrous for people and the environment. Whereas if the process gets too cold then the viscosity can change which can cause blockages and this can increase pressure within the pipelines which can cause them to burst and damage people or the environment. The RTD then goes into a 4/20mA temperature transmitter "shown in figure 4" which can be set up to trip so that it sends a signal to a PLC and this goes to a contact which can go to different outputs which can heat or cool the process.



Figure 4

*Again with analog input.*



Figure 5

A level switch "shown in figure 6" works in a way as it is wired as normally open or normally closed. If it is normally open then it is for a high level switch, this is because that when level is lower than the switch it won't do anything but when the level rises it switches the micro switch which will send a signal to the contact within the PLC. If it is a low level it is wired normally closed because when the level is at its normal set point then the contact won't be on because the float will constantly make. When the level then goes below the set point then it will bring it back to its normal state of normally closed and send a signal to the contact within the PLC.

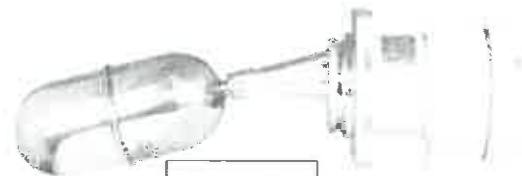


Figure 6

- b. An analogue to digital convertor is an electronic process which turns a AC current into a digital number

When the ADC process takes place it first starts by you taking a sample of the input voltage and holding it. "Shown in figure 7".

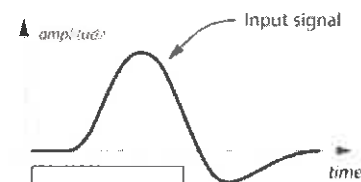


Figure 7

This is also known as the sample and hold or S/H.

Quantization is when you split the sampled input voltage into different sectors within a time scale. This process searches for a value closest to the amplitude of the S/H out of a number within the full amplitude range. This is because the quantizer is limited to search only potential values.

Once the closest value is obtained then it is assigned a number which is then made into binary. The range of the process is to the power of 2 which is represented as  $2^N$  this is why when the binary number is implemented into this it is called N bits. The binary is used as the output which powers the devices.

Although the process cannot be completely accurate so it is only an approximation of the input voltage.

Figure 8 shows an ADC converter chip which is configured as 5 input to 4 output. This works as due to the capacitors having a programmed reference voltage that matches the incoming voltage to the closest reference voltage which then converts it into a binary output.



Figure 8

I cannot see this image

- c. A Pump is used as an output due to when something needs moving an operator can either choose to switch the pump on so that it can get rid of a level and move it to somewhere else. Or a level could hit a high level and then this is used as a safety signal. As the level is tripped then it will send a signal into the PLC, alarm the control room and then switch the pump on.

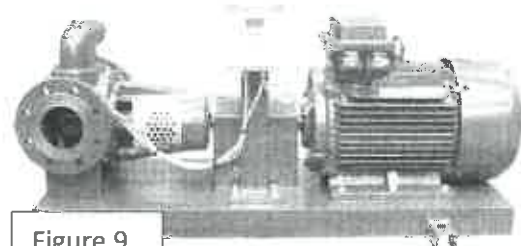


Figure 9

This is very useful due to the operator cannot view every vessel on the plant because there may be hundreds. This means although he has to take care due to human error there will be no risk or over filling.

A control Valve works as an output because it cannot work without first receiving a signal. The valve signal works through two types of process which is an I to P or a SMART positioner the difference between them is that the SMART positioner has an I to P built in. These both work off the same principle which is air is sent to the valve in either two inputs or one. The way you determine how many inputs is if it spring return or a rubber diaphragm. The position of the valve is determined by the current passed through the I to P or the SMART positioner. Within the PLC there is programming so that the amount of flow is calculated so keep it steady and not oscillate. It also changes the position of the valve so that the flow stays at the Set Point.

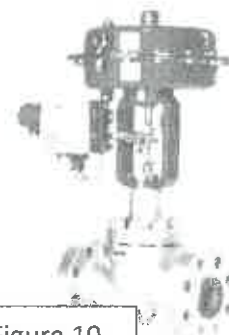


Figure 10

A siren could be used as a visual alarm so that if something trips or a gas is detected then it lets people who are working near the area know to move so that they don't get injured. The way this could be used is when the input is triggered as it does the protocol to minimise the problem the contact for the siren could also be triggered and then outputted.

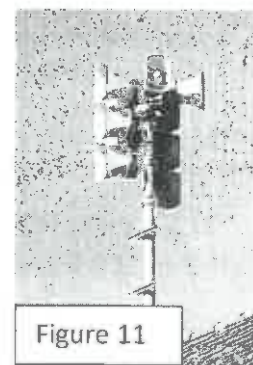


Figure 11

A heater can be used as an output due keeping the control temperature at a constant similar to the control valve although there is only an electrical input. When the temperature device input is reading to the PLC the PLC has an internal device which has a temperature set point so it will allow the heater to turn on and off depending on the temperature.

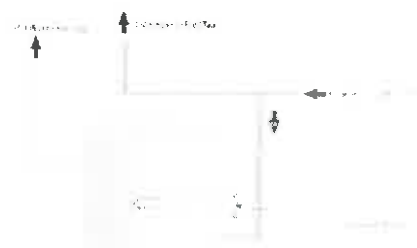


Figure 12

A Fin Fan works as an output because if the heat coming off pumps and exchangers is too high then the fin fans are switched on. This works by the same principle as the heater it has a set point and this will then turn the fans on or off, from experience the fans are usually always on due the reactions and pumps constantly on then they usually stay on. Although these are a great safety system to remove heat and send it above the process to keep the plant slightly cooler.

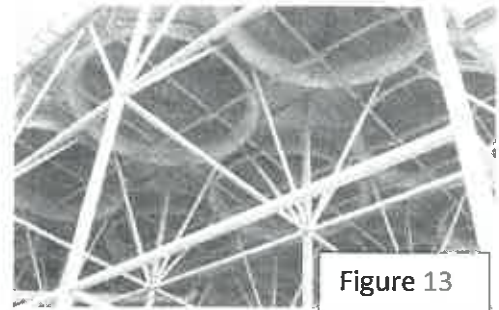


Figure 13

- d. The difference between a relay and a transistor is that a relay is an on or off and transistor is able to have its voltage drop varied. Also the transistor is a faster switching phase. Relays work by an electromagnetic switch what this does is as the electromagnet is energised it changes the contact position so depending on whether it is wired normally open or normally closed. It also works with AC and DC current whereas the transistor only works with DC. A transistor can also work as an amplifier or as a switch.

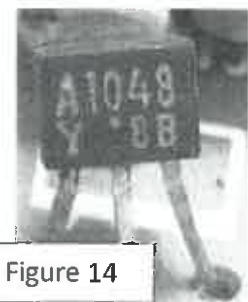


Figure 14

*A little stand-on device,*

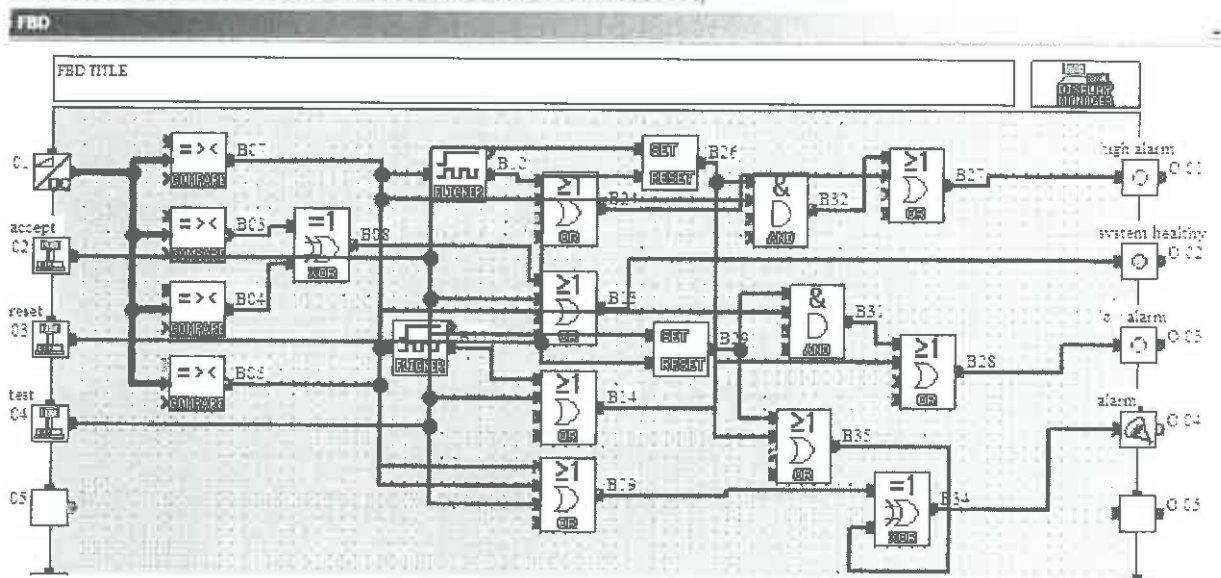
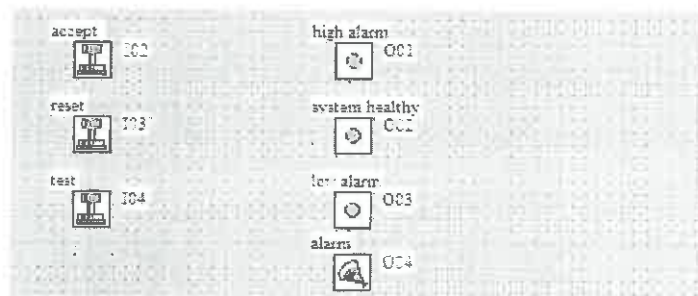
## Task 2

- a. There are many types of maintenance you can do on a PLC, some of these check that the program works and writes to your PLC and check the output voltage. There is also preventative maintenance, what this does is catching things out before it is too late and the PLC breaks down. Some of these are check the PLC LED's, feel the PLC check for overheating and also clear dust from the vents.

GAMP is a standard that is followed for the validation on automated systems. What this means it is like a regulation that is followed to prove that the PLC is safe to use. GAMP has you check the operation of the PLC so that you know if it is working properly. If the PLC is not up to standard then it can be condemned until it is deemed safe to use.

- b. When developing a PLC program the PLC can be programmed to show if there is a fault with the wiring which will show on the PLC print out this can be a printer when the PLC does not go through its steps to start something up. An example of this is when starting up a boiler which has tripped there could be a PLC set up to read faults and Print out why the boiler has tripped and print out what happens as the boiler is starting up, what this will show if there is a valve which doesn't open allowing gas into the burner and so forth this is good because you can then go through the PLC to see why this isn't working, due to their contact within the PLC may be faulty.

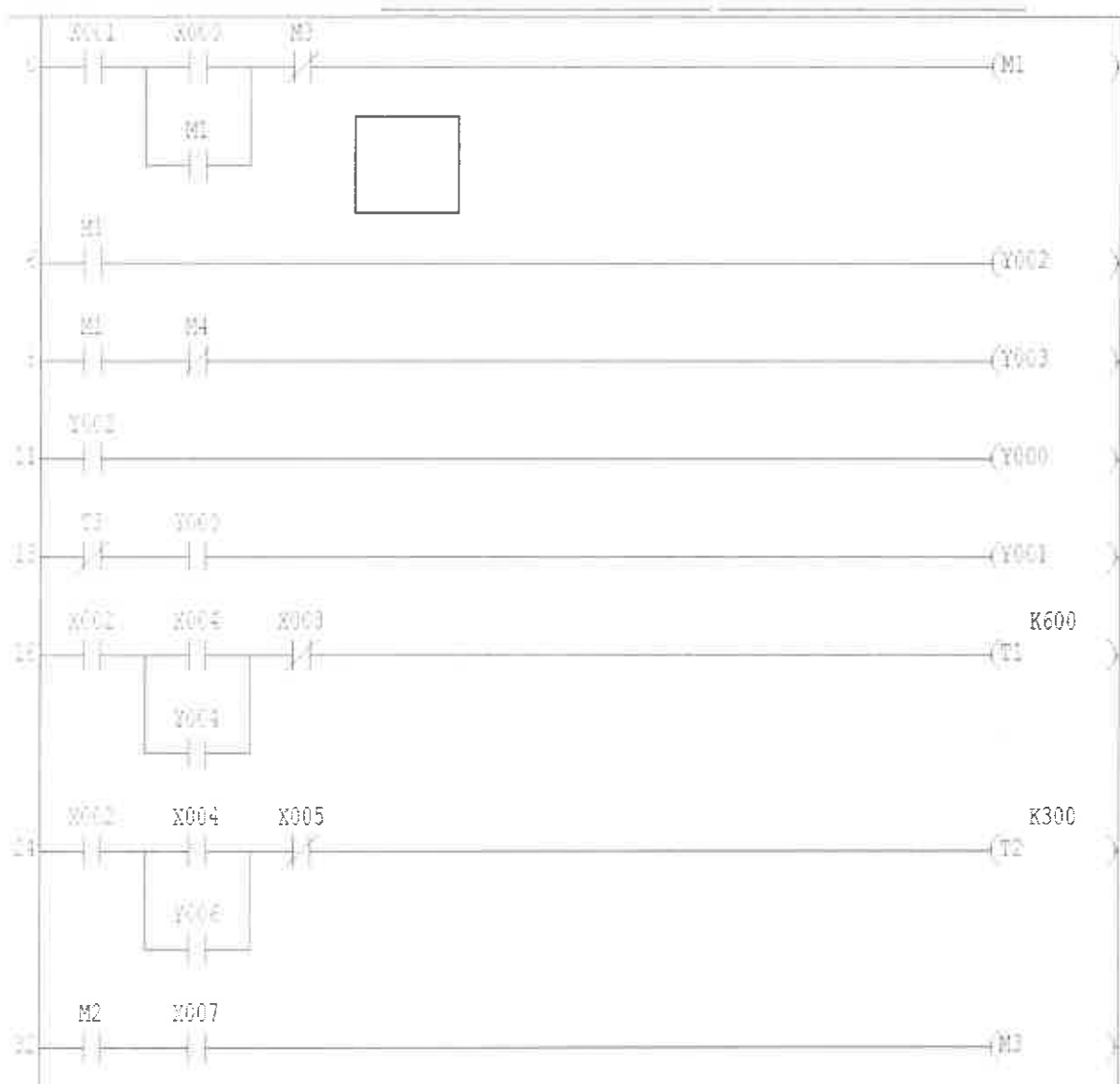
### Task 3

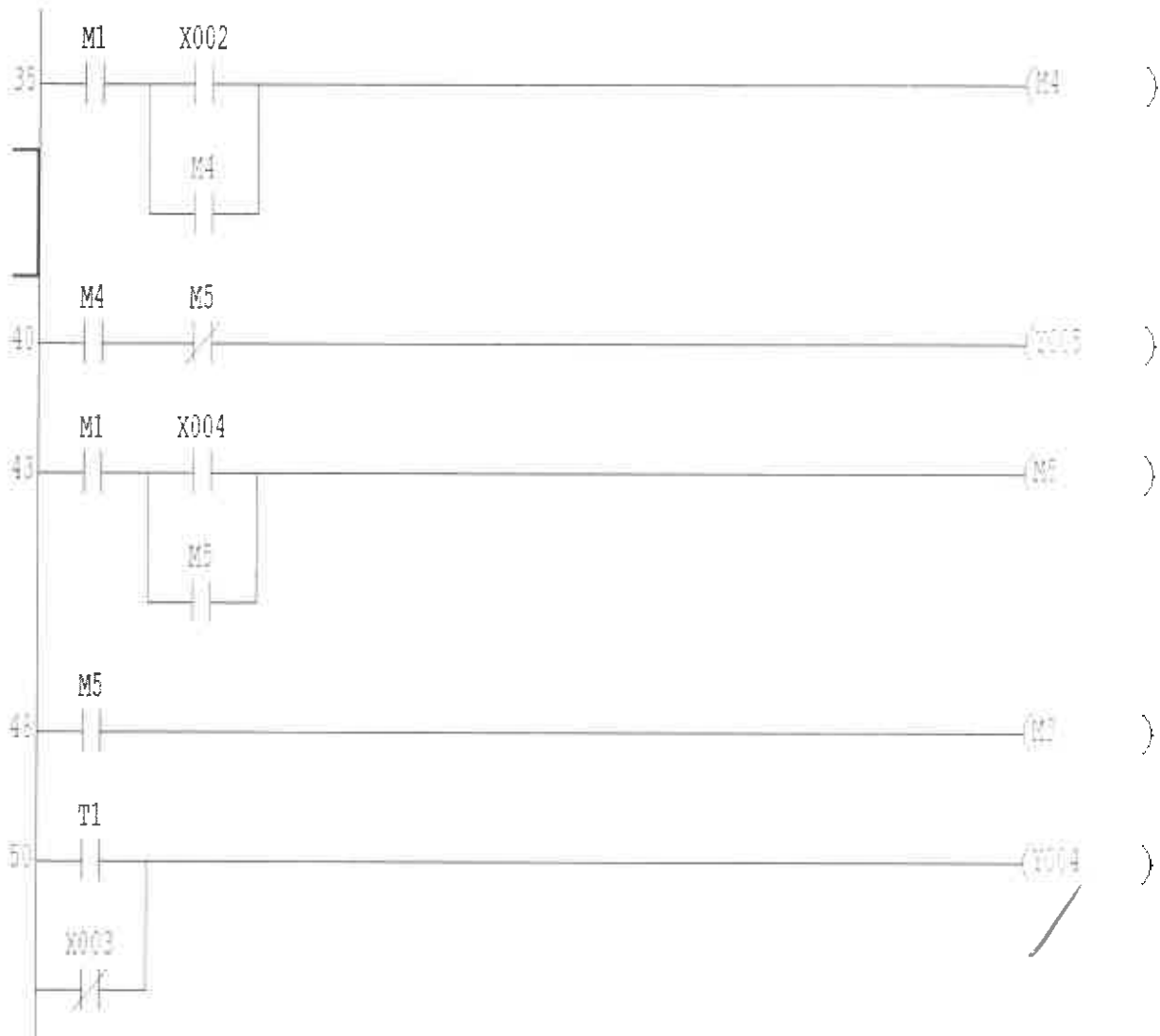


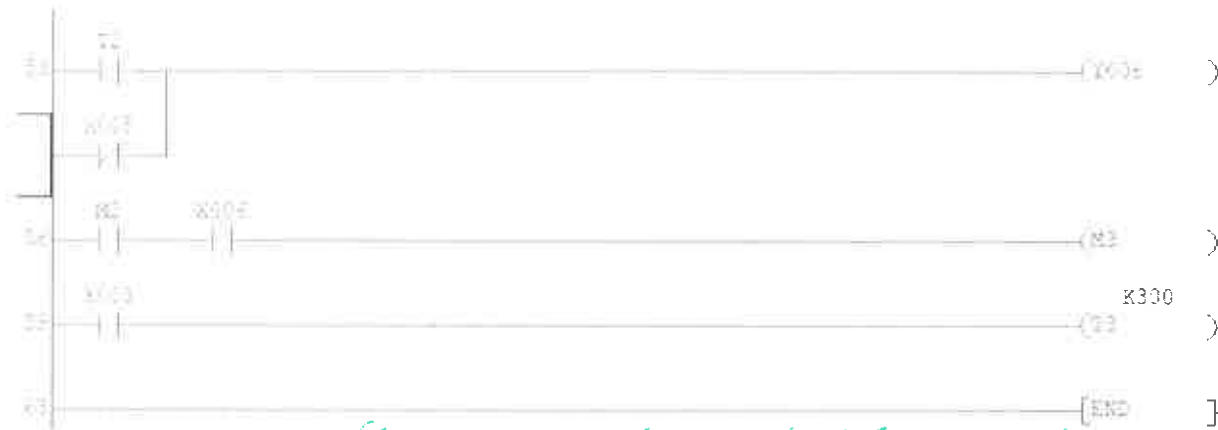
Program witnessed.  
Met design criteria

/SDP

## Task 4







*Program witnessed, Missing hold point between filling and emptying cycle.*

The operation of this program is to fill two tanks at separate times but keeping a constant flow. The flow should then change between two flows so that they both fill until the high level in each tank are reached. An agitator should then start and two separate timers for each tank. Once the timer counts down then the tank bottom valve should open filling the main tank with the agitator in. once the other timer goes in the second tank then it will open and empty also into the main tank. The two tanks both empty until the low level is reached then the valve should close preventing the tanks emptying more.

The operation of the program is very good because it is a good example of what happens in the real world and how PLC's are used to overcome the obstacles of safe movement of liquid or process. My program worked very well except for the timing of the bottom valves opening, this is the only problem I could not overcome when designing my program.

Another functionality that could have been implemented is a valve which varies the flow so you get a constant flow through the system. This would help because it would act as another safety feature other than the high and low level switches. This would act as a controlling action so the flow can have a set point of fast or slow depending on the speed you want the program to run. ✓

*/SDP*

## References

Start button - [http://ww1.prweb.com/prfiles/2016/03/09/13257802/gl\\_89137\\_EPS-2XPB-SG-MS-PR01.png](http://ww1.prweb.com/prfiles/2016/03/09/13257802/gl_89137_EPS-2XPB-SG-MS-PR01.png)

Pressure transmitter - [https://image.ec21.com/image/reliameter/OF0017688446\\_1/Sell\\_rosemount\\_3051\\_pressure\\_transmitter.jpg](https://image.ec21.com/image/reliameter/OF0017688446_1/Sell_rosemount_3051_pressure_transmitter.jpg)

Relay - [https://media.rs-online.com/t\\_large/F0385941-01.jpg](https://media.rs-online.com/t_large/F0385941-01.jpg)

Rtd transmitter - <http://www.kemtronix.com/uploads/1/8/8/1/18816716/4685577.jpg?261>

Rtd - <https://4.imimg.com/data4/PT/WK/MY-10288925/rtd-sensor-500x500.jpg>

Level switch - [http://mtcin.com/mtc\\_live/wp-content/uploads/image-for-magnetic-coupling-level-switches.jpg](http://mtcin.com/mtc_live/wp-content/uploads/image-for-magnetic-coupling-level-switches.jpg)

Figure 7 - <https://www.nutag.com/blog/analog-digital---part-2-conversion-process>

Quote for task 1b - <https://www.nutag.com/blog/analog-digital---part-2-conversion-process>

Figure 8 - <https://www.allaboutcircuits.com/worksheets/analog-to-digital-conversion/>

Figure 9 - <http://www.petronab.com/index.php/gear-pumps/>

Figure 10 - <https://www.indiamart.com/proddetail/single-seated-globe-control-valve-16303090730.html>

Figure 11 - [https://en.wikipedia.org/wiki/Siren\\_\(alarm\)](https://en.wikipedia.org/wiki/Siren_(alarm))

Figure 12 - <https://www.wattco.com/2011/11/154/>

Figure 13 - <http://www.processtechacademy.com/thar-she-blows/>

Figure 14 - <http://www.explainthatstuff.com/howtransistorswork.html>

