



COLLEGE OF ENGINEERING, SCIENCE AND TECHNOLOGY
SCHOOL OF ELECTRICAL AND ELECTRONICS ENGINEERING

BACHELOR OF ENGINEERING PROGRAMME, YEAR 3 (BENG 3)

EEE 761 PLC AND SCADA SYSTEM

FINAL EXAMINATION (SEMESTER 1, 2017)

DATE/TIME/ROOM – Refer to Timetable

Total marks – 100

Time – 3 hours and 10 minutes

INSTRUCTIONS TO STUDENTS

1. You are allowed 10 minutes Extra reading time during which you are NOT to write.
2. Begin each answer on a fresh page and use both sides of the sheet.
3. Write your candidate-number at the top of each attached sheet.
4. Insert all written sheets in their correct sequence and secure with string.
5. For all sheets of paper on which rough/draft work has been done, cross it though and you MUST ATTACH to your answer scripts.
6. Write clearly the number(s) of the question(s) attempted on the top of each sheet.
7. ANSWER ALL QUESTIONS.
8. Show all workings where necessary.
9. Do not use programmable calculators, especially the ones that do the conversions of number systems.

Total no. of pages – 6 (including cover page)

Question 1

Write the program for creating a process start section in ladder logic. Explain how the new section and programming language is selected.

| Variable Name | Data Type |
|-----------------|-----------|
| Stop_Process | BOOL |
| Process_Started | EBOOL |
| Plant_Running | EBOOL |

(5 marks)

Question 2

Write the program using structured text for refilling the tank. Part of the program is given below.

```
IF Refill THEN
  Tank_Level := Tank_Level +10;
END_IF;
IF Empty THEN
  Tank_Level := Tank_Level -10;
END_IF;
```

(5 marks)

Question 3

- (a) Provide 2 differences between Modbus and Modbus Plus .
- (b) Analyse how do input and outputs card act as an interface between the PLC and external device?
- (c) Explain why do PLC do a self check in every scan?
- (d) What are the benefits of input/output modules?

(5marks)

Question 4

- (a) Design a program that will turn on a light, after Switch A has been closed 5times. Push button B will reset the Counter. *(4marks)*
- (b) Would it be possible to set a PID controller up on PLC, and adjust its set point / AUTO / MANUAL selection from a SCADA system? *(1mark)*

Question 5

Design the ladder logic used to rinse the process tank after each process reaction with the water fill, mix and flush described in the process statement. The empirical design information includes:

All data values present are integer data

The selector switch is in the rinse position and the tank is filled with water and then drained.

The mixer is used throughout the cycle.

Outputs are mixer contactor, water drain valve, and water fill valve.

The following Boolean logic should be used in the ladder design

Mixer contactor = rinse selected AND low level float switch

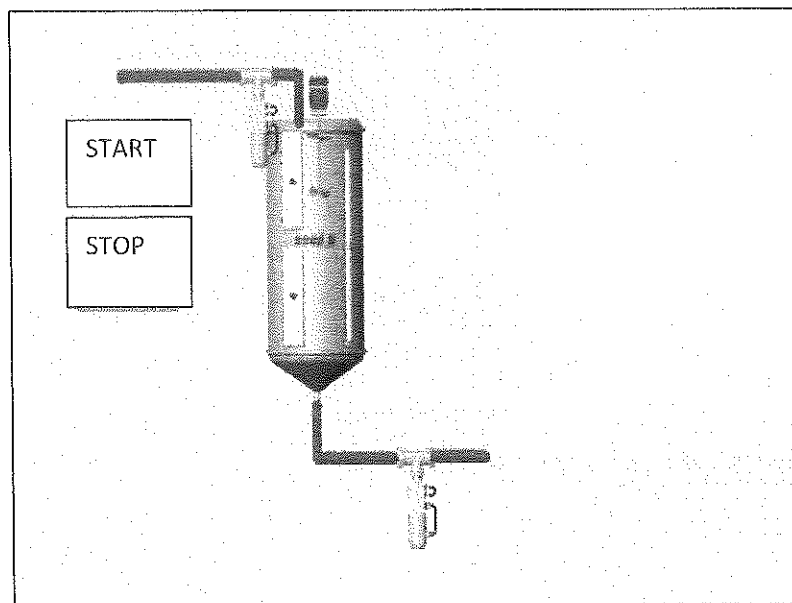
Rinse water fill valve = start bit AND rinse selected AND NOT high level float switch AND NOT rinse water drain valve

Rinse water drain = start bit AND rinse selected AND high level float switch (sealed with rinse water drain valve XIC instruction) AND low level float switch.

(15marks)

Question 6

The sequence of the given process needs to be controlled. The process should be started by pressing a START switch and can be stopped by pressing a STOP switch. Both start and stop switches are momentary contact type switch. The float switches are both normally opened (NO) and both the solenoid is energized to open. The sequence of the process should be as follows: First the FILL SOLENOID will open as soon as the start switched is pressed allowing fluid A to flow into the tank. As soon as the fluid level reaches 2nd (upper) float switch FILL SOLENOID must close and an AGITATOR motor will start and the agitator should run for 2 minutes. As soon as the agitator stops, EMPTY solenoid will open and empty the process fluid from the tank. The EMPTY SOLENOID remains open until the tank level comes down to 1st (lower) float switch. Once the tank is empty, the process should wait for another manual start of the process. Implement using the PLC control. Use the appropriate software to draw control and power circuit.



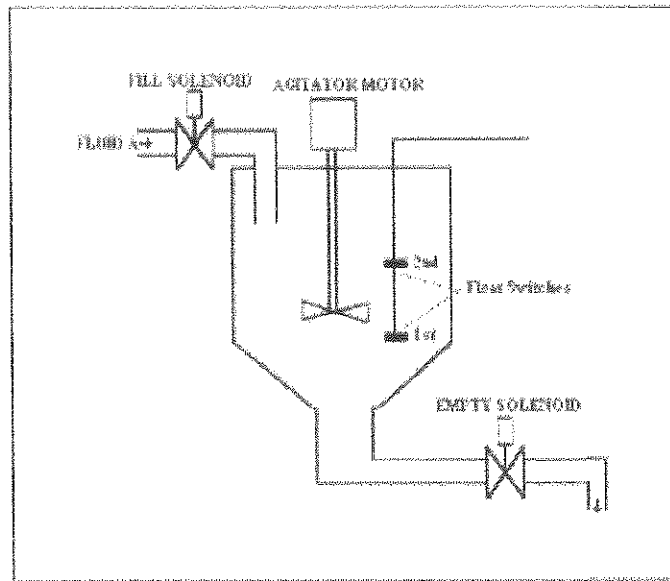


Figure: 1. Control Schematic and Single Line Diagram

(15 marks)

Question 7

Use elementary Functions (EFs) to write the program for the calculation of tank average with the given information below. Unity Pro is supplied with over 900 in built functions. An EF is represented graphically as a box with multiple input pins and one output pin. The name of the EF (that is, the EF type), is displayed in the Centre of the box.

AND FUNCTION

The output of an AND function is TRUE when all the inputs are TRUE. That is, if any input is FALSE, the output will be FALSE. The simplest AND function has only two inputs.

OR FUNCTION

The output of an OR function is TRUE when any the inputs are TRUE. The simplest OR function has only two inputs.

Unity Pro has hundreds of Elementary Functions, for example, ABS (absolute Functions value), ADD_TIME (add two or more times), EQ (equal to), TAN (tangent in radians).

Create a Function Block Diagram to calculate the average tank level.

| Name | Value | Data Type | Comment |
|-------------|-------|-----------|---------|
| FBD_Level1 | 100 | INT | |
| FBD_Level2 | 200 | INT | |
| FBD_Level3 | 300 | INT | |
| FBD_Level4 | 400 | INT | |
| FBD_Average | 250 | INT | |

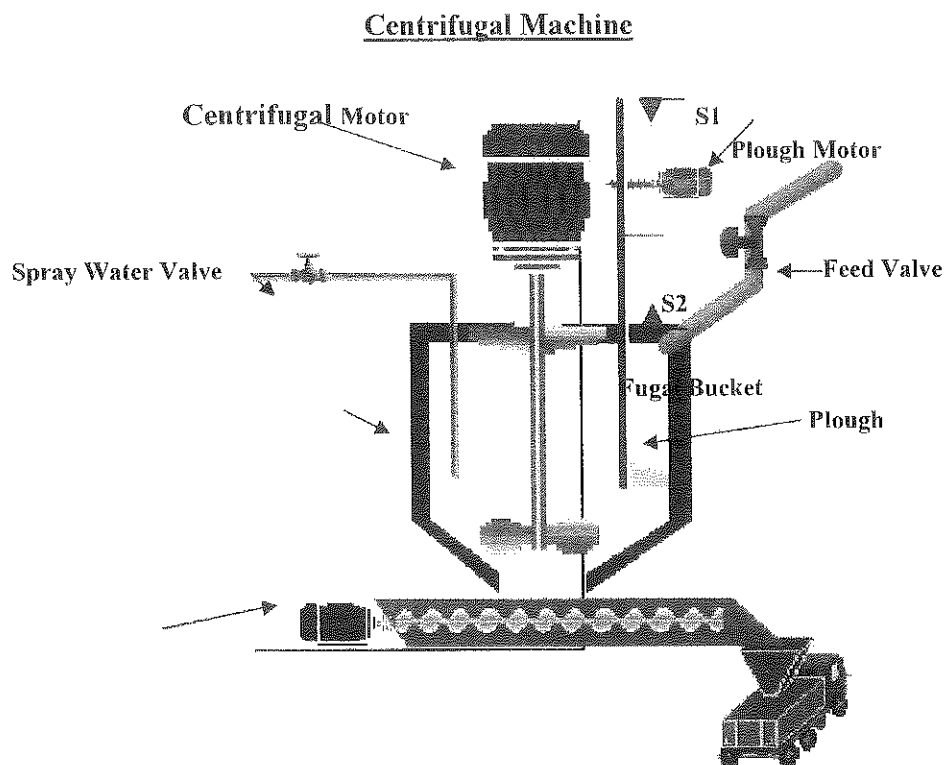
(10 marks)

Question 8

- (a) Explain the PID Control Using PLC and illustrate your answer with a diagram (7marks)
- (b) Explain the concept of hysteresis, when dealing with some old Instrument. (4marks)
- (c) In temperature measurement, an RTD will have a positive temperature coefficient, whereas a thermistor will typically have a negative temperature coefficient. Please explain what this means. (4marks)

Question 9

Automatic Centrifugal Control



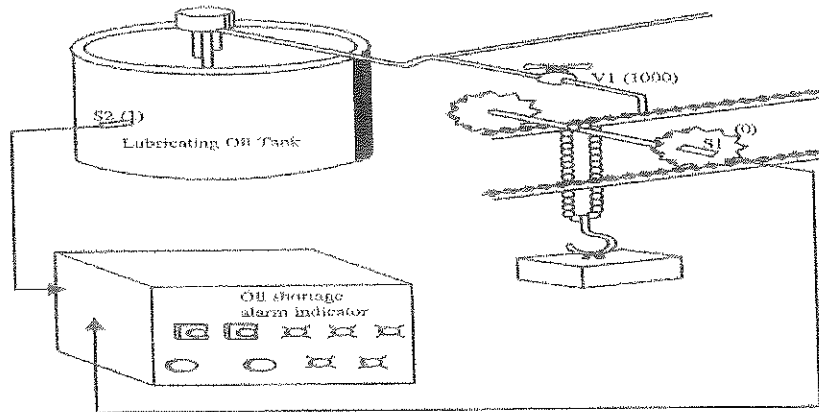
Design a ladder logic for a fugal operation that deploys the following conditions. When on automatic the screw starts first. The fugal motor starts running, 5 sec after the fugal motor has started the spray water valve opens 10 sec for rinsing and closes again. As soon as the spray water valve has closed the feed valve opens for 15 sec and takes feed. The fugal motor spins for 20secs after this and stops. The braking cylinder applies brake to the fugal bucket for 3 sec and then allows it to rotate freely at a lower speed. After the brake has de-energized, the plough motor starts running until the plough hits the low limit switch. Hereafter the motor reverses and pulls the plough up until the top limit switch is activated. The whole cycle begins again and continues.

(15 marks)

Question 10

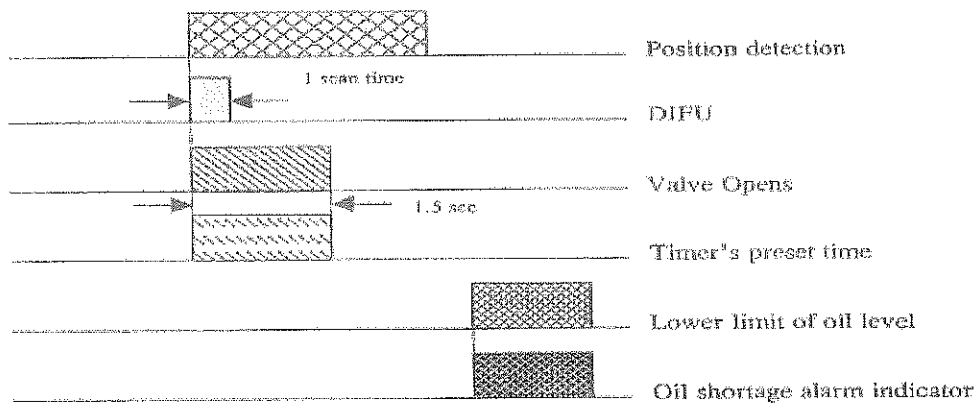
Automatic Lubrication of Gear

Design a PLC programme when the gear is moved towards S1, the sensor S1 will detect the gear and signal the electromagnetic valve for oil supply on the gear. The valve (V1) will open for a short period of time, supplying a predetermined quantity of oil. When sensor S2 sense that the lubricating tank oil level is low, the oil shortage alarm indicator will be ON.



| INPUT | DEVICE | OUTPUT | DEVICE |
|-------|-----------------------|--------|-----------------------|
| 0.00 | Position Detection S1 | 100.01 | Electromagnetic Valve |
| 0.02 | Lower limit of oil S2 | 100.02 | Oil shortage alarm |

TIMING DIAGRAM



(10 marks)

[THE END]