



# FNU FIJI NATIONAL UNIVERSITY

COLLEGE OF ENGINEERING, SCIENCE & TECHNOLOGY

SCHOOL OF ELECTRICAL & ELECTRONIC  
ENGINEERING

BACHELOR OF ENGINEERING (HONORS) (ELECTRICAL ENGINEERING)  
YEAR 4

EEB851 –INDUSTRIAL AUTOMATION

Total [100marks] Exam Duration [3hour 10 minutes] Total # Pages 5

SEMESTER 1 - 2018.

DAY/DATE:            TIME:            ROOM: As per timetable.

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 does the conversions of number systems.
10. **ALWAYS CHECK YOUR WORK BEFORE YOU LEAVE THE ROOM!**

**SECTION A:** **Instruction:** *Answer all questions. Total (10 marks)*

**Question 1:**

Explain the fundamentals of digital input/output and analog input/output the basics of automation. (3marks)

**Question 2:**

Explain the concept of scaling using the gradient method  $Y = m \times x + b$ . (3marks)

**Question 3:**

Determine the number of pounds per digital count when the input of 4 to 20mA is used. At 4 mA reading is 0IB, while at 20mA the reading should be 100IB. Here assume a 16-bit card that gives reading of 0 at 4mA and 65,536 at 20mA. This implies that the range of pounds at 100 the current is 65536. The scalar is then determining by  $100/65,536 = 0.0015259$ . If the value of 27000 is read from the card, then what will be the actual the value in pounds. (4 marks)

**SECTION B:** **Instruction:** *Answer all questions. Total (50 marks)*

1. Unity Pro is able to use the five IEC standard languages name those five languages. (5marks)
2. Write ladder logic for the application of a process that is filling the tank with water. You should have a start/ stop circuit to start the application and should assure that the tank does not run empty or overflow using the unity pro M340 plc. Assume all the inputs are discrete and assign input and output address.

*Table 1: List of I/O*

I/O	
start	
stop	
Run Valve	
Pump	
High Level sensor	
Low Level sensor	
High Level indicator	

- Illustrate the hard wiring using M340 plc clearly by identify the control and power circuit. (15marks)
3. The function block PI\_B depicts a PI-algorithm with a mixed structure (series/parallel). Its functions derive from function block PIDFF. These functions enable the function block to perform most classical control applications, without compromising user friendliness or using too many system resources. Write a program using FDB to control the temperature. (10marks)

4. 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 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	

(20 marks)

**SECTION C: Instruction: Answer all questions. Total (35 marks)**

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)

2. Write the program using FBD to control the speed of the induction motor using PIDFF function. Create two sections, one for the LAG Filter and other for PIDFF function. The simulation should be displayed using the operator screen. Assume all parameters for the two function and display the necessary variables that should be visible in the operator screen for viewing the data.
- (8 marks)
3. Briefly explain about SCADA systems.
- (2 marks)
4. Briefly explain how the new project is created in the Citect explorer SCADA.
- (5 marks)

5. 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 switch 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 3 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 (unity pro xi) and M340 plc with digital inputs and outs card to draw control and power circuit.

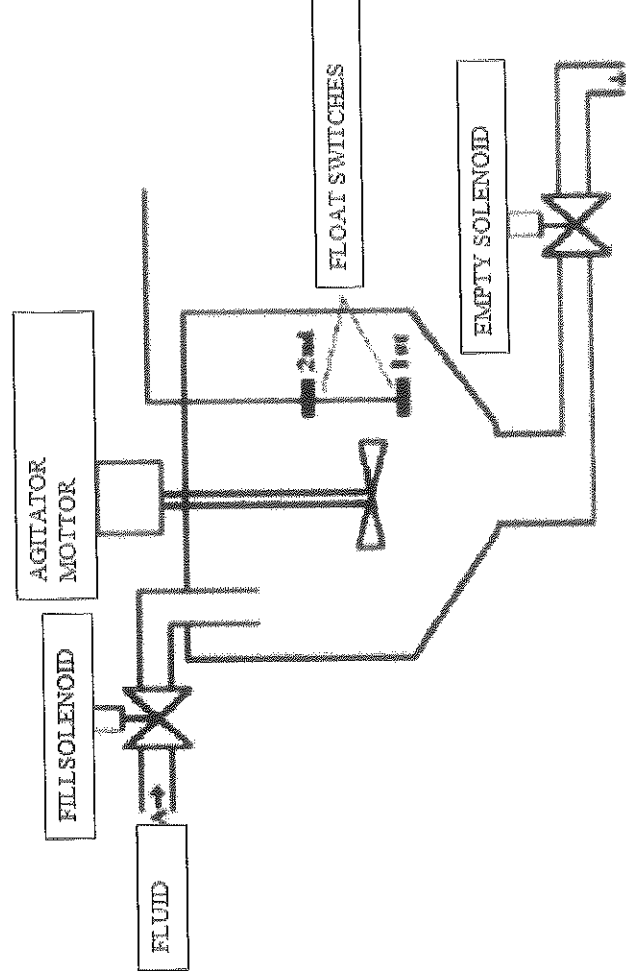


Figure: 1 Single Line Diagram

(15 marks)

All the Best  
The End...