UNIVERSITY
OF
JOHANNESBURG

PROGRAM	:	NATIONAL DIPLOMA *ENGINEERING: ELECTRICAL*
SUBJECT	:	**Process Instruments 3**
CODE	:	**PRI 3221**
DATE	:	January 2020
DURATION	:	180 minutes
WEIGHT	:	40 : 60
TOTAL MARKS	:	100

ASSESSOR	:	Mr. Johan Venter
MODERATOR	:	Mrs. J Buisson-Street
NUMBER OF PAGES	:	3 PAGES (Cover page Included)

INSTRUCTIONS	:	ONLY ONE POCKET CALCULATOR PER CANDIDATE MAY BE USED. ANSWER ALL THE QUESTIONS ON THE QUESTION PAPER

INSTRUCTIONS TO STUDENTS

PLEASE ANSWER ALL QUESTIONS.

PROCESS INSTRUMENTATION - PRI 3221 - SUPPLEMENTARY

QUESTION 1   [20 marks]

A level sensor has an output of 0V-10V. During calibration the following readings were noted:

SITUATION	SENSOR OUTPUT
Tank empty (0 Litre)	1V
4000 Litre	5V
Tank full (8000 Litre)	9V

1.1   **Draw** a linearization graph (similar to the Unitronics PLC) indicating the sensor voltage on the horizontal axis and the tank volume on the vertical axis. Clearly indicate the values of the 3 calibration points.   (10)

1.2   **Calculate** the span of the sensor.   (3)

1.3   **What** is the ZERO-OFFSET value?   (2)

1.4   **Calculate** the gain of the sensor system (The slope of the graph).   (5)

QUESTION 2   [8 marks]

2.1 With the use of a graph, discuss OPTIMISING CONTROL.   (4)

2.2 Discuss the advantages and disadvantages of the Ultimate Method?   (4)

QUESTION 3   [15 marks]

3.1   Design a PLC program which performs the following functions.   (15)

TAKE NOTE OF THE FOLLOWING SEQUENCE OF EVENTS using Visilogic.

- The application is flow measurement of a magnetic flow sensor
- The system needs to be switched on by the power-up bit (SB2)
- Input to the PLC is provided by the analogue 3 input (MI 2)
- The input is a 12 bit input
- Flow rate is from 2 m^3/s to 20 m^3/s. Save the calibrated value in MI 4
- The system needs to verify the flow rate every 10 seconds. Be careful in your selection here
    - Separately for this linearization block, state the following values
        - X1, X2, Y1, Y2, X, Y
- At the user's request, the power can be cut to the system at any time. For this switch 2 (I 2) must be switched OFF.

QUESTION 4   [48 marks]

4.1   Explain with the use of sketch what feed-forward control is.   (4)

4.2   Design a circuit illustrating Derivative control using a comparator.   (5)

4.3   Compare the 10Base-5 and 1000Base-TX network protocol by completing the following table: (6)

Name	Access	Topology	Data Rate
10Base-5			
1000Base-TX			

4.4   Draw the Ring and Star network topologies.   (6)

4.5   Sketch the Profibus DP and Profibus PA terminators.   (8)

4.6   With the use of graphs only, explain how noise can be perfectly cancelled out?   (3)

4.7   List six (6) PROFIsafe safety monitoring features.   (6)

4.8   Discuss five (5) disadvantages of the 4-20 mA Analogue Communication Protocol. (5)

4.9   Discuss in your own words five (5) advantages of the Digital Communication Protocol.   (5)

QUESTION 5   **[9 marks]**

5.1   In a boiler water exists in most of the phases of matter. **Draw** a detailed diagram that **explain** the phase / heat / temperature relationship of water. **Indicate** the different latent heat regions clearly.   (4)

5.2   Show, with a sketch, how **COLUMN PRESSURE CONTROL WITH VAPOUR DISTILLATE PLUS INERTS PRESENT** is achieved?   (5)

TOTAL of the Paper = [100]