NATIONAL UNIVERSITY OF SCIENCE AND TECHNOLOGY
FACULTY OF ENGINEERING

DEPARTMENT OF ELECTRONIC ENGINEERING

INDUSTRIAL CONTROL

TEE 5241

Special Supplementary Examination Paper

September 2024

This examination paper consists of 3 pages

Time Allowed: 3 hours

Total Marks: 100

Special Requirements: None

Examiner's Name: Reginald Gonye

INSTRUCTIONS AND INFORMATION

1. This question paper comprises of two sections. Section A carries a total of 40 marks and each question in Section B carries 30 marks.

2. Answer **all** questions.

3. Show your steps clearly in any calculation.

4. Start the answers for each question on a fresh page.

SECTION A (Answer all questions in this section)

Question 1
Using a diagram, describe and explain how input isolation can be achieved in a controller such as a PLC whilst ensuring that the input signal is coupled into the controller. Why is input isolation necessary? [8 marks]

Question 2
Outline how an *ac* drive operates. [6 marks]

Question 3
Pneumatics is used in many control operations. Outline the major components of a pneumatic system. [8 marks]

Question 4
Outline the different types of interface modules (inputs and output signal types) found in a PLC. [8 marks]

Question 5
Give the various levels of control in a distributed control system. Outline their functions and control equipment found at each level. [10 marks]

SECTION B (Answer any TWO questions from this section)

For each of the questions in this section the distribution of marks is as follows:
  a) Diagrams and accounts of how sensors and actuators are connected to the PLC and how actuators will be used to effect the required actuation. [15 marks]
     Take note to clearly indicate the allocation of I/O points to the sensors and actuators.

  b) Ladder program for the PLC. [15 marks]
     Take note to clearly indicate the allocation of I/O and memory addresses to sensors, actuators and memory based variables.

Question 6
An automatic car-wash system uses a suitable sensor to detect the presence of a vehicle in the washing bay. When this occurs, the system will operate a pump for 20 seconds, then spray detergent for 5 seconds, after which it will operate the water pump again for 20 seconds. The process will conclude with activating hot air blowers for 30 seconds. There are two lights near the entrance to the bay, one green and one red to indicate the state of the washing bay as

occupied or free to incoming customers. There is also another set of a green and red light to give information to the driver whose car is being washed so that s/he knows when to drive out of the washing bay.

Develop a PLC based solution for the car wash system. [30 marks]

Question 7

A PLC based safety system is required for a large industrial press. The press is activated by turning on the compressor power relay R (connected to O:013/05). After R has been on for 30 seconds the press can be activated to move. Activation is achieved by activating a mechanism P (connected to O:013/06). The delay is needed for pressure to build up. After the press has been activated (P is on for 1.0 second) the system must be shut down (R and P put off), after which the cycle may begin again. For safety, there is a sensor S (connected to I:011/02) that detects when a worker is inside the press. The sensor must be off before the press can be activated. If at any time the worker enters the press (and S becomes active) the press will be shut down (P and R turned off). There is also a button B (connected to I:011/01) that must be pushed 5 times before the press cycle can begin.

Design a PLC based system to control the process. [30 marks]

End of Paper