NATIONAL UNIVERSITY OF SCIENCE AND TECHNOLOGY

FACULTY OF INDUSTRIAL TECHNOLOGY
DEPARTMENT OF ELECTONIC ENGINEERING
BACHELOR OF ENGINEERING (HONS) DEGREE

Final Examination May 2013

TEE 5241 INDUSTRIAL CONTROL

Duration of Examination – 3 Hours

INSTRUCTIONS TO CANDIDATES

1. Answer any **FIVE**questions only.
2. Each question carries 20 marks.
3. Show all your steps clearly in any calculations.
4. Start each new question on a fresh page.

Question 1

a) Differentiate between an industrial computer and a general purpose computer, clearly indicating the significance of features of an industrial computer to its application in industrial control. [6 marks]

b) What are the differences between supervisory and direct digital control? What are the advantages of supervisory control over direct digital control? [6 marks]

c) What are the benefits of distributed control? [4 marks]

Question 2

a) Using an example of an instrumentation and control application
   i. Describe the application highlighting why control is necessary. [4 marks]
   ii. Describe how a named transducer/sensor in the process operates [5 marks]
   iii. Describe how a named actuator in the process operates. State how it is controlled to achieve the control goal. [6 marks]

b) Why is it important to have standard signals for transducers and controllers? Give examples of standard signals for analog and descrete sensors. [5 marks]

Question 3

a) State and explain the use of RAM, ROM and EPROM in a PLC. [9 marks]

b) Describe the role of input interface in a PLC. Using a diagram , describe and explain how input isolation is achieved. [6 marks]

c) What are the advantages of PLCs in industrial control? [5 marks]

Question 4

a) What is remote I/O? What are its benefits in industrial control? [6 marks]

b) Using a diagram, show and explain how closed loop control is implemented using a PLC. Explain the role of each component in the system. [7 marks]

c) Using a named example, discuss and explain the importance of intelligent modules for some PLC applications. [4 marks]

d) State the effect of proportional, integral and derivative terms in PID control. [3 marks]

Question 5

a) Explain the major components of a SCADA system. Describe the interface between the SCADA system and the plant and between the SCADA system and the operator. Highlight the significance of SCADA systems. [10 marks]

b) Describe the hierarchical organization of a process control system for a plant. Indicate the duties of each level and the typical equipment, both hardware and software required to implement each level. [10 marks]

Question 6

In an industrial process, an oven is used to bake production units placed on a turn table. Design a PLC based system to control the process. Use diagrams to aid clarity. Produce a ladder program for the PLC. The operations of the system are listed below:

1. The oven begins in an IDLE state.
2. An operator presses a start button and an ALARM output is turned on for 1 minute.
3. The ALARM output is turned off and the HEAT is turned on for 3 minutes to allow the temperature torise to the acceptable range.
4. The TURNTABLE output is turned on.
5. If the STOP input is activated (turned off) the HEAT will be turned off, but the TURNTABLE output willbe kept on for two minutes. After this the oven returns to IDLE.

[20 marks]

Question 7

A machine is being designed to wrap boxes of chocolate. The boxes arrive at the machine on a conveyor belt. The list below shows the process steps in sequence.

1. The box arrivesbox arrives and is detected by an optical sensor (**P**), after this the conveyor is stopped (**C**) and the box is clamped in place (**H**).
2. A sticker cylinder (**S**) is turned on for 1 second to put consumer labeling on the box.
3. A wrapping mechanism (**W**) is turned on for 2 seconds.
4. The clamp (**H**) is turned off and the conveyor (**C**) is turned on.
5. After the box leaves the system returns to an idle state.

Design a PLC based system to control the process. Use diagrams to aid clarity. Produce a ladder program for the PLC. [20 marks]

END OF PAPER