BINDURA UNIVERSITY OF SCIENCE EDUCATION

FACULTY OF SCIENCE AND ENGINEERING

DEPARTMENT OF ENGINEERING AND PHYSICS

PROGRAMME: BSc. Honours Degree in Electronic Engineering

COURSE CODE EEE 5103(2) : INDUSTRIAL CONTROL

DURATION: 3Hrs TOTAL MARKS: 100 NOV 2024

INSTRUCTIONS TO CANDIDATES

1. This examination paper consists of 6 Questions
2. Each question carries 25 marks
3. Answer any Four (4) questions
4. Start each question on a new page

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1. (a) Explain the primary purpose of an Industrial Control System in manufacturing. [2]
   (b) Describe any three types of sensors used in industrial instrumentation. [6]
   (c) Describe the key components of a process control system and explain how they work together to regulate an industrial process. [17]
   (25 Marks)

2. (a) Name two common types of control systems used in industrial automation and describe their main functions. [4]
   (b) Describe the role of a PID controller in process control and explain its three main components. [8]
   (c) Differentiate between analog and digital signals in context of instrumentation [6]
   (d) Describe the differences between electric, pneumatic, and hydraulic actuators. [7]
   (25 Marks)

3. (a) Define a SCADA, and how it contribute to industrial control [4]
   (b) Differentiate between an active and a passive transducer with examples. [6]
   (c) Practical application of actuators in industrial process control:

(i). In an automated manufacturing system, an actuator is required to precisely control the movement of a conveyor belt. State the type of actuator would be most suitable for this application giving reasons. [5]

(ii). Consider a robotic arm designed to handle heavy lifting in construction. Discuss the advantages of using hydraulic actuators over electric actuators in this scenario [5]

(iii). You are tasked with designing a system that needs to operate efficiently in a low-noise environment. Recommend the type of actuator to be used giving reasons for your choice. [5]

(25 Marks)

4. (a) Explain how the implementation of sensors improve industrial control systems. [6]

(b) In a robotics application, you are tasked with designing a control system to ensure smooth and accurate movement of a robotic arm:

(i). Describe the role of a controller in this application and how it affects the performance of the robotic arm. [3]

(ii). Give the considerations you would make when choosing between a PID controller and a simpler proportional controller for this application. [4]

(c) Explain the significance of the following time-domain characteristics in a control system:

(i). Rise Time [3]

(ii). Settling Time [3]

(iii). Overshoot [3]

(iv). Steady-State Error [3]

(25 Marks)

5. (a) Describe the function of an actuator in an industrial control system. [4]

(b) Consider a SCADA system implemented in a water treatment plant. Describe how a SCADA system can be used to monitor and control various processes within the plant. [12]

(c) Describe common security risks associated with SCADA systems and how can they be mitigated. [9]

(25 Marks)

6. (a) Discuss the significance of cybersecurity in control systems citing examples. [12]

(b) Consider a manufacturing plant that uses an HMI system for monitoring and controlling production processes. Describe how the HMI can be used to improve operational efficiency and decision-making in this setting. [6]

(c) Discuss the potential cybersecurity risks associated with HMIs and propose measures to mitigate these risks. [7]

(25 Marks)

END OF PAPER