

CONFIDENTIAL



UTHM

Universiti Tun Hussein Onn Malaysia

UNIVERSITI TUN HUSSEIN ONN MALAYSIA

**FINAL EXAMINATION
SEMESTER II
SESSION 2023/2024**

- COURSE NAME : PROCESS INSTRUMENTATION
- COURSE CODE : BNQ 30304
- PROGRAMME CODE : BNN
- EXAMINATION DATE : JULY 2024
- DURATION : 3 HOURS
- INSTRUCTIONS :
1. ANSWER ALL QUESTIONS
 2. THIS FINAL EXAMINATION IS CONDUCTED VIA
 - Open book
 - Closed book
 3. STUDENTS ARE **PROHIBITED** TO CONSULT THEIR OWN MATERIAL OR ANY EXTERNAL RESOURCES DURING THE EXAMINATION CONDUCTED VIA

THIS QUESTION PAPER CONSISTS OF **FOUR (4)** PAGES.

CONFIDENTIAL

TERBUKA

Q1 Static and dynamic characteristics is normally used to show the performance of an instruments.

(a) Differentiate between static and dynamic instrumentation characteristics with **TWO (2)** examples each.

(6 marks)

(b) This question focusses on static characteristic of an instrument.

(i) Define the term 'precision', 'tolerance' and 'drift'.

(6 marks)

(ii) Describe your understanding on 'Resolution'.

(4 marks)

(c) Two pressure gauges (pressure gauge A and B) have a full-scale accuracy of $\pm 5\%$. Sensor A has a range of 0 - 10 bar and sensor B has a range of 0 – 50 bars. Determine which gauge is more suitable to be used if the reading is 7 bars. Explain your answer.

(5 marks)

(d) A temperature sensor has a span of -10 to 300 °C. A measurement results in a value of 80°C for the temperature. Calculate the error and the possible actual temperature if the accuracy is:

(i) $\pm 0.75\%$ span

(ii) $\pm 0.8\%$ of reading

(4 marks)

Q2 Process control strategies are the methodologies used to manage and regulate the operations of a process system. These strategies determine how the controller responds to the error between the setpoint and the process variable.

(a) Differentiate between feedback control loop and feed forward control loop together with their respective labelled block diagram.

(8 marks)

(b) Choose **SIX (6)** criteria to be considered when selecting a transducer and explain their importance.

(9 marks)

(c) Identify **THREE (3)** elements of signal modifier with their specific functions.

(6 marks)

- (d) Process measurements can be divided into two categories namely measurement of the condition of the material or the equipment and measurement of the physical properties, or physical makeup of the materials handled. Recognize **TWO (2)** importance of measurement.

(2 marks)

Q3 A sensor is a device that detects the change in the environment and responds to some output on the other system. A sensor converts a physical phenomenon into a measurable analog voltage (some as digital signal) converted into a human-readable display or transmitted for reading or further processing.

- (a) A scenario is given where you supervise a fire department in Australia. During summer, a forest fire is nearly inevitable. The temperature involved can reach up to 2500-degree Kelvin. Choose the most appropriate temperature sensor to monitor the forest fire from spreading. Demonstrate your understanding on the types of temperature sensor chosen with the following details:
- i. Explain on the principal operation of the chosen temperature sensor (with related equation)
 - ii. Draw the appropriate temperature sensor schematic diagram with label.
 - iii. List the advantages and disadvantages of the chosen sensor (**TWO (2)** for each category)

(13 marks)

- (b) There are **TWO (2)** types of level measurement known as direct and inferential measurement. Differentiate each type of measurement together with **TWO (2)** examples of level sensor from each category.

(6 marks)

- (c) Compare both analog representation to digital representation in term of definition, important features and advantages.

(6 marks)

Q4 Following questions covers signal modifier, controller, and final control elements.

- (a) Instruments normally operate on digital signals. Therefore, analog signals need to be converted into digital signals using Analog to Digital Converter (ADC) device. Two operations which normally involved in this process is sampling process and quantization process. Express your understanding on quantization process.

(5 marks)

- (b) Analog to digital 5-bits converter has \pm bits of quantization error and 10V of input full scale voltage. Determine the following:
- (i) Number of outputs. (1 mark)
 - (ii) Transition (1 mark)
 - (iii) Resolution (1 mark)
 - (iv) Quantization error (2 marks)
 - (v) Percentage accuracy (2 marks)
- (c) Differentiate between Supervisory Digital Control (SDC) and Distributed Digital Control (DiDC) in term of its operating procedure. (3 marks)
- (d) “The operation of a generator is based on Faraday’s Law where the voltage will be induced when the conductor passes through magnet flux”.
- With the aid of a few diagrams, illustrate the operation of basic DC generator for one complete cycle of induced voltage complete with label and brief description. (8 marks)
- (e) Name **TWO (2)** types of actuators used in control system. (2 marks)

- END OF QUESTIONS -