



UTHM
Universiti Tun Hussein Onn Malaysia

UNIVERSITI TUN HUSSEIN ONN MALAYSIA

**FINAL EXAMINATION
SEMESTER II
SESSION 2018/2019**

COURSE NAME : PROCESS INSTRUMENTATION
COURSE CODE : BNQ 30304
PROGRAMME CODE : BNN
EXAMINATION DATE : JUNE/JULY 2019
DURATION : 3 HOURS
INSTRUCTION : ANSWER ALL QUESTIONS

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

- Q1** (a) (i) Differentiate between static and dynamic instrumentation characteristics with **TWO (2)** examples each. (4 marks)
- (ii) Define the term ‘*accuracy*’, ‘*range of span*’ and ‘*drift*’. (6 marks)
- (iii) 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 bar. Determine which pressure gauge is more suitable to be used if the reading is 7 bar and explain your answer. (6 marks)
- (b) (i) Describe the term ‘*instrumentation system*’. Your description must include definition, form and advantage. (4 marks)
- (ii) Draw a flow chart consisting a basic measurement system complete with labels. The flow chart must begin with a measurand and end with a display unit. Explain the operation of the flow chart in **ONE (1)** sentence. (5 marks)

- Q2** (a) Describe your understanding on ‘*resolution*’ in instrumentation characteristics. (4 marks)
- (b) **Table Q2 (b)** show types of material for a thermocouple complete with its temperature span and sensitivity.

Table Q2 (b): Types of thermocouple with its characteristics

Type	Materials	Span ($^{\circ}\text{C}$)	Sensitivity, S ($\mu\text{V}/^{\circ}\text{C}$)
A	Platinum 30% rhodium/ platinum 6% rhodium	0 to 1800	3
B	Chromel / constantan	-200 to 1000	63
C	Iron / constantan	-200 to 900	53
D	Chromel / alumel	-200 to 1300	41
E	Nirosil / nisil	-200 to 1300	28
F	Platinum / Platinum 13% rhodium	0 to 1400	6
G	Platinum/ Platinum 10% rhodium	0 to 1400	6
H	Copper / Constantan	-200 to 400	43

Based on **Table Q2 (b)**, determine the type of thermocouple with:

- (i) Largest range of span (1 mark)

- (ii) Highest measurement capacity (1 mark)
- (iii) Smallest range of span (1 mark)
- (iv) Largest output span (Output span = range of span x S) (2 marks)
- (c) 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) $\pm 0.9\%$ FS
- (ii) $\pm 0.07\%$ span
- (iii) $\pm 3.8\%$ of reading (6 marks)
- (d) (i) Compare analog representation to digital representation in term of its definition, important features and advantages (6 marks)
- (ii) Draw signals that shows both analog representation and digital representation with **ONE (1)** example of application each. (4 marks)
- Q3** (a) (i) Name **SIX (6)** criteria that are required to be considered when selecting a transducer/sensor. (3 marks)
- (ii) Pressure sensor can be divided into a few types but the most common are deflection, strain gauge and piezoelectric. Differentiate all these types of pressure sensor in term of each respective principle operation. (9 marks)
- (b) An analog to digital converter (ADC) for UTHM has a transition number of 7
- (i) Calculate the number of output bits for the UTHM ADC converter. (2 marks)
- (ii) With the aid of a diagram, illustrate the relationship between digital output code and analog input signal for UTHM ADC converter. (3 marks)

- (iii) Simple Ramp ADC is using a counter operation and it is considered slow as it needs longer time if the number of bits increased. Formulate the conversion process using analog to digital simple ramp converter via the counter operation if an analog input of 5V is supplied. It is advisable to answer in tabulated form. (5 marks)
- (c) Differentiate between Supervisory Digital Control (SDC) and Distributed Digital Control (DiDC) in term of its operating procedure. (3 mark)
- Q4** (a) “The operation of a generator is based on Faraday’s Law where the voltage will be induce when the conductor passes through magnet flux”.
- (i) 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)
- (ii) Draw the graph for voltage versus angular position drawn in question **Q4 (a) (i)** for **THREE (3)** complete rotation. (2 marks)
- (iii) List **TWO (2)** types of noise with an example for each type. (3 marks)
- (b) Compare globe and needle valve in terms of their applications, advantages and disadvantages. You are advised to answer in a table form. (6 marks)
- (c) Describe the characteristics of control valve openings, commonly known as linear, equal percentage and quick opening type. (6 marks)

-END OF QUESTIONS-