

10



# KIBABII UNIVERSITY

**UNIVERSITY EXAMINATIONS  
2020/2021 ACADEMIC YEAR**

**THIRD YEAR SECOND SEMESTER  
SUPPLEMENTARY EXAMINATIONS**

**FOR THE DEGREE OF B.SC (RENEWABLE ENERGY AND BIOFUELS  
TECHNOLOGY)**

**COURSE CODE:** REN 327

**COURSE TITLE:** INSTRUMENTATION AND AUTOMATION

**DATE:** 17/1/2022

**TIME:** 11-1PM

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## INSTRUCTIONS TO CANDIDATES

TIME: 2 Hours

Answer question ONE and any TWO of the remaining

KIBU observes ZERO tolerance to examination cheating

### Question One (Compulsory)

- a) Define the following: (3 marks)
- i) Range
  - ii) Hysteresis
  - iii) Resolution
- b) List **two** types of temperature transducers. (2 marks)
- c) State **three** advantages of thermocouples. (3 marks)
- d) Distinguish between the following: (4 marks)
- i) Inverse transducers and active transducers
  - ii) Analogue and digital transducers
- e) State **three** factors to be considered in the selection of a good transducer. (3 marks)
- f) State **three** types of flow sensors. (3 marks)
- g) Define what is meant by 'data acquisition system' (2 marks)
- h) What are the uses of data acquisition systems? (3 marks)
- i) State **three** advantages of using Programmable Logic Controllers (PLC) over electrical relays. (3 marks)
- j) State the **four** stages of operation of a PLC. (4 marks)

### Question Two

- a) Describe each of the following types of errors. (8 marks)
- i) Gross Errors
  - ii) Systematic Errors
- b) The expected value of the voltage across a resistor is 80 V. However, the measurement gives a value of 79 V. Calculate (12 marks)
- i) absolute error,
  - ii) percentage error,
  - iii) relative accuracy,
  - iv) percentage of accuracy

### Question Three

- a) With the aid of a diagram, describe the principle of operation of a thermocouple. (6 marks)
- b) With the aid of a diagram, explain the operation of galvanometer pen-chart recorder. (6 marks)
- c) With the aid of a diagram, explain the construction and operation of a liquid Crystal Display (LCD). (8 marks)

### Question Four

- a) With the aid of a block diagram, describe the components of data loggers. (6 marks)
- b) With the aid of a block diagram, explain the process of computer data logging. (8 marks)
- c) A strain gauge with a gauge factor of a 2 is fastened to a metal and is subjected to a stress of  $1000\text{kg/cm}^2$ . The Young's modulus of the metal is  $2 \times 10^6 \text{ kg/cm}^2$ . Determine the percentage change in the resistance of the strain gauge. (6 marks)

### Question Five

- a) With the aid of a labelled block diagram, explain the functions of the elements of a Programmable Logic Controller (PLC) system. (10 marks)
- b) Explain any **five** static characteristics of measuring instruments. (10 marks)