



KIBABII UNIVERSITY

**UNIVERSITY EXAMINATIONS
2021/2022 ACADEMIC YEAR**

**THIRD YEAR SECOND SEMESTER
MAIN EXAMINATIONS**

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

COURSE CODE: REN 327

COURSE TITLE: INSTRUMENTATION AND AUTOMATION

DATE: 29/08/2022

TIME: 9:00AM-11:00AM

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 term 'Measurement'. (1 mark)
- b) Distinguish between the following as used in measuring instruments: (4 marks)
 - i) Accuracy and precision
 - ii) Repeatability and reproducibility
- c) Briefly describe the classification of different standards of measurements. (4 marks)
- d) Enumerate the disadvantages of using moving iron type of instruments. (3 marks)
- e) State **FIVE** characteristics of a good transducer. (5 marks)
- f) Sketch a block diagram of an instrumentation system. (4 marks)
- g) List **FOUR** application of a Data Acquisition System. (4 marks)
- h) Define signal conditioning as applied in measurement. (1 mark)
- i) State the **FOUR** stages of operation of a PLC. (4 marks)

Question Two

- a) An analog indicating instrument with a scale range of 0 – 5V indicates a voltage of 2.65V. The true value of the voltage is 2.7V. Determine the: (6 marks)
 - i) Absolute error
 - ii) Relative error as a function of true value
 - iii) Percentage relative error as a function of full-scale deflection.
- b) Describe each of the following types of errors. (8 marks)
 - i) Instrumental errors
 - ii) Environmental errors
- c) A parallel plate capacitive transducer uses plates of area 500mm^2 which are separated by a distance of 0.2mm. determine the: (6 marks)
 - i) Capacitance when the dielectric is air having permittivity of $8.85 \times 10^{-12}\text{F/m}$.
 - ii) Change in capacitance if a linear displacement reduces the distance between the plates to 0.18mm.

Question Three

- a) Enumerate four factors one should consider in selecting a transducer for measuring purposes. (4 marks)
- b) Giving advantages and disadvantages for each case, describe the operating principle of following devices used for measuring temperature. (12 marks)
- i) Resistor temperature detector (RTD)
 - ii) Thermocouple
 - iii) Thermistor
- c) As a design engineer, provide any **FOUR** devices you would use to measure the flow of water through a turbine. (4 marks)

Question Four

- a) Differentiate between recording and displaying devices. (3 marks)
- b) Briefly the following types of recorders, giving their advantages and disadvantages. (12 marks)
- i) Strip Chart Recorder
 - ii) Circular Chart Recorder
 - iii) X-Y Recorders
- c) Enumerate five reasons why data recording is necessary in instrumentation systems. (5 marks)

Question Five

- a) With the aid of a diagram, describe the main components of a programmable logic controller (PLC) system. (10 marks)
- b) Enumerate the main elements of a data acquisition system. (8 marks)
- c) State two applications of data acquisition system. (2 marks)