



KIBABII UNIVERSITY

**UNIVERSITY EXAMINATIONS
2020/2021 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: 1/10/2021

TIME: 8:00-10:00AM

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) Distinguish between the following as used in measuring instruments: (4 marks)
- i) Accuracy and precision
 - ii) Repeatability and reproducibility
- b) Distinguish the following types of instruments. (4 marks)
- i) Absolute instruments
 - ii) Indicating instruments.
- c) Distinguish between display and recording devices. (2 marks)
- d) State **three** advantages of thermocouples. (3 marks)
- e) State **two** merits of electromagnetic flow sensors. (2 marks)
- f) State **two** advantages of the magnetic tape recorder. (2 marks)
- g) List **three** merits of Light Emitting Diode (LED). (3 marks)
- h) State **three** advantages of using Programmable Logic Controllers (PLC) over electrical relays. (3 marks)
- i) List **two** output devices used in programmable logic controllers (PLC). (2 marks)
- j) Define what is meant by 'data acquisition system' (2 marks)
- k) What are the uses of data acquisition systems? (3 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

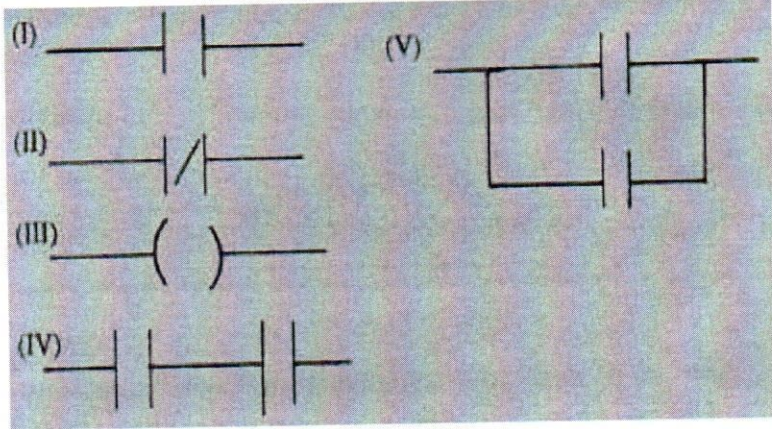
- a) With the aid of a diagram, describe the principle of operation of nixie tubes. (6 marks)
- b) With the aid of a block diagram, describe the components of data loggers. (6 marks)
- c) With the aid of a diagram, explain the principle of operation of a U-V recorder. (8 marks)

Question Four

- a) State three merits of inductive proximity sensors. (3 marks)
- b) With the aid of a diagram, explain the Seebeck effect in a thermocouple. (4 marks)
- c) With the aid of a diagram, describe the principle of operation of a thermocouple. (7 marks)
- d) A strain gauge with a gauge factor of a 2 is fastened to a metal and is subjected to a stress of 1000kg/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) State the **four** stages of operation of a PLC. (4 marks)
- b) With the aid of a labelled block diagram, explain the functions of the elements of a Programmable Logic Controller (PLC) system. (11 marks)
- c) State the meaning of the following symbols used in PLC ladder programming. (5 marks)



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