



*(KNOWLEDGE FOR DEVELOPMENT)*

**KIBABII UNIVERSITY**

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**UNIVERSITY EXAMINATIONS**

**2022/2023 ACADEMIC YEAR**

**END OF SEMESTER EXAMINATIONS**

**YEAR THREE SEMESTER TWO EXAMINATIONS**

**FOR THE DEGREE OF BACHELOR OF SCIENCE IN**

**COMPUTER SCIENCE**

**COURSE CODE: CSC 355.E /CSC356**

**COURSE TITLE: MEASUREMENTS AND INSTRUMENTATION**

**DATE: 17/04/2023**

**TIME: 2.00pm-4.00pm**

**INSTRUCTIONS TO CANDIDATES**

**ANSWER QUESTION ONE AND ANY OTHER TWO (2) QUESTIONS**

### QUESTION ONE-COMPUSORY (30 mks)

- a) Outline **FOUR** classification of standards as used in measurement [8mks]
- b) With the aid of a labeled diagram, explain the parts of a measurement system. [12mks]
- c) Explain what is meant by:
- i) Active instruments [3mks]
  - ii) Passive instruments [3mks]
- Give examples of each and discuss the relative merits of these two classes of instruments. [4mks]

### QUESTION TWO (20mks)

- d) Explain three application areas of measuring instruments [6mks]
- e) Briefly define and explain any three static characteristics of measuring instruments. [9mks]
- f) (i) An instrument is calibrated in an environment at a temperature of 20°C and the following output readings  $y$  are obtained for various input values  $x$ :

$y$	13.1	26.2	39.3	52.4	65.5	78.6
$x$	5	10	15	20	25	30

Determine the measurement sensitivity, expressed as the ratio  $y/x$ . [3mks]

- (ii) When the instrument is subsequently used in an environment at a temperature of 50°C, the input/output characteristic changes to the following:

$y$	14.7	29.4	44.1	58.8	73.5	88.2
$x$	5	10	15	20	25	30

Determine the new measurement sensitivity. Hence determine the sensitivity drift due to the change in ambient temperature of 30°C. [2mks]

### QUESTION THREE (20 marks)

- a) Explain the difference between systematic and random errors. What are the typical sources of these two types of error? [4mks]
- b) In what ways can the act of measurement cause a disturbance in the system being measured? [4mks]
- c) (i) A circuit requirement for a resistance of 550 is satisfied by connecting together two resistors of nominal values 220 and 330 in series. If each resistor has tolerance of  $\pm 2\%$ , determine the error in the sum of the two resistors [4mks]
- (ii) A fluid flow rate is calculated from the difference in pressure measured on both sides of an orifice plate. If the pressure measurements are 10.0 bar and 9.5 bar and

- the error in the pressure measuring instruments is specified as  $\pm 0.1\%$ , determine values for e and f [2mks]
- (iii) If the power in a circuit is calculated from measurements of voltage and current in which the calculated maximum errors are respectively  $\pm 1\%$  and  $\pm 2\%$ , determine the maximum likely error in the calculated power value. [2mks]
- (iv) A rectangular-sided block has edges of lengths a, b and c, and its mass is m. If the values and possible errors in quantities a, b, c and m are as shown below, calculate the value of density and the possible error in this value.  $a = 100\text{mm} \pm 1\%$ ,  $b = 200\text{mm} \pm 1\%$ ,  $c = 300\text{mm} \pm 1\%$ ,  $m = 20\text{ kg} \pm 0.5\%$ . [4mks]

**QUESTION FOUR (20mks)**

- a) State and explain What four basic elements of a generalized measurement system [4mks]
- b) List any four Static characteristics of a measuring system. [4mks]
- c) Define the following terms [8mks]
- (i) Accuracy
  - (ii) Error
  - (iii) Calibration
  - (iv) Precision
- d) Differentiate between accuracy and Precision [2mks]
- e) State the condition to be satisfied to make an a.c bridge balance. [2mks]

**QUESTION FIVE (20mks)**

- a) Outline the sources of errors in D.C voltage measurement [6mks]
- b) List any four important features of instrumentation amplifier [4mks]
- c) Briefly explain three basic requirements for a computer operated test system [3mks]
- d) Give any two applications of microprocessor based measurement [2mks]
- e) Briefly explain three requirement of an automatic test system [3mks]
- f) State any two instruments used in computer controlled instrumentation [2mks]