

(Knowledge for Development)

KIBABII UNIVERSITY

(KIBU)

UNIVERSITY S EXAMINATIONS

2020/2021 ACADEMIC YEAR

END OF SEMESTER EXAMINATIONS

YEAR THREE SEMESTER TWO EXAMINATIONS

FOR THE DEGREE OF

(COMPUTER SCIENCE)

COURSE CODE: CSC 356E

COURSE TITLE: MEASUREMENT AND INSTRUMENTATION

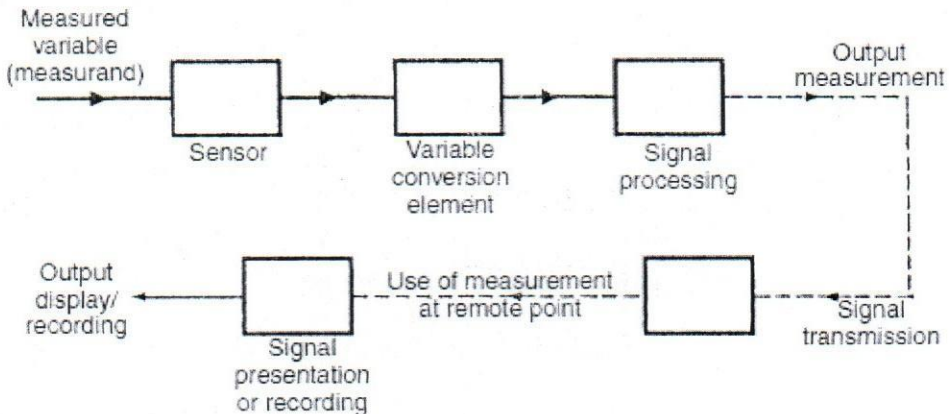
DATE: 04/ 10/2021 TIME: 09.00 A.M – 11.00 A.M

INSTRUCTIONS TO CANDIDATES

ANSWER QUESTION ONE AND ANY OTHER TWO QUESTIONS

QUESTION ONE (COMPUSORY) [30 MARKS]

- a) Discuss three areas of application of measuring instruments [6 mks]
- b) Explain the parts of a measurement system as depicted in the figure below. [14 mks]



- c) Differentiate between active and passive instruments. Give examples of each and discuss the relative merits of these two classes of instruments. [4 mks]
- i) Active instruments [3 mks]
- ii) Passive instruments [3 mks]

QUESTION TWO [20 MARKS]

- a) Outline the advantages and disadvantages of null and deflection types of measuring instrument. What are null types of instrument mainly used for and why? [6 mks]
- b) Discuss any three static characteristics of measuring instruments. [9 mks]
- c) (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	14.0	23.3	37.9	52.0	66.2	79.3
x	4	8	12	16	20	24

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

- (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	15.2	32.3	47.9	63.4	79.2	90.3
x	4	8	12	16	20	24

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

QUESTION THREE [20 MARKS]

- a) Differentiate between systematic and random errors. What are the typical sources of these two types of error? [4 mks]
- b) Outline how the act of measurement can cause a disturbance in the system being measured? [4 mks]
- c) (i) A circuit requirement for a resistance of 470 is satisfied by connecting together two resistors of nominal values 220 and 250 in series. If each resistor has tolerance of $\pm 2\%$, determine the error in the sum of the two resistors [4 mks]
- (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 12.0 bar and 6.5 bar and the error in the pressure measuring instruments is specified as $\pm 0.1\%$, determine values for e and f [2 mks]
- (iii) If the power in a circuit is calculated from measurements of voltage and current in which the calculated maximum errors are respectively $\pm 0.5\%$ and $\pm 2\%$, determine the maximum likely error in the calculated power value. [2 mks]

- (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. $a = 100\text{mm} \pm 1\%$, $b = 200\text{mm} \pm 1\%$, $c = 300\text{mm} \pm 1\%$, $m = 20\text{ kg} \pm 0.5\%$. [4 mks]

QUESTION FOUR [20 MARKS]

- a) Briefly explain four basic elements of a generalized measurement system [4 mks]
- b) State any four Static characteristics of a measuring system. [4 mks]
- c) Explain the following terms [8 mks]
- (i) Accuracy
 - (ii) Error
 - (iii) Calibration
 - (iv) Precision
- d) Outline any two applications of microprocessor-based measurement [2 mks]
- e) State the condition to be satisfied to make an a.c bridge balance. [2 mks]

QUESTION FIVE [20 MARKS]

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