MACHAKOS UNIVERSITY

University Examinations for 2024/2025 Academic Year

SCHOOL OF ENGINEERING AND TECHNOLOGY
DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

SECOND YEAR FIRST SEMESTER EXAMINATION FOR DEGREE IN BACHELOR OF SCIENCE (CLOUD COMPUTING)

SCC 202: SENSORS PRINCIPLES & APPLICATIONS

DATE: 17TH JANUARY 2025 **TIME: 2.00 PM - 4.00 PM**

INSTRUCTIONS:
*Answer question **ONE (Compulsory)** and **any other TWO** questions*

QUESTION ONE *(COMPULSORY)* (30 MARKS)

a) Explain the terms:
   (i) Measurement
   (ii) Accuracy
   (iii) Precision
   (iv) Sensitivity
   (v) Repeatability **(5 marks)**

b) Describe primary sensing element, listing the commonly used in the field of measurement. **(2 marks)**

c) Giving examples, distinguish between active and passive electrical transducers. **(3 marks)**

d) Outline the three basic requirements for the results of measurements to be meaningful and valid **(2 marks)**

e) Explain how thermistor can be used for temperature measurement. **(2 marks)**

f) What are the errors that occur during the measurement using a thermocouple. **(2 marks)**

g) Explain the principle of operation of piezoelectric transducer **(4 mark)**

h) List two types of sensors based on input quantity measured **(2 marks)**

i) The measured value of a resistance is 10.25 Ω, whereas its true value is 10.22 Ω. Calculate absolute error of the measurement. **(2 marks)**

j) Explain the three errors that can occur in measurement of a quantity **(6 marks)**

QUESTION TWO (20 MARKS)

a) With the aid of a diagram, analyze temperature measurement using thermocouple **(6 marks)**

b) State two applications of thermocouples **(2 marks)**

c) Outline two applications of thermistors **(2 marks)**

d) With the aid of a circuit diagram evaluate the determination of resistance using wheatstone bridge **(5 marks)**

e) Outline various primary effects that may arise as a result of application of heat or its withdrawal from a given body **(5 marks)**

QUESTION THREE (20 MARKS)

a) Define calibration as used in measurement systems **(1 mark)**

b) Briefly discuss the need for calibration and when it is necessary in measurement systems **(5 marks)**

c) Describe signal conditioning and its importance in instrumentation system **(3 marks)**

f) Analyze the operation of a motion detector using infrared technology **(6 marks)**

d) Discuss how pressure measurement can be achieved using primary transducers **(4 marks)**

a) Differentiate between ac and dc bridges as used in measurements **(1 mark)**

QUESTION FOUR (20 MARKS)

a) Analyze static and dynamic sensor characteristics **(4 marks)**

b) Evaluate the principle of operation of a photoelectric sensor **(5 marks)**

b) Differentiate between digital and analogue sensors **(4 marks)**

c) A transducer should have some basic requirements to determine the relationship between input and output quantities. Explain at least three requirements **(6 marks)**

d) Define signal as used in measurement of electrical quantities **(1 mark)**

QUESTION FIVE (20 MARKS)

a) Dimensional expressions indicate the nature of derived quantities in terms of fundamental dimensions' length, mass and time. Evaluate three main purposes of these expressions. **(3 marks)**

b) In relation to electricity and magnetism, derive the dimensional expression for:

i. Voltage **(3 marks)**

ii. Resistance **(3 marks)**

c) With the aid of an electrical circuit diagram, evaluate the general expression for balance in ac bridges **(6 marks)**

d) Explain the basic principle of operation of ultrasonic sensor **(5 marks)**