



MERU UNIVERSITY OF SCIENCE AND TECHNOLOGY

P.O. Box 972-60200 – Meru-Kenya

Tel: +254(0) 799 529 958, +254(0) 799 529 959, + 254 (0) 712 524 293,

Website: info@must.ac.ke Email: info@must.ac.ke

University Examinations 2024/2025

FOUR YEAR FIRST SEMESTER FOR THE DEGREE OF BACHELOR OF SCIENCE IN
COMPUTER TECHNOLOGY

CIC 3401: SENSOR AND SENSOR TECHNOLOGY

DATE: JANUARY 2025

TIME: 2 HOURS

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

QUESTION ONE (30 MARKS)

- a) Differentiate between the following
 - i. Active and Passive transducer (2 Marks)
 - ii. Primary and Secondary transducer (2 Marks)
 - iii. Analogue and Digital transducer (2 Marks)
- b) Define self-generating sensors and state two applications of such sensors in the world of today (4 Marks)
- c) Using a well labelled diagram, explain the working of a Linear Variable Differential Transformer (LVTD) (4 Marks)
- d) List two sources of noise in sensor circuits and provide detailed strategies for minimizing each type of noise mentioned (4 Marks)
- e) Using a well labeled diagram, illustrate the concept of a closed loop industrial control system (6 Marks)
- f) The plates of a parallel capacitor have a separation distance of 3.55 mm, and each plat has an area of 8.2 cm^2 . If a charge of $4.85 \times 10^{-8} \text{ C}$ is carried by each plate, calculate the value of capacitance (6 Marks)

QUESTION TWO (20 MARKS)

- a) Briefly explain the following sensor characteristics
 - i. Accuracy (2 Marks)
 - ii. Response Time (2 Marks)
 - iii. Precision (2 Marks)
- b) With help of a well labeled diagram, explain the two types of inductive transducer available (4 Marks)
- c) Define the term capacitive sensors and list any three compositions that makes up such sensors (5 Marks)
- d) Using a block diagram, illustrate the key components used in development of a temperature control system in a modern car (5 Marks)

QUESTION THREE (20 MARKS)

- a) Briefly describe on the following
 - i. Hydraulic actuators (2 Marks)
 - ii. Pneumatic actuators (2 Marks)
 - iii. Electronic signal (2 Marks)
- b) Explain the working principle of capacitive transducers (3 Marks)
- c) Using a well labelled diagram, discuss the working of Hot wire Anemometer (5 Marks)
- d) During the design of a temperature sensor experiment set-up, discuss three factors that influence the choice of an appropriate sensor (6 Marks)

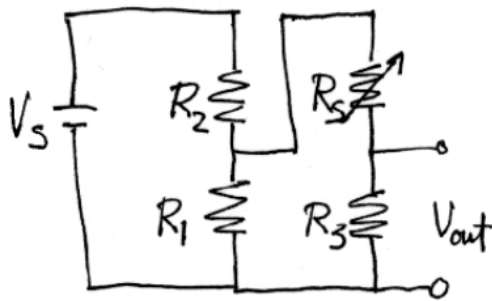
QUESTION FOUR (20 MARKS)

- a) Using a diagram state, the fundamental principles of operation of the following
 - i. Capacitive microphone (3 Marks)
 - ii. Vacuum deposition (3 Marks)
 - iii. Strain gauge (3 Marks)
- b) Describe the mathematical formulae used to calculate power in an electronic circuit (5 Marks)

- c) A hall sensor is made of an n-type silicon doped to a concentration level of $4 \times 10^{15} \text{cm}^{-3}$. Its dimension is 1mm (length) x 0.5mm (width) x 0.025 mm (thickness), its resistivity is $0.0168 \Omega \text{m}$ at room temperature. Determine its resistance (6 Marks)

QUESTION FIVE (20 MARKS)

- a) Define the following terms
- i. Ultrasonic Sensors (2 Marks)
 - ii. Reluctance (2 Marks)
 - iii. Permeability (2 Marks)
- b) Differentiate in terms of working principle, advantages, and applications of a resistive sensor and capacitive sensors (4 Marks)
- c) For the following circuit, give the equation for V_{out} (5 Marks)



- d) Calculate the gain in an inverting amplifier with a feedback resistor of $10 \text{ k}\Omega$ and an input resistor of $2 \text{ k}\Omega$. Explain how changes in these resistor values affect the gain. (5 Marks)