



MERU UNIVERSITY OF SCIENCE AND TECHNOLOGY

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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 (LVDT) (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)

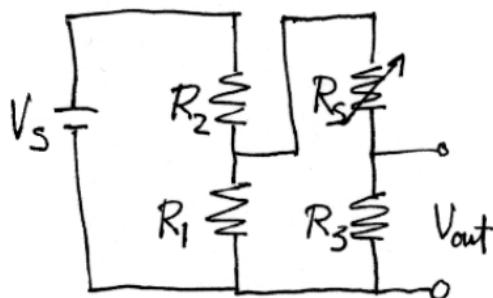
QUESTION FIVE (20 MARKS)

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)