



TECHNICAL UNIVERSITY OF MOMBASA

SCHOOL OF ENGINEERING AND TECHNOLOGY

DEPARTMENT OF ELECTRICAL ENGINEERING

UNIVERSITY EXAMINATION FOR:

BACHELOR OF TECHNOLOGY IN ELECTRICAL ENGINEERING

TEE 4317: MEASUREMENT TECHNOLOGY (PP1)

END OF SEMESTER EXAMINATION

SERIES: APRIL 2025.

TIME: 2 HOURS.

DATE: APRIL 2025.

Instructions to Candidates

The paper consists of five questions.

Answer any three Questions.

Do not write on the question paper.

Question One.

(a)(i). Define pressure measurements, hence differentiate between absolute and gauge pressure.

(ii). Explain the operational differences between a Strain Gauge Pressure Sensor and Capacitive Pressure Sensor.

(iii). State any two types of pressure sensors. **(8 Marks).**

(b)(i). With the aid of a diagram, explain how a capacitive transducer can be used to measure displacement.

(ii). Define a strain gauge sensor and explain how it operates.

(iii). The water tank diagram in figure 1 has a strain gauge sensor fixed at the base and is strained by water pressure. When the tank is empty, the gauge resistance is $30\ \Omega$ and when full, the resistance is $30\text{K}\Omega$. Given the tank height to be 20 meters, calculate the circuit current when tank is a quarter full and 3 quarter full. **(12 Marks).**

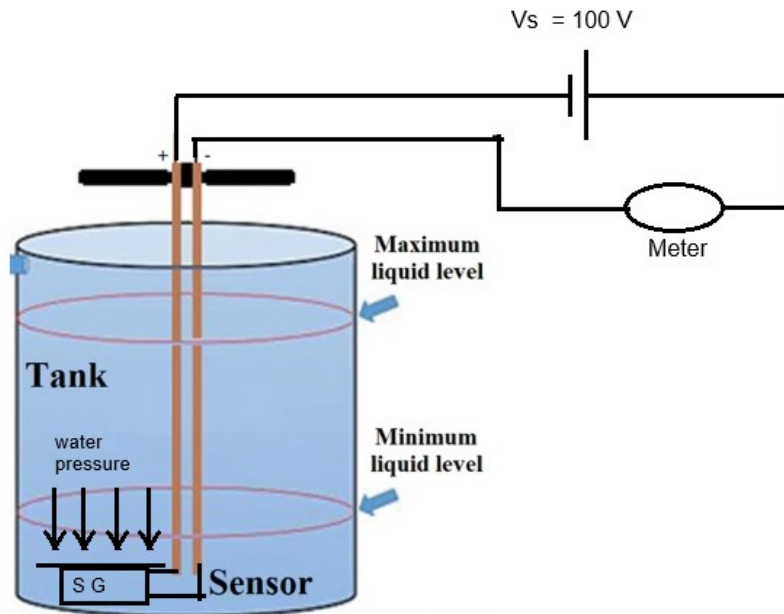


Fig Q 1

Question TWO.

a) (i). Define instrumentation measurements, hence state the functions of the following elements in a measurements system.

(I). Primary sensing element. (II) Variable conversion element.

(ii). Differentiate between a recording and an indicating instruments.

(8 Marks).

(b)(i). Differentiate between active and passive instruments.

(ii). Mention any two examples of passive instruments.

(5 Marks).

(c). (i). Draw and explain the operation of a simple water tank level indicator using a float system.

(ii). Explain the meaning of the following terms as related to tank level indication.

(I). Accuracy. (II). Linearity.

(7 Marks).

Question THREE

(a)(i). Define a transducer, hence explain why a thermocouple is referred as an active transducer.

(ii). State two advantages of transducing a non-electrical signal into an electrical type.

(7 Marks).

(b)(i). Mention two advantages of using thermistors compared to thermocouples for constructing domestic thermometers.

(ii). Draw a basic thermocouple based temperature indicating thermometer and explain how it functions.

(iii). A linear thermistor with resistance of $20\ \Omega$ at 30°C and $1480\ \Omega$ at 80°C is connected in series with a $100\ \Omega$ and a 50V DC power supply. Calculate the two extreme temperature current and power dissipated across the fixed resistor. **(13 Marks).**

Question FOUR

- (a)(i). Define heat, hence explain the need for heat measurements in an industrial process.
- (ii) Name any two types of heat sensors and how they operate. **(8 Marks).**
- (b). (i). Draw and explain the construction and operation of a bi-metallic strip.
- (ii). With the aid of a diagram, explain the operation of a spiral strip bimetallic thermometer.
- (iii). State any two advantages and disadvantages of bimetallic strip thermometers. **(12 Marks).**

Question FIVE

- (a)(i). Define a sensor, hence explain the difference between passive and active sensors.
- (ii). Name any two types of passive sensors. **(6 Marks).**
- (b)(i). Explain the meaning of the following Basic Requirements of a Sensor.
- (I). Accuracy. (II) Sensitivity.**
- (ii). With the aid of a diagram explain how a thermistor can be used to construct an analogue thermometer **(10 Marks).**
- (c). The circuit of figure Q 5 uses a thermistor whose resistance value is $10\ \text{K}\Omega$ at 25°C and $100\ \Omega$ at 100°C . Assuming a linear change in resistance, determine
- The voltage drop across the thermistor and output voltage for the two extreme temperatures given the multiplication factor A as 2. **(4 Marks).**

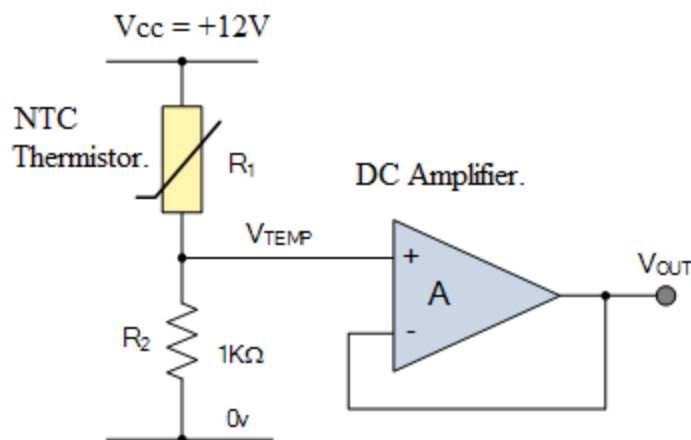


Figure 5