KISII UNIVERSITY

UNIVERSITY EXAMINATIONS

THIRD YEAR EXAMINATION FOR THE AWARD OF THE DEGREE OF BACHELOR OF SCIENCE

SECOND SEMESTER 2022/2023

[JANUARY-APRIL, 2023]

PHRE 325: INSTRUMENTATION

STREAM: Y3S2 **TIME: 2 HOURS**

DAY: MONDAY, 12:00 – 2:00 PM **DATE: 17/04/2023**

INSTRUCTIONS

1. **Do not write anything on this question paper.**
2. ***Answer question ONE and any other TWO questions.***

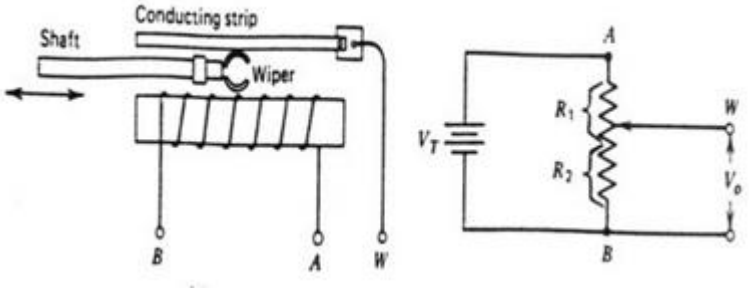
QUESTION ONE (30 MARKS)

a) Define the following terms in relation to instrumentation system (6marks)
   (i) Accuracy
   (ii) Repeatability
   (iii) Sensitivity

b) Distinguish between the following terms as applied in instrumentation: (9 marks)
   i. Mean and median
   ii. Atmospheric and absolute pressure
   iii. Null-type and deflection-type instruments

c) With the aid of a diagram explain the working of a capacitive load cell. (6 marks)

d)
   i. State three physical measurements.
   ii. A displacement transducer with a shaft stroke of 3.0 in. is applied in the circuit of Figure below. The total resistance of the potentiometer is 5K, and the applied voltage V_T=5.0V. When the wiper is 0.9 in. from B what is the value of the output voltage V_O? (9marks)



QUESTION TWO (20 MARKS)

a) Explain the working principle of a resistance temperature detector (RTD).

(4 marks)

b) Explain the following components of biomedical instrumentation system.

i. Measurand
ii. Signal conditioner
iii. Display

(6 marks)

c) Explain the digital data acquisition system with the aid of a block diagram.

(10 marks)

QUESTION THREE (20 MARKS)

a)

(i) Define the term telemetry.

(ii) State two applications of telemetry. (4 marks)

b) Explain the working principle of a photo electric transducer. (5 marks)

c) A 10kΩ negative temperature coefficient (NTC) thermistor has a "β" value of 3455 between the temperature range of 25°C and 100°C. Calculate its resistive value at 25°C and again at 100°C. Data given: B = 3455, R1 = 10kΩ at 25°. In order to convert the temperature scale from degrees Celsius, °C to degrees Kelvin add the mathematical constant 273.15. Hence complete the table below and plot the variation of resistance as a function of temperature.

Temperature (°C)	20	25	30	40	50	60	70	80	90	100	110
Resistance (Ω)											

(11 marks)

QUESTION FOUR (20 MARKS)

a) (i) What is a manometer?

(ii) State two applications of a U-tube manometer. (4 marks)

b) Explain the application of a Wheatstone bridge in the measurement of temperature. (6 marks)

(c) With the aid of a diagram explain the working of a U-tube manometer.

(10 marks)

QUESTION FIVE (20 MARKS)

a) Define the terms (4 marks)
   (i) Load cell
   (ii) Earth conductor

b) Explain the use of a search coil in the measurement of varying magnetic fields (6 marks)
   Describe the construction of a linear variable differential transformer (LVDT). (10 marks)