

KISII UNIVERSITY
UNIVERSITY EXAMINATIONS

**THIRD YEAR EXAMINATION FOR THE AWARD OF
THE DEGREE OF BACHELOR OF SCIENCE (RENEWABLE ENERGY)**

SECOND SEMESTER 2021/2022
(FEBRUARY – JUNE, 2022)

PHRE 325: INSTRUMENTATION

STREAM: Y3 S2

TIME: 2 HOURS

DAY: MONDAY, 12:00 PM – 2:00 PM

DATE: 30/05/2022

INSTRUCTIONS

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

QUESTION ONE (30 MARKS)

- a) Define the following terms in relation to instrumentation system
- | | |
|-----------------------|----------|
| (i) System | (1 mark) |
| (ii) Resolution | (1 mark) |
| (iii) Dynamic error | (1 mark) |
| (iv) Fidelity | (1 mark) |
| (v) Active instrument | (1 mark) |
- b) Distinguish between the following terms as applied in instrumentation:
- | | |
|--|-----------|
| i. Active and passive transducers | (4 marks) |
| ii. Static and dynamic characteristics | (4 marks) |
| iii. Gross and random errors | (4 marks) |
| iv. Analogue and digital instruments | (4 marks) |

c) i. Explain SI system and state any three of its basic units.

(4 marks)

ii. An electrode diaphragm pressure transducer has plates whose area is $5 \times 10^{-3} \text{ m}^2$ and whose distance between plates is $1 \times 10^{-3} \text{ m}$. Calculate its capacitance if it measures air pressure. The dielectric constant of air is $k=1$.

(5 marks)

QUESTION TWO (20 MARKS)

a) A platinum resistance thermometer has a resistance of 150Ω at 20°C . Calculate its resistance at 50°C ($\alpha_{20} = 0.00392$).

(4 marks)

b) State and explain two types of data acquisition systems

(6 marks)

c) Explain five components of biomedical instrumentation System.

(10 marks)

QUESTION THREE (20 MARKS)

a) i) Explain the term telemetry.

(2 marks)

ii) State three advantages of telemetry.

(2 marks)

b) Explain the working principle of a thermocouple.

(5 marks)

c) A linear variable differential transformer (LVDT) has a stroke length of $\pm 150\text{mm}$ and produces a resolution of 40mV/mm . Determine;

i) The LVDT's maximum output voltage

ii) The output voltage when the core is moved 120mm from its null position

iii) The core position from center when the output voltage is 3.75 volts

iv) The change in output voltage when the core is moved from +80mm to -80mm displacement.

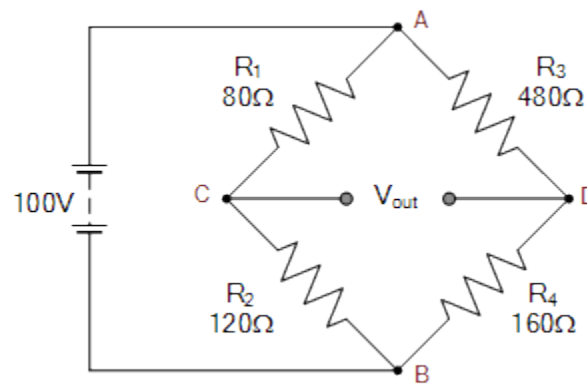
(11 marks)

QUESTION FOUR (20 MARKS)

a) (i) Explain the concept environmental measurement (2 marks)

(ii) Describe two environmental instruments in practice. (2 marks)

b) The following unbalanced Wheatstone bridge is constructed. Calculate the output voltage across points C and D and the value of resistor R_4 required to balance the bridge circuit.



(6marks)

(c) With a side view of the orifice plate assembly and pressure-measuring instrument explain howto measure the flow rate of a fluid. Sketch the mathematical characteristic of this flow measurement technique.

(10 marks)

QUESTION FIVE (20 MARKS)

a) Explain the following terms

(i) Hall probe (2 marks)

(ii) Transducer (2 marks)

(iii) RTD (2 marks)

b) A slice of semi conducting material 0.5 mm thick is placed at right angles to a magnetic field of flux density 0.05 T. If a Hall voltage of 0.3 mV is generated across the specimen when a current of 100 mA flows through it calculate the number of free electrons per cubic metre of the specimen.

(4 marks)

c) With the aid of a diagram explain the working of a pneumatic load cell.

(10 marks)