NATIONAL UNIVERSITY OF SCIENCE AND TECHNOLOGY

FACULTY OF SCIENCE AND TECHNOLOGY EDUCATION

DEPARTMENT OF TECHNICAL AND ENGINEERING EDUCATION AND TRAINING

PTE 2153 INSTRUMENTATION AND CONTROL

First Semester Examination

NOVEMBER 2024

This examination paper consists of 3 pages

Time allowed: 3 hours **Total Marks: 100**

Special requirements: NONE **Examiner's name: Mrs D. Chasokela**

INSTRUCTIONS

1. The paper consists of 3 printed pages with 6 questions.
2. Each question carries 20 marks.
3. Answer any 5 questions.

MARK ALLOCATION

QUESTION	MARKS
1.	**20**
2.	**20**
3	**20**
4.	**20**
5.	**20**
TOTAL	**100**

Question 1

a) Explain the terminology accuracy, precision, error, sensitivity, and repeatability in measurement systems. **[5 marks]**

b) Represent a system using a block diagram. **[5 marks]**

c) Discuss the main sources of error in measurement systems and provide examples. **[10 marks]**

Question 2

a) Compare and contrast active and passive sensors and give two examples of each. **[10 marks]**

b) Describe the working principle of a thermocouple and discuss its typical applications in industry. **[10 marks]**

Question 3

In instrumentation draw the symbol for the following switches and briefly explain how they operate: temperature, level switch, speed switch, limit switch, proximity switch, hand switch, and flow switch. **[20 marks]**

Question 4

a) A cylindrical steel rod with a diameter of 10 mm and a length of 1 m is subjected to a tensile force of 10 kN. Calculate the:

(i) stress in the rod (in MPa). **[3 marks]**

(ii) The strain in the rod if the modulus of elasticity of steel is 200 GPa. **[3 marks]** (iii) The extension (in mm) of the rod under the applied load. **[4 marks]**

b) In tensile testing, the table below shows the load and extension of a material. Calculate the sensitivity of the material.

LOAD (kg)	0	10	20	30	40	50	60	70	80	90	100
EXTENTION (mm)	0	1.5	3.1	5.0	6.8	9.2	11.5	13.9	15.6	18.0	20

[10 marks]

Question 5

a) What is the purpose of calibration in instrumentation? Describe the general procedure for calibrating a micrometer.

[5 marks] b) Differentiate a digital instrument from an analogue instrument. **[5 marks]**

c) A copper wire has a length of 2 meters and a diameter of 1 mm. The wire is measured and found to have a resistance of 0.5 ohms. Calculate the resistivity of copper. **[10 marks] Question 6**

A metal wire has a resistance of 10 ohms at 20°C. When the temperature is increased to 80°C, the resistance of the wire measures 12 ohms. Calculate the temperature coefficient of resistance of the metal wire. **[20 marks]**