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University of Ruhuna- Faculty of Technology

Bachelor of Engineering Technology Honours

Level 2 (Semester 2) Examination, November/December - 2022

Course Unit: ENT2232 – Instrumentation & Calibration

Duration: 2 hours

Instruction to Candidates

- Read all instructions carefully before answering the questions
- Answer all **Five (05)** questions.
- All questions carry equal marks.
- Calculators are allowed.
- Present necessary, but relevant facts and information briefly. Any missing information can be sensible and reasonably assumed, provided that you state them clearly.

1.

i. Define the term "variable", and give two (02) examples of variables.

(05 marks)

ii. In a particularly remote area, there is a spike in the number of people with water-borne diseases. The water quality of the area is said to be below the standards. Consider the following assumptions:

- Acidity/basicity of the water may fluctuate above the normal values due to the use of agrochemicals.
- These agrochemicals may change the level of ion conduction/conductivity in water.
- Level of ion conduction changes with temperature.

You are asked to design a measuring system to monitor water quality. For that, identify and write down the parameters that you are going to measure, considering the above conditions.

(06 marks)

iii. Draw a block diagram of a measuring system indicating the three (03) main functional elements.

(06 marks)

iv. Identify the above-stated functional elements in relation to an instrument that measures force.

(03 marks)

2.

i. State the three (03) main types of errors that could occur in a measurement. (03 marks)

ii. Briefly explain the three (03) types of instrumental errors with examples. (06 marks)

iii. The current in a circuit is determined by measuring the voltage drop across a resistor. If the resistor value is 200 (± 5%) Ω and the voltmeter reading V = 2.50 (±0.01) V, Calculate the current, I, and the associated error.

(06 marks)

iv. Derive dimensions for the following where each symbol denotes its usual meanings.

a. Universal Gravitation Constant (G); $F = \frac{Gm_1m_2}{r^2}$

b. α and β; $T = 2\pi\sqrt{\frac{\beta}{g-\alpha}}$

(05 marks)

3.

i. Illustrate accuracy and precision using suitable diagrams. (04 marks)

ii. What is tolerance? (02 marks)

iii. A spring balance is calibrated in an environment at a temperature of 20 ^{0}C and has the following deflection/load characteristics.

Load / Kg	0	1	2	3	4
Deflection (Degrees)	0	0	20	40	60

a. State the independent and dependent variables. (02 marks)

b. Sketch a graph for the above deflection/load characteristics. Label the axes and other relevant information. (05 marks)

c. Which of the following static measurement characteristic/s are evident in the input-output graph you sketched above: nonlinearity, dead space, threshold, sensitivity? (02 marks)

d. Determine the static measurement characteristic/s you mentioned in part c above. (05 marks)

4.

i. State four (04) applications of instrument systems. (04 marks)

ii. Draw block diagrams with essential functional elements for the following measuring systems in figure 1(a) and figure 1(b).

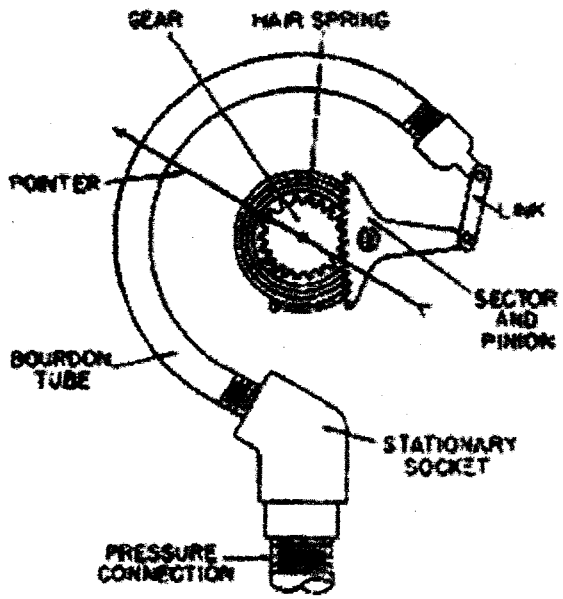

Figure 1(a)

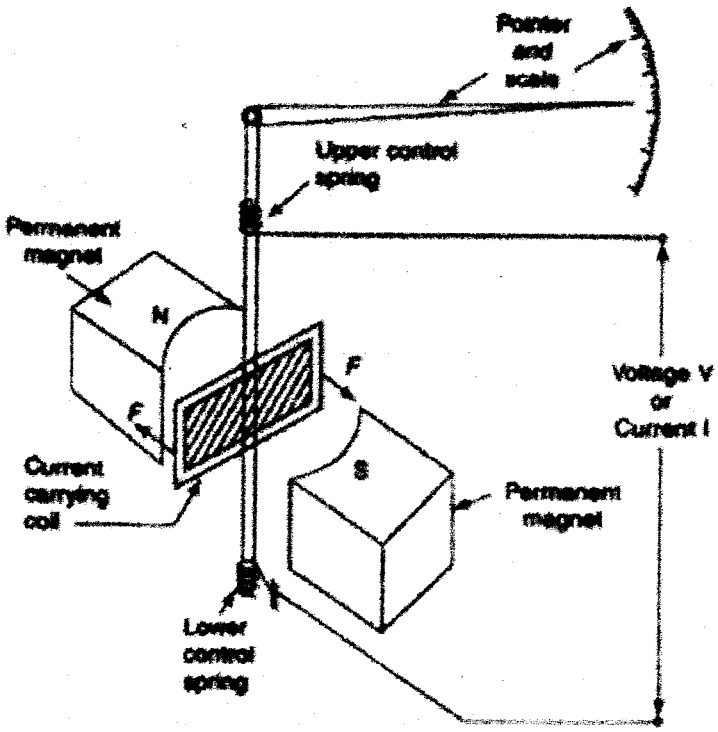

Figure 2(b)

(14 marks)

iii. Give two (02) examples of measuring instruments/systems used in each of the following areas:

a. Military & Aerospace

b. Automobile

(02 marks)

5.

i. State the two (02) fundamental types of calibration. (02 marks)

ii. Give four (04) reasons why periodic calibrations are important in industries.

(04 marks)

iii. "All calibrations should be performed traceable to a nationally or internationally recognized standard"

a. Explain the term traceability. (04 marks)

b. Define the five measurement standards related to calibration.

(10 marks)

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