JARAMOGI OGINGA ODINGA UNIVERSITY OF SCIENCE AND TECHNOLOGY

SCHOOL OF ENGINEERING AND TECHNOLOGY

UNIVERSITY EXAMIMATION FOR THE DEGREE IN SCIENCE IN RENEWABLE ENERGY TECHNOLOGY AND MANAGEMENT

2ND YEAR 2ND SEMESTER 2023/2024 ACADEMIC YEAR

CENTRE: MAIN CAMPUS

COURSE CODE: TEB 1211

COURSE TITLE: MEASUREMENT AND INSTRUMENTATION

EXAM VENUE: **STREAM: BSc. REN ENGY TEC & MGT**

DATE: /04/2024   **EXAM SESSION:**

DURATION: 2 HOURS

Instructions

1. **Answer question 1 (Compulsory) and ANY other two questions**

2. **Candidates are advised not to write on question paper**

3. **Candidates must hand in their answer booklets to the invigilator while in the examination room.**

QUESTION ONE

Q1 (a) (i) Define measurement, instrument and instrumentation.   **(3 Marks)**

 (ii) Briefly explain the three essential aspects of instrumentation systems. **(6 Marks)**

Q1 (b) Explain each of the following characteristics used to describe the performance of instrument systems, giving clear examples.

(i) Accuracy **(ii)** Precision **(iii)** Repeatability **(v)** Reproducibility   **(6 Marks)**

(vi) Differentiate between static and dynamic characteristics, giving examples (**4 Marks**)

QUESTION TWO

Q2 (a) (i) Explain why every measurement must contain an error, giving examples. **(6 Marks)**

(ii) In a schematic logical diagram show how the errors above result in Total Error. **(3 Marks)**

(iii) What are causes of each error and how can each of these errors be eliminated during measurement? Give at least two common methods of elimination   (**4 Marks**)

2Q (b) Use the given table below to solve the following questions.

	TEST FREQUENCY (HZ)	INDICATED FREQUENCY (HZ)
1	10.0	8.0
2	100.0	108.0
3	200.0	190.0
4	500.0	510.0
5	1000.0	998.0

Q2 (b) (i) Determine the systematic error of the instrument that is being tested; give any assumptions taken and clearly explain the meaning of your results.   **(2 Marks)**

(ii) What action would you take once you have estimated the above error?   **(1 Mark)**

(iii) Find the probable error in the distributed frequency (HZ) from the data of systematic error you generated from the table of measurement in **Q2b (i).**   **(2 Marks)**

(iv) Evaluate the total error in the measurement exercise process take above. **(1 Mark)**

(v) Calculate the class of the class of the instrument in the above measurement if it has a scale with a range of 0 to 100 Hz   **(1 Mark)**

QUESTION THREE

Q3 (a) Explain clearly the difference between analogue and digital instruments, in terms of their output variation, number of values, pointer positions and discrimination. Give one example of each of the two instruments. **(5 Marks)**

Q3 (b) Why has the distinction between analogue and digital instruments become so particularly important with the rapid growth in the application of microcomputers to automatic control systems? **(5 Marks)**

Q3 (b) (i) Explain the three basic elements of instrumentation system. Give examples. (**3 Marks)**

(ii) List the five-broad range of consideration used in categorization of transducers. Give two examples of each categorisation. **(4 Marks)**

QUESTION FOUR

Q4 (a) With the aid of a clearly labelled diagram, briefly explain fully the basic working of moving coil instrument, showing how the total moment is created in N turns of a coil, then derive the deflection equation from the total moment. **(10 Marks)**

4(b) (i) Using diagrams, show how the moving coil meter movement can be adapted to measurements of voltages and current to results in instruments called Voltmeter and Ammeter. **(2 Marks)**

4(b) (ii) A moving coil-coil instrument gives full-scale deflection with 2mA and full-scale deflection voltage is 1 mV.

  (i)   Find the value of a multiplier resistance to extend its range to measure voltages in the range of 0-100volts. **(2 Marks)**
  (ii)   Find the value of a shunt resistor to enable the meter to indicate currents within the range 0 to 50 Amperes. **(1 Mark)**

Q4 (c) List four merits and four demerits of employing the moving coil instrument**. (2 Marks)**

QUESTION FIVE

Q5 (a) Draw a cathode ray oscilloscope and labelled all the major parts, giving describing clearly the function of each of these parts. **(13 Marks)**

 Q5 (b) Draw a typical face panel of an oscilloscope **(1 Mark)** then label, and explain the function of any three important features on the scope **(3 Marks)**.