INTERNATIONAL UNIVERSITY OF EAST AFRICA

'Learning to Succeed'

FACULTY OF ENGINEERING

END OF SEMESTER EXAMINATIONS - APRIL 2025

PROGRAMME: BACHELOR OF ELECTRICAL AND CONTROL ENGINEERING

YEAR/SEM: YEAR 2/SEMESTER 2

COURSE CODE: ELE2211

NAME: ELECTRICAL MEASUREMENT & INSTRUMENTATION II

DATE: 2025-04-15

TIME: 9:00AM-12:00PM

INSTRUCTIONS TO CANDIDATES:

1. Read the instructions very carefully
2. The time allowed for this examination is STRICTLY three hours
3. Read each question carefully before you attempt and allocate your time equally between all the Sections
4. Write clearly and legibly. Illegible handwriting cannot be marked
5. Number the questions you have attempted
6. Use of appropriate workplace examples to illustrate your answers will earn you bonus marks
7. Any examination malpractice detected will lead to automatic disqualification.

DO NOT WRITE ANYTHING ON THE QUESTION PAPER

Section A Answer any TWO questions from this section

Question 1:

a What are the advantages and uses of the LVDT? (5 Marks)

b) What are capacitive transducers? (5 Marks)

c What are their advantages and disadvantages? (5 Marks)

d) Explain the working, construction and applications of thermistors. Compare resistance temperature characteristics of a typical thermistor and platinum. (10 Marks)

Question 2:

a) Explain the working principle of a linear variable differential transformer (LVDT). Show how it can be used for measuring small mechanical displacements. (10 Marks)

b) What are its advantages and uses? (5 Marks)

c) Write down the construction and working principle of a thermocouple. Compare different thermocouple materials. Describe the advantages, disadvantages and applications of thermocouple. (10 Marks)

Question 3:

a) Distinguish between active and passive electrical transducers and give some examples of them. (7 Marks)

b) What are the differences between sensors and transducers? (4 Marks)

c) Describe a method for measurement of differential pressure.(14 Marks)

Question 4:

a) What is the definition and importance of *primary sensing element?. (3 Marks)*

b) Enlist some of the most commonly used primary sensing elements. (7 Marks)

c) Name different elastics pressure elements and give their useful working range and other characteristics. (15 Marks)

Section B Answer any TWO questions from this section

Question 1:

a) An analog to digital converter (ADC) measures voltages in the range of 0 to 25 V and has 12-bit accuracy. What is the smallest voltage step that the ADC can resolve? **(5 MARKS)**

b) Determine the number of output bits required for an ADC so that quantizing error less than 1 %.**(5 MARKS)**

c) A ramp-type ADC system uses a 10 MHz clock generator and a ramp voltage that increases from 0 V to 1.25 V in a time of 125 ms. Determine the number of clock pulses counted into the register when V = 0.9 V, and when it is 0.75 V. **(7 MARKS)**

d) If 3.45 V is applied to a 4-bit successive-approximation-type A/D converter which has a reference voltage of 5 V, what will be the digital output of the ADC? **(8 MARKS)**

Question 2:

a) What are the advantages of a digital voltmeter over analog type? What are its types? With a block diagram, explain the working of an integrating type. Compare its performance with other types. **(10 Marks)**

b) Explain the operating principle of a DVM using a suitable block diagram. With a neat sketch, describe the operating principle of dual slop integrating type of DVM. **(5 Marks)**

c) With the help of a functional block diagram, describe the principle of operation of a digital multimeter. **(15 Marks)**

Question 3:

a) The output of an LVDT is connected to a 5 V voltmeter through an amplifier of amplification factor 250. The voltmeter scales has 100 divisions and the scale can be read to 1/5th of a division. An output of 2 mV appears across the terminals of the LVDT when the core is displaced through a distance of 0.5 mm. Calculate (a) the sensitivity of the LVDT, (b) that of the whole set up, and (c) the resolution of the instrument in mm. **(25 MARKS)**

Question 4:

a) How are the digital input and output system connected with digital I/O pins of DAQ hardware? How do the devices connected with IEEE 488 bus communicate with each other? **(8 Marks)**

b) What are the different components of a DAQ? Briefly discuss those. **(6 Marks)**

c) What are the different signal-conditioning units a data acquisition system contains? Briefly discuss those. **(4 Marks)**

d) An 8-bit ADC is converting a temperature signal which has a measuring range of 0 deg C to 800 deg C. Calculate the resolution of the temperature-measuring instrument. **(2 Marks**