(University of Choice)
MASINDE MULIRO UNIVERSITY OF SCIENCE AND TECHNOLOGY (MMUST)

MAIN CAMPUS
UNIVERSITY EXAMINATIONS
2023/2024 ACADEMIC YEAR

FOURTH YEAR FIRST SEMESTER

MAIN EXAMINATIONS

FOR THE DEGREE
OF
BACHELOR OF TECHNOLOGY EDUCATION
IN
ELECTRICAL AND ELECTRONIC ENGINEERING

COURSE CODE: TEE 414

COURSE TITLE: MEASUREMENT & INSTRUMENTATION

DATE: THURSDAY 14/12/2023   **TIME: 12.00 PM - 2.00 PM**

INSTRUCTIONS TO CANDIDATES

Question ONE (1) is compulsory
Answer Any Other TWO (2) questions
Constants:

TIME: 2 Hours

MMUST observes ZERO tolerance to examination cheating

This Paper Consists of 4 Printed Pages. Please Turn Over.

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QUESTION ONE (Compulsory)

(a) Explain virtual instrumentation system and state four advantages of virtual instruments. **[2 Mks]**

(b) Explain the classification and working principle of optical transducer. **[4 Mks]**

(c) Distinguish between analog and digital instrumentation systems. Enumerates advantages of digital instruments. **[4 Mks]**

(d) State and explain two sources of Noise in Instrumentation Systems. **[3 Mks]**

(e) With neat circuit diagram, derive the equations for measurement of capacitance using Schering bridge. **[4 Mks]**

(f) Enumerate two advantages of LVDTs **[1 Mks]**

(g) A moving coil voltmeter has a uniform scale with 100 divisions, the full-scale reading is 200 V and 1/10 of a scale division can be estimated with a fair degree of certainty. Determine the resolution of the instrument in volt. **[2 Mks]**

(h) Explain the working principle of capacitive and resistive sensors. **[4 Mks]**

(i) Using neat diagram, explain the working principle of Hall-effect Sensors. **[4 Mks]**

(j) Derive the equation of balance for Anderson bridge. **[2 Mks]**

QUESTION TWO

(a) With an aid of well labelled diagram, explain instrumentation amplifier operation principle and state areas of application. **[6 Mks]**

(b) State and explain three types of light transducers. **[6 Mks]**

(c) Analog- to- Digital converters are used to convert the electrical signals to their digital equivalent. However, in real world applications, the signal produced from sensors is continuously varying hence the need for a sample and hold circuit. With the aid of relevant circuit diagrams, describe a typical circuit diagram of the sample and hold operations. **[5 Mks]**

(d) An AC bridge is balanced at 2KHz with the following components in each arm: Arm AB=10KΩ, Arm BC=100μF in series with 100KΩ, Arm AD=50KΩ Find the unknown impendence R±jX in the arm DC, if the detector is between BD. **[3 Mks]**

QUESTION THREE

(a) Describe the construction and principle of operation of an LVDT transducer. [6 Mks]

(b) State and explain **three** techniques for reducing measurement noise. [6 Mks]

(c) Why is damping required for an electromechanical measuring instrument? [2 Mks]

(d) Using a block diagram, explain the architecture of a virtual instrument. [6 Mks]

QUESTION FOUR

(a) Explain **four** methods for Data Transmission of instrumentation system. [4 Mks]

(b) Describe the difference between deflection and null type of instruments giving suitable examples. Discuss about their accuracy, sensitivity, and suitability for dynamic measurement. [6 Mks]

(c) Explain the following terms in reference to measurement system.

     i. Drift
     ii. Sensitivity
     iii. Measuring lag
     iv. Precision. [4 Mks]

(d) With an aid of well labelled diagram, explain the generalized Telemetry System. [6 Mks]

QUESTION FIVE

a) State **four** comparisons between Traditional instruments vs Virtual instruments. [4 Mks]

b) A strain gauge is bonded to a beam 0.1m long and has a cross section area 4cm2. Young modulus for steel is 207GN/m2. The strain gauge has unstrained resistance of 240 Ω and a gauge factor of 2.2. When a load is applied the resistance of the gauge changes by 0.013Ω. Calculate the change in length of the steel beam and the amount of force applied to the beam. [6 Mks]

c) With a well labelled diagram, explain Microprocessor based Instrumentation system. [10 Mks]