(University of Choice)

MASINDE MULIRO UNIVERSITY OF SCIENCE AND TECHNOLOGY (MMUST)

MAIN CAMPUS

UNIVERSITY EXAMINATIONS
2021/2022 ACADEMIC YEAR

THIRD YEAR SPECIAL/SUPP EXAMINATIONS

FOR THE AWARD
OF
DIPLOMA IN ENGINEERING

COURSE CODE: DEE 086

COURSE TITLE: INSTRUMENTATION

DATE: Friday 7ᵗʰ Oct, 2022   **TIME:** 8.00a.m – 10.00a.m

INSTRUCTIONS TO CANDIDATES

ANSWER QUESTION ONE AND ANY OTHER TWO QUESTIONS.
QUESTION ONE CARRIES 30 MARKS AND ALL OTHERS 20 MARKS EACH.

TIME: 2 Hours

MMUST observes ZERO tolerance to examination cheating

This Paper Consists of 3 Printed Pages. Please Turn Over.

QUESTION ONE (30mks)

a) (i) Define the term instrumentation. (2Mks)

(ii) With the aid of a labelled diagram, explain the FOUR blocks of an instrumentation system giving an example in each case. (8Mks)

b) (i) State and explain the **four** dynamic characteristics of a measuring instrument. (4Mks)

(ii) List THREE causes of Systematic errors in an instrument. (3Mks)

c) (i) A parallel plate capacitor has an area of $0.4cm^2$ and distance between the plate is 15mm. Calculate its capacitance given dielectric constant of the material is 2.5. Taking Absolute permittivity $\epsilon_0 = 8.85 \times 10^{-12}$ F/m. (3Mks)

d) The figure below shows a block diagram for a BCD to seven segment display. Complete the bit pattern for the table below. (8Marks)
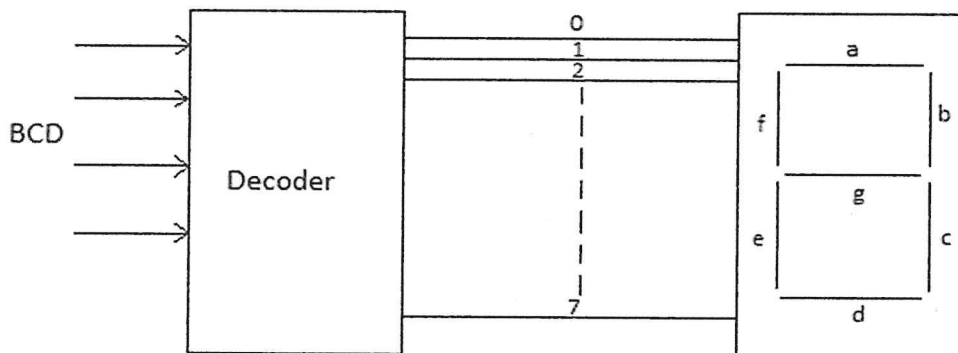
e)

Decimal number	BCD CODE D C B A	7 SEGMENT OUTPUT a b c d e f g
0	0 0 0 0	1 1 1 1 1 1 0
1	0 0 0 1	0 1 1 0 0 0 0
2	0 0 1 0	1 1 0 1 1 0 1
3	0 0 1 1	1 1 1 1 0 0 1
4	0 1 0 0	0 1 1 0 0 1 1
5	0 1 0 1	1 0 1 1 0 1 1
6	0 1 1 0	1 0 1 1 1 1 1
7	0 1 1 1	1 1 1 0 0 0 0
8	1 0 0 0	1 1 1 1 1 1 1
9	1 0 0 1	1 1 1 0 0 1 1

f) State any two properties of an ideal operational amplifier. (2Mks)

QUESTION TWO

a) Define calibration. (1Mks)

b) Name FOUR types of standards and state where they are found. (4Mks)

c) Give three merits of an Electronic Instrumentation System. (3Mks)

d) State the two types of Transducer classification. (2Mks)

e) (i) With an aid of a schematic and circuit diagram, explain the principle of operation of a Resistive position transducer. (4Mks)

(ii) From (i) above, calculate the output voltage of the system given that input voltage is 12V and R1,R2 is 50k,100k respectively. (3Mks)

(iii) A platinum resistance thermometer has a resistance of 100Ω at 25^0C. Temperature coefficient of platinum is 0.00392 Ω/Ω^0C. Determine resistance at 65^0C. (3Mks)

QUESTION THREE

a) The figure below shows a Digital to Analogue Converter with binary weighted resistors. Calculate the output Voltages of a digital values of 3-bit DAC given that V_R is **5V**.
   (i) 001_2 (3Mks)
   (ii) 101_2. (3Mks)
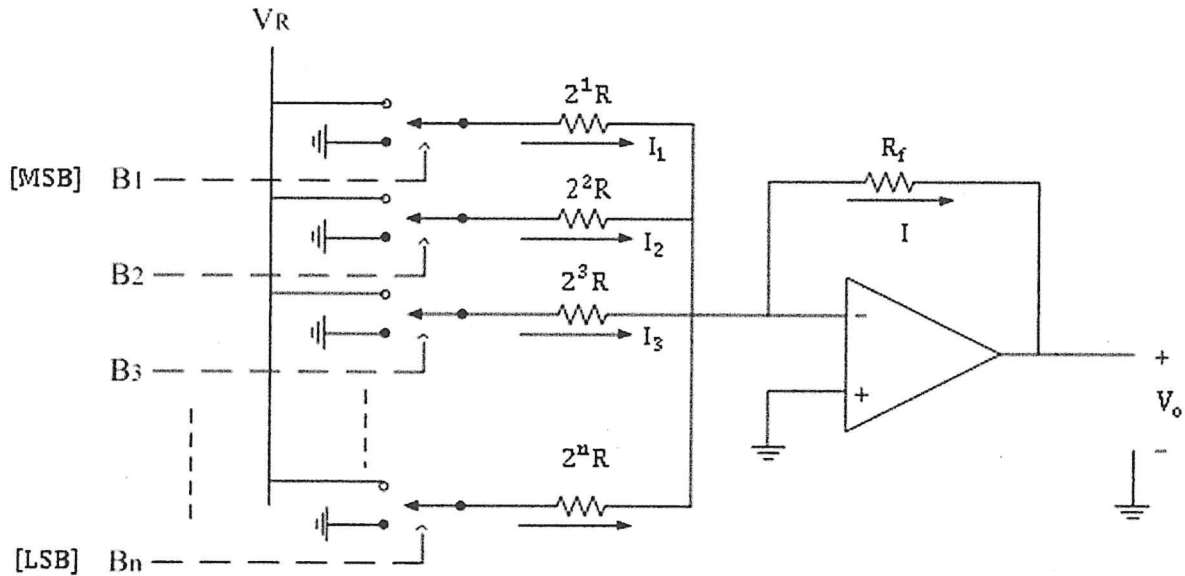
b) With the help of a suitable diagram, explain the operation of Linear Variable Differential Transformer (LVDT) (8Mks)
c) By use of relevant sketches, illustrate the characteristics of an instrument that exhibits hysteresis defining all the terms involved. (6Mks)

QUESTION FOUR

a) What is a Transducer as used in Electrical Instrumentation? (2Mks)
b) Define the TWO types of Electrical transducers and give an example in each. (4Mks)
c) (i)With the aid of a well labelled diagram, explain the operation of Elastic diaphragm gauge. (10Mks)
   (ii) Give two merits and demerits of the above instrument respectively. (4Mks)
       Merits

QUESTION FIVE

a) Using successive approximation, a 4-bit is used to convert analogue input voltage of V_A of 11 V. What will be its equivalent Digital output? (4Mks)
b) Using relevant equations and diagram, show that the output of an Instrumentation Amplifier is: (16Mks)