KIBABII UNIVERSITY

UNIVERSITY EXAMINATIONS
2021/2022 ACADEMIC YEAR

FOURTH YEAR SECOND SEMESTER
MAIN EXAMINATIONS

FOR THE DEGREE OF BSC (PHYSICS)

COURSE CODE: SPC 421

COURSE TITLE: MEASUREMENT & INSTRUMENTATION

DURATION: 2 HOURS

DATE: 06/09/2022 **TIME: 2:00-4:00PM**

INSTRUCTIONS TO CANDIDATES

- Answer **QUESTION ONE** (Compulsory) and any other two (2) Questions.
- Indicate **answered questions** on the front cover.
- Start every question on a new page and make sure question's number is written on each page.

This paper consists of **3** printed pages. Please Turn Over

QUESTION ONE [30Marks]

1. a) Define the term 'unit of measurement' [2mks]
   b) State and explain any two types of standards. [4mks]
   c) State the similarities between Electronic Counters and Digital Voltmeters [4mks]
   d) Identify any three sensors an engineer is likely to use in measuring temperature [3mks]
   e) Differentiate between determinate and indeterminate errors [2mks]
   f) Highlight any two main causes of random errors. [2mks]
   g) Define the term calibration [2mks]
   h) Explain any two methods of instrument calibration. [4mks]
   i) State and explain any two static characteristics of measuring instruments. [4mks]
   j) Identify any three types of systematic errors [3mks]

QUESTION TWO [20Marks]

a) A 150-V DC voltage source is coupled to a 50 kΩ load resistor through a 100 kΩ source resistance. Two voltmeters (A) and (B) are available for the measurement. Voltmeter-A has a sensitivity 1000 Ω/V, while voltmeter-B has a sensitivity 20000 Ω/V. Both meters have 0 – 50 V range.

i) Calculate reading of each voltmeter. [4mks]

ii) Calculate error in each reading expressed in a percentage of the true value [4mks]

b) In chemical process industries, the most commonly used temperature sensors are thermocouples, resistive devices and infrared devices. Briefly describe these devices. [12mks]

QUESTION THREE [20Marks]

a) What is a digital voltmeter (DVM)? State any four advantages of the DVM. [5mks]

b) Use a block diagram to illustrate the principle of operation of a digital voltmeter. [7mks]

c) Using diagrams explain how the Analog to Digital Converter (ADC) works [8mks]

QUESTION FOUR [20Marks]

a) Using a well labeled diagram, explain the working mechanism of a wheatstone bridge in measuring resistance. Indicate its equivalent circuit configuration, derive the balance equation and show how it can be used to measure the output voltage. [10mks]

b) Briefly explain the AC voltmeters and show that the average power is equivalent to the power that would be generated by a DC current called the effective current i.e

$I_{eff}=0.707I_m$ [10mks]

QUESTION FIVE [20Marks]

a) Using a flow diagram, describe the various elements of a generalized measurement system. [6mks]

b) Draw a well labeled schematic diagram of a cathode ray tube and highlight the functions of its four basic parts [8mks]

c) Explain the various limitations of the Oscilloscope as a Measuring Instrument [6mks]

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