**CHUKA**  **UNIVERSITY**



**UNIVESRITY EXAMINATION**

**RESIT/SPECIAL EXAMINATION**

**EXAMINATION FOR THE AWARD OF DEGREE OF BACHELOR OF SCIENCE IN FOOD SCIENCE AND TECHNOLOGY**

**FOST 233: FOOD PROCESSING INSTRUMENTATION AND CONTROL**

**STREAMS:** **TIME: 2 HOURS**

**DAY/DATE: TUESDAY 02/11/2021** **11.30 A.M – 1.30 P.M**

**INSTRUCTIONS**

- **Answer ALL questions in Section A and any TWO in Section B**
- **Do not write anything on the question paper. All rough work to be done on the answer booklet and crossed through**.

**SECTION A: Answer all questions (30 Marks)**

1. Differentiate between the following terms as used in food instrumentation (use diagrams where necessary);
   - **a)** Measurement and evaluation of a process **(3 Marks)**
   - **b)** Accuracy and precision of a measuring instrument **(4 Marks)**
   - **c)** Transducer and a sensor **(3 marks)**
2. Show your understanding of the following pressure measurement devices
   - **a)** Bourdon tube **(4 Marks)**
   - **b)** Bellows **(3 Marks)**
   - **c)** Manometer **(3 Marks)**
3. During initial stages of design and layout of a food pilot plant at Chuka University, the width of the laboratory is measured in order to place different equipment appropriately. An ultrasonic rule is used which gives the following measurements (in metres): **4.431, 4.429, 4.428, 4.432, 4.430, 4.433, 4.429, 4.427, 4.430** and **4.431**. The width of the same room is then measured by a calibrated steel tape that gives a reading of **4.424**, which can be taken as the correct value for the width of the room.
   - **a)** What is the measurement precision of the ultrasonic rule? **(4 Marks)**
   - **b)** What is the maximum measurement inaccuracy of the ultrasonic rule? **(4 Marks)**
   - **c)** Comment on the values obtained in (a) and (b) above **(2 Marks)**

**SECTION B: Answer any two questions (40 MARKS)**

**4.** You have been contracted as the instrumentation and control engineer at an upcoming fruit processing plant in Thika, Kenya. The directors of the company want you to guide them in the sourcing and installation of measurement and control devices. To do this you have prepared a power-point presentation which you intend to present in the next director's meeting. Discuss the content of your presentation under the following subheadings:

**a)** How instrumentation will be useful during processing of mangoes (**8 Marks**)

**b)** Factors to consider in the selection of measurement and control devices (**9 marks**)

**c)** Any three variables that need to be controlled to assure quality of the end product (**3 Marks**)

**5.** Measurement and control of temperature is inevitable in any food processing plant. With this in mind, Explain;

**i)** The working principles of a thermocouple and bimetallic strip (**10 Marks**)

**ii)** How the desired milk pasteurization temperature is controlled and diversion is achieved in case of control failure (**10 Marks**)

**6.** Show your understanding of water level control in a steam boiler under the following subheadings

**a)** Illustrate how steam is produced and show where instruments for control mechanism are located (**7 Marks**)

**b)** Water feed system control (**3 Marks**)

**c)** Combustion system control (**2 Marks**)

**d)** Pressure and temperature monitoring and control (**2 Marks**)

**e)** Illustrate and briefly explain working of steam pressure reducers (**4 Marks**)

**f)** How a safety valve works (**2 Marks**)

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