



**2<sup>ND</sup> SEM. 2014/15**

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**UNIVERSITY OF SWAZILAND  
FINAL EXAMINATION PAPER**

**PROGRAM : BACHELOR OF SCIENCE IN FOOD SCIENCE,  
NUTRITION AND TECHNOLOGY YEAR IV**

**COURSE CODE : FSNT 410**

**TITLE OF PAPER : PROCESS CONTROL AND AUTOMATION**

**TIME ALLOWED : TWO (2) HOURS**

**INSTRUCTIONS : ANSWER QUESTION ONE (1) AND ANY OTHER  
TWO (2) QUESTIONS.**

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THE CHIEF INVIGILATOR**

**QUESTION 1 [COMPULSORY]**

- (a) Peanuts are roasted in oven at  $180^{\circ}\text{C} \pm 2^{\circ}\text{C}$ . The temperature of the oven is continuously measured using a temperature sensor to make sure the roasting temperature is within required limit. The temperature of the ambient air is  $24^{\circ}\text{C}$ . Heat is generated electrically by resistance heating system which is connected to a relay switch to turn on/off the heater based on the signal sent from the controller.
- i. With the help of a sketch (block diagram) describe how control is achieved by automatic closed-loop control structure. **(10 Marks)**
- ii. For the roasting operation identify:
1. The controlled variable
  2. Manipulated variable
  3. Set point
  4. Actuator
  5. Final control element
- (10 Marks)**
- (b) Discuss the advantages and disadvantages of feed-back control strategy and give an example of a food processing operation (unit) where such a control strategy could be used. **(10 Marks)**
- (c) Identify **five (5)** factors to be considered while selecting transducers based on their performance. **(10 Marks)**

**[TOTAL MARKS = 40]**

**QUESTION 2**

- (a) Write short notes on the following:
- i. Controlled variable
  - ii. Under damped (cyclic) response
  - iii. Settling time
  - iv. Final control elements
- (20 Marks)**
- (b) Explain how a strain gauge works and suggest how it could be used (integrated) in a food processing operation for automation and control. **(10 Marks)**

**[TOTAL MARKS = 30]**

**QUESTION 3**

- (a) Discuss the working principle of a sequential control and give an example on how it could be used in a food process operation. **(15 Marks)**
- (b) Describe On–off control and On–off control action with a differential gap and explain the advantage of one over the other, if there is any. **(15 Marks)**

**[TOTAL MARKS = 30]**

**QUESTION 4**

- (a) Explain how turbine flow meters measure flow. **(15 Marks)**
- (b) What are the points that must be considered when applying infra-red thermometers **(15 Marks)**

**[TOTAL MARKS = 30]**