



2nd SEM. 2017/18

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**UNIVERSITY OF SWAZILAND
FINAL EXAMINATION PAPER**

PROGRAMME : **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) A food is concentrated using single effect evaporator. A control valve used to regulate the flow rate of steam that is used as a heat source. A control loop is in place to attain the right concentration of the product by measuring the degree brix ($^{\circ}$ brix).
- i. With the help of a sketch (block diagram) describe how control is achieved by automatic feed-backward closed-loop control structure. **(10 Marks)**
- ii. For the evaporation system, identify the following: **(3x 2 = 6 Marks)**
1. The controlled variable
 2. manipulated variable
 3. Final control element
- (b) Describe how on/off type controller works using graphical illustration. **(14 Marks)**
- (c) Describe a programmable automation system. **(10 Marks)**
- [TOTAL MARKS = 40]**

QUESTION 2

- (a) Describe the following: **(4x5 = 20 Marks)**
- i. Settling time and maximum error
 - ii. Robustness
 - iii. Thermocouples
 - iv. under damped (cyclic response)
- (b) Show the classification of the different modes of control action. **(10 Marks)**

[TOTAL MARKS = 30]

QUESTION 3

- (a) Identify the taste quality groups and examples for the associated compounds in E-tongue **(10 Marks)**
- (b) Describe the principle behind a resistive transducer and name four (4) such transduce. **(10 Marks)**
- (c) 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 4

- (a) Outline the factors to be considered in the selection of transducers based on handling. **(12 Marks)**
- (b) Describe how time-of-flight methods work in measuring level. **(8 Marks)**
- (c) Explain how turbine flow meters measure flow. **(10 Marks)**

[TOTAL MARKS = 30]