



(The University of choice)

**MASINDE MULIRO UNIVERSITY OF
SCIENCE AND TECHNOLOGY
(MMUST)**

**UNIVERSITY EXAMINATIONS
2022/2023 ACADEMIC YEAR**

**YEAR THREE SEMESTER TWO EXAMINATIONS
(Main examination)**

BACHELOR OF SCIENCE IN FOOD SCIENCE AND TECHNOLOGY

COURSE CODE: APT 309

COURSE TITLE: Plant Utilities, Sanitation and Waste Management

DATE: 25th, April 2023

TIME: 3 – 5 PM

Instructions: This paper consists of 5 questions

Section A is compulsory, Answer any 3 questions from Section B

Observe the regulations governing clarity in expression of your answers

SECTION A

Question One (25 marks)

- (a) Outline the features of a typical CIP system that is used in plant sanitation **(5 marks)**
- (b) State and briefly discuss the physical, chemical and microbiological properties of water **(5 marks)**
- (c) Differentiate between Fire Tube and water Tube Boilers **(3 marks)**
- (d) Briefly explain how different boiler water treatment is from the typical water treatment process **(4 marks)**
- (e) Giving examples of each, distinguish between aerobic and anaerobic waste water treatment **(4 marks)**
- (f) Outline the effect of the following modifications to improve efficiency that can be incorporated in a Typical Rankine Cycle, giving the effect of each modification **(4 marks)**
 - i. Reheat
 - ii. Regeneration
- (g) Briefly discuss the functions of water in a food processing facility **(4 marks)**

SECTION B (45 marks)

Question Two (15 marks)

- (a) Differentiate between COD and BOD with respect to waste water treatment **(5 marks)**
- (b) State the elements of the Carnot cycle then Explain why the Carnot Cycle, despite being ideal has limitations and hence give the remedy for these limitations **(4 marks)**
- (c) Briefly discuss the factors to consider when establishing sanitation protocols for a food processing facility **(6 marks)**

Question Three (15 marks)

- (a) State the different sources of water that are available for the food processing industry **(5 marks)**
- (b) State and briefly discuss the requirements that a typical steam boiler should fulfil **(5 marks)**

- (c) Outline the features of the following waste water treatment systems
- i. Grit trap
 - ii. Facultative pond
 - iii. Maturation pond
 - iv. Anaerobic sludge blanket
 - v. Wetland
- (5 marks)**

Question Four (15 marks)

- (a) Outline the characteristics of air that is to be used in pneumatic applications **(5 marks)**
- (b) Differentiate between open and closed feedwater heaters **(4 marks)**
- (c) Outline how waste water from a food processing facility will be treated and hence give a schematic diagram of the process that you have outlined **(6 marks)**

Question Five (15 marks)

- (a) State and show on a psychrometric chart the different psychrometric processes **(6 marks)**
- (a) A flow of $1800\text{m}^3\text{h}^{-1}$ of air initially at a temperature of 18°C and 50% RH is to be used in an air dryer. It is heated to 140°C and passed over a set of trays in a shelf dryer, which it leaves at 60% RH. It is then reheated to 140°C and passed over another set of trays which it leaves at 60% RH again. Estimate the energy necessary to heat the air and the quantity of water removed per hour. **(9 marks)**