MANICALAND STATE UNIVERSITY OF APPLIED SCIENCES

FACULTY OF ENGINEERING, SCIENCE AND TECHNOLOGY

DEPARTMENT: CHEMICAL AND PROCESSING ENGINEERING

MODULE: ENVIRONMENTAL POLLUTION CONTROL

CODE: HCHE 525

SESSIONAL EXAMINATIONS
APRIL 2023

DURATION: 3 HOURS

EXAMINER: K. NYENYAYI

INSTRUCTIONS

1. *Answer **All** in Section A*
2. *Answer **three** questions in Section B.*
3. *Start a new question on a fresh page*
4. *Total marks 100*

Additional material(s): *Calculator.*

SECTION A

QUESTION 1

a) Describe in brief the following different methods of solid waste disposal.

i) Land disposal

ii) Thermal treatment

iii) *Biological treatment* [10]

b) **Table 1** shows selected physical and chemical characteristics of waste from wet scrubber of an incinerator in b), and their permissible limit.

Table 1

Parameter	**Value**	**Permissible limit (SI 6 of 2007)**			
		Blue	**Green**	**Yellow**	**Red**
Temperature (°C)	54	< 35	< 40	≤ 40	≤45
Total dissolved solids (mg/L)	5350	≤ 500	≤ 1500	≤ 2000	
pH	3.1	6 - 9	5 - 6	4 - 5	0 – 4
COD (mg/L)	400	≤ 60	≤ 90	≤ 150	≤ 200
Total lead (Pb, mg/L)	1.5	≤ 0.05	≤ 0.1	≤ 0.2	≤ 0.5
Phenol (mg/L)	3	≤ 0.01	≤ 0.04	≤ 0.06	≤ 0.1
Total acidity (as $CaCO_3$) (mg/L)	9950	-	-	-	-

i. State two (2) most likely characteristics of this waste, for purposes of hazardous waste classification. [2]

ii. Justify each of the two (2) characteristics stated in a). [2]

c) For the active treatment of this waste state and justify:

(i) One (1) form of chemical treatment [3]

(ii) One (1) form of physical treatment [3]

QUESTION 2

a) Briefly explain five (5) strategies used in efforts to reduce the ecological & environmental impacts of industrial activities. [15]

b) List and justify parameters that you would consider useful for characterization of citrus waste for biological treatment. [5]

SECTION B

QUESTION 3

a) Give differences between combustion, gasification and pyrolysis processes of solid waste treatment. [6]

b) Gaseous emissions from a cylindrical smokestack of an incinerator was analyzed by gas chromatography and gave 6.5 mg/ml of acid gas (anhydrous HCl). The smokestack had an internal diameter of 0.9 m and a gas exit velocity is 8 m/s. Given that the gas had an average temperature of 42 °C at 0.8 atmospheres, and that the incinerator runs for a total of 9 hours per day: Calculate the total amount of HCl emitted from the smokestack in t/day. [8]

c) List three (3) categories of industrial wastewater (effluent) treatment. Provide examples from each category. [6]

QUESTION 4

a) (i) Differentiate between aerobic and anaerobic processes.

(ii) Name some of the *suspended growth processes* and *attached growth processes* used in biological wastewater treatment. [10]

b) Design a facultative lagoon for a temperate climate when the flow rate is 3800 m^3/d and the BOD_5 is 200 mg/L. Use these steps:

1. Select a reasonable depth.
2. Calculate the surface area based on the BOD_5 areal load.
3. Calculate the volume and hydraulic detention time.
4. Calculate the volumetric loading (kg BOD_5/(1000 m^3-day)). [10]

QUESTION 5

a) Flue gases from both mobile and immobile sources must be subjected to:

- Cooling or heat recovery
- Dust separation
- Scrubbing
- Finishing treatments

With help of neat sketches, explain any **three** air pollution control devices used in achieving any of the above-mentioned processes. [14]

b) Describe the adverse effects of noise pollution and methods of control for the same. [6]

QUESTION 6

a) State the **three** types of forces that act on suspended particles in water. [3]

b) Briefly explain, with the aid of a flow diagram or otherwise, the unit operations and processes in a typical surface water treatment plant for purposes of urban drinking water supply. [10]

c) Justify the importance Break point method of chlorination during drinking water disinfection. [7]

END OF EXAMINATION