



UNIVERSITY OF ESWATINI
Faculty of Health Sciences
Department of Environmental Health Science

DEGREE IN: - ENVIRONMENTAL MANAGEMENT &
OCCUPATIONAL SAFETY AND HEALTH
- ENVIRONMENTAL MANAGEMENT
AND WATER RESOURCES

RESIT EXAMINATION PAPER 2020

TITLE OF PAPER : WASTEWATER MANAGEMENT
COURSE CODE : EHM 418
DURATION : 2 HOURS
MARKS : 100

INSTRUCTIONS :

- : READ THE QUESTIONS & INSTRUCTIONS CAREFULLY
- : ANSWER **ANY FOUR** QUESTIONS
- : EACH QUESTION **CARRIES 25** MARKS.
- : WRITE NEATLY & CLEARLY
- : NO PAPER SHOULD BE BROUGHT INTO THE EXAMINATION ROOM.
- : BEGIN EACH QUESTION ON A SEPARATE SHEET OF PAPER.

DO NOT OPEN THIS QUESTION PAPER UNTIL PERMISSION IS GRANTED BY THE INVIGILATOR.

QUESTION ONE

1A. Wastewater is to be treated in a complete mix reactor. Assuming that the reaction rate is irreversible and first order ($r = -kC$) with a reaction rate coefficient equal to 0.15 /days, determine the flow rate that can be treated if the reactor has a volume of 20 m³ and 98% treatment efficiency is required.

.....[13 Marks]

1B. What volume would be required to treat the flow rate determined in question 1A above if the required treatment efficiency is 92%?[12 Marks]

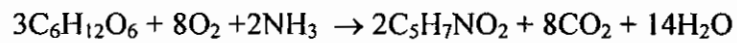
QUESTION TWO (Each question below carries five marks)

- 2A.** List the chemicals that are commonly used for the precipitation of metals from waste waters.
- 2B.** Compare the efficiency of chemical removal of phosphorous in i) primary settlement tanks and ii) secondary settlement tanks.
- 2C.** Describe with the help of a chemical equation how ammonia in wastewater may be removed by chemical oxidation processes.
- 2D.** Compare the energy efficiency of ozone/UV advanced oxidation process with that of hydrogen peroxide/UV processes for the treatment of wastewaters.
- 2E.** Discuss possible chemical pretreatment methods for scale control of wastewater that is to be treated with reverse osmosis and nano filtration processes.

QUESTION THREE

3A. Define the following terms: i) heterotrophs ii) autotrophs iii) chemoautotrophs
iv) fermentative metabolism v) respiratory metabolism.[5 Marks]

3B. Given the chemical reaction equation for the conversion of glucose to cell mass
below, compute the cell yield for this reaction.



.... [5 Marks]

3C. The rate of substrate utilization r_{su} for anaerobic processes can be expressed in
terms of the well-known Monod equation:

$$r_{su} = \frac{-kSX}{K_s + S}$$

- i. Discuss the variation of the rate of substrate utilization with i) substrate
concentration and ii) biomass present.[5 Marks]
- ii. Indicate which of the above two would be the limiting variable for
maximum substrate utilization and state the reasons.[5 Marks]
- iii. Make an approximate sketch of the rate of substrate utilization with the
substrate concentration (S) present.[5 Marks]

QUESTION FOUR

A sludge collected from primary settlement tank has an initial solids content (on dry basis) of 435 kg. Using the solids processing data given in the table below, determine:

- i. The sludge volume before anaerobic digestion[13 Marks]
- ii. The sludge volume after anaerobic digestion[12 Marks]

Parameter	Primary	Digested
Solids (%) (mass basis)	5	10
Volatile volume (%)	60	60 (destroyed)
Specific gravity of fixed solids	2.5	2.5
Specific gravity of volatile solids	≈ 1.0	≈ 1.0

QUESTION FIVE (Each question below carries 5 marks)

- 5A.** List the causes of possible toxicity in activated sludge processes and state the means of reducing or controlling toxicity.
- 5B.** Describe the possible causes of sludge bulking in activated sludge processes.
- 5C.** List the four groups of anaerobic bacteria that are involved in the degradation of organic matter in anaerobic process and state in each category the conversion of organic matter that takes place.
- 5D.** Discuss the adverse effects of the presence of oxidized sulfur compounds such as sulfate, sulfite and thiosulfate on the performance of anaerobic treatment process of wastewater.
- 5E.** Indicate possible remedial actions for the following operational problems in wastewater treatment:
- i. Poor BOD removal in trickling filters. (3 marks)
 - ii. Bulking sludge in activated sludge processes.(2 marks)