UNIVERSITY OF SWAZILAND
Faculty of Health Sciences
Department of Environmental Health Sciences

BSc Environmental Health

MAIN EXAMINATION PAPER DECEMBER 2011

|		
TITLE OF PAPER	:	INDUSTRIAL WASTE MANAGEMENT I
COURSE CODE	:	EHS:553
DURATION	:	2 HOURS
MARKS	:	100
INSTRUCTIONS	:	THERE ARE FIVE QUESTIONS IN THIS EXAM
	:	QUESTION 1 AND 2 ARE COMPULSORY AND SHOULD BE ANSWERED
	:	IN ADDITION ANSWER ANY TWO OUT OF QUESTIONS 3, 4 AND 5
	:	EACH QUESTION CARRIES 25 MARKS
	:	NO PAPER SHOULD BE BROUGHT INTO OR OUT OF THE EXAMINATION ROOM

QUESTION ONE (25 Marks)

A rectangular primary clarifier is to be designed for the treatment of an industrial waste water. The average flow rate of the industrial waste water treatment plant is 30,000 m^3/day. The highest observed peak daily flow rate is 50,000 m^3/day. The overflow rate should not exceed 50 m^3/m^2.day at any time of operation of the clarifier. Use a side water depth of 4 meters. For calculation of scour velocity assume k= 0.05, specific gravity = 1.25 and friction factor f= 0.025.

A. Determine the number of tanks operating in parallel assuming that when one tank is taken out for cleaning and maintenance each of the other tanks should carry extra discharge not more than 30% of what they carry when all tanks are in operation

...[7 Marks]

B. Determine the length, volume and detention time of the rectangular primary clarifiers assuming that the minimum length to width ratio (L:W) of each of the individual tanks is 4:1 ……...…………………………………………….[10 marks]

C. Calculate the scour velocity and determine if settled material will become resuspended or not. …………………………...…………………………….[8 marks]

QUESTION TWO (25 Marks)

A metal plating waste water contains 70 mg/L of CN^- ions. It is desired to reduce the CN^- ions to 0.1 mg/L by chlorine oxidation before the waste water is discharged from the plant. Compute the required chlorine dose at a pH of 9.0 for the oxidation of cyanaide to cyanate. Assume that the operation temperature is 25^0c and the initial chloride concentration in the waste water is 20 mg/L.

Oxidation of Cyanide with chlorine: $CN^- + OCL^- \leftrightarrow CNO^- + Cl^-$
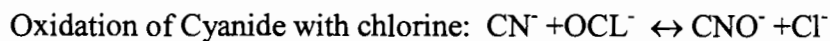
Equilibrium constant for the above equation is $K_a = 2.5 \times 10^{16}$

$HOCL \leftrightarrow H^+ + OCL^-$
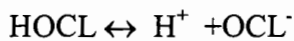
Equilibrium constant for the above equation is 3×10^{-8}

QUESTION THREE (25 Marks)

A tracer test was conducted for the flow measurement of industrial waste water effluent using sodium chloride as tracer material. The initial background Chloride concentration of the waste water before the salt was added is 15 mg/L. The test was carried out between two manholes 40 meters apart. A 10 Kg salt solution was added to the effluent line at the upstream manhole and the chloride concentration was measured at different times at the downstream manhole. The table below shows the result of the measurement. Determine the discharge of the industrial waste water effluent.

Time (Sec)	0	20	30	35	40	45	50	55	60	65	70	75	80
Chloride (mg/L)	15	15	20	40	300	380	200	60	40	20	15	15	15

QUESTION FOUR (25 Marks)

   A. A total system approach is suggested for environmental pollution control in respect of gas, liquid and solid pollution from industries. Discuss the interrelationship among these three different pollution phases by giving an example. ....[5 Marks]

   B. Explain the difference between direct emissions and fugitive emissions. ......[5 Marks]

   C. The three types of solid wastes from industries are classified as i) solid wastes ii) industrial solid wastes and iii) hazardous wastes. Briefly mention the nature of wastes generated under each category and their implication for disposal into a municipal landfill site. ....[5 Marks]

   D. Explain the difference between pilot scale and bench scale waste water treatability studies. What are the critical factors that must be taken into account when establishing a pilot scale waste water treatment studies? ....[5 Marks]

   E. What are the objectives of performing i) Preliminary design and ii) final design of waste water treatment technologies in an industrial waste management plan? [5 Marks]

QUESTION FIVE (25 Marks)

Characterize the quality of waste water generated from the following industrial processes
- **A.** Fertilizer manufacturing...[5 Marks]
- **B.** Leather tanning and finishing......................................[5 Marks]
- **C.** Pesticide chemicals..[5 Marks]
- **D.** Dairy products processing...[5 Marks]
- **E.** Cement manufacturing..[5 Marks]