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

BSc Environmental Health Science

MAIN EXAMINATION PAPER MAY 2012

TITLE OF PAPER	:	INDUSTRIAL WASTE MANAGEMENT II
COURSE CODE	:	EHS:554
DURATION	:	2 HOURS
MARKS	:	100
INSTRUCTIONS	:	THERE ARE FIVE QUESTIONS IN THIS EXAM
	:	ANSWER ANY FOUR OF THE FIVE QUESTIONS
	:	EACH QUESTION CARRIES 25 MARKS
	:	NO PAPER SHOULD BE BROUGHT INTO OR OUT OF THE EXAMINATION ROOM

QUESTION ONE (25 Marks)

A. Draw a simplified flow diagram of the entire waste water treatment also involving activated sludge for the biological process. Include all necessary unit operations from the raw water influent to the final treated effluent. .....[5 Marks]

B. Why are facultative ponds not appropriate for the treatment of dye laden industrial wastes? .....[5 marks]

C. Describe the role of the following types of bacteria in waste water treatment processes:
i) Chemo hetrotrophs ii) Chemoautotrophs iii) fermentative metabolites iv)anoxic bacteria v) Facultative anaerobes. .....[5 marks]

D. Describe to what condition and types of biological growth processes the following substrate utilization rates apply i) $r_{su} = -k$ ii) $r_{su} = -kS$ iii) $r_{su} = -kXS$ and iv) $r_{su} = -kX\left(\frac{S}{S_s}\right)$. .....[5 marks]

E. Describe how i) denitrification and ii) phosphorous removal may be achieved in suspended growth biological treatment systems, including a discussion of the factors that influence the kinetics of the biological reactions.....[5 marks]

QUESTION TWO (25 Marks)

A complete mix activated sludge system with recycle is used to treat municipal waste water after primary sedimentation. The characteristics of the primary effluent are: flow 1350 m^3/day, bsCOD = 156 g/m^3 , nbVSS = 25 g/m^3 and inert organics = 12 g/m^3. The aeration tank MLVSS = 2100 g/m^3. The solids retention time is 6 days. Using the kinetic data provided below, determine

A. The effluent soluble and biodegradable COD .....[12 Marks]

B. The aeration tank volume. .....[13 Marks]

Kinetic data:

k= 12.5 gCOD/gVSS.day	K_s = 10 g COD/m^3
Y = 0.40 g VSS / g COD used	F_d = 0.15g VSS/g VSS
K_d = 0.10 g VSS/g VSS.day	Biomass VSS/TSS = 0.85

$$S = \frac{K_s[1 + (k_d)SRT]}{SRT(Yk - k_d) - 1}$$

$$X_T = \frac{Y(S_o - S)SRT}{[1 + (k_d)SRT]\tau} + (f_d)(k_d)(X)\ SRT + \frac{(X_{0,i})SRT}{\tau}$$

QUESTION THREE (25 Marks)

A. Two common problems encountered during biological treatment of pulp and paper industry wastewaters are i) limiting nitrogen and phosphorus nutrients and ii) the existence of filamentous organisms. Discuss ways of eliminating these two problems from treatment.

. .....[5 Marks]

B. Describe the process of treatment of wastewater using sequencing batch reactor and its advantages compared to complete mix activated sludge process. .....[5 marks]

C. How do you compare aerated lagoons with that of complete mix activated sludge conventional reactor in handling shock loads of toxic waste, pH and shock organic load (BOD) discharges from industries? .....[5 marks]

D. Describe the effect of the following parameters on the operation of the activated sludge process i) Temperature ii) pH .....[5 marks]

E. Describe how the following compounds affect the activated sludge process and how the effects may be reduced: i) Phenol ii) heavy metals iii) inorganic salts and ammonia.

.....[5 marks]

QUESTION FOUR (25 Marks)

A. Describe the mechanisms of biological film loss in plastic and rock packing of percolating filters. .....[5 Marks]

B. The table below shows the characteristics of water generated during rubber manufacturing. Describe the sequence of treatment needed for treating the wastewater from this particular industry. .....[10 Marks]

Processing unit	Source	Nature of wastewater contaminants
Caustic soda scrubber	Spent caustic solution	High pH, alkalinity and color, extremely low average flow rate
Excess monomer stripping	Decant water layer	Dissolved and particulate organics
Tanks, reactors and strippers	Cleanout rinse water	Dissolved organics, suspended and dissolved solids. High quantities of uncoagulated latex
Tank cars and tank trucks	Cleanout rinse water	Dissolved organics, suspended and dissolved solids. High quantities of uncoagulated latex
All plant areas	Area washdowns	Dissolved and particulate organics. Dissolved and suspended inorganic solids.

C. Describe

i. With the help of a diagram the principle of operation of a fluidized bed bioreactor (FBBR)

ii. The advantages of a fluidized bed bioreactor.....[5 Marks]

D. What are the advantages and disadvantages of anaerobic waste water treatment processes for the treatment of industrial wastewaters? .....[5 Marks]

QUESTION FIVE (25 Marks)

A. Answer the following in relation to upflow anaerobic sludge blanket clarifiers:

i. Draw a sketch of a UASB reactor indicating the important parts.

ii. What is the use of packing material at the top of a modified UASB reactor?

iii. What are the advantages and disadvantages of UASB reactor?

.....[5 Marks]

B. What is the effect of emulsification grease and oil by detergents on bacteria present in a biological treatment process for the treatment of wastewater of soap and detergent industries? .....[5 Marks]

C. Characterize the solids or sludge produced from the following wastewater unit processes:

i. Screenings

ii. Sludge from primary treatment tank

iii. Anaerobically digested biosolids.....[5 Marks]

D. Briefly describe the following process of solids thickening:

i. Gravity thickening

ii. Floatation thickening

iii. Centrifugal thickening. .....[5 Marks]

E. Mention five important parameters for monitoring aerobic sludge composting processes for stabilization of solids from industrial wastewater treatment processes.

.....[5 Marks]