

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

**BSc Environmental Health**

**MAIN EXAMINATION PAPER DECEMBER 2014**

**TITLE OF PAPER** : INDUSTRIAL WASTE MANAGEMENT I  
**COURSE CODE** : EHS:553

**DURATION** : 2 HOURS

**MARKS** : 100

**INSTRUCTIONS** : THERE ARE FIVE QUESTIONS IN THIS EXAM  
: ANSWER ANY 4 OF THE 5 QUESTIONS  
: EACH QUESTION CARRIES 25 MARKS  
: NO PAPER SHOULD BE BROUGHT INTO OR OUT OF THE  
EXAMINATION ROOM  
:

EHS 553  
DECEMBER 2014

**QUESTION ONE (25 Marks)**

A wastewater contains the following:

130 mg/L ethylene glycol

85 mg phenol

30 mg/L sulfide ( $S^{2-}$ )

100 mg/L ethylene diamine hydrate

(ethylenediamine is essentially non-biodegradable).

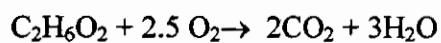
1A. Compute the COD and TOC .....[ 10 marks]

1B. Compute the  $BOD_5$  if the  $k_{10}$  is 0.18 /day. ....[ 8 marks]

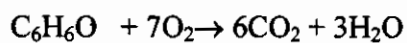
1C. After treatment the  $BOD_5$  is 25 mg/L. Estimate the COD of the effluent (  $k_{10} = 0.1/\text{day}$ ).....[ 7 marks]

Chemical equations of oxidation

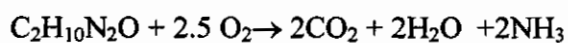
i) Ethylene glycol:



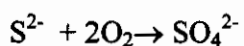
ii) Phenol:



iii) Ethylene diamine hydrate:



iv) Sulfide:



**QUESTION TWO (25 Marks) (Note each question carries 5 marks)**

- 2A.** What are the main factors that must be considered when designing a pilot scale experiment for industrial waste treatment?
- 2B.** What is the effect of temperature inversion with respect to emissions of pollutants from industries? When is temperature inversion likely to occur?
- 2C.** Give four examples of bio refractory organics.
- 2D.** Compare the variation of the re-aeration coefficient and de-aeration coefficient with water temperature and the implication on thermal pollution of water sources from industrial discharges.
- 2E.** Discuss the type of sampling appropriate for each of the following parameters:
- i. pH
  - ii. BOD for the design of activated sludge process unit
  - iii. BOD for the design of aerated lagoons
  - iv. Nutrients for the design of sequencing batch reactors.

**QUESTION THREE (25 Marks)**

An industry discharges waste water in to an equalization basin between 0hr and 16 hr. Between 0hr and 8hr the total amount of waste water discharged was 12 Million liters, discharged uniformly in to the equalization basin. Between 8hr and 16 hr, the total amount of waste water discharged in this period was 16 Million liters discharged at a uniform rate. Between 16hr and 24hr the industry is closed so that there is no waste water flow in to the equalization basin. If the outflow from the equalization basin is such that 30 % of the total out flow occurs during the day (between 0 hour and 12 hour) at a uniform rate and 70 % during the night (between 12 hr and 24 hour) at uniform rate,

**3A.**Determine the volume of the equalization basin. ....[ 13 Marks]

**3B.**Determine the volume of the equalization basin if the outflow from the equalization tank was uniform throughout the 24 hour period and compare with the result obtained in 3A above. ....[ 12 marks]

**QUESTION FOUR (25 Marks)**

- 4A.** What is the importance of grit chambers in waste water treatment?...[4 Marks ]
- 4B.** Describe the cause of short circuiting in sedimentation tanks and the methods to prevent them.....[4 Marks ]
- 4C.** Differentiate between the following oil suspension in wastewater and indicate the methods for their removal from wastewater:
- i) Free oil
  - ii) Physical emulsion
  - iii) Chemical emulsion
  - iv) Dissolved oil. ....[7 Marks ]
- 4D.** Describe briefly the nature of wastes generated and treatment alternatives for wastewater generated in pharmaceutical industries. ....[ 10 Marks]

**QUESTION FIVE (25 Marks)**

- 5A.** Compare the use of lime and caustic soda for the treatment of acidic industrial wastewaters. ....[ 5 Marks]
- 5B.** Describe treatment mechanisms for:
- i) Laundry wastes containing synthetic detergents .....[ 3 marks]
  - ii) Polymer wastes from latex manufacture .....[ 2 Marks]
- 5C.** List the technologies available for heavy metal removal from industrial wastewaters .....[ 5 Marks]
- 5D.** Describe the treatment method that can be used for the removal of cyanide form industrial wastewaters. ....[ 5 Marks]
- 5E.** Describe the advantages and disadvantages of employing wet air oxidation processes for the treatment of industrial wastewaters. ....[5Marks]