

**UNIVERSITY EXAMINATIONS
2013/2014 ACADEMIC YEAR**

FIFTH YEAR FIRST SEMESTER EXAMINATION

**FOR THE DEGREE OF
BACHELOR OF SCIENCE
IN CIVIL AND STRUCTURAL ENGINEERING**

COURSE CODE: CSE 531

COURSE TITLE: SEWERAGE AND WASTE WATER TREATMENT

INSTRUCTIONS

- Answer **FIVE** questions only
- Marks for each question are indicated in the parenthesis

Question 1

- (a) Outline the importance of the following parameters in sewage treatment
- (i) Temperature
 - (ii) pH
- [2 marks]**
- (b) List FOUR advantages of the waste stabilization pond system over the conventional waste water treatment system
- [4 marks]**
- (c) Briefly explain how the following processes occur in rivers
- (i) Re-oxygenation
 - (ii) De-oxygenation
- [4 marks]**
- (d) Design an aerated flow-through type lagoon to serve a population of 10, 000 people whose water consumption is estimated at 150 Liters/ person /day. The BOD₅ per capital contribution may be assumed at 50 g per day. The soluble fraction of BOD effluent is to be kept at more than 33 mg/L. The design temperature for the pond is 15⁰C. Assume the following
- Wastewater flow = 80% of water consumption
 - Rate constant at 10⁰C = 2.0 day⁻¹
 - Temperature coefficient = 1.05
 - Cell decay rate = 0.07
 - Yield coefficient = 0.5
- [10 marks]**

Question 2

- (a) State, giving sources and environmental significance, SIX contaminants in wastewater
- [9 marks]**
- (b) (i) Using neat sketches explain the operation of a circular primary sedimentation tank in wastewater treatment
- [7 marks]**
- (ii) Given the following conditions design a circular sedimentation tank
- Average wastewater flow to the treatment plant = 4500m³/d
 - Suspended solids removed = 70 %
 - Overflow rate = 20m³/m².d
- [4 marks]**

Question 3

- (a) Outline the differences between centralized and decentralized wastewater collection and transport **[5 marks]**
- (b) Define the following terms as encountered in water pollution and control
- (i) Eutrophication
 - (ii) Point Source
 - (iii) Non-point source
 - (iv) Oligotrophic
 - (iv) Natural purification **[5 marks]**
- (c) (i) List the 3 important functions of a septic tank **[3 marks]**
- (ii) Sketch a typical percolation trench and describe how its length is determined **[7 marks]**

Question 4

- (a) (i) With a neat sketch describe the operation of two-stage anaerobic digestion system **[5 marks]**
- (ii) Calculate the capacity required per population equivalent for a single stage floating cover digester given the following data
- 90 grams solids contributed per person per day
 - 4% solids content in raw sludge
 - 7% Solids concentration in digested sludge
 - 40% Solids reduction during digestion
 - 30 days digestion period
 - 90 days storage for digested sludge **[7 marks]**
- (b) Explain the following types of sludge
- (i) Excess activated sludge **[1 marks]**
 - (ii) Digested sludge **[1 marks]**
- (c) Describe the following methods of reducing sludge volumes
- (i) Incineration **[2 marks]**

(ii) pyrolysis [2 marks]

(iii) Composting [2 marks]

Questions 5

(a) (i) List the factors that affect the amount of wastewater that can be re-used and outline FOUR possible ways for the direct and indirect reuse of wastewater [4 marks]

(ii) Differentiate between Combined and Separated Sewers as encountered in sewerage systems [2 marks]

(iii) OUTLINE the typical requirements for manholes in sewer systems [2 marks]

(b) Describe briefly with the aid of sketches the operation of the following units of wastewater processing:-
(i) Oxidation ditch
(ii) Trickling Filters
(iii) Conventional sludge digester [12 marks]

Questions 6

(a) (i) Distinguish among Primary, Secondary, and Tertiary treatments for municipal sewage. [3 Marks]

(ii) Comment on the following with respect to a sewage pumping station:
(a) Capacity of the wet-well
(b) Number of pumps and standby capacity of the pumping units [5 marks]

(b) (i) Discuss the significance and operation of screening and grit removal in wastewater treatment [7 Marks]

(ii) Design a grit chamber to remove substance with [5 Marks]
• Diameter 0.2 mm
• Specific gravity 2.65

- Settling velocity ranging from 0.016 to 0.02
- Wastewater flow of 10,000 m³/day
- Flow through velocity 0.3 m/s
- Assume depth is 1.5 multiplied by width at maximum flow