



MACHAKOS UNIVERSITY

University Examination 2019/2020

**SCHOOL OF ENGINEERING AND TECHNOLOGY
DEPARTMENT OF BUILDING AND CIVIL ENGINEERING
FIFTH YEAR FIRST SEMESTER EXAMINATION FOR
BACHELOR OF SCIENCE IN CIVIL ENGINEERING
ECV 506: PUBLIC HEALTH ENGINEERING III**

DATE: 17/12/2019

TIME: 8.30-10.30 AM

INSTRUCTIONS

Answer Question One and Any Other Two Questions

Reasonable assumptions should be made where necessary

QUESTION ONE (30 MARKS)

- a) The unit operations that are placed at the upstream end of the wastewater treatment plant (WWTP) are referred to as preliminary treatment. Preliminary treatment typically serves three important functions: removal of untreatable solid materials; protection of subsequent treatment units; and improvement of the performance of subsequent treatment units. There are a large number of arrangements for the preliminary treatment processes that will prove satisfactory. These are dependent on both the upstream and downstream processes that are employed. With the aid of diagrams discuss four alternative arrangements for a preliminary treatment system (10 marks)
- b) Why is flow measurement important in the design and operation of wastewater treatment plants (WWTPs)? Give ways in which flow measurement is accomplished (10 marks)
- c) Discuss the main pathways of Biological Oxygen Demand (BOD) removal in biological wastewater treatment (10 marks)

QUESTION TWO (20 MARKS)

- a) Using Newton's equation and Camp's scour equation, demonstrate that a grit particle with a diameter of 200 μm and a specific gravity of 2.65 results in a design overflow rate of 0.021 m/s and a horizontal velocity greater than 0.056 m/s and less than 0.23 m/s for an horizontal flow grit chamber if the organic particles of the same size have a specific gravity of 1.10. Assume $\beta = 0.06$ and $f = 0.03$ (10 marks)
- b) Most developing countries within the tropics accomplish wastewater treatment using wastewater stabilization ponds which are also known as lagoons. Discuss the rationale behind this. Hence discuss the types of ponds based on the type of processes occurring within the ponds (10 marks)

QUESTION THREE (20 MARKS)

Design a coarse screen and determine the headloss through the rack given the following information:

Peak design wet weather flow = 600 l/s

Velocity through rack at peak wet weather flow = 0.89 m/s

Velocity through rack at maximum design dry weather flow = 0.59 m/s

Angle of inclination of screen = 60°

Upstream depth of wastewater = 1200 mm

QUESTION FOUR (20 MARKS)

- a) The bulk of suspended solids which enter a wastewater treatment plant and the waste solids generated in biological treatment result into sludge. Discuss the importance of sludge treatment and management in a WWTP. Hence list and discuss five sludge conditioning processes (10 marks)
- b) Design a secondary wastewater clarifier given the following information
- A circular sedimentation tank
 - Minimum detention time of 1/6 days
 - Maximum overflow rate of $2000 \text{ m}^3/100 \text{ m}^2 \cdot \text{d}$.

Determine the required diameter of the tank and the side water depth (SWD) if the average flow rate through the tank is $6 \times 10^6 \text{ l/d}$ (10 marks)

QUESTION FIVE (20 MARKS)

- a) Define solid waste and state the factors that influence its generation? (10 marks)
- b) Any system employed to process solid waste must have the inherent flexibility to cope with its varying character. There are myriad influences of varying intensity that continually alter the quantity, composition, and physical and chemical character of the material. Discuss three purposes of waste characterization (10 marks)