MACHAKOS UNIVERSITY

University Examinations for 2022/2023

SCHOOL OF ENGINEERING AND TECHNOLOGY

DEPARTMENT OF BUILDING AND CIVIL ENGINEERING

THIRD YEAR FIRST SEMESTER EXAMINATION FOR

BACHELOR OF SCIENCE (CIVIL ENGINEERING)

ECV303: PUBLIC HEALTH ENGINEERING I

DATE:9/3/2023 **TIME:2;00-4:00 P.M**

INSTRUCTIONS
Answer Question One and Any Other Two Questions

QUESTION ONE (COMPULSORY) (30 MARKS)

a) Discuss five (5) basic water quality requirements for drinking water giving a reason (s) for each requirement (5 marks)

b) Calculate the terminal settling velocity for sand in water at 10°C having particle diameters of 60 and 200 µm and a density of 2650 kg/m^3 (5 marks)

c) Sedimentation is the separation of suspended particles that are heavier than water by gravitation settling. Highlight 5 water and wastewater treatment processes where this operation is used. (5 marks)

d) Describe Four types of settling (4 marks)

e) Explain the purpose of filtration in water treatment and give a general description of the process of membrane filtration (6 marks)

f) Explain why rapid granular filters must have coagulation pretreatment to be effective but membrane filters do not (5 marks)

QUESTION TWO (20 MARKS)

a) Describe the significance of the following terms and phrases in context of coagulation and flocculation and water treatment (4 marks)

b) Explain the role of coagulation and flocculation in surface water treatment plant (5 marks)

c) Describe the chemicals used as coagulants and the primary mechanisms that coagulants use to destabilize particles (6 marks)

d) The pH and dose of coagulants is critical in the optimization of coagulation operation. Briefly outline the procedure used in water treatment works to determine the most suitable dose and pH for coagulation efficiency (5 marks)

QUESTION THREE (20 MARKS)

a) Explain the use of aeration in water treatment and give the conditions necessary for its effectiveness in water treatment including benefits accruing this operation. (10 marks)

b) A small community water supply scheme is considering rainwater harvesting as the source of water supply. Design the roof catchment area required for a discharge of 1000litres/day if the 90% probability annual rainfall for the area has been estimated by the meteorological department to be 800mm (10 marks)

QUESTION FOUR (20 MARKS)

a) Discuss the three strategies used to reduce microbial contaminants in water treatment

b) Examine Four characteristics of disinfectants commonly used in drinking water treatment and the trends regarding their use (4 marks)

c) Identify specific chlorine species present in free chlorine and combined-chlorine residuals; which disinfectant is most effective germicidally (4 marks)

d) Explain how the production of disinfection by-products influence effectiveness of disinfection process (2 marks)

e) Describe issues associated with maintaining a combined-chlorine residual in large water distribution systems (2 marks)

f) Narok Town has an existing horizontal –flow sedimentation tank with an overflow rate of $0.708 m^3/h.m^2$. What percentage removal should be expected for each of the following particle settling velocities in an ideal sedimentation tank: 0.01cm/s, 0.02cm/s and 0.1cm/s. (5 marks)

QUESTION FIVE (20 MARKS)

Assume you have been requested to design a water supply scheme for a high-class housing suburb in Ruiru town and the design life of the system is to end in the year 2030. The demand is purely residential. The population in this section of town has been obtained by census every 10 years by the Kenya National Bureau of Statistics as tabulated in Table 05. Calculate the initial, future and ultimate water demand using 2010 as the initial (base year). The design population in the town should be estimated using geometric growth projection

Table 05: Population for Ruiru from KNBS

Year	Population
1930	125000
1940	150000
1950	150000
1960	185000
1970	185000
1980	210000
1990	280000
2000	320000