TECHNICAL UNIVERSITY OF MOMBASA

FACULTY OF ENGINEERING AND TECHNOLOGY

DEPARTMENT BUILDING AND CIVIL ENGINEERING

UNIVERSITY EXAMINATION FOR:

BSC IN CIVIL ENGINEERING

ECE 2305: **PUBLIC HEALTH ENGINEERING I**

END OF SEMESTER EXAMINATION

SERIES:APRIL2016

TIME:2HOURS

DATE:18May2016

Instructions to Candidates

You should have the following for this examination

-Answer Booklet, Drawing Instruments, Scientific calculator, examination pass and student ID

This paper consists of five questions. Attemptquestion ONE (Compulsory) and any other TWO questions.

QUESTION 1:

a) Rain is the primary source of water. When the rain falls part of it percolates into the ground, another part is lost through evaporation and the rest flows into rivers and eventually into lakes and oceans as runoff. Briefly describe five factors that determine the amount of runoff. **(5 Marks)**

b) Both surface water and underground water sources can be utilized as water sources for water supply projects. What are the major factors which influence the selection of the source of water for a water supply project? **(5 Marks)**

c) State the source and significance of the following substances in drinking water:

i. Aluminium

ii. Chlorine

iii. Fluoride
iv. Magnesium
v. Nitrates **(5 Marks)**

d) Water demand projection is an important step towards design and sizing of various components of a water supply project. To arrive at reasonable water demand requirements, fairly accurate population projection and establishing water consumption per capita will be necessary. What are the factors that influence water consumption per capita? **(5 Marks)**

e) A small rural area in a high land potential in Kenya has a present (2016) population of 40,000 people. The Government is in the process of planning a water supply project for the area to meet its water requirements up-to the "ultimate" year. Its population is projected to grow at a growth rate of 3.0% for the period between now (2016) and the "future" year and 2.0% from the "future" year to the "ultimate" year. If the initial year is 2020, project the domestic water demand for the "initial", "future" and "ultimate" years for the area. Assume water consumption per capita for the area of 60 l/h/d. **(8 Marks)**
It is estimated that losses will be 15% of the domestic water demand. Calculate the water production required to meet the ultimate domestic water demand together with the losses. **(2 Marks)**

QUESTION 2:

a. Explain the importance of disinfection of water supplied to the public. **(2 Marks)**
b. What is the difference between sterilization and disinfection and why is the former not essential in water treatment. **(3 Marks)**
c. What are the essential properties of a good disinfectant? **(3 Marks)**
d. In a small water treatment plant handling 500 m^3/d, the water is disinfected using calcium hypochlorite, $Ca(OCl)_2$. The commercially available product has 90% $Ca(OCl)_2$ and that $Ca(OCl)_2$ contains 60% by weight of free chlorine. It is required to have a residual of 0.2 mg/l of free c hlorine after 15 minutes contact time, which is estimated to be only 20 % of the initial dose. Find the total annual cost if it costs kshs. 300 per kg of the commercially available product. **(10 Marks)**
e. Why is it important to maintain residual chlorine in water after treatment? **(2 Marks)**

QUESTION 3:

a. It is normal to find a river with a wide variation of flow between different seasons of the year. In such case if the river is chosen as a source of water for a water supply project it may not be possible to meet the average daily water demand during the lowest flow. To mitigate this shortage an impounding reservoir is necessary. List the

salient features that should be considered in the selection for a suitable site for the impounding reservoir. **(4 Marks)**

b. Discuss the characteristics of groundwater. **(3 Marks)**

c. Derive the formula

$$Q = \frac{2\pi bK(H - h)}{2.3\log(R/r)}$$

for calculating discharge from a confined aquifer. **(7 Marks)**

d. A 300mm diameter well fully penetrates a confined aquifer 30m thick. After pumping to steady state at a rate of 0.9m^3/min, the draw downs in wells at 24 and 48 m from the pumping well are found to be 2.4 and 1.8 m respectively. Determine the drawdown in the pumped well if the radius of the circle of influence is 300m. **(6 Marks)**

QUESTION 4:

a. What are the main factors that should be considered when selecting a site for a river intake? **(3 Marks)**

b. What is the difference between a dry and wet in take? Which of the two would you choose for a reservoir in which there is a wide range of in water quality and water level? Give reasons for your choice. **(4 Marks)**

c. Differentiate between the terms coagulation and flocculation. **(3 Marks)**

d. State why coagulants are required in the sedimentation process. **(2 Marks)**

e. A town in Nyeri County has a total water demand of 9,000 m^3/d. Its source of water is a river whose water is turbid and requires sedimentation before filtration. Design a horizontal flow sedimentation tank for the town's water treatment plant. Assume a detention period of 5 hours and velocity of flow of 0.20 m/minute. **(8 Marks)**

QUESTION 5:

a. Explain the role of the following in water distribution systems:
   i. Balancing tanks
   ii. Break pressure tanks
   iii. Air valves
   iv. Washouts
   (4 Marks)

b. Differentiate between tree or dead end water distribution systems and loop or ring water distribution systems. What are the advantages and disadvantages of each of these systems? **(6 Marks)**

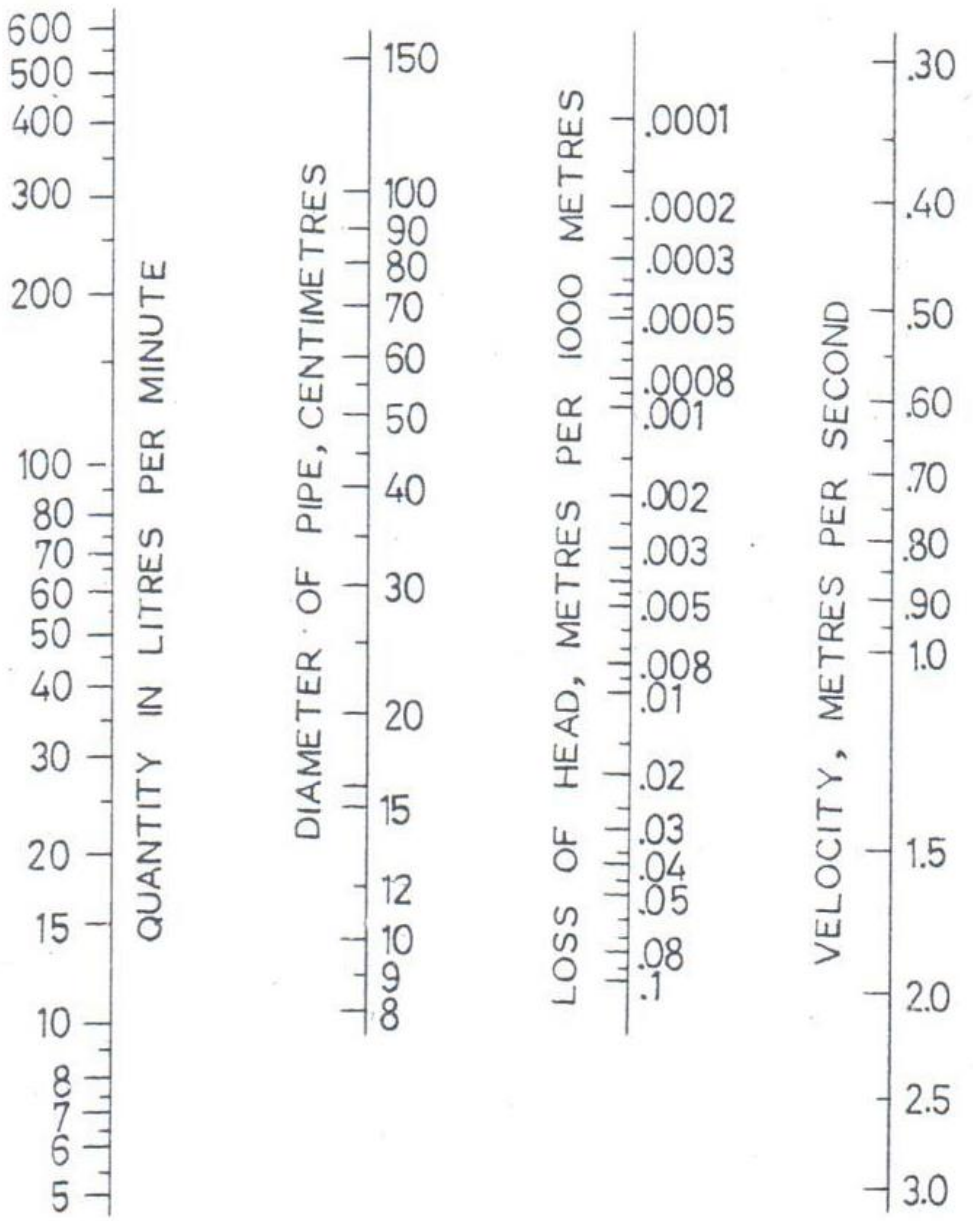
c. Steel pipes and plastic (uPVC) pipes are widely used in Kenya. Discuss when it is advantageous to use each of these pipes and why. **(4 Marks)**

d. A water pipe has a flow of 100 litres per minute and a slope of 1 metre per 1000 metres. The Hazen-William's coefficient, C of the pipe is 100. Using the Nomogram based Hazen-William's formula provided, determine the following:

   i. The diameter of the pipe

   ii. The velocity of flow in the pipe

   (6 Marks)



Nomogram based on Hazen-William's formula ($C=100$)