(*University of Choice*)

MASINDE MULIRO UNIVERSITY OF SCIENCE AND TECHNOLOGY (MMUST)

MAIN CAMPUS

UNIVERSITY EXAMINATIONS
2019/2020 ACADEMIC YEAR

FOURTH YEAR SECOND SEMESTER EXAMINATIONS

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

COURSE CODE: CSE 452

COURSE TITLE: WATER SUPPLY AND SYSTEMS

DATE: FRIDAY 13TH NOVEMBER 2020 TIME: 9.00 – 11. 00 AM

INSTRUCTIONS:

1. This paper contains FIVE Questions
2. Answer FOUR Questions only
3. Marks for each question are indicated in the parenthesis.
4. It is in the best interest of the student to write legibly
5. Examination duration is **2 Hours**

MMUST observes ZERO tolerance to examination cheating

This Paper Consists of 4 Printed Pages. Please Turn Over.

QUESTION ONE

a) A town in Kakamega County has a population of 50,000 and per demand of 60 l/day. Assume industrial use 10%, institutional & commercial use 15 %, public use 5% and livestock 10% of domestic demand. Determine the demand required to size the water treatment and water distribution systems. Take daily and hourly peak factors as 1.6 and 2.7, respectively, and leakage accounts for 5% of domestic demand. **[6 marks]**

b) The demand of water is governed by the following relationship

$$Q = kP^e$$

where Q is water demand at a price, P, per unit of consumption, k is a constant and e is the elasticity of water demand.

Explain how water service providers (companies) can use the above model in setting water tariffs **[4 marks]**

c) For a proposed reservoir, the following data were obtained. The prior water rights required the release of full natural flow or 5 m^3/s whichever is less. Assuming an average reservoir area of 20 km^2, estimate the storage required to meet these demands. Assume that 25% of the rainfall has reached the stream in the past. **[10 marks]**

Month	Inflow ($\times 10^6$) m^3/s	Demand ($\times 10^6$) m^3	Monthly Evaporation (cm)	Monthly rainfall (cm)
Jan	25	22	12	3
Feb	20	23	13	3
Mar	15	24	17	2
April	10	26	18	2
May	4	26	20	3
June	9	26	16	13
Jul	90	16	12	24
Aug	102	16	12	19
Sep	70	16	12	19
Oct	40	16	12	3
Nov	30	16	11	6
Dec	30	22	17	4

Assume a month has 30 days.

QUESTION TWO

a) A 30 cm diameter well completely penetrates a confined aquifer of permeability 45 m/day. The length of the strainers is 20 m. Under steady state of pumping, the drawdown at the well was found to be 3.0 m and the radius of influence was 300 m. Calculate the yield from the well. **[5 marks]**

b) Coagulation using alum is governed by the following equation

$Al_2(SO_4)_3.18H_2O + 3Ca\,(HCO_3)_2 = 2Al\,(OH)_3 + 3CaSO_4 + 18H_2O + 6CO_2$

At a water treatment plant, 12 million litres of water is treated daily using alum dosage of 16 mg/l. Find **[5 marks]**

i) The total quantity of alum used daily
ii) Amount of carbon dioxide released

c) Differentiate between a coagulant and a coagulant aid giving 2 examples for each **[4 marks]**

d) i) Explain the necessity of filtration **[2 marks]**
ii) Outline the actions taking place during filtration **[4 marks]**

QUESTION THREE

a) Briefly describe the methods that can be used for the removal of the following impurities in groundwater supply **[8 marks]**

i) Iron and Manganese
ii) Fluoride
iii) Methane
iv) Calcium Chloride and Magnesium Sulphate

b) A pumping station situated at an elevation of 610 m uses pumps which require NPSH of 32 kPa when delivering water at 20^{0}C. Determine the allowable suction lift of these pumps if the entrance and frictional losses are 12 kPa. Take the atmospheric pressure at 610 m altitude as 94 kPa and vapour pressure at 20^{0}C as 2.35 kPa. **[4 marks]**

c) Explain the features of a good water distribution system **[6 marks]**
d) Differentiate between potable and palatable water **[2 marks]**

QUESTION FOUR

a) Outline the functions of the following appurtenances in water supply system **[6 marks]**
i) Sluice valves
ii) Check valves
iii) Air valves

b) A large service reservoir supplies water to two estates as under
Estate A: Population 12,000
Estate B: Population 60,000

Determine the sizes of water supply pipes and the hydraulic gradient at which the pipelines should be laid. Assume average daily water consumption as 200 L/capita/day and the daily maximum demand as 1.6 times the average demand. The velocity in the pipe can be taken as 1.2 m/s. C = 100 in the Hazen-Williams formula ($Q = 0.278CD^{2.63}S^{0.54}$) **[8 marks]**

c) Describe the flocculation process in drinking water supply **[6 marks]**

QUESTION FIVE

a) Outline why pumping is necessary in water supply **[5 marks]**

b) Outline factors affecting disinfection efficiency of chlorine **[4 marks]**

c) Sketch a suitable treatment flow diagram for reservoir water **[5 marks]**

d) i) Design a circular sedimentation tank to treat 2.4 million litres of raw water per day. The detention period may be assumed to be 3 hours and the depth of the tank is 3 m. **[4 marks]**
ii) Check if the surface loading in i) above meets the allowable limit of 40 $m^3/d/m^2$ **[2 marks]**

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