



TECHNICAL UNIVERSITY OF MOMBASA
**Faculty of Engineering &
Technology**

DEPARTMENT OF BUILDING & CIVIL ENGINEERING

UNIVERSITY EXAMINATION FOR DECREE IN:

BACHELOR OF SCIENCE IN CIVIL ENGINEERING (BSCE)

ECE 2305: PUBLIC HEALTH ENGINEERING I

END OF SEMESTER EXAMINATION

SERIES: APRIL 2015

TIME ALLOWED: 2 HOURS

Instructions to Candidates:

You should have the following for this examination

- Answer Booklet
- Pocket Calculator

This paper consists of **FIVE** questions. Answer question **ONE (COMPULSORY)** and any other **TWO** questions

Maximum marks for each part of a question are as shown

Use neat, large and well labeled diagrams where required

This paper consists of **THREE** printed pages

Question One (Compulsory)

- a) List and describe FIVE sources of water using sketches where necessary **(5 marks)**
- b) A well in an unconfined aquifer has its original water table horizontal. When the water is pumped out of the well a constant rate Q for a long time the water level in the well stabilizes. There are two observation wells 1 and 2 at distance of r_1 and r_2 from the pumping well with corresponding height of water on the drawdown curve of h_1 and h_2 respectively. K is the coefficient of permeability. Sketch the diagram of the pumping well and observation wells and derive the formula **(8 marks)**

$$Q = \frac{\pi k \left[(h_2)^2 - (h_1)^2 \right]}{2.3 \log_{10} \left(r_2 / r_1 \right)}$$

- c) The diameter of a well in an unconfined aquifer is 30cm and the static head of the water table is 15m. The radius of the circle of influence is 135m. The coefficient of permeability of the soil is 30m/day. Calculate the water level in the well and the drawdown when the yield of the well is 200m³/day
(7marks)

Question Two

- a) Explain the importance of water quality in public water supplies. Illustrate how water quality influences the choice of a water source for a water supply project (5 marks)
- b) Analysis of raw water from a river was found to contain the following organisms/substances
 Coliform organizations: 400 number/100ml
 Iron : 0.2mg/l
 Manganese : 0.1mg/l
 Turbidity : 50NTU
 Colour : 30 TCU

If the recommended water quality standards for drinking water are as given in the table below, describe the health/aesthetic significance of the above organisms/substance in water (5 marks)

Table: Limits for inorganic and microbiological for drinking water

Organisms/Substance	Limit
Coliforms in 100ml	Shall be absent
E-coli in 100ml	Shall be absent
Colour	15TCU
Turbidity in Nephelometric Turbidity units	5NTU
Iron	0.3mg/l
Manganese	0.1mg/l
Suspended matter	Nil
Total dissolved solids	1.500mg/l
Hardness as CaCO ₃	500mg/l

- c) Recommend the treatment required for the above raw water to make it suitable for drinking (10 marks)

Question Three

- a) What is water intake works? (2 marks)
- b) Describe with the help of sketches the following types of water intakes (6 marks)
- Reservoir intake
 - Lake intake
 - River intake
- c) A medium sized town in Kenya is experiencing chronic water shortages. The town management is intending to plan a major water supply project to meet its water demand for the next twenty years and beyond and they have engaged a consultant for that purpose. The population growth rate is projected to be 3% from now and throughout the planning period. The current (2015) population is estimated at

400,000 and the average per capita consumption is 120l/h/d. If the project is expected to be operational in 2019 (initial year), calculate;

- (i) The projected population in the initial, future and ultimate years
 - (ii) The initial, future and ultimate years domestic water demand in cubic metres for the town
- (10 marks)**

d) When the consultant submitted their preliminary design report, the technical team noted that the consultant had not considered the peak demand in calculating the projected water demand.

If the peak water demand is 1.25 times the average water demand, calculate the peak water demand based on the figures obtained in (c) above

(2 marks)

Question Four

a) Describe with sketches where applicable the following:

- (i) Rapid sand filters
- (ii) Pressure filters
- (iii) Effective size of filter media
- (iv) Coefficient of uniformity of filter media

(8 marks)

b) Sieve analysis was conducted on a sample of sand proposed as filter media for rapid and filters in a water treatment plant. The results were as follows:

Sieve Size in Mm	Cumulative % Passing
0.10	0
0.15	4.0
0.20	4.0
0.30	0.25/10.0
0.35	47.0
0.40	60.0
0.50	78.0
0.60	90.0
0.8	94.0
1.00	99.0
2.00	100

From this result of sieve analysis, find the effective size and the coefficient of uniformity. In your opinion, is the sand suitable to be used as filter media in the proposed rapid sand filters? Explain the reason for your opinion

(4 marks)

c) Design rapid sand filters to treat 27,000m³/d water supply of a town. The filter works for 12 hours a day. Assume a filtration rate of 4.5m³/h/m². Sketch in plan the arrangement of the filter units

(8 marks)

Question Five

a) What is the purpose of disinfection of water in water supplies

(2 marks)

- b) What are the essential properties of a good disinfectant **(3 marks)**
- c) List and describe FOUR methods of disinfection **(4 marks)**
- d) What is breakpoint chlorination? Use a sketch to illustrate your answer **(3 marks)**
- e) In a large water treatment plant handling $120,000\text{m}^3/\text{d}$, the water is disinfected using Calcium hypochlorite $\text{Ca}(\text{OCl})_2$. The commercially available produce has 95% of $\text{Ca}(\text{OCl})_2$ has 70% available free chlorine. It is recommended to have $0.2\text{mg}/\text{l}$ of residual chlorine after 15 minutes contact time, which is estimated to be 25% of the initial dose, calculate:
- (i) The initial chlorine dosage
 - (ii) The bleaching powder required daily and;
 - (iii) The total cost of the disinfectant per year if its cost per kg is kshs 75.00 of the commercially available product
- (8 marks)**