



THE MOMBASA POLYTECHNIC UNIVERSITY COLLEGE

(A Constituent College of JKUAT)

(A Centre of Excellence)

Faculty of Engineering & Technology

DEPARTMENT OF BUILDING & CIVIL ENGINEERING

UNIVERSITY EXAMINATION FOR:
BACHELOR OF SCIENCE IN CIVIL ENGINEERING (Y5, S3)

ECE 2512: PUBLIC HEALTH ENGINEERING IV

END OF SEMESTER EXAMINATION

SERIES: DECEMBER 2012

TIME: 2 HOURS

Instructions to Candidates:

You should have the following for this examination

- *Answer Booklet*

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

This paper consists of **THREE** printed pages

Question One (Compulsory)

a) Design a waste stabilization pond system, incorporating anaerobic facultative and maturation ponds, using the following information.

- Population of the town = 200,000
- Waste water generation = 100 litres per capita per day
- Influent BOD₅ = 680mg/l
- Design temperature = 21°C
- FC/100ml of influent = 4×10^7
- Effluent standards to be achieved
 - = Faecal coliform <1000/100ml
 - = BOD₅ <20mg/l

Assume any other data (16 marks)

b) Explain ways in which a designer can control odour in anaerobic pond. (4 marks)

Question Two

a) A combined sewer is to be designed to serve an area of 20km² with population density of 320 persons per hectare. The average rate of wastewater flow is 320 litres per capita per day. The maximum flow is 200 percent in excess of average together with the rainfall equivalent of 17mm in 24 hours, all of which velocity of flow as 3m/s. Determine:

- (i) The capacity of the sewer
- (ii) The size of the circular sewer (10 marks)

b) A city with a population of 20,000 has an area of 14000 hectares of which 200 hectares are zoned commercial and 200 hectares are zoned industrial. The average water consumption is 150 litres per hectare per day and 70 per cent of this water reaches the sewers. On the basis of sewer gauging, the average flow from the commercial area is 200,000 litres per day. The peaking factor is 1.75. Using an industrial allowance of 5000 litres/hectare per day with a peaking factor of 1.8.

- (i) Estimate the average flow rate
- (ii) Peak wastewater flow rate
- (iii) Determine the overall peaking factor
- (iv) What is the effect of commercial industrial and infiltration on the overall peaking factor? (10 marks)

Question Three

a) Explain the importance of the following in the design of sewer systems:

- (i) Minimum flow rate
- (ii) Maximum dry weather flow rate (2 marks)

b) Design a rectangular sedimentation tank excluding influent and effluent structures for the following data:

- Required overflow from sedimentation tank = 350m³/h
- Water used in dislodging = 2%
- Minimum size of particles to be removed = 0.018mm
- Expected removal efficiency of minimum size particle = 75%
- Specific gravity of particle = 2.65
- Assumed performance of setting tank = Good (n=1/4)
- Kinematic viscosity of water at 20°C = 1.01 x 10⁻⁶m²/s
- Assume detention time as 4 hours (13 marks)

c) Design a water main required to carry the water from a source 3.218km away from the town. The yield from the source (spring) is 180 litres per minute. The reduced levels of spring and the centre of the town are 1828.800m and 1767.840m respectively. Take f = 0.01 (5 marks)

Question Four

a) Discuss the main factors to be considered by the designer of a screen installation on a water supply intake. (5 marks)

- b)** Design a ball mouth canal for a city of 200,000 persons drawing water from a canal which runs for 12 hours a day with a depth of 2.7m. Assume the following data:
- Per capita consumption per person as 150litres per day
 - The velocity through the screen as 0.4m/s
 - The velocity through the bell mouth as 0.38m/s
 - The area occupied by solid bars as 25% of the total area.
 - The minimum water level at 0.35m below the normal water level
 - The screen placed at 0.32m above canal level
- (8 marks)**
- c)** Design a water intake bar screen for a peak average flow of 50,000m³ per day. Assume the following:
- Angle of inclination 45° to the vertical
 - Bar size 9mm x 45mm
 - Clear spacing between bars 36mm
 - Velocity at peak flow = 0.75m/s
- (7 marks)**

Question Five

- a)** Describe a procedure for economic analysis of water supply project. **(10 marks)**
- b)** Find the dimensions of a rapid sand filter unit for 45,000m³/day.
- Assume 4 percent as allowance to backwash
 - Allowing half an hour for backwashing in a day
 - Rate of filtration 5m³/m².d
- (5 marks)**
- c)** Describe the types and sources of pollution and possible control measures. **(5 marks)**