



ZIMBABWE

**MINISTRY OF HIGHER AND TERTIARY EDUCATION,
INNOVATION, SCIENCE AND TECHNOLOGY
DEVELOPMENT**

**HIGHER EDUCATION EXAMINATIONS COUNCIL
(HEXCO)**

NATIONAL DIPLOMA

IN

WATER AND SANITATION MANAGEMENT

**MODULE: Wastewater Treatment and
Analysis**

PAPER CODE 511/23/M06

DURATION: 3 Hours

NOVEMBER/ DECEMBER 2025 EXAMINATION

REQUIREMENTS

Calculator

INSTRUCTIONS TO CANDIDATE

Answer any five (5) questions

This paper consists of 3 printed pages.

QUESTION 1

- a) Differentiate between primary, secondary and tertiary wastewater treatment. (6marks)
- b) Outline common challenges in maintaining consistent wastewater quality in a treatment facility. (6marks)
- c) How does laboratory testing of wastewater and final effluent quality contribute to regulatory compliance. (4marks)
- d) Provide two technologies used in the biological treatment of wastewater. (4marks)

QUESTION 2

- a) For a given wastewater stabilization pond system, evaluate the design of an anaerobic pond according to its mode of operation. (10marks)
- b) Discuss the process as they happen in an anaerobic pond in the treatment of organic matter
 - i) Hydrolysis
 - ii) Acidogenesis
 - iii) Acetogenesis
 - iv) Methanogenesis (8marks)
- c) Recommend the main/primary objective of pre-treatment in wastewater treatment. (2marks)

QUESTION 3

- a) A trickling filter receives a wastewater flow rate of $2000\text{m}^3/\text{day}$ with an influent BOD_5 concentration of 250mg/l . The filter dimensions measures 10m high with a diameter of 6m. Tabulate the organic loading rate of the cylindrical filter. (13marks)
- b) Asses the problems associated with operation and maintenance of trickling filters. (7marks)

QUESTION 4

- a) For a dairy farm in Mhondoro Ngezi explain how do the following pollutants be removed from the produced wastewater of that farm, so that the water can be used to irrigate their pasture.

- i) Heavy metals as a result of chemicals they use during their clean in progress session (CIP)
 - ii) Greases and oils
 - iii) Solids in suspension
 - iv) Bacteria, protozoa
 - v) Odours (8marks)
- b) The sludge produced needs to be stabilized for reuse. Review three sludge thickening methods available that can be used. (8marks)
- c) State any key information that should be included in a report on wastewater final effluent composition. (4marks)

QUESTION 5

- a) Deduce the removal of nitrogen and phosphorus from wastewater at a wastewater treatment plant. (6marks)
- b) Produce a relationship between the design of the facultative pond and the operation of the facultative pond in treating wastewater. Clearly outline the process that takes place within the pond. (10marks)
- c) Why is it important to determine daily and seasonal wastewater inflow variations at Marlborough water works? (4marks)

QUESTION 6

- a) Identify the work of maturation ponds clearly mentioning the processes involved. (4marks)
- b) From the maturation pond water is sometimes directed into a simulated wetland containing aquatic weeds. Specify the significance of aquatic weeds in wastewater treatment. (4marks)
- c) State components of a trickling filter (4marks)
- d) Calculate the hydraulic surface loading rate of circular filter. The diameter measure 8 meters. The influent flow is 3000m³/day
HSLR=discharge/surface area (Q/SA) (3marks)
- e) Calculate the detention time of the particle of fluid within the filter from the moment it enters to the time it leaves when the filter is 12 meters high. (5marks)