



UNIVERSITY COLLEGE TATI (UCTATI)

FINAL EXAMINATION QUESTION BOOKLET

COURSE CODE	: BCE 4043
COURSE	: WASTEWATER ENGINEERING
SEMESTER/SESSION	: SEM 2-2023/2024
DURATION	: 3 HOURS

Instructions:

1. This booklet contains 4 questions. Answer **ALL** questions.
2. All answers should be written in answer booklet.
3. Write legibly and draw sketches wherever required.
4. If in doubt, raise your hands and ask the invigilator.

DO NOT OPEN THIS BOOKLET UNTIL YOU ARE TOLD TO DO SO

THIS BOOKLET CONTAINS 5 PRINTED PAGES INCLUDING COVER PAGE

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QUESTION 1

- a) Describe the processes needed to supply a modern city with clean drinking water from well or river. Describe also the processes needed to treat water after use. (Clarify your answer with sketches if needed). (10 marks)
- b) The results shown in **Table (1)** were obtained for a wastewater sample taken at the headworks to a wastewater-treatment plant. All of the tests were performed using a sample size of 50 ml.

TABLE (1)

Item	Weight, g
Tare mass of evaporating dish	43.5436
Mass of evaporating dish plus residue after evaporation at 105°C	43.5725
Mass of evaporating dish plus residue after ignition at 550°C	43.5695
Tare mass of Whatman GF/C filter	1.5436
Mass of Whatman GF/C filter plus residue after drying 105°C	1.5735
Mass of Whatman GF/C filter plus residue after ignition at 550°C	1.5631

Determine the followings:

- i. Concentration of total solids (4 marks)
- ii. Total volatile solids (3 marks)
- iii. Total suspended solids (3 marks)
- iv. Volatile suspended solids (3 marks)
- v. Dissolved solids (3 marks)

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QUESTION 2

a)

Define the followings:

- i. COD (1 mark)
- ii. BOD (1 mark)
- iii. TN (1 mark)
- iv. Toxicity (1 mark)
- v. TSS (1 mark)
- vi. Aerobic (1 mark)
- vii. Anaerobic (1 mark)
- viii. Nitrification (1 mark)
- ix. Denitrification (1 mark)

b)

The results of a water analysis are shown in **Table (2)** below:**Table (2)**

Cations	Mg/L	Anions	Mg/L
Ca	58.0	HCO ₃	342
Mg	32.8	SO ₄	72
Na	46.0	Cl	48
K	35.0	-	-

- i. Convert milligrams per liter concentration to milliequivalents per liter. (4 marks)
- ii. Draw the milliequivalence per liter bar graph (4 marks)
- iii. List hypothetical combinations. (4 marks)
- iv. Calculate hardness as mg/L of CaCO₃ for this water analysis (4 marks)

QUESTION 3

- a) If the Dissolved oxygen (O_2) in H_2O is 100 g/L.
Determine the mole fraction of dissolved oxygen (5 marks)
- b) Determine the carbonaceous 5-day BOD and k-rate for an un-chlorinated effluent after treatment by activated sludge aeration. Nine identical test bottles were prepared, with 60 ml of wastewater added to each bottle followed by 240 ml of dilution water. Three bottles were titrated after setup to determine the initial DO of 8.1 mg/l. The remaining 6 bottles were incubated and tested for time-residual DO data with the following results: 1.3 days, DO = 7.2 mg/l; 3.3 days, 6.4 mg/l; 4.3 days, 6.2 mg/l; 5.3 days, 5.8 mg/l; 8.3 days, 4.5 mg/l; and 11.3 days, 3.5 mg/l.
- i. Draw the BOD-time curve (10 marks)
- ii. Draw the graph for determination k-rate (10 marks)

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QUESTION 4

- a) Define the followings:
- i. Multiple- tube fermentation technique (5 marks)
 - ii. Most Probable Number (MPN) (4 marks)
- b) **Table (3)** shows collects from domestic wastewater plant every 2 hours for complete period of 24 hrs.

Table (3)

Time, h	BOD, mg/L	TSS, mg/L	Flowrate, m ³ /d
0200	130	150	8000
0400	110	135	6000
0600	160	150	9400
0800	220	205	12800
1000	230	210	13000
1200	245	220	14400
1400	225	210	12000
1600	220	200	9600
1800	210	205	11000
2000	200	210	8000
2200	180	185	9000
2400	160	175	8400

Compute the followings:

- i. Weighted total BOD in g/m³ (8 marks)
- ii. Weighted total TSS in g/m³ (8 marks)

-----End of questions -----

