



NATIONAL UNIVERSITY OF SCIENCE AND TECHNOLOGY  
FACULTY OF APPLIED SCIENCES  
DEPARTMENT OF CHEMICAL ENGINEERING  
WATER CHEMISTRY FOR ENGINEERS  
TCE 7103

END OF FIRST SEMESTER EXAMINATION PAPER

DECEMBER 2024

This examination paper consists of 4 pages

TIME ALLOWED: 3 HOURS  
TOTAL MARKS: 100  
SPECIAL REQUIREMENTS: PERIODIC TABLE  
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**INSTRUCTIONS**

1. Section A is **COMPULSARY** and answer **ANY THREE** questions in section B.
2. Each question carries **25 MARKS**.
3. Use of calculators is permissible

**MARK ALLOCATION**

QUESTION	MARKS
1.	25
2.	25
3.	25
4.	25
5.	25
<b>TOTAL POSSIBLE MARKS</b>	<b>100</b>

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## SECTION A

1. (a) Define the following terms:  
(i) Pollutant  
(ii) Contaminant  
(iii) sink. [6]
- (b) Quoting from the EPA website: The main threat to surface water quality is eutrophication, which is the over-abundant growth of plant and algae arising from excess nutrients in the water
- (i) What are the nutrients referred to above? At what stage of sewage treatment are their levels lowered so that eutrophication does not occur downstream from sewage works? [2]
- (ii) A sample of brewery effluent was diluted from 50cm<sup>3</sup> to 5.0 litres with well-aerated pure water. The dissolved oxygen concentration of half the sample was measured immediately; the other half was stored under suitable conditions and its dissolved oxygen concentration was measured later. Concentrations of dissolved oxygen of 9.8 ppm and 4.7 ppm, respectively, were recorded. What are the suitable conditions for, and the duration of, storage of the second sample? [3]
- (iii) Calculate the BOD of the brewery effluent. [3]
- (c) Explain clearly how suspended solids are removed in the treatment of water for drinking. [9]
- (d) What problems would arise if the pH of a public water supply were outside the range 6-8? [2]
- [Total: 25]**

## SECTION B

2. (a) Use chemical equations and diagrams to describe the role of each of the four (4) major stages involved in oxidation pond technology for treatment of domestic effluent. [8]
- (b) Treatment technologies are specific for industrial wastewater.

- (i) Describe how biofilter technology works and give an example of the type of industrial pollutants it is targeted for. [3]
- (ii) Describe how activated sludge technology works, and give an example of the type of industrial pollutants it is targeted for. [3]
- (iii) Describe how reverse osmosis works and give an example of the type of industrial pollutants it is targeted for. [3]
- (iv) Describe how ozonolysis works and give an example of the type of industrial pollutants it is targeted for. [3]
- (c) Explain how each of the following disinfection technologies used in wastewater treatment plants today work and describe any one advantage and any one disadvantage of each.
- (i) Chlorination
- (ii) UV radiation. [5]
- [Total: 25]**
3. (a) Use chemical equations to describe the phenomenon of “acid rain.” [5]
- (b) One of the concerns with coal-fired power stations is sulphurous emissions.
- (i) What is the source of sulphurous emissions in these types of plants. [2]
- (ii) Describe how sulphurous emissions are reduced in coal-fired power plants. [5]
- (iii) Explain how pollutants from ash disposal sites are prevented from polluting groundwater and how this is monitored. [5]
- (c) Give a brief discussion of biomagnification. Use an example to illustrate your answer? [5]
- (d) Carbon nanotube technology is becoming widely used in water treatment. What are carbon nanotubes, and how do they work in water treatment? [3]
- [Total: 25]**
4. (a) What could be the harmful effects of improper management of industrial and domestic solid waste in a city? [10]
- (b) Describe and explain what photochemical smog is. Use equation to illustrate your answer. [15]
- [Total: 25]**

5. (a) (i) Use diagrams and chemical equations to describe the Nitrogen cycle. [10]
- (ii) What are the adverse effects of excess nutrients? Explain taking the case of nitrogen and phosphorus? [7]
- [Total: 25]

**END OF QUESTION PAPER**

