

**National Exams May 2002**

**98-BS-16, Environmental Engineering**

3 hours duration

NOTES:

1. If doubt exists as to the interpretation of any question, the candidate is urged to submit with the answer paper, a clear statement of any assumptions made.
2. Candidates may use one of two calculators, the Casio or Sharp approved models. This is a Closed Book examination.
3. Any five questions constitute a complete paper. Only the first five questions as they appear in your answer book will be marked.
4. All questions are of equal value.

1. (i) Explain the difference between “carbonaceous biochemical oxygen demand” and “nitrogenous biochemical oxygen demand” using appropriate sketches.

Discuss briefly two other parameters used in quantifying organic content in municipal wastewater discharges.

A stream with a flow rate of  $5 \text{ m}^3/\text{s}$  and a certain pollutant “X” concentration of  $0.08 \text{ mg/L}$  feeds into a lake having a volume of  $10 \times 10^6 \text{ m}^3$ . A wastewater treatment plant also discharges its treated effluent at the rate of  $0.5 \text{ m}^3/\text{s}$  into the same lake. The concentration of X in the wastewater effluent is  $1 \text{ mg/L}$  and the reaction rate coefficient is  $0.2/\text{day}$ .

- (a) Find the steady-state concentration of X in the lake, and
- (b) If the wastewater effluent discharge is eliminated to improve the quality of water in the lake, what will be the new steady-state concentration of X in the lake?

State the basic assumptions that you made.

2. (i) List the ecological effects of air pollutants such as total suspended particulates, sulphur dioxide and nitrogen dioxide on humans, plants, soil/microorganisms and climate/atmosphere.

- (a) An air quality standard for nitrogen dioxide is given as  $0.46 \text{ mg/m}^3$  at 1 atm of pressure and at a temperature of  $25^\circ\text{C}$ . Express the concentration in ppm, clearly stating all the assumptions that you made.
- (b) What is the advantage of expressing an air quality standard in ppm compared to  $\text{mg/m}^3$ ?

[ N = 14; O = 16 ]

3. (i) Discuss the following terms with respect to drinking water treatment using a typical process schematic:
- (a) Coagulation and Flocculation
  - (b) Filtration
  - (c) Disinfection
- (ii) (a) Ammonia in wastewater discharges exist in two forms: free/unionized ammonia and ammonium/ionized ammonia. Find the fraction of the free/unionized form of ammonia as a function of pH at a temperature of 25°C.
- (b) Illustrate this relationship by using an appropriate sketch for the pH range of 7 to 12.
- (c) Which form of ammonia is more toxic to aquatic organisms? Why?
- Assume that the equilibrium constant at 25°C is  $1.82 \times 10^{-5}$ .

4. Write short notes on the following:

- (i) Population pyramid
- (ii) Water hardness
- (iii) Stratospheric ozone depletion
- (iv) Landfill leachate control
- (v) Sewage biosolids treatment

5. (i) Explain the terms “acute toxicity”, “chronic toxicity” and “bioassay”.

How are these used in assessing the impacts of pollutants on biota.

List the ideal characteristics for indicator species in bioassays. Explain why each characteristic is important.

What are the two major constituents in a typical sewage treatment plant effluent that are commonly associated with causing toxicity in receiving waterbodies?

Explain the measures that can be implemented at the treatment plants/processes to reduce or eliminate effluent toxicity.

6. (i) List and discuss the major phases of an environmental impact assessment?

Briefly outline the intent of any three important Acts or Regulations in your Province used to protect the environment.

7. (i) Describe the various types of environmental conflict resolution.

Discuss the environmental impacts of urbanization. Use a tabular form with atmosphere, hydrosphere, lithosphere and human impacts as environmental components and population, land use, transportation and services as urban components to facilitate your discussion.

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Marking Scheme

1.	(i)	8
		12
2.	(i)	12
		8
3.	(i)	12
		8
4.	(i)	4
	(ii)	4
	(iii)	4
	(iv)	4
	(v)	4
5.	(i)	6
	(ii)	6
	(iii)	8
6.	(i)	14
		6
7.	(i)	10
	(ii)	10