NATIONAL UNIVERSITY OF SINGAPORE

ESE5001 ENVIRONMENTAL ENGINEERING

(Semester 2: AY2016/2017)

Time Allowed: 2 Hours

INSTRUCTIONS TO CANDIDATES

1. Please write your student number only. **Do not write your name**.

2. This assessment paper contains **THREE Parts: Part A Water Quality**
Part B Air Quality
Part C Waste Management

and comprises **SIX** printed pages.

3. Answer **ALL** questions. All questions **DO NOT** carry equal marks.

4. Please start each question on a new page.

5. This is a "**CLOSE BOOK**" assessment.

PART A – WATER QUALITY

Question 1 (8 marks)

Describe the growth kinetics of microorganisms in (a) a continuous flow completely mixed reactor, and (b) a batch completely mixed reactor for microorganisms in an activated sludge process for wastewater treatment using the Monod equation.

Question 2 (7 marks)

A wastewater treatment plant is designed to meet the following discharge permit requirement. Determine the mean design effluent BOD_5 and SS concentrations required to meet 98 percent reliability level in this treatment plant. The coefficient of variation is estimated to be 0.75. The values of the standardized normal distribution are listed in the table below.

BOD_5 = 20 mg/l
SS = 30 mg/l

Cumulative probability, 1-α	Percentile, $Z_{1-\alpha}$
99.9	3.090
99	2.326
98	2.054
95	1.645
92	1.405
90	1.282
80	0.842
70	0.525
60	0.253

Question 3 (15 marks)

Using the following daily flow rate data obtained from an industrial discharge for twelve days, predict the maximum daily flow rate that will occur during an operation period of one month.

Day	Flow rate, m^3/d
1	255
2	314
3	282
4	318
5	354
6	327
7	336
8	345
9	377
10	381
11	385
12	367

$$\mu = \frac{\mu_m S}{k_s + S}$$

$$COR = (V_x^2 + 1)^{1/2} e\{-Z_{1-\alpha} \ln(V_x^2 + 1)^{1/2}\}$$

PART B - AIR QUALITY

SECTION A: Multiple Choice Questions (10 Marks)
Indicate the letter of the correct answer in the answer space provided. Each question = 1 mark

No.	Question	Answer
1	One of the problems that occurs as a consequence of CFC pollution is _____. (A) increasing skin cancer in humans (B) respiratory irritation and lung cancer (C) damage to human red blood cells (D) movement of toxins into lakes and rivers, which poisons fish (E) eutrophication	a
2	Which of the following is a consequence of acidic deposition? (A) It increases the likelihood of low-lying ground fogs. (B) It results in offshore eutrophication, damaging coral reefs. (C) It creates rainwater that can damage skin cells or cause cancers. (D) leaching out important minerals from soils and loss of biodiversity (E) It is increasing the rate of global warming.	d
3	The most obvious cause of industrial smog is _____. (A) burning trash (B) fires for heating food (C) indoor air pollution (D) burning fossil fuels (E) generation of nuclear power	d
4	You have been hired by a rapidly growing small city to improve the air quality, which has deteriorated in the past 10 years. Your first suggestion is to _____. (A) investigate the large city downwind whose factories produce large amounts of pollution (B) decrease the amount of CFCs used locally (C) move or close the cattle feed lots near the river (D) improve transportation options, including carpool lanes, buses, and light rail (E) remove the hydroelectric dam on the river	a

No.	Question	Answer
5	The reason that temperature increases with altitude through most of the stratosphere is _____. (A) heat is released by absorption of UV radiation by oxygen and ozone (B) sunlight is more intense in the stratosphere (C) jet stream winds produce frictional heat (D) water vapor levels are high and store heat (E) greenhouse gases warm the air	
6	The Montreal Protocol _____. (A) addressed transnational movement of acid-forming pollutants (B) developed the framework for reduction of carbon dioxide in the US and Canada (C) developed the international treaty for eliminating radon emissions from nuclear power plants (D) resulted in significant reduction in the production of CFCs by signatory nations (E) is an example of a failed attempt to reduce international air pollution	
7	Which one of the following is *not* yet regulated by the National Environment Agency? (A) sulfur and nitrogen oxides (B) lead (C) carbon dioxide (D) ozone (E) carbon monoxide	c
8	Recent evidence suggests that controlling emissions of this gas, _____ would reduce both ozone depletion and global warming. A) carbon dioxide B) methane C) carbon monoxide D) nitrous oxide E) ammonia	d

No.	Question	Answer
9	The greenhouse effect involves warming of Earth's surface and the _____. A) troposphere B) mesosphere C) stratosphere D) thermosphere E) ionosphere	
10	The most recent analyses of polar ice cores have given us the ability to profile global climate change back as far as _____ years. A) 800,000 B) 100,000 C) 1000 D) 50,000 E) 300,000,000	

SECTION B: Essay Questions

Question 1 (10 marks):

Discuss the major differences between the "good ozone" and the "bad ozone" in the atmosphere in terms of their origin, characteristics, significance/impacts and their current status of the related environmental issues from the policy viewpoint. (No need to write a number of chemical reactions).

Question 2 (10 marks):

In the context of climate change mitigation, you are asked to propose innovative ideas to boost national economic growth without growing "carbon emissions". Discuss your ideas.

PART C – WASTE MANAGEMENT

Question No.: 3

Paper or plastic? They both have their advocates and detractors. For example, recycling advocates often point to the plastic bags as the prototype of wastage and pollution, as stuff that clogs up our landfills. In retaliation, plastic bag manufacturers developed a public relation campaign to promote their product. On one of the flyers (printed on paper) they said:

"*The plastic bag does not emit toxic fumes when properly incinerated. When burned in waste-to-energy plants, the resulting by-products from combustion are carbon dioxide and water vapour, the very same by-products that you and I produce when we breathe. The bag is inert in landfills, where it does not contribute to leaching, bacterial or explosive gas problems. The bag photodegrades in sunlight to the point that normal environmental factors of wind and rain will cause it to break into very small pieces, thereby addressing the unsightly litter problem.*"

In approximately 500 words, critique this statement. Is all of it true? Is anything misleading? Do you agree with their evaluation?

[30 marks]

END OF PAPER