NATIONAL EXAMS May 2018

04-Env-A5, Air Quality and Pollution Control Engineering

3 hours duration

NOTES

1. If doubt exists as to the interpretation of any questions, the candidate is urged to submit with the answer paper, a clear statement of any assumptions made.

2. This is an Open Book Exam .

3. Candidates may use one of two calculators, the Casio or Sharp approved models. Write the name and model designation of the calculator on the first inside left hand sheet of the exam work book.

4. Four (4) for a total of five (5) questions constitute a complete paper. Only the four (4) answers as they appear in your work book(s), will be marked.

5. Each question is worth a total of 25 marks with the section marks indicated in brackets ( ) at the left margin of the question. A completed exam consists of four (4) answered questions with a possible maximum score of 100 marks.

Problem 1

Provide answers to the following questions related to *source and classifications of atmospheric pollutants, indoor and outdoor air pollutants and health and ecological impacts.*

(10)   (i) what is air pollution? give example of at least two (2) sources of various sources and associated contaminants. Include description of how the contaminant is generated.

(10)   (ii) chose two (2) indoor air pollutants from the given list and describe their origins and potential health impacts.

List: radon, carbon monoxide, nitrogen dioxide, lead

(5)   (iii) What is indoor pollution? Provide an example, describe specific substance and impact on human health.

Problem 2

Provide answers to the following questions related to influence of *solar radiation and wind fields on stack plumes, dispersion and deposition modelling of atmospheric pollutants and Eddy and Gaussian diffusion models.*

(10)   (i) For Gaussian, Eulerian or Lagrangian dispersion model, select only one (1): give example of a model and its name, basic approach what information is required to successfully run it, list two (2) assumptions that must be met when using the model, list one (1) limitation.

(10)   (ii) name 4 types of plume behavior. Select three (3) and draw a simple diagram (i.e. side view) and describe the behavior in terms of distance away from the stack and dispersion.

(5)   (iii) describe one air quality model that <u>is not</u> based on dispersion.

Problem 3

Provide answers to the following questions related to *measurement techniques of air pollutants, characteristics of various air pollutant particulates and health and aesthetic considerations of PM$_{2.5}$ and PM$_{10}$.*

(10)   (i) List two (2) measurement techniques for particulate matter. Describe in detail how each technique works, for which pollutant it should be used and what are the limitations and advantages of each.

(10)   (ii) select a source of particulate emissions and relevant industry. For the source list control technology that could be applied on that source. Discuss and explain significance of particle size distribution.

(5)   (iii) Define PM$_{2.5}$ and PM$_{10}$. Describe 3 (3) key differences in the health effects and aesthetics between the PM$_{2.5}$ and PM$_{10}$ categories of particulate pollutants.

Problem 4

Provide answers to the following questions related to *air toxics, mobile sources of air pollutants, noxious pollutants and odour control and emission trading.*

(10)   (i) Select three (3) air toxics from the list and provide source of the pollutant, example of industry and how it can be controlled.

List: polycyclic aromatic hydrocarbons (PAHs), volatile organic compounds (VOCs), nitric oxide, gaseous ammonia

(5)   (ii) What is a mobile source? Select one type of mobile source and provide a description of the source, and list two (2) air pollutant associated with the source.

(10)   Select any two (2) programs, provide brief description of the program. Mention which jurisdiction the program or regulation falls under, what are the similarities and differences between each.

List:

- **National Air Pollution Release Inventory (NPRI),**
- **Ontario Regulation 127 O. Reg. 127/01: Airborne Contaminant Discharge Monitoring and Reporting, Toxics Reduction Act, ChemTRAC Chemical Tracking in Industry,**
- **O. Reg. 194/05: Industry Emissions – Nitrogen Oxides and Sulphur Dioxide**
- **Program from other country of your choice.**

Problem 5

Provide answers to the following questions related to *behavior of gaseous pollutants (CO, SO$_x$, NO$_x$, etc)*
in the atmosphere and monitoring and control of particulate emissions.

(10)   (i) Select any two (2) of following gas cleaning equipment and **for each**: (a) describe when it
would be appropriate to use it with respect to gas composition and particulate size, (b) provide
example of source/industry that would utilize this equipment, (c) list and elaborate on two (2)
design aspects.

Air Pollution Control Equipment: baghouse, electrostatic precipitator, settling chamber, cyclone

(10)   (ii) For an industrial dryer fired with fuel describe three (3) options to reduce Sulphur Oxide
emissions from the unit.   Describe one (1) way to reduce NOx emissions.

(5)   (iii) select two (2) gaseous pollutant (CO, SO$_2$, NOx, PM) describe their behavior in the
atmosphere.