

NATIONAL EXAMS MAY 2017

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 total out of five (5) questions constitute a complete paper. Only the first 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. The complete Marking Scheme is also provided on the final page. A completed exam consists of four (4) answered questions with a possible maximum score of 100 marks.

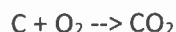
Marking Scheme

1. (i) 7, (ii) 10, (iii) 8, 25 marks total
2. (i) 12, (ii) 8 (iii) 5, 25 marks total
3. (i) 10, (ii) 10, (iii) 5, 25 marks total
4. (i) 10, (ii) 8, (iii) 4, (iv) 3, 25 marks total
5. (i) 9, (ii) 10, (iii) 6, 25 marks total
6. (i) 10, (ii) 10, (iii) 5, 25 marks total

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.*

- (7) (i) Define and describe classifications of atmospheric pollutants. For each provide 2 examples.
- (10) (ii) For a typical plant 10,000 MW which consumes approximately 80,000 US tons of coal per day calculate air required for combustion due to energy generation. State all assumptions.



- (8) (iii) Select indoor and outdoor air pollutant, define each and describe how each impacts health and ecology.

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 dispersion models..*

- (12) (i) Consider three (3) different types of air quality models and describe their differences.
- (8) (ii) Select one of the three dispersion models mentioned in (i) and describe when it would be appropriate to apply the model, under which circumstances. Discuss assumptions that must hold true. You may use a real case scenario.
- (5) (iii) Using Gaussian dispersion model describe how solar radiation, wind fields and one additional aspect of your choice, effect on the stack plumes.

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 PM₁₀.*

- (10) (i) Define PM_{2.5} and PM₁₀. For each, in detail, describe their characteristics, health impacts and aesthetic considerations.
- (10) (ii) Describe a method of measuring PM, use a diagram, and list at least two (2) merits and two (2) disadvantages.
- (5) (iii) Provide examples of condensable and respirable PM fractions and their sources.

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) Describe two (2) methods of controlling odour emissions listing fundamental principles of the design. Define the type of odour emissions and source and provide diagram of the system.
- (8) (ii) Define noxious pollutant. Provide three examples of a noxious pollutant and their sources.
- (4) (iii) Describe what emission trading is, for what purpose it exists, how is it currently applied in at one jurisdiction.
- (3) (iv) Define air toxic and provide two (2) examples.

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*.

- (9) (i) List and describe monitoring techniques of stack emissions, one for emissions of particulate, one for emissions of CO, one for emissions of SO_x.
- (10) (ii) Select two gaseous pollutant (CO, SO₂, NO_x) describe their behavior in the atmosphere.
- (6) (iii) List and describe (use schematics) two (2) types of control technologies for emissions of particulate matter from industrial sources.

Problem 6

Provide answers to the following questions related to *control of gases and vapour emissions to the atmosphere and control mechanisms including adsorption, absorption, combustion and incineration*.

- (10) (i) Describe in detail adsorption or absorption. Use diagram. Provide real application. Define governing principles and limitations of the control mechanism.
- (10) (ii) Describe combustion or incineration. Use diagram. Provide real application. Define governing principles and limitations of the control mechanism.
- (5) (iii) Pick OTHER, not previously selected in (i) and (ii), control mechanisms and discuss performance efficiency.