SEE4220: MEASUREMENTS OF AIR POLLUTANTS

Effective Term

Semester A 2022/23

Part I Course Overview

Course Title

Measurements of Air Pollutants

Subject Code

SEE - School of Energy and Environment

Course Number

4220

Academic Unit

School of Energy and Environment (E2)

College/School

School of Energy and Environment (E2)

Course Duration

One Semester

Credit Units

3

Level

B1, B2, B3, B4 - Bachelor's Degree

Medium of Instruction

English

Medium of Assessment

English

Prerequisites

SEE2002 Chemical Sciences for Energy and Environmental Engineers;
SEE2003 Introduction to Energy and Environmental Data Analysis; and
SEE3101 Engineering Thermofluids II

Precursors

BCH2004 OR CHEM2004 Principles of Analytical Chemistry

Equivalent Courses

Nil

Exclusive Courses

Nil

Part II Course Details

Abstract

To introduce students to the principles of different instruments for the measurements of gaseous and particulate pollutants based on the Reference methods (USEPA approved methods) and advanced research methods. Students will learn the fundamental concepts in the design of instruments used in typical air quality monitoring stations (AQMS) and research facilities. In addition to introducing the techniques for assessing the criteria pollutants, we will put emphasis on measurements of various physical and chemical characteristics of particulate matters. Real time techniques will also be discussed.

Course Intended Learning Outcomes (CILOs)

	CILOs	Weighting (if app.)	DEC-A1	DEC-A2	DEC-A3
1	Explain the principles and limitations of the Reference methods used for criteria pollutants in AQMS	40	x	x	
2	Explain the principles and limitations of real time techniques for measurements of PM concentrations and their properties	40		x	
3	Evaluate the significance and the limitations of emerging technologies in air pollutant measurements	20		x	x

A1: Attitude
Develop an attitude of discovery/innovation/creativity, as demonstrated by students possessing a strong sense of curiosity, asking questions actively, challenging assumptions or engaging in inquiry together with teachers.

A2: Ability
Develop the ability/skill needed to discover/innovate/create, as demonstrated by students possessing critical thinking skills to assess ideas, acquiring research skills, synthesizing knowledge across disciplines or applying academic knowledge to real-life problems.

A3: Accomplishments
Demonstrate accomplishment of discovery/innovation/creativity through producing /constructing creative works/new artefacts, effective solutions to real-life problems or new processes.

Teaching and Learning Activities (TLAs)

	TLAs	Brief Description	CILO No.	Hours/week (if applicable)
1	Lectures	Explain key concepts and principles related to air pollutant measurements and the design of instruments	1, 2, 3	
2	Lab demonstrations	Visit to research facilities of advanced instruments for measurements of air pollutants	1, 2, 3	
3	Field trip	Visit to AQMS	1, 2	

4	Project	Students to present a publication on the principle and/or application of a new technique	1, 2, 3	

Assessment Tasks / Activities (ATs)

	ATs	CILO No.	Weighting (%)	Remarks (e.g. Parameter for GenAI use)
1	Assignments	1, 2, 3	15	
2	Mid term	1, 2	30	
3	Project	3	20	

Continuous Assessment (%)

65

Examination (%)

35

Examination Duration (Hours)

2

Additional Information for ATs

Examination duration: 2 hrs
Percentage of coursework, examination, etc.: 65% by coursework; 35% by exam

To pass a course, a student must do ALL of the following:
1) obtain at least 30% of the total marks allocated towards coursework (combination of assignments, pop quizzes, term paper, lab reports and/ or quiz, if applicable);
2) obtain at least 30% of the total marks allocated towards final examination (if applicable); and
3) meet the criteria listed in the section on Assessment Rubrics.

Assessment Rubrics (AR)

Assessment Task

1. Assignments

Criterion

Ability to explain concepts, analyze and solve problems related to measurements of air pollutants

Excellent (A+, A, A-)

Excellent understanding of concepts and ability to analyze and solve problems related to measurements of air pollutants

Good (B+, B, B-)

Good understanding of concepts and ability to analyze and solve problems related to measurements of air pollutants

Fair (C+, C, C-)

Acceptable understanding of concepts and ability to analyze and solve problems related to measurements of air pollutants

Marginal (D)

Marginally acceptable understanding of concepts and ability to analyze and solve problems related to measurements of air pollutants

Failure (F)

Poor understanding of concepts and ability to analyze and solve problems related to measurements of air pollutants

Assessment Task

2. Mid term

Criterion

Ability to explain concepts, analyze and solve problems related to measurements of air pollutants

Excellent (A+, A, A-)

Excellent understanding of concepts and ability to analyze and solve problems related to measurements of air pollutants

Good (B+, B, B-)

Good understanding of concepts and ability to analyze and solve problems related to measurements of air pollutants

Fair (C+, C, C-)

Acceptable understanding of concepts and ability to analyze and solve problems related to measurements of air pollutants

Marginal (D)

Marginally acceptable understanding of concepts and ability to analyze and solve problems related to measurements of air pollutants

Failure (F)

Poor understanding of concepts and ability to analyze and solve problems related to measurements of air pollutants

---

Assessment Task

3. Project

Criterion

Ability to explain concepts, analyze and solve problems related to measurements of air pollutants

Excellent (A+, A, A-)

Excellent understanding of concepts and ability to analyze and solve problems related to measurements of air pollutants

Good (B+, B, B-)

Good understanding of concepts and ability to analyze and solve problems related to measurements of air pollutants

Fair (C+, C, C-)

Acceptable understanding of concepts and ability to analyze and solve problems related to measurements of air pollutants

Marginal (D)

Marginally acceptable understanding of concepts and ability to analyze and solve problems related to measurements of air pollutants

Failure (F)

Poor understanding of concepts and ability to analyze and solve problems related to measurements of air pollutants

---

Assessment Task

4. Examination

Criterion

Ability to explain concepts, analyze and solve problems related to measurements of air pollutants

Excellent (A+, A, A-)

Excellent understanding of concepts and ability to analyze and solve problems related to measurements of air pollutants

Good (B+, B, B-)

Good understanding of concepts and ability to analyze and solve problems related to measurements of air pollutants

Fair (C+, C, C-)

Acceptable understanding of concepts and ability to analyze and solve problems related to measurements of air pollutants

Marginal (D)

Marginally acceptable understanding of concepts and ability to analyze and solve problems related to measurements of air pollutants

Failure (F)

Poor understanding of concepts and ability to analyze and solve problems related to measurements of air pollutants

Part III Other Information

Keyword Syllabus

1.0 Characteristics of Air Pollutants

2.0 Statistical Issues

3.0 General Air Sampling Techniques

4.0 Particulate Sampling

5.0 Denuder sampling techniques for semi-volatile particles

6.0 Direct Measurement Techniques of mass and number concentration of particles

7.0 Volatile Organic Compounds (VOC) and Chemical Composition Measurements of Particles

8.0 Real time Chemical Analysis of Ambient Particles

Reading List

Compulsory Readings

	Title
1	AEROSOL MEASUREMENT: Principles, Techniques, and Applications Third Edition, Wiley, 2011
2	J. Chow (1995) Measurement methods to determine compliance with ambient air quality standards for suspended particles. J. Air & Waste Manage. Assoc. 45: 320-382. 1995
3	McMurry (2000) A review of atmospheric aerosol measurements, Atmospheric Environment, 34, 1959-1999. https://doi.org/10.1016/S1352-2310(99)00455-0
4	Synder et al. (2013) The Changing Paradigm of Air Pollution Monitoring. Environ. Sci. Technol. 2013, 47, 20, 11369–11377 https://doi.org/10.1021/es4022602
5	Li et al. (2017) Real-time chemical characterization of atmospheric particulate matter in China: A review. Atmospheric Environment. 158, p. 270-304

Additional Readings

	Title
1	Web info, e.g. from USEPA, California Air Resources Board, and research organization, https://www.epa.gov/air-research/air-monitoring-measuring-and-emissions-research, https://ww2.arb.ca.gov/our-work/topics/air-quality-monitoring Company product information