

## **AIR SAMPLING AND ANALYSIS TECHNIQUES**

**11:375:424, 16:375:536**

**Instructor: Gedi Mainelis, Ph.D.**

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**Wed. 9:15 – 10:35 and 10:55 – 1:55**

**Cook Campus, Operator Training Center, Rooms 102 and 103**

The class is a combination of lecture and laboratory exercises

### **IMPORTANT**

Arrive on time and be prepared for laboratory exercises.

No texting or web browsing during the class.

You must wear shoes with closed toes.

You must wear safety glasses during all laboratory exercises.

Most course business will be conducted through the Rutgers SAKAI site.

### **COURSE DESCRIPTION**

- The course provides scientific basis to understand the reasons, principles and techniques of air sampling as they are applied in our study of environmental and health effects of air pollution as well as in regulatory compliance.
- The course provides hands-on experience of various aspects of air sampling. Preparation and quality of written reports is emphasized.

### **LEARNING GOALS**

The learning goals for the Environmental Science major are posted on our website at [http://envsci.rutgers.edu/current\\_students/envsci\\_undergrad\\_program/learning\\_goals.shtml](http://envsci.rutgers.edu/current_students/envsci_undergrad_program/learning_goals.shtml)

This class will contribute toward the following goals:

1. Apply knowledge from the sciences and mathematics to environmental problems and solutions
2. Use the skills and modern environmental science techniques and tools necessary for a successful career in the field
3. Design and conduct experiments, and analyze and interpret data
4. Function effectively on multidisciplinary teams
5. Communicate technical information effectively (orally, in writing, and through electronic media)

## OUTLINE

1	<b>Lecture:</b> Introduction to air sampling, basic gas laws, standards, calibration
2	<b>Lecture:</b> Introduction to air sampling, basic gas laws, standards, calibration <b>Lab:</b> Calibration of wet test meter (WTM) and dry test meter (DGM)
3	<b>Lecture:</b> Gas flow rate measuring devices; <b>Lab:</b> Calibration of rotameter and air sampling train with impinger
4	<b>Lecture:</b> Gas flow rate measuring devices; transport phenomena, Bernoulli's theorem <b>Lab:</b> Calibration of a limiting orifice
5	<b>Lecture:</b> Pitot tube; Volume measuring devices; pumps. <b>Lab:</b> "Velocity and flow measurement in a stack or duct" and "Calibration of an S-type pitot tube"
6	<b>Lecture:</b> Continuation of volume measuring devices; pumps. <b>Lab:</b> Bernoulli's Theorem Demo using a Venturi Meter
7	<b>Lecture:</b> Exposure assessment, particle size distributions, aerosol properties <b>Lab:</b> 1. Calibration of a personal sampling pump; 2. Hand pump calibration
8	<b>Lecture:</b> Exposure assessment, particle size distributions, aerosol properties. <b>Lab:</b> Use and comparison of different flow measurement techniques.
9	<b>SPRING BREAK</b>
10	<b>Lecture:</b> "Biologically relevant measurements" and "Particle sampling and analysis techniques" <b>Lab:</b> Collection of airborne particles and determination of their concentration.
11	<b>Lecture:</b> Dynamic particle measurements <b>Lab:</b> 1. Measurement of PM10 mass fraction using dynamic methods. 2. Measurement of airborne particle number concentration using an Optical Particle Counter
12	<b>Lecture:</b> Biological aerosols. <b>Lab:</b> 1. Airborne particles measurement using Optical Particle Counter (OPC): Investigation of losses. 2. Determination of impactor collection efficiency.
13	<b>Lecture:</b> Principles of CO, Ozone, SO <sub>2</sub> and NO <sub>x</sub> analysis <b>Lab:</b> Measurement of biological aerosols indoors and outdoors
14	<b>Lecture:</b> EPA source sampling methods; EPA Sampling train. <b>Lab:</b> Gas measurement
15	<b>Review. Topics</b>
16	<b>FINAL EXAM</b>

### Literature:

- 11:375:424 and 16:375:536 Laboratory manual (provided on the class website) and handouts
- Lecture material and PowerPoint Presentations
- Book: "Fundamentals of Air Sampling" by Gregory D. Wight, 1994, ISBN-10: 0873718267. Large portions available on Google Books.
- EPA, Air Pollution Training Institute, Course 435, "Atmospheric Sampling".

**Optional:**

1. "Air sampling Instruments for Evaluation of Atmospheric Contaminants", by ACGIH, 9<sup>th</sup> edition, 2001 (or newer if available).
2. "Aerosol technology" by W. Hinds, 1999.
3. "Controlled Test Atmospheres: Principles and Techniques", by Gary O. Nelson, 1982.

***Lab reports:***

Due 1 week following the lab. Please follow the suggested format. Reports up to 1 week late will be discounted 10%. Reports more than 1 week late will be discounted 50%.

Submit the reports to SAKAI, or as email attachments to Dr. Mainelis [mainelis@envsci.rutgers.edu](mailto:mainelis@envsci.rutgers.edu) and TA of the class (TBD).

The report file names should indicate your name and the lab number, i.e., "Smith-Lab2.doc" or "Smith-Lab2.docx".

**Grading:**

Undergraduate students  
Laboratory Reports (70 %)  
Final Exam (30 %)

Graduate students  
Laboratory Reports, including a set  
of additional calculations (70 %)  
Final Exam (30 %)

**ASSESSMENT ACTIVITIES**

1. Apply knowledge from the sciences and mathematics to environmental problems and solutions

Instructional Activity

Students will be instructed how to measure the presence of airborne particulate matter in indoor and outdoor environments.

Students will be instructed how to measure the presence of biological aerosols in indoor and outdoor environments.

Assessment Activity

Student reports detailing the process, results and interpretation of measuring the concentration of airborne particulate matter in indoors and outdoors (50% of assessment).

Student reports detailing the process, results and interpretation of measuring the presence of biological aerosols indoors and outdoors (50% of assessment).

2. Use the skills and modern environmental science techniques and tools necessary for a successful career in the field

Instructional Activity

Measurement and calculation of pollutant penetration/losses through sampling lines.

Assessment Activity

Student reports detailing the process, results and interpretation of pollutant penetration/losses through sampling lines (100% of assessment).

3. Design and conduct experiments, and analyze and interpret data

Instructional Activity

Data accuracy and uncertainty will be discussed

Concepts of sampling train calibration will be discussed

Assessment Activity

Describe and calculate data uncertainty in a lab report (50% of assessment).

Calibrate impinger sampling train using a vacuum gage and describe it in a lab report (50% of assessment).

4. Function effectively on multidisciplinary teams

Instructional Activity

Students will work in teams of 3-4 to conduct laboratory exercises.

Assessment Activity

Students function in teams to perform exercises and collect data. Instructor assesses how they function in teams (100% of assessment)

5. Communicate technical information effectively (orally, in writing, and through electronic media)

Instructional Activity

Students will write lab reports that report and interpret the data gathered during the laboratory exercises. Reports will use the scientific structure (Abstract, Introduction, Methods, Results, Discussion, References).

Description and discussion of various air sampling techniques

Assessment Activity

Students will communicate data and their interpretation in three specific laboratory reports (50% of assessment).

Students will answer specific technical questions in final exam (50% of assessment).