ENVIRONMENTAL & OCCUPATIONAL HEALTH SCIENCES
UNIVERSITY of WASHINGTON | SCHOOL OF PUBLIC HEALTH
(https://deohs.washington.edu/)

ENVH 555A: Industrial Hygiene Methods - Laboratory

Quarter: Spring 2021
Credits & Grading: 3 credits, graded
Time: Mondays & Wednesdays, 10:30 to 11:30 AM
Zoom Location: https://washington.zoom.us/j/92520043995 (https://washington.zoom.us/j/92520043995) (https://washington.zoom.us/j/986004073) (https://washington.zoom.us/j/986004073)

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Course Description

This course and the companion lecture course ENVH 553 cover the detection, sampling and analysis techniques for Industrial Hygiene assessment and monitoring. ENVH 553 (Winter quarter) should be taken by students as it covers the descriptive and theoretical material that complements the practical lab and field experiences covered in ENVH 555 lab. The laboratory experiments are intended to simulate typical industrial hygiene measurement situations and to provide a basis for the selection of sampling and analytical techniques and for the critical evaluation of the laboratory results.

The course emphasizes industrial hygiene sampling and measurement techniques primarily for airborne exposures to chemical agents. Students are introduced to the most common types of field measurements, sampling methods and laboratory analyses, which are used in evaluating occupational health hazards. A familiarization with the instrumentation and techniques is obtained through application in a laboratory-based scenario. The direct measurement techniques are compared to each other and to laboratory based methods. Methods of generating test atmospheres are used to provide concentrations for field type sampling methods. Typical samples are collected for later laboratory analysis. The principles of sampling are emphasized and the laboratory results and environmental results are evaluated by use of quality control measures. The students will learn the format as well as the content of a number of the standard methods that are used. While the examples used in this class focus on workplace sampling and analysis, the techniques that you'll learn are also directly applicable for measuring personal exposures and contaminant concentrations in the ambient environment.

Note: Due to the COVID pandemic, this "laboratory course will be taught in a synchronous, online format in 2021. Students will be provided with lab guides that describe each "virtual" experiment, and you'll view short videos that demonstrate filed sampling and laboratory analysis techniques. You'll also be provided with experimental data, similar to what you would have collected yourselves if the lab had been in person, and you'll be expected to process, summarize and interpret that data and write up your results in individual lab reports for each experiment.

Content

- Calibration of airflow measuring devices

- Aerosol sampling using filter samplers, cyclones and cascade impactors. Aerosol analysis using gravimetric and real-time methods.
- Direct measurement techniques for gases and vapors: Detector tubes and direct reading instruments.
- Infra red spectroscopy: non-dispersive carbon dioxide monitor and the dispersive MIRAN instrument for the measurement of single compounds and the evaluation of mixtures in air.
- Adsorption sampling for organic gases using charcoal tube and badge samplers and analysis by gas chromatography.
- Sampling for ultrafine PM and Black Carbon using direct reading instruments.
- Atomic absorption and x-ray fluorescence spectroscopies for analysis of metals in airborne particles and surface samples.
- Computer spreadsheet technology will be applied to the processing of the data and for testing method reliability.

Course Learning objectives

At the end of this course, students should be able to accomplish the following:

1. Identify literature sources of standard methods for measurement of occupational exposures to chemical contaminants
2. Identify the advantages and the limitations inherent in a variety of techniques and instruments used for industrial hygiene measurements, and what specific factors in the sampling situation might prevent accurate application of that approach.
3. Describe a framework for selection of appropriate methods for measurements of specific workplace contaminants.
4. Demonstrate knowledge of the operating principles of several kinds of contemporary field meters for chemical agents. Demonstrate proficiency in the use of these devices.
5. Demonstrate knowledge of the operating principles, advantages and limitations of several kinds of major laboratory instruments commonly used for chemical analysis, including: FTIR, UV/visible absorption spectrometers, gas chromatographs, atomic absorption spectrometers. Demonstrate proficiency in the operation of these devices.
6. Apply basic concepts in quality control and quality assurance for chemical measurement data.
7. Critically evaluate the reliability of chemical measurement data.
8. Express and interpret the chemical measurement results in terms that are applicable to occupational standards and situations.
9. Demonstrate competency in technical writing.
10. Demonstrate the ability to work effectively, co-operatively, and safely as part of a team.

Responsibilities

The student responsibilities for the course are the following:

1. Prepare in advance of each lab period. Read/understand each experiment and assigned readings before class. Complete all necessary calculations for adequate sampling times, for preparation of standard solutions, and for dilution schemes to provide appropriate concentrations.
2. Complete and submit a lab report on each experiment. Reports will be due the Monday following the scheduled completion date for each experiment, unless otherwise announced.

Class organization

Refer to the **modules (https://canvas.uw.edu/courses/1447721/modules)** section on the course canvas site. Each week we will work on a new experiment. Students will prepare individual reports describing their finding from each experiment. We'll meet via zoom Mondays & Wednesdays, 10:30 to 11:30 AM to discuss the requirements for each experiment, and to answer any questions that come up as you process the data that is provided to you and prepare your lab reports.

Grading

Each experimental report will be graded as described in the Guidelines for Preparation of Lab Reports Section. The questions at the end of the procedures will be given emphasis because of their importance. Penalties for late reports could affect the grades.

Guidelines for Preparation of Lab Reports

All students will be required to submit an individual lab report for each lab. In general, lab reports should follow this outline:

Experimental Objectives - In one paragraph, state the major aims of the lab.

Methods - List the citation for the methods and/or references used, serial numbers of the equipment utilized, and any procedural modifications. Do not re-write the manual. Where appropriate, provide the calculations and the schemes for preparation of standard solutions and dilutions. **The Objectives and Methods sections typically should not exceed 2 pages combined, and for some labs may only consist of a couple of paragraphs.**

Results - Provide all sample data, standards data, and regression data with appropriate curves. Show precision of replicates and coefficient of variation for the method. Also give worked examples of all your calculations, equations and formulas, especially when serial calculations are calculated by spreadsheet. Listing numeric results of calculations, without showing the equation used to arrive at the result, will be deducted points on the assignment. If you are not familiar with appropriate numbers of significant digits when reporting numbers, please read this: **Significant Figures.pdf (https://canvas.uw.edu/courses/1447721/files/74645445/download?wrap=1)**

Discussion - Compare your observed vs. expected results where appropriate. Include any information on variables which might have spuriously affected your results. Speculate as to the reasons your results may differ from theoretical expecttations. Address recovery problems, analytical errors, and uncertainties.

Conclusions - The conclusion section of the reports should provide not only your evaluation of the method and the validity of your data, but should also address the relation of the measured levels of contaminants to those of exposure standards such as TLVs or PELs. The optimum length of the Discussion and Conclusion sections should be ~ 1 page in total.

Questions – Specific questions may be included in the lab guide. These questions can be answered at an appropriate place in the report, such as the results, discussion or conclusion sections (clearly identify the question/answer using bold font).

Grading: The reports will be graded on the accuracy and precision of the results, the clarity of your write-up, the depth of understanding evident in your discussion, the validity of your conclusions, and the investigation and explanations of any errors or anomalies. The reports should be prepared using a word processor, and must be neat, legible and organized. They must be submitted by electronic file upload via the canvas site. Grades can be adversely affected by data that cannot be readily found and/or recognized because of poor organization of the report.

Academic Integrity

Students at the University of Washington (UW) are expected to maintain the highest standards of academic conduct, professional honesty, and personal integrity.

The UW School of Public Health (SPH) is committed to upholding standards of academic integrity consistent with the academic and professional communities of which it is a part. Plagiarism, cheating, and other misconduct are serious violations of the University of Washington Student Conduct Code (WAC 478-120). We expect you to know and follow the university's policies on cheating and plagiarism, and the **SPH Academic Integrity Policy (http://sph.washington.edu/students/academicintegrity/)** . Any suspected cases of academic misconduct will be handled according to University of Washington regulations. For more information, see the University of Washington **Community Standards and Student Conduct (https://www.washington.edu/cssc/)** website.

Access and Accommodation

Your experience in this class is important to me. If you have already established accommodations with Disability Resources for Students (DRS), please communicate your approved accommodations to me at your earliest convenience so we can discuss your needs in this course.

If you have not yet established services through DRS, but have a temporary health condition or permanent disability that requires accommodations (conditions include but not limited to; mental health, attention-related, learning, vision, hearing, physical or health impacts), you are welcome to contact DRS at 206-543-8924 or **uwdrs@uw.edu (mailto:uwdrs@uw.edu)** or **disability.uw.edu (http://disability.uw.edu/)** . DRS offers resources and coordinates reasonable accommodations for students with disabilities and/or temporary health conditions. Reasonable accommodations are established through an interactive process between you, your instructor(s) and DRS. It is the policy

and practice of the University of Washington to create inclusive and accessible learning environments consistent with federal and state law.

Religious Accommodations

Washington state law requires that UW develop a policy for accommodation of student absences or significant hardship due to reasons of faith or conscience, or for organized religious activities. The UW's policy, including more information about how to request an accommodation, is available at **Religious Accommodations Policy (https://registrar.washington.edu/staffandfaculty/religious-accommodations-policy/)** . Accommodations must be requested within the first two weeks of this course using **the Religious Accommodations Request form (https://registrar.washington.edu/students/religious-accommodations-request/)** .

Classroom Climate

The UW School of Public Health seeks to ensure all students are fully included in each course. We strive to create an environment that reflects community and mutual caring. We encourage students with concerns about classroom climate to talk to your instructor, your advisor, a member of the departmental or SPH Diversity Committee and/or the program director. **DCinfo@uw.edu (mailto:DCinfo@uw.edu)** is a SPH resource for students with classroom climate concerns. UW students can also report incidents of bias or violations of UW policies for non-discrimination using the Bias Reporting Tool available at: **http://www.washington.edu/bias/ (http://www.washington.edu/bias/)**

Textbook and Readings

- Each experiment is listed as a "module" on the canvas website for the class, and the lab guide and other associated specific readings for each experiment are hot-linked to the modules on the website. Any students who have not taken or are currently taking either ENV H 553 or ENV H 453 should ask about additional reference material. Suggested references are:

  Ramachandran, G., Occupational Exposure Assessment for Air contaminants, CRC Press, Boca Raton FL

  McDermott, H.J., Air monitoring for toxic exposures, 2nd Ed. John Wiley and sons, Hoboken, NJ

  Cohen, BS and McCammon, CS Jr., eds. Air Sampling Instruments, 9th edition. Cincinnati: ACGIH, 2001.

  NIOSH Manual of Analytical Methods (NMAM), Online at **http://www.cdc.gov/niosh/nmam/ (http://www.cdc.gov/niosh/nmam/)**

  0500--Nuisance Dust

  0600--Respirable Dust

7082--Lead

7030--Zinc

1500—Hydrocarbons

2019 TLVs® and BEIs® ACGIH®

Copies of important readings from the references will be made available electronically.

SCHEDULE

See the **Modules (https://canvas.uw.edu/courses/1447721/modules)** for each week's lab instructions and due dates for lab reports.