SYLLABUS & COURSE INFORMATION

SCHOOL OF PUBLIC HEALTH
UNIVERSITY OF MINNESOTA

PUBH 6174

Control of Workplace Exposure
Spring Semester 2019

COURSE & CONTACT INFORMATION

Credits: 3
Meeting Day(s): Mondays
Meeting Time: 4:40 – 7:40 PM
Meeting Place: Weaver-Densford Hall (WDH) 2-110

Instructor: Pete Raynor, PhD, Professor
Email: praynor@umn.edu
Office Phone: (612) 625-7135
Office Hours: By appointment
Office Location: 1242 Mayo

COURSE DESCRIPTION

Occupational and environmental health specialists spend much of their time recognizing and evaluating potential health or safety hazards. However, these activities, by themselves, do not alleviate problems. Control measures must be implemented to reduce the risk of disease or injury among exposed populations. This course investigates qualitatively and quantitatively the options for reducing human exposure to airborne hazards, particularly in the workplace. Among the options considered will be general and local exhaust ventilation, air pollution control equipment, and personal protective equipment. The course will include lectures, a tour, a laboratory session, and a design project. Many of the assignments undertaken during this course will have no single correct answer; the selection and design of a control method will vary depending on assumptions and approaches taken by the students.

COURSE GOALS & OBJECTIVES

By the end of the course, students should be able to:

- explain the reasons that air moves
- measure air movement
- design a simple dilution ventilation system
- evaluate the effectiveness of a local exhaust ventilation system
- design a simple local exhaust ventilation system
- explain the operating principles behind air pollution control devices
- select appropriate personal protective equipment for different hazardous situations
- state the requirements for a respiratory protection program
- prioritize potential control solutions when confronted with a hazard
- discuss industrial ventilation systems and air pollution control equipment effectively with design engineers

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EXPECTATIONS

What the Instructors Expect from Students

- Students are expected to attend all classes, arrive on time, and pay attention.
- Students should be sure that electronic devices are muted during class sessions.
- Students will download handouts and assignments from the course's Canvas site that can be accessed through http://canvas.umn.edu/.
- Students should bring a calculator (or a laptop or phone with a calculator) to all classes.
- Because the course text will be referred to repeatedly during many lectures, students should look at assigned readings prior to class and bring the text to class.
- Students are expected to answer questions posed by the instructors and participate in classroom discussions.
- Students are responsible for asking questions and/or letting instructors know when they do not understand lectures or course materials.
- Students are expected to turn assignments in on time.
- Although students may work together on homework assignments and laboratory reports, each student should turn in a separate paper. Students should understand that they are responsible for knowing how to do all homework problems.
- Students must work independently on take-home exams.
- Students may discuss their design projects with one another in general, but they must perform all of the detailed work on their own.
- Students are encouraged to provide constructive feedback to the instructors when they are dissatisfied with the course content or teaching methods.

What Students Should Expect from the Instructors

- The instructors will be enthusiastic about the class and the subject matter.
- The instructors will post assignments on the course's Canvas site more than 1 week before they are due.
- The instructors will post lecture slides on the course's Canvas site more than 24 hours before class time.
- The instructors will begin and conclude classes on time.
- The instructors will take two 5-minute breaks during each class session.
- The instructors will answer all questions posed during class by students. Whenever possible, questions will be answered immediately. As an alternative, an instructor may indicate that the question will be addressed later in the class or that he will answer the question at the beginning of the next lecture if he does not know the answer.
- The instructors will ensure that all discussions in class are conducted in a professional and collegial manner.
- The instructors will create assignments with clear expectations.
- The instructors will grade and return assignments within one week of submission.
- The instructors will grade assignments objectively.
- The instructors will provide feedback on assignments that identifies both strengths and weaknesses in student work with constructive suggestions for improvement.
- The instructors will make themselves available outside of class to discuss any aspect of the course with students.

Course Workload Expectations

PubH 6174 is a 3-credit course. The University expects that for each credit, you will spend a minimum of three hours per week attending class or comparable online activity, reading, studying, completing assignments, etc. over the course of a 15-week term. Thus, this course will require at least 135 hours of effort – but probably more – spread over the course of the term in order to earn an average grade.

Learning Community
School of Public Health courses ask students to work in teams or discussion groups. We do not come to our courses with identical backgrounds and experiences and building on what we already know about collaborating, listening, and engaging is critical to successful professional, academic, and scientific engagement with topics.

In this course, students are expected to engage with each other in respectful and thoughtful ways.

Like other work in the course, all student to student communication is covered by the Student Conduct Code (https://z.umn.edu/studentconduct).

COURSE TEXT & READINGS

Students are expected to purchase *Industrial Ventilation: A Manual of Recommended Practice for Design, 29th Edition* (American Conference of Governmental Industrial Hygienists, ISBN 978-1-607260-87-5). A few books are available from the U of M Bookstore; it may be less expensive to purchase a book directly from ACGIH at https://www.acgih.org/forms/store/ProductFormPublic/industrial-ventilation-a-manual-of-recommended-practice-for-design-29th-edition.

For supplemental reading, a copy of the second edition of *Ventilation for Control of the Work Environment* by W. A. Burgess, M. J. Ellenbecker, and R. D. Treitman has been placed in the small Midwest Center of Occupational Health and Safety (MCOHS) library in the conference room in 1260 Mayo, the Division of Environmental Health Sciences main office. This book, which should be used in 1260 Mayo or nearby, may help to explain concepts discussed in class and in the *Industrial Ventilation* manual from another perspective.

Web-based reading assignments will also be required for some classes.

COURSE OUTLINE/WEEKLY SCHEDULE

1/28/19 Week 1

Course Introduction
Course syllabus; units; hierarchy of control; types of ventilation systems

Properties of Air
Composition of air; kinetic theory of gases; concept of pressure; ideal gas law; air density; humidity

Required Reading: PubH 6174 Course Syllabus
Supplemental Reading: *Vent Manual*, Chapters 1 & 2

2/4/19 Week 2

Airflow
Basic fluid mechanics; concepts of static, velocity, and total pressure

Ventilation Measurements
Manometers and aneroid gauges for pressure readings; pitot tubes, vane anemometers, and thermal anemometers for velocity measurement; orifice and venturi meters for flow measurement; tracer gases; flow visualization

Required Readings: (1) *Vent Manual*, Chapter 3, (2) *Vent Manual for Operation & Maintenance*, Chapter 3 (posted on-line)
Supplemental Reading: Burgess et al., Chapters 2 & 3

HOMEWORK #1 DUE

2/11/19 Week 3

Ventilation Measurements Laboratory
★★★ Meet in Industrial Hygiene Laboratory, Boynton S-35 ★★★
Measure velocity and flow in a duct; calibrate instruments for measuring velocity; measure face velocity of a laboratory hood; measure hood static pressure; measure static pressure entering and leaving a fan

Required Reading: Instructions for Ventilation Measurements Lab
Supplemental Reading: Burgess et al., Chapter 7

HOMEWORK #2 DUE

2/18/19 Week 4

Tour
★★★ Meet in Regis Center for Art, West Bank Campus ★★★
The tour will be led by Mr. Mike Austin, Department of Environmental Health and Safety

General Exhaust Ventilation
Control by displacement and dilution; models for a well-mixed room; reasons to supplement general exhaust ventilation with local exhaust ventilation

Required Reading: *Vent Manual*, Chapter 4
Supplemental Reading: Burgess et al., Chapter 4

LAB REPORT DUE

2/25/19	Week 5	**Ducts & Hoods** Types of duct; friction losses; types of hoods, booths, and enclosures; face velocity; capture velocity; consideration of cross flow drafts; entry losses; push-pull ventilation Required Reading: *Vent Manual*, Chapters 5 & 6 Supplemental Reading: Burgess et al., Chapters 5 & 13 HOMEWORK #3 DUE
3/4/19	Week 6	**Local Exhaust Ventilation System Design #1** Single-hood systems; calculation sheets; tracking pressure through a system; bends; expansions/contractions; stacks Required Reading: *Vent Manual*, Chapter 9 Supplemental Reading: Burgess et al., Chapter 8 **Assign Take-Home Exam #1** Exam covers Weeks 1-5 HOMEWORK #4 DUE
3/11/19	Week 7	**Local Exhaust Ventilation System Design #2** Multiple-hood systems; blast gates; branch entries; balancing ventilation systems Supplemental Reading: Burgess et al., Chapter 9 TAKE-HOME EXAM #1 DUE
3/18/19		*SPRING BREAK!!* ☺
3/25/19	Week 8	**Fans** Types of fans; operating characteristics; fan static pressure curves; fan selection; fan efficiencies and power consumption; placement of fans Required Reading: *Vent Manual*, Chapter 7 Supplemental Reading: Burgess et al., Chapter 10 Introduction to Design Project Discuss design project requirements HOMEWORK #5 DUE

4/1/19	Week 9	**Air Pollution Control Equipment** Evaluation criteria for control devices; absorbers; adsorbers; oxidizers; settling chambers; inertial collectors; cyclones; scrubbers; electrostatic precipitators; fibrous and fabric filters; Required Reading: *Vent Manual*, Chapter 8 Supplemental Reading: Burgess et al., Chapter 11 HOMEWORK #6 DUE
4/8/19	Week 10	**Air Pollution Control Equipment** Integration of control equipment into ventilation systems **Replacement Air Considerations** Flow rates; pressure differential; temperature considerations; humidity considerations; inlet/outlet placement; energy usage **Assign Take-Home Exam #2** Exam covers Weeks 6-10 Required Reading: *Vent Manual*, Chapters 10 & 11 Supplemental Reading: Burgess et al., Chapter 12 HOMEWORK #7 DUE
4/15/19	Week 11	This session will be led by Dr. Gerhard Knutson, Knutson Ventilation, Inc. **Control Economics** Operating costs; capital costs; hidden costs; estimating costs; ramifications of cost estimates **Example of Real Ventilation Design** Required Reading: *Vent Manual*, Chapter 12 TAKE-HOME EXAM #2 DUE

4/22/19 Week 12 **Introduction to Personal Protective Equipment**
Regulations governing use of PPE; acceptable uses for PPE; types of PPE

Types of Personal Protective Equipment
Respiratory protection; hearing protection; head protection; eye protection; foot protection; hand protection

PPE Programs
Elements of PPE programs; resources for developing your own program

Respiratory Protection Programs
Elements of respiratory protection programs; resources for developing your own program

Hearing Conservation Programs
Elements of hearing conservation programs; resources for developing your own program

Required Reading: "Assessing the Need for Personal Protective Equipment: A Guide for Small Business Employers", OSHA 3151-12R (2003), http://www.osha.gov/Publications/osha3151.pdf
Supplemental Reading: Standards – 29 CFR Part 1910, Subpart I, Sections 132-138 (Personal Protective Equipment), https://www.osha.gov/SLTC/personalprotectiveequipment/standards.html

HOMEWORK #8 DUE

4/29/19 Week 13 This session will be led by Mr. Scott Larson and Ms. Megan Torgrude, 3M Company

Respiratory Protection
Types of respiratory protection; selection of respiratory protection; demonstrations and hands-on activities with respiratory protection; certification of respiratory protection; respirator fit testing; respiratory protection against chemical, biological, and radiation/nuclear agents

Required Readings: (1) OSHA Respiratory Protection eTool, http://www.osha.gov/SLTC/etools/respiratory/index.html (investigate the web site!), (2) 3M Respirator Selection Guide (2015): http://multimedia.3m.com/mws/media/639110O/3m-respirator-selection-guide.pdf?fn=Respirator Selection Guide Final
Supplemental Reading: "Small Entity Compliance Guide for the Respiratory Protection Standard", OSHA Pub. No. 3384-09 (2011), Introduction & Sections (a)-(f), http://www.osha.gov/Publications/3384small-entity-for-respiratory-protection-standard-rev.pdf

HOMEWORK #9 DUE

5/6/19	Week 14	**Chemical Protective Clothing** Selection of chemical protective clothing; demonstrations and hands-on activities with chemical protective clothing; special considerations for emergency response **HVAC Systems** Types of systems used to supply fresh air to buildings; common elements to all systems; similarities and differences between HVAC systems and ventilation systems for control of pollutants **Exposure Control Plans** Required Reading: "Guide for the Selection of Personal Protective Equipment for Emergency First Responders", National Institute of Justice Guide 102-00, Volume 1 (2002), pp. 1-41, https://www.ncjrs.gov/pdffiles1/nij/191518.pdf HOMEWORK #10 DUE
5/15/19		DESIGN PROJECTS DUE BY 4:00 PM

SPH AND UNIVERSITY POLICIES & RESOURCES

The School of Public Health maintains up-to-date information about resources available to students, as well as formal course policies, on our website at www.sph.umn.edu/student-policies/. Students are expected to read and understand all policy information available at this link and are encouraged to make use of the resources available.

The University of Minnesota has official policies, including but not limited to the following:

- Grade definitions
- Scholastic dishonesty
- Makeup work for legitimate absences
- Student conduct code
- Sexual harassment, sexual assault, stalking and relationship violence
- Equity, diversity, equal employment opportunity, and affirmative action
- Disability services
- Academic freedom and responsibility

Resources available for students include:

- Confidential mental health services
- Disability accommodations
- Housing and financial instability resources
- Technology help
- Academic support

EVALUATION & GRADING

The course will include 10 homework assignments and a laboratory report. These assignments, due in Dr. Raynor's hands or through Canvas on the dates indicated on the course schedule, will each be graded on a 20-point scale. Students may work together on homework and lab reports. However, each student should submit her/his own assignment for grading.

Two take-home exams will be administered as part of the course. Students are expected to do all work themselves on these exams. For both exams, students will be allowed to use their books and notes and any other resources they choose. These exams will include short answer questions on information covered during classes and longer quantitative questions similar to the homework assignments.

The design project will allow the students to demonstrate their grasp of course material by integrating the control concepts they have learned about and applying them to a problem modeled on a real workplace. The project will require design of hoods and duct systems, selection of fans and air pollution control equipment, and an economic analysis. Details of the design project requirements will be provided to students near the mid-point of the semester.

For all assignments, partial credit will be awarded generously, so students should show all work. In addition, the neatness of the work is important because the instructor will be able to follow the students' reasoning more easily when trying to award partial credit.

The breakdown of grading for the course is:

Homework assignments	30 %
Lab report	3 %
Take-Home Exam #1	17 %
Take-Home Exam #2	17 %
Design project	33 %

Grading Scale
The University uses plus and minus grading on a 4.000 cumulative grade point scale in accordance with the following, and you can expect the grade lines to be drawn as follows:

% in Class	Grade	GPA
93 - 100%	A	4.000
90 - 93%	A-	3.667
87 - 90%	B+	3.333
83 - 87%	B	3.000
80 - 83%	B-	2.667
77 - 80%	C+	2.333
73 - 77%	C	2.000
70 - 73%	C-	1.667
67 - 70%	D+	1.333
63 - 67%	D	1.000
< 63%	F	0.000

- A = achievement that is outstanding relative to the level necessary to meet course requirements.
- B = achievement that is significantly above the level necessary to meet course requirements.
- C = achievement that meets the course requirements in every respect.
- D = achievement that is worthy of credit even though it fails to meet fully the course requirements.
- F = failure because work was either (1) completed but at a level of achievement that is not worthy of credit or (2) was not completed and there was no agreement between the instructor and the student that the student would be awarded an I (Incomplete).

- S = achievement that is satisfactory, which is equivalent to a C- or better
- N = achievement that is not satisfactory and signifies that the work was either 1) completed but at a level that is not worthy of credit, or 2) not completed and there was no agreement between the instructor and student that the student would receive an I (Incomplete).

Evaluation/Grading Policy	Evaluation/Grading Policy Description
Scholastic Dishonesty, Plagiarism, Cheating, etc.	You are expected to do your own academic work and cite sources as necessary. Failing to do so is scholastic dishonesty. Scholastic dishonesty means plagiarizing; cheating on assignments or examinations; engaging in unauthorized collaboration on academic work; taking, acquiring, or using test materials without faculty permission; submitting false or incomplete records of academic achievement; acting alone or in cooperation with another to falsify records or to obtain dishonestly grades, honors, awards, or professional endorsement; altering, forging, or misusing a University academic record; or fabricating or falsifying data, research procedures, or data analysis (As defined in the Student Conduct Code). For additional information, please see https://z.umn.edu/dishonesty The Office for Student Conduct and Academic Integrity has compiled a useful list of Frequently Asked Questions pertaining to scholastic dishonesty: https://z.umn.edu/integrity. If you have additional questions, please clarify with your instructor. Your instructor can respond to your specific questions regarding what would constitute scholastic dishonesty in the context of a particular class-e.g., whether collaboration on assignments is permitted, requirements and methods for citing sources, if electronic aids are permitted or prohibited during an exam. Indiana University offers a clear description of plagiarism and an online quiz to check your understanding (http://z.umn.edu/iuplagiarism).
Late Assignments	At the discretion of the instructor, grades on assignments may be reduced by 5% for each weekday that the assignment is late.
Attendance Requirements	While attendance is not graded, students are expected to attend all class sessions. Students are responsible for all material covered during each class session.
Extra Credit	No extra credit is awarded in PubH 6174.