THE UNIVERSITY OF ARIZONA
MEL AND ENID ZUCKERMAN COLLEGE OF PUBLIC HEALTH

Mel and Enid Zuckerman College of Public Health
University of Arizona

SYLLABUS
CPH 655 Control of Occupational Exposures
SPRING 2016

Time: Lecture: Tuesday 9-11 AM
Laboratory: Thursday 9 AM – 12 PM
(check schedule for specific weeks)

Location: Lecture: Drachman Hall A-116
Laboratory: BRL 112

Instructor: Paloma Beamer, PhD, pbeamer@email.arizona.edu

Office Hours: Tuesdays, 11 AM -12 PM

Teaching Assistant: Jong Sang Youn, jongsang@email.arizona.edu

TA Office Hours: TBA

Catalog Description: Design and evaluation of systems controlling occupational exposures. Emphasis is on industrial ventilation but also includes administrative and personal protective controls. Specific industrial operations and exposure models will be addressed. 3 hr lecture, 6 lab projects. (3 units).

Course Prerequisites: CPH 584 and CPH 502

Course Learning Objectives: The field of environmental health sciences encompasses the anticipation, recognition, evaluation and control of hazards. Many courses involve identifying hazards, but this course provides students with skills to design and implement systems to control exposures in the occupational environment. Where contaminants are generated in an operational process, ventilation is the preferred method of controlling exposures. Design criteria are available to optimize and evaluate ventilation systems.

However, some exposures are controlled using personal protective equipment, such as respirators, or with enclosures. The range of control options will be explored in this course, allowing students to understand the effectiveness of each option and the desired hierarchy of selecting control measures.

Upon completion of this course, students will be able to:
1. Classify the hierarchy of control options and define the requirements for each option
2. Use simple models to estimate exposures in occupational settings to determine ventilation and control needs.

3. Display a fundamental, working knowledge of fluid dynamics.
4. Demonstrate an understanding of design considerations and methods for industrial ventilation systems.
5. Quantitatively evaluate the performance of industrial ventilation systems.
6. Select appropriate respirators and personal protective equipment

MPH/SECTION Competencies Covered:

Analytical Skills

- Defines a problem
- Determines appropriate uses and limitations of data
- Selects and defines variables relevant to defined public health problems
- Evaluates the integrity and comparability of data and identifies gaps in data sources
- Makes relevant inferences from data

Communication Skills

- Communicates effectively in writing
- Leading and participating in groups to address specific issues, including ability to work in teams, span organizational boundaries, and cross systems

Policy Development/ Program Planning Skills

- Identifying public health laws, regulations, and policies related to specific programs
- Developing mechanisms to monitor and evaluate programs for their effectiveness and quality

Cultural Skills

- Developing and adapting approaches to public health problems that take into account cultural differences

Basic Public Health Science Skills

- Applying the basic public health sciences including behavioral and social sciences, biostatistics, epidemiology, environmental public health, and prevention of chronic and infectious diseases and injuries
- Understanding of the historical development and structure of state, local and federal public health agencies

Financial Planning and Management Skills

- Monitoring program
- Conducts cost-effectiveness, cost benefit, and cost utility analyses

Course Website: http://d2l.arizona.edu

Course Notes: Lecture notes will be provided on d2l. Please print before class. If they are not posted within 24 hours of the lecture meeting time, they will be distributed in class.

Recommended Texts/Readings:
Primary: ACGIH. (2013). Industrial Ventilation – A Manual of Recommended Practice for Design (28th Edition). Cincinnati, OH. *Check for most recent errata at:*

http://www.acgih.org/docs/default-source/Store/errata_listing_-_28th-edition_42115.pdf?sfvrsn=2

Recommended: Burgess W.A., Ellenbecker M.J., Treitman R.D. (2004) Ventilation for Control of the Work Environment. Hoboken, N.J: Wiley-Interscience. (ISBN: 047109532X) Available as an electronic book through eBary:
http://ezproxy.library.arizona.edu/login?url=http://site.ebrary.com/lib/arizona/Doc?id=10114073

ACGIH. (2007). Industrial Ventilation – A Manual of Recommended Practice for Design for Operation and Maintenance. Cincinnati, OH.

Additional readings: Assigned in class.

Course Requirements: Completion of reading assignments, 6 problem sets, 6 laboratory reports, midterm and final. Lowest problem set and laboratory report will be dropped. The final laboratory (#6) cannot be dropped.

Grading/Student Evaluation: The grading system for this course is based on the following items. Grading criteria for each metric given with assignments.

Problem Sets:	5 at 25 pts each	(125)
Lab Reports:	5 at 30 pts each	(150)
Exams:	midterm =50 pts, final=100 pts**	(150)
Point total =		425

**Note that half of the final will be a take-home design problem.

Final grades will be based on the following relative point system:

A = 90-100%
B = 75-89%
C = 65-74%
E = < 65

Class Attendance/Participation: You are expected to attend class and participate by responding to rhetorical questions, complete readings, submit the assignments on time, take exams on the specified dates. All holidays or special events observed by organized religions will be honored for those students who show affiliation with that particular religion. Absences pre-approved by the UA Dean of Students (or Dean's designee will be honored.)

Required Statements:

Communications: You are responsible for reading emails sent to your UA account from your professor and the announcements that are placed on the course web site. Information about readings, news events, your grades, assignments and other course related topics will be communicated to you with these electronic methods. The official policy can be found at: http://www.registrar.arizona.edu/emailpolicy.htm. You should also check the d2l website frequently for updates and announcements. Consider setting your account in d2l to forward all messages to your UA email account. They are not automatically linked.

Disability Accommodation: If you anticipate issues related to the format or requirements of this course, please meet with me**.** I would like us to discuss ways to ensure your full participation in the course. If you determine that formal, disability-related accommodations are necessary, it is very important that you be registered with Disability Resources (621-3268; drc.arizona.edu) and notify me of your eligibility for reasonable accommodations. We can then plan how best to coordinate your accommodations. The official policy can be found at:
http://catalog.arizona.edu/2015%2D16/policies/disability.htm

Academic Integrity: All UA students are responsible for upholding the University of Arizona Code of Academic Integrity, available through the office of the Dean of Students and online: The official policy found at:
http://deanofstudents.arizona.edu/codeofacademicintegrity

Classroom Behavior: The Dean of Students has set up expected standards for student behaviors and has defined and identified what is disruptive and threatening behavior. This information is available at:
http://deanofstudents.arizona.edu/disruptiveandthreateningstudentguidelines

Students are expected to be familiar with the UA Policy on Disruptive and Threatening Student Behavior in an Instructional Setting found at:

http://policy.arizona.edu/education-and-student-affairs/disruptive-behavior-instructional-setting

and the Policy on Threatening Behavior by Students found at:
http://policy.arizona.edu/education-and-student-affairs/threatening-behavior-students

Grievance Policy: Should a student feel he or she has been treated unfairly, there are a number of resources available. With few exceptions, students should first attempt to resolve difficulties informally by bringing those concerns directly to the person responsible for the action, or with the student's graduate advisor, Assistant Dean for Student and Alumni Affairs, department head, or the immediate supervisor of the person responsible for the action. If the problem cannot be resolved informally, the student may file a formal grievance using the Graduate College Grievance Policy found at
http://grad.arizona.edu/academics/policies/academic-policies/grievance-policy

Grade Appeal Policy: http://catalog.arizona.edu/2015-16/policies/gradappeal.htm

UA Smoking and Tobacco Policy:
The purpose of this Policy is to establish the University of Arizona's (University) commitment to protect the health of University faculty, staff, students, and visitors on its campuses and in its vehicles. The latest version of the policy is available at:
http://policy.arizona.edu/ethics-and-conduct/smoking-and-tobacco-policy

Syllabus Changes: Information contained in the course syllabus, other than the grade and absence policies, may be subject to change with reasonable advance notice, as deemed appropriate.

Office Hours and Contact Policy: If no one has arrived during the first half of office hours, the rest of the office hours are canceled. Instructors will check email at least once a day excluding weekends.

Homework Guidelines: For assignments to receive full credit they must be legible, and you must state all of your assumptions and show all work, including sample calculations for every type of calculation in a spreadsheet as necessary. If a problem specifies units, those specified units must be used, and if a problem asks for a table or graph, you must create the requested table or graph. You can discuss your results, problems, methods with each other, but each problem set write-up should be completed individually. 6 problem sets will be assigned, the lowest grade will be dropped.

Lab Report Guidelines: To receive full credit, lab reports should include a title, objective, method, results, discussion, conclusion and appendices. Each of the following should be a new, labeled section in the write-up but does not need to be a new page. You can discuss your results, problems, methods with each other, but each problem set write-up should be completed individually. 6 laboratory assignments will be assigned, the lowest grade will be dropped excluding the final laboratory assignment. Laboratory #6 is mandatory. There will be no make up for labs allowed.

TITLE	Meaningful, short. Less than 15 words in your own words and give date of experiment.
OBJECTIVE	One or two sentences.
METHOD	One or two paragraphs in your own words describing the methods used.
RESULTS	Report results collected during class. Use tables and graphs as appropriate. No tables or graphs not referred to appropriately in the written text of the results section will be counted! Refer to data in appendix as appropriate.
DISCUSSION	Discuss the relevance and importance of the results collected. Be sure to include a discussion of bad results if appropriate. Address all questions in the laboratory assignment.
CONCLUSION	Briefly, summarize what you discovered and how this relates to the objective.
APPENDICES	Should include the pre-lab with instructor's initials and data collected during lab.

Late Assignment and Make-up Policy: All assignments must be submitted in hard copy format to be graded. Assignments should be submitted to my office (A223, Drachman Hall) by 5 pm on the due date. Any late assignments will be graded down 10% per day that it is late. An assignment is considered one day late if it is submitted after 5 on the due date.

This applies to problem sets and lab reports. The final design project (take-home final) will not be accepted late.

Telephone and Computer Use: **Please limit computer use during class, unless it is absolutely necessary.** Turn your cell phones to silent or vibrate in order to not disrupt the class and disturb your fellow students and professor.

Plagiarism: What counts as plagiarism?

- Copying and pasting information from a web site or another source, and then revising it so that it sounds like your original idea.
- Doing an assignment/essay/take home test with a friend and then handing in separate assignments that contain the same ideas, language, phrases, etc.
- Quoting a passage without quotation marks or citations, so that it looks like your own.
- Paraphrasing a passage without citing it, so that it looks like your own.
- Hiring another person to do your work for you, or purchasing a paper through any of the on- or off-line sources.
- If you are determined to have engaged in any of the above academic misconduct this could result in failure of the course.

COURSE SCHEDULE AT A GLANCE

	Tuesday	**Thursday**
Week 1		January 14; 9-10:30 AM Introduction, Control Hierarchy
Week 2	January 19 Cancelled	January 21; 9 AM – 12 PM Problem Characterization Principles of Fluid Dynamics I
Week 3	January 26; 9-10:30 AM Principles of Fluid Dynamics II	January 28; 9-10:30 AM Measurement Techniques HW #1 Due
Week 4	February 2; 9-11 AM General Exhaust Ventilation and Thermal Control	February 4; 9 AM – 12 PM Lab 1: Instrument Calibration and Use HW #2 Due
Week 5	February 9; 9-11 AM Hood Design and Selection	February 11; 9 AM – 12 PM Lab 2: Coefficient of Entry and Velocity Contours Lab #1 Due
Week 6	February 16 Cancelled	February 18; 9-10:30 AM Specific Hood Operations Quantification of Hood Performance Lab #2 Due
Week 7	February 23; 9-11 AM Duct and Stack Design, Replacement Air, Dispersion Modeling	February 25; 9 AM – 12 PM Lab 3: Evaluation of Chemical Hood Performance HW #3 Due
Week 8	March 1; 9-10:30 AM Air Cleaners and Emission Permitting	March 3; 9-10:30 AM Fan Selection Lab #3 Due
Week 9	March 8; 9-10:30 AM Local Exhaust Ventilation Design I	March 10; 9-10:30 AM Local Exhaust Ventilation Design II
Week 10	SPRING BREAK ☺	
Week 11	March 22; 9-11 AM Midterm	March 24; 9 AM – 12 PM Lab 4: LEV Design HW # 4 Due
Week 12	March 29; 9-10:30 AM Operation & Maintenance, Cost Estimation	March 31; 9-10:30 AM Troubleshooting and Case Studies Lab #4 Due
Week 13	April 5; 9-10:30 AM Substitution Principles and Administrative Controls	April 7; 9-10:30 AM PPE Standards and Selection HW #5 Due
Week 14	April 12; 9-11 AM Respiratory Protection	April 14; 9 AM – 12 PM Lab 5: Respirator Fit-Testing HW #6 Due
Week 15	April 19; 9-11 AM Overview of Anatomy Lab & Hazardous Waste Facility	April 21; 9 AM – 12 PM Lab 6: Hazardous Waste Facility Tour Lab #5 Due
Week 16	April 26; 9-10:30 AM Case Studies in Controls of Occupational Exposure	April 28; 9 AM – 12 PM Lab 6: Tour of Anatomy Lab Lab # 6 Due
Week 17	May 3; 9-10:30 AM Review and Design	

DETAILED COURSE SCHEDULE

DATE	TOPIC	READINGS
Jan. 14	**Introduction, Control Hierarchy** Course introduction and policies Workplace control hierarchy Standards and guidelines Setting an exposure control strategy	Vent Manual Ch. 1, Burgess Ch. 1
Jan. 19	***Cancelled***	
Jan. 21	**Problem Characterization** Emission source behavior Characterization of air, space, climate Evaluation of worker behavior Vapor generation rate Exposure box model	TBD Check D2L
	Principles of Fluid Dynamics I Ideal gas law Standard air conditions Density, specific gravity, density factor Conservation of mass Conservation of energy	Vent Manual Ch. 3, Burgess Ch. 2
Jan. 26	**Principles of Fluid Dynamics II** System pressures Reynolds number System losses Losses in fittings Tracking pressure losses	Vent Manual Ch. 3, Burgess Ch. 2
Jan. 28	**Measurement Techniques** Pitot tube including traverse Mechanical devices Thermal anemometers Other devices: orifice, venturi meters Limitations and sources of error *HW #1 Due*	Vent Manual II Ch. 3, Burgess Ch. 3
Feb. 2	**General Exhaust Ventilation and Thermal Control** Dilution ventilation principles Rate of purging Supply air Air conditioning systems	Vent Manual Ch. 4 and 10, Burgess Ch. 4

DATE	TOPIC	READINGS
Feb. 4	**Lab 1: Instrument Calibration and Use** *HW #2 Due*	Vent Manual II Ch. 3.6, Burgess Ch. 3.6
Feb. 9	**Hood Design and Selection** Local exhaust ventilation components Hood types Capture velocity Hood flow rate, losses, flow coefficient Hood losses Hood flow coefficient	Vent Manual Ch. 5 and 6, Burgess Ch. 5
Feb. 11	**Lab 2: Hood flow coefficient and velocity contours** *Lab #1 Due*	Vent Manual Ch. 6.7
Feb. 16	***Canceled***	
Feb. 18	**Specific Hood Operations** Enclosing hoods Exterior hoods Receiving hoods Specific industrial operations Chemical laboratory hoods Bio-safety hoods **Quantification of Hood Performance** Hood air flow measurements Hood capture efficiency Factors affecting hood performance *Lab #2 Due*	Vent Manual Ch. 6, Burgess Ch. 5, 6, and 7 Vent Manual II Ch. 3 and 5; Burgess Ch. 5.5 and 13
Feb. 23	**Duct and Stack Design; Replacement Air; Dispersion Modeling** Selection and design of duct work Stack dilution factors and heights Replacement air systems Re-entry and recirculation considerations Dispersion Modeling	Vent Manual Ch. 5 and 10; Burgess Ch. 12 and 15
Feb. 25	**Lab 3. Evaluation of Chemical Hood Performance** *HW #3 Due*	TBD Check D2L

DATE	TOPIC	READINGS
Mar. 1	**Emission Permitting, Air Cleaners** Types of emission permits Process for obtaining emission permits Dust collecting devices Gas and vapor removal devices Special types of air cleaners	Vent Manual Ch. 8; Burgess Ch. 11
Mar. 3	**Fan Selection** Types of fans Fan curves Fan Laws Fan motors Safety, installation and maintenance *Lab #3 Due*	Vent Manual Ch. 7; Burgess Ch. 10
Mar. 8	**Local Exhaust Ventilation Design I** Design approach Velocity pressure method Procedures for system design Design of single-hood system	Vent Manual Ch. 9.1-9.6; Burgess Ch. 8
Mar. 10	**Local Exhaust Ventilation Design II** Multi-hood system design approach Static pressure method Non-standard mixing conditions Mixing of airflows Design of multi-hood systems	Vent Manual Ch. 9.7-9.17 Burgess Ch. 9
Mar. 12-20	**SPRING BREAK**	
Mar. 22	**MIDTERM**	
Mar. 24	**Lab 4. LEV Design Evaluation** *HW #4 Due*	
Mar. 29	**Operation & Maintenance;** **Cost Estimation** Maintenance of air cleaning devices Modifying existing ventilations systems Capital and annual operating costs Ventilation system energy use Recirculation of exhaust air	Vent Manual II Ch. 5, 6, and 8 Vent Manual Ch. 11 and 12

DATE	TOPIC	READINGS
Mar. 31	**Troubleshooting and Case Studies** Indication of System Change or Problem Selection of Troubleshooting Methods Air Handling Unit Troubleshooting Case Studies of Ventilation Systems *Lab #4 Due*	Vent Manual II Ch. 7
Apr. 5	**Substitution Principles and Administrative Controls** Substitution Worker rotation Worker training and hazard communication	TBD Check D2L
Apr. 7	**PPE Standards and Selection** OSHA Standards Hazards and Selection Evaluations *HW#5 Due*	TBD Check D2L
Apr. 12	**Respiratory Protection** Selection of respirator Fit testing Development of change schedule	TBD Check D2L
Apr. 14	**Lab 5. Respirator Fit Testing** *Guest Lecturer: Julia Rosen* *HW #6 Due*	TBD Check D2L
Apr. 19	**Overview of Anatomy Lab and UA Hazardous Waste Facility**	TBD Check D2L
Apr. 21	**Lab 6. Hazardous Waste Facility Tour** *Guest Lecturer: Jeff Christensen* *Lab # 5 Due*	TBD Check D2L
Apr. 26	**Case Studies in Control of Occupational Exposures**	TBD Check D2L
Apr. 28	**Tour of Anatomy Lab** *Guest Lecturer: Julia Rosen* *Lab # 6 Due*	TBD Check D2L
May 3	**Course Review**	