ENVR 754 Air Pollution Control

Course Objectives, Policies, and Grading

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Course Website

On the course website you will find links to many documents and relevant sites. Please copy the address into your browser. We will refer to it often.

http://www.unc.edu/courses/2007spring/envr/754/001/

Objectives

This is an engineering design course. The objective of the course is to discuss engineering aspects of industrial gas cleaning. The emphasis in this course will be control of particulate pollutants although we will touch on gas removal processes as well. When you have finished the course, you should be able to design an effective control system or to evaluate a design that someone else gives you. You should also be able to read the technical literature associated with controlling air pollution and be prepared to conduct research on this topic yourself.

Removal of gaseous pollutants is the province of chemical engineering; those who wish further education on removal of pollutant gases should consider taking a course in mass transfer processes. You might consider taking a course titled "Engineering Principles of Air Pollution Control", CE 576, offered by Prof. Christopher Frey in the Civil Engineering Department at North Carolina State. Professor Frey's course, taught in the fall, discusses generation and control of gaseous pollutants from industrial and combustion processes. His course and this one are complementary.

Prerequisites

The course requires some knowledge of calculus, college-level physics, and aerosol physics. ENVR 416, Aerosol Technology, is a prerequisite for this course. If you have not taken ENVR 416 you will need to learn the relevant material on your own. I will assume you have access to a personal computer and understand how to write and use spreadsheets written in Excel.

If you have questions of any kind regarding the course or its contents, please raise them in class, call me in my office, in the lab, or at home, send me an e-mail, or come in to see me. Do

not hesitate to call me at home if you have a question in the evening or over the weekend. I would much rather have you call than be frustrated.

Format

As you will see from looking at the lecture schedule, the course is divided into sections that cover various aspects of pollutant generation, sampling, and gas cleaning. We will examine factors that affect collection efficiency and energy consumption for each control device, as well as practical characteristics that distinguish each device from alternatives. We have no textbook for this course. We will depend on published articles from the technical literature and on notes that I distribute. Most of these notes will be posted on our class website.

Assignments

We will have assignments that draw on the material covered in each section of the course. These assignments will include homework problems, laboratory work, and review of articles from the technical literature.

Homework Assignments

Each course section except the last will have homework problems assigned. The problems for each section will be distributed at the beginning of the semester. You should work all problems. Please work these problems in whatever fashion is most effective for you and draw on all resources available; discuss them with your classmates, with students who took the class in previous years, with practicing professionals not in school, or with anyone else who may be of help. Use any reference books or computer programs you wish. You can work these problems alone or in groups. Most of these problems are intended to be "real world" rather than academic. In the "real world" you will draw on all resources available to you. You should do the same in this course.

In solving these problems, you should think about *how* to solve them as well as whether the final answer you determine is *reasonable*. Many of the problems do not have one, fixed answer; instead, different answers are possible depending upon the approach you take. You should try different approaches and be satisfied only when your answer seems the best reasonably possible and makes intuitive sense. Your answer to each problem should demonstrate your appreciation for what is asked, your understanding of how to approach the problem, and any concerns you may have about the reliability of your solution. Calculation without evidence of thought is not sufficient, even if the numerical value of the result obtained is reasonable.

Each student will be responsible for leading the discussion of several homework problems during the course. At the beginning of the semester, we will distribute a sign-up list, so that each of you can volunteer for problems of your choice. Once you have signed up to discuss a problem, feel free to switch any problem assigned to you with that assigned to another student as long as you both agree to the switch.

On problem discussion days, the student presenter for each problem must pass out copies of his or her solution to each class member and to me at the beginning of that class day.

The presenter should then discuss his or her solution, referring to the pass-outs. The discussion should include the rationale for the approach taken and whether the final result seems reasonable.

I will collect and grade your solutions to the homework problems. The problem sets are due at the end of class on the day we discuss the problem sets.

Laboratory Assignments

For those course sections for which we have a laboratory experiment, we will distribute a lab guideline the week before the laboratory is to begin. This guideline will discuss what is to be done in the laboratory and provide general instructions on how to do it. Some of these guidelines are already posted on our lab website. The purpose of the laboratory sessions is to determine the value of the theory we discuss in class. Thus, you should compare results you obtain in the laboratory with predictions based on the theory from class. Explain discrepancies between theory and experimental results in terms of inadequacies in the theory or inadequacies in the experiments. Do not necessarily assume that the theory is correct and that discrepancies are due to faulty experimental technique. Think about the assumptions on which the theory rests and whether these assumptions are valid.

You will work in a team to conduct each laboratory experiment. We will decide how many members are on each team once we see how many students take the course, but about three members per team should be about right. Each student must write up his or her own lab report for each experiment. The lab reports must be typed. Each report must not exceed four pages, including all figures and tables. The first page of these four must be a title page that contains a summary in which you present all essential information and conclusions. You may attach appendices to your report if necessary to contain original data, example calculations, or other items you feel are important. Your reports will be graded on clarity of presentation as well as on technical content. Do not expect a good grade unless your reports are well written. Reports are due at the beginning of class on the day given on the course schedule.

Literature Assignments

For sections in which we do not have a laboratory, we will have a literature assignment. The purpose of each literature assignment is to gain skills in the critical evaluation of work conducted by others. We will distribute literature discussion assignments during the first week or so of class. Each student will be responsible for leading a discussion of several articles from the technical literature during the semester.

For each day you are responsible for literature discussion, you have several responsibilities. First, you must find a recent article from the technical literature that is relevant to the topic under discussion. Check journals such as Aerosol Science and Technology, Aerosol Science, Filtration and Separation, Atmospheric Environment, a chemical engineering journal, or the Journal of the Air and Waste Management Association each of which (except for the chemical engineering

journals) is available in the Health Sciences library or online. You must check with me at least one week before your literature discussion day, to be sure your article choice is appropriate. At least one class period before your discussion day, you must distribute a copy of your article to each class member and to me. All class members must read the article before coming to class on the day the article is to be discussed. On discussion day, you should first go over the article with the class, to discuss what the authors did and why they did it. You should then lead a discussion that covers the techniques used, the major findings, and any points that are unclear or seem incorrect.

On the day you present your paper to the class for discussion, each class member must hand in a written critique of the paper we discuss using the guidelines issued to reviewers of papers considered for publication in the journal Environmental Science and Technology. A copy of these guidelines is on the course website. Your grade for this work will depend half on your selection and presentation of the paper, including the appropriateness of the subject, the technical level of the article selected, your proficiency in presenting the work, and half on the quality of your write-up. The grade for all other class members will depend on the quality of their write-ups.

Computers

Many students have chosen to solve problem sets by writing spreadsheets. This approach can be effective; however, handing in a spreadsheet alone as your answer to a problem is not sufficient. If you use a spreadsheet, you must still explain the equations you use, any assumptions you make in your solution, as well as present your best solution to the question asked. Other students have chosen to work all problems by hand rather than using a computer. It probably takes about as much time to write a spreadsheet as it does to solve a problem by hand. The difference is that after the problem is solved, a spreadsheet solution stays with you and can be used for other problems in the future.

I have written an Excel spreadsheet that can help with many of the problems assigned in the course. A link is on the course website under “Control spreadsheet” and can be downloaded. The spreadsheet requires a password, which I will give you during class. You can then save the spreadsheet on your computer in a mode that does not require a password. In the past, I’ve had problems with people who download and use the spreadsheet without taking the class, then attempt to use it without understanding its limitations. The password protection is to prevent such use. Please understand that this spreadsheet comes with no guarantees; it probably contains errors. I will be very grateful if you can point out any errors to me; students who follow you in this course will be grateful also.

Grading

We will not have any quizzes, tests, or exams for this course. Your entire grade will be based on your take-home assignments. All problem sets, lab reports, and literature reviews will carry equal weight to determine your grade. Failure to turn in your work on time will result in loss of one full letter grade.