

UNIVERSITY OF CALIFORNIA, RIVERSIDE
Bourns College of Engineering
Chemical and Environmental Engineering

ENVR 160C: Environmental Engineering Lab
Winter 2014

- Day/Time/Place: B108 Bourns Hall, CEE Teaching Laboratory
Section 1 Lab: Tuesday 12:40 p.m. – 3:30 p.m.
Section 2 Lab: Thursday 12:40 p.m. – 3:30 p.m.
- Oral Presentations Weeks 6 and 10:
Presentation 1: February 11/13, 12:40 p.m. – 3:30 p.m.
Presentation 2: March 11/13, 12:40 p.m. – 3:30 p.m.
- Instructor: Haizhou Liu
A239 Bourns Hall
Email: haizhou@engr.ucr.edu
Office phone: 951-827-2076
- Office hours: Wednesday 3:00-5:00 p.m. or by appointment
- Prerequisites: CHE 114, CHE 120; instructor's consent
- Teaching Assistants: Dawit Wodorfa (dword001@ucr.edu) Bourns A212
- Required Textbook: None
- Suggested Textbook: *Design and Analysis of Experiments Douglas Montgomery (electronic version)*
Water Quality Engineering, Tchobanoglous.
Unit Operations in Environmental Engineering, Noyes, Robert (electronic)
Separation Process Principles: Seader & Henley.
Environmental Biotechnology: Principles and Applications, Bruce E. Rittmann & Perry L. McCarty.
Perry's Handbook for Chemical Engineers. (electronic version)
- Grading distribution: Lab Reports and Pre-Labs (4).....75%
Oral Presentations (2).....20%
Attendance/Punctuality.....5%

COURSE OBJECTIVES

This course is the third required laboratory course designed to allow students to gain hands-on experience in application areas. Emphasis is on reinforcing the student's understanding of principles learned in earlier courses on water quality engineering and unit operation design and for the student to develop confidence in apply principles learned in the classroom to solve practical problems. Students work in teams to design processes, take measurements, analyze the data, and report their findings in oral presentations and several written formats.

LEARNING OBJECTIVES

- Familiarity with safety, good laboratory practices and water quality standards.
- Ability to use the tools associated with design of experiment.
- Ability to identify, formulate and follow a project plan to meet a water specification by removing man-made or natural compounds from water
- Familiarity with design and conducting unit operations at the bench-scale levels for processes associated with removing from water: nitrate, hardness, salinity, wastewater impurities, hexavalent chromium, bacteria or hydrocarbon.
- Ability to analyze lab-scale data and scale up to commercial size.
- Ability to prepare verbal and written reports for a professional audience in a logic and clear fashion
- Ability to prepare written final engineering design reports for business/science audiences and present findings.

Weekly Schedule:

| Week No. | Date | Task |
|-----------------|-----------------|-----------------------------|
| 1 | January 7, 9 | Logistics and Lab |
| 2 | January 14, 16 | Lab |
| 3 | January 21, 23 | Lab and Pre-lab Due |
| 4 | January 28, 30 | Lab |
| 5 | February 4, 6 | Lab |
| 6 | February 11, 13 | Oral Presentation 1 and Lab |
| 7 | February 18, 20 | Lab |
| 8 | February 25, 28 | Lab and Pre-lab Due |
| 9 | March 4, 6 | Lab |
| 10 | March 11, 13 | Lab and Oral Presentation 2 |

ENVE 160C Group Assignments (these are non-negotiable):

| Group Number | Tuesday | | Group Number | Thursday | |
|--------------|-----------|-----------|--------------|-----------|-----------|
| 1A | Castillo | Kevin | 2A | Alkurdi | Danh |
| | Scholte | Katelyn | | Corona | James |
| | Nguyen | Carlton | | Eatinger | Stephanie |
| | Fan | Nolan | | Haddad | Ramsey |
| 1B | Juarez | Alejandro | 2B | Cruz | Brian |
| | Mende | Elizabeth | | Soh | Han |
| | Lee | Kurtis | | Dakak | Nataly |
| | Luna | Alberto | | Ng | Wartini |
| | McCoy | Kelly | | Nguyen | Dennis |
| 1C | Russell | Kyle | 2C | Kenzhebek | Aidarbek |
| | Rodriguez | Edwin | | Schneider | Margaret |
| | Yeh | Tiffany | | Mak | Samantha |
| | Dickson | Yee | | Pacheco | Alan |
| | Cuevas | Eduardo | | | |
| 1D | Nishii | Ray | 2D | Alonzo | Adam |
| | Tran | Neil | | Beingolea | Javier |
| | Lee | Kyung | | Cazares | Hector |
| | Crean | Belem | | Gomez | Laura |
| | Cho | Abraham | | Godinez | Andriana |

Topics Covered and Laboratory Rotation:

| Tuesday Lab | Group 1A | Group 1B | Group 1C | Group 1D |
|-------------|---|---|---|--|
| Weeks 1-5 | Lab 1 <i>Disinfection</i> | Lab 2 <i>Coagulation and Flocculation</i> | Lab 3 <i>Adsorption</i> | Lab 4 <i>Ion exchange</i> |
| Weeks 6-10 | Lab 6 <i>Membrane treatment</i> | Lab 8 <i>Advanced Reduction</i> | Lab 7 <i>Advanced Oxidation</i> | Lab 5 <i>GAC and Stripping</i> |

| Thursday Lab | Group 2A | Group 2B | Group 2C | Group 2D |
|--------------|---|---|---|--|
| Weeks 1-5 | Lab 1 <i>Disinfection</i> | Lab 2 <i>Coagulation and Flocculation</i> | Lab 3 <i>Adsorption</i> | Lab 4 <i>Ion exchange</i> |
| Weeks 6-10 | Lab 6 <i>Membrane treatment</i> | Lab 8 <i>Advanced Reduction</i> | Lab 7 <i>Advanced Oxidation</i> | Lab 5 <i>GAC and Stripping</i> |

Lab 1: Disinfection and sterilization

Scale up to the UCR design for boiler feed water
What recommendations would you make for the UCR utility?
What were your plans and results of your sterilization trial?
To scale up; did your UV source and intensity match EPA protocols?

Lab 2: Wastewater Treatment – coagulation and flocculation of hexavalent chromium

How did jar tests work out?
Did you surrogate waste water prove representative of commercial ww; better surrogate?
How are jar trials used in commercial operations
For which primary processes is your data valuable. What can you scale-up with your data?
How would handle a different waste water; what properties of your ww & jar trials are useful for scale up decisions.

Lab 3: Adsorption processes: nitrate and hexavalent chromium

What was your plan & results?
How did your 2 materials function? Which would you recommend for scale up?
How would you scale up from your scale to process Chino water? What was your mass velocity in the lab vs. a commercial unit (Chino, Redlands..or?)

Lab 4: Ion exchange: hardness and nitrate

What was your plan & results? What was the waste/fresh water ratio? Did results march literature?
Based on your results, how would you advise a client interested in membrane treatment of the Santa Monica water supply?
Is there a model to design commercial sizes? And what are the key parameters.

Lab 5: GAC and stripping: hydrocarbon removal

What was your plan & results?
How would you scale up to commercial size based on your results? How would handle other hydrocarbons?
What was the mass velocity in your lab units vs. commercial designs?

Lab 6: Membranes: brackish waters & nitrate

What was your plan & results? What was the waste/fresh water ratio? Did results march literature?
Why was the membrane life so short; provide technical reasons? Is there a way to regenerate the membrane based on the theory of deterioration?
Based on your results, how would you advise a client interested in membrane treatment of brackish water?
Is there a model to design commercial sizes? And what are the key parameters.

Lab 7: Advanced oxidation: hydrocarbon removal

What was your plan & results?
How would you scale up to commercial size based on your results? How would handle other hydrocarbons?

Lab 8: Advanced reduction: hexavalent chromium removal

What was your plan & results?
What are the favored commercial designs and how does your process fit in?

Laboratory Sessions:

- To avoid a crowded laboratory setting, each lab section is limited to 18 students. Students will work in groups of four or five that will stay together throughout the quarter. The groups will be assigned randomly and will not be changed once they have been assigned.
- There are two sets of lab groups for each section of the course. Your lab group will conduct work either on Tuesday or Thursday from 12:40 pm to 3:30 pm on the dates assigned. You will not necessarily need to attend the lab on the other day, but that period must be used as a time for your lab group to meet and work on data analysis and laboratory write-ups/reports. You are also encouraged to come to the laboratory on off dates to examine future modules and develop your laboratory protocols for prelabs and reports.
- Attendance at your assigned laboratory sections is mandatory and counts toward your grade. In the event that you miss or are late to your assigned laboratory period, you will lose attendance points (5% of your grade). In the event you miss a laboratory, you will be required to make up the laboratory as soon as possible on your own time (which requires an individually produced laboratory report separate from your groups). If you know you will miss a date, tell me as something as soon as possible.

Laboratory Preparation and Prelabs:

- Laboratory preparation is critical. It is required that each group review the informational handouts and laboratory manual posted in iLearn together prior to developing laboratory protocols and conducting lab work.
- **THE LABORATORY MANUAL DOES NOT CONTAIN STEP-BY-STEP PROTOCOLS.** Part of your responsibility in this class is to design a protocol or work plan to achieve the stated objectives of each laboratory module. The professor and TAs are here to help you with this task, but we will only guide you in the right direction when appropriate questions are asked. We will not simply tell you how it is done.
- Prelab assignments are worth a total of 20% of your final grade. Prelab assignments must clearly state (i) the objective of the module, (ii) a hypothesis regarding the module to be tested during the laboratory period, (iii) the key equations and a brief description of the relevant theory pertaining to the module, (iv) a detailed description of the module/apparatus to be employed, (v) a clear, concise, step-by-step description of the experimental plan (this is the protocol that your group will follow to achieve the stated module objective), (vi) a description of the key data to be collected and a brief description of how the data will be analyzed, and (vii) a list of references used to develop the prelab.
- Each group should use the laboratory time period to inspect future modules and become familiar with all apparatuses. This can be done during your group's off weeks or concurrently while your group collects data on another module. There should be sufficient time for your group to both collect data and prepare for future laboratories during the scheduled class periods. It is up to each member of the group to make sure the revised version returned to the group is included in the laboratory notebook of each member.

Lab Reports:

Each group will conduct 2 open-ended laboratory design experiments. For each experiment you are required to submit a pre-lab, copies of the collected data and accompanying calculations made in your lab notebook, and a post-lab final report. Calculations and notebook copies must be submitted for individually.

- Lab reports are due at 5 p.m. on the due date and are to be submitted to Dr. Liu's office mailbox.
- The policy for late lab reports is as follows. One late day results in a 15 % reduction of your lab report grade. Reports handed in 3 days late will result in a 30 % reduction of your lab report grade. Lab reports one week late will result in a 50 % reduction of your lab report grade.
- Details and requirements for the lab write-ups will be discussed later in the syllabus and in additional handouts.

Oral Presentations:

- Two oral presentations will be required, one in Week 6 and a second in Week 10.
- Each group will prepare a presentation of 15 minutes and allow for 5 minutes for questions.
- Presentations should be conducted in a professional manner. Use Powerpoint and dress appropriately. Again, it is each group's responsibility to make sure work on the oral presentation is evenly distributed among members.

Laboratory Supplies:

- The laboratory manual will be made available to you on ilearn. You must download and print this for next week.
- You must provide your own lab notebook, goggles and lab coat.
- A scientist is only as good as his or her laboratory notebook! Notes and data should be recorded with an ink pen in a permanently bound laboratory notebook. The most useful notebook is one that has pages that makes graphing easy. Students should purchase one before the beginning of the first exercise and use the same notebook for each experiment. Record pre-experiment notes, changes from standard procedures made during the course of the experiment, data, preliminary data reduction (for example, checks of a calibration curve to make sure an instrument is operating correctly), and any other observations that you may feel are interesting and noteworthy.

Grading:

- Grades will be awarded using a scale aimed at measuring student mastery of course material. The following grade "floors" will be guaranteed by the instructor: students scoring $\geq 90\%$ are guaranteed to receive at least an A-, 80-89% will receive at least a B-, 70-79% will receive at least a C-, and 60-69% will receive at least a D-. The instructor will not raise the minimum percentages required to achieve each grade, but reserves the right to lower them if necessary.

Peer Evaluation:

- For every report, all group members will fill out and hand in a peer evaluation form, which will be distributed on iLearn. This form is provided to make sure all students in the group are pulling equal weight on the workload, and to provide students an avenue to express concerns over the effort of their labmates. In the event the workload is not shared evenly, I will use these evaluations at my discretion to alter the grade of those group members not fulfilling all their responsibilities. **IN THE INTEREST OF ANONYMITY, THESE PEER EVALUATIONS MUST NOT BE SUBMITTED WITH THE LABORATORY REPORT.** They must be turned into the drop box outside of Dr. Liu's office by the laboratory report deadline.
- **WORK AND RESPONSIBILITY SHOULD BE SHARED AND EVENLY DISTRIBUTED. DO NOT RELY ON A SINGLE GROUP MEMBER TO DO ALL OF THE WORK FOR YOUR GROUP. PART OF THIS COURSE IS TO LEARN TO WORK ON INTERDISCIPLINARY TEAMS. YOU MUST LEARN TO WORK TOGETHER!!**

Ethics and Integrity:

- All students at UCR are expected to uphold the highest ethical standards, be honest, and practice academic integrity in this class. This includes doing original work and properly citing any sources used. In terms of behavior toward fellow students, you are expected to abide by the UCR Principles of Community (available on line).