EECE 425 - Environmental Engineering Laboratory  
Course Syllabus – Fall 2015

Time and Location: 4:00-7:00 PM Wednesday  
3011 Brauer Hall for Laboratory Sessions  
318 Whitaker Hall for Lecture Sessions  
Additional times as needed for sampling and use of analytical instruments

Instructor: Prof. Daniel Giammar  
1023 Brauer Hall, (314) 935-6849  
giammar@wustl.edu
  
Office Hours: Mondays 12:00 – 1:00PM  
and by appointment

Teaching Assistants:  
Yeunook Bae – yeunook.bae@wustl.edu
Chao Pan – panchao@wustl.edu

Office Hours:  
table outside of Brauer 1038  
Tuesdays 5:30 – 6:30PM

Website: https://bb.wustl.edu/

Course Description
This laboratory-based course involves weekly experiments that demonstrate important environmental engineering concepts. The course will introduce commonly used tools for the analysis, characterization, and modeling of environmental systems. These tools include analytical instruments, such as inductively coupled plasma mass spectrometers, pH and dissolved oxygen meters, and spectrophotometers, simple analytical methods that are based on wet chemical analysis, as well as chemical equilibrium modeling software programs. The collection of experimental data will serve as the basis for the important task of data interpretation. Statistical tools and quality control techniques will be introduced.

Course Objectives
After taking this course, students should be able to:  
• Use laboratory techniques commonly used in environmental engineering.  
• Better understand concepts covered in lecture-based courses through performing hands-on experiments.  
• Use data to interpret the behavior of environmental engineering systems  
• Appreciate issues associated with data quality and have the ability to perform data interpretation.

Readings


Additional Reading: Supplemental readings handed out in class or distributed on course website.
Course Logistics

This course was originally developed by Professor Jay Turner and then modified by Professors Brian Wrenn and Lars Angenent. Several of the experiments and aspects of the course logistics were originally developed by these professors. Professor Dan Giammar re-offered this course in Spring 2011 and he most recently taught this course in Fall 2014.

Coursework

- **Laboratory Experiment Final Deliverables** (40% of grade).
- **Prelaboratory Assignments** (15% of grade).
- **Final Exam** (20% of grade).
- **Laboratory Notebook** (15% of grade).
- **Laboratory Briefings** (10% of grade).

Prelaboratory Assignments:

A prelaboratory assignment is due at the start of most classes. The assignment questions will be provided with the written descriptions of each experiments and will be available at least one week before the laboratory session. Many experiments will have the prelaboratory assignments divided into two sections (A and B) because the experiments will be performed over two weeks. Prelab assignments should be printed neatly like any homework assignment. Prelabs are to be done individually, although coordination of laboratory partners is recommended for certain questions.

Final Laboratory Deliverables:

A final report is required for each of the experiments. Final reports and presentations are due one week (see the schedule for due dates) after the experiment is completed. There will be two different types of final laboratory deliverables:

- **Full laboratory reports.** Each group will prepare two full laboratory reports. The class will be divided into two large groups for the field sampling and analysis experiments (Experiment 3), and each large group will submit a single report. The format and organization of final reports is described in the *Guidelines for Preparation of Laboratory Reports*, which will be distributed in the second or third week of the class. (Note: Where equations are required, use an appropriate equation editor or neatly hand write the equations in your report. Points will be deducted for inadequate presentation of equations.)

- **Short research reports.** Each group will prepare short research reports for two of the experiments instead of a full laboratory report. These will be short (less than 3000 word equivalents – figures and tables count for 200 word equivalents each) and should be formatted according to the guidelines of *Environmental Science & Technology Letters* ([http://pubs.acs.org/journal/estlcu](http://pubs.acs.org/journal/estlcu)). Additional information will be provided before the first short report is assigned.

There is no laboratory deliverable for the last experiment, but the content of this experiment will be heavily used in the final exam.

Laboratory Briefings:

Each student will be responsible for two laboratory briefings associated with the laboratory reports. These briefings will consist of ten minute one-on-one question and answer sessions with the instructor that will be scheduled outside of the normal class meeting time (usually on Thursdays and Fridays). While the laboratory reports will be submitted as a group, the laboratory briefings will be individual. The specific students responsible for the briefings for each experiment will be determined when the laboratory reports are turned in.
Final Exam:

There will be a final exam during the exams period. The exam is closed book and students may bring a single sheet of paper (any size and both sides) with handwritten notes.

Laboratory Notebooks:

Record keeping in the laboratory is extremely important. Each student must keep a bound lab notebook for recording results, observations, and deviations from the method. Each student must keep their own lab notebook, and these will be inspected before students are allowed to begin an experiment. This means that students should have written down the objectives and procedure (including a flow chart) for the experiment and have a section prepared to record data. Cutting and pasting of printed text and procedures is acceptable, but only having the verbatim procedures from the experiment descriptions is not acceptable. Guidelines and standard procedures for keeping your notebook will be discussed in the first class session. For group experiments, one member may record data associated with specific activities and all group members should copy the data to their own notebooks before leaving the laboratory. The grading criteria for laboratory notebooks will be on a scale of 10: done well = 10, some big problems = 8, many big problems = 6, not done =0
Course Policies

Letter Grades. Final letter grade decisions will be made by the instructor; however, students are guaranteed the following minimum letter grades.

<table>
<thead>
<tr>
<th>Composite Score</th>
<th>Minimum Letter Grade</th>
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<tbody>
<tr>
<td>score ≥ 90</td>
<td>A (A-, A, A+)</td>
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<tr>
<td>score ≥ 80</td>
<td>B (B-, B, B+)</td>
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<tr>
<td>score ≥ 70</td>
<td>C (C-, C, C+)</td>
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<tr>
<td>score ≥ 60</td>
<td>D (D-, D, D+)</td>
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Late Policy. No late work will be accepted. Exceptions may be made for extenuating circumstances.

Attendance Policy: Attendance is mandatory in this course. If you cannot avoid missing a class, you must notify the instructor in advance and arrange to reschedule performing an experiment. Unexcused absences will result in a grade of zero for the report for that week.

Collaboration Policy. Experiments will be performed by groups of two to three students, and for some experiments we will pool data from the entire class. Each lab group will submit one laboratory report, but each student will be required to submit individual prelab assignments. Students are encouraged to discuss the coursework outside of class, but all writing and preparation of tables and figures of data must be the independent work of each group.

Office Hours Policy. No questions regarding assignments will be entertained by the instructor or teaching assistants after 6:30PM on Tuesdays (i.e., end of the last office hours before assignments are due).

Laboratory Safety. The safety and protocol procedures for this course will be covered in the first class session. Always observe appropriate safety measures when working in or visiting any laboratory. The university’s lab safety training presentation is accessible through the EH&S website at: http://www.ehs.wustl.edu/. Safety is a priority in this course. The need for rigid safety protocols may not be obvious during every activity in this laboratory, but safe work habits are essential to preventing accidents. All students and instructors will be required to take the appropriate precautions at all times. Never assume that bench-scale apparatus, or small amounts of chemicals, do not represent a hazard.

Student Liability for Breakage. Students will be held responsible for damage or breakage resulting from negligence or careless handling. Failure to observe specific precautions noted in the text, posted near the equipment, or explained by the instructor will constitute negligence. Normal wear and tear is, of course, excluded. The following procedure will be observed:

- Before beginning an experiment, you should check the equipment for defects. Report any obvious damage to one of the instructors before you start work.
- The instructors will inspect the equipment before and after class and will note any new damage. If new damage is noticed, the instructors will assume that the most recent users are responsible.

This procedure is intended to provide a record of defects to facilitate prompt repair and improve equipment reliability. It will also give each student an incentive to exercise reasonable care in the laboratory.

Academic Integrity Policies. All students are expected to adhere to high standards of academic integrity as outlined in the Academic Integrity Policy (http://wustl.edu/policies/undergraduate-academic-integrity.html). If you have any questions about the policies, please ask the instructor.
## Course Schedule

<table>
<thead>
<tr>
<th>Class Date</th>
<th>Topics and Experiment</th>
<th>Assignments Due</th>
<th>Lead TA</th>
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<tr>
<td>August 26</td>
<td>Overview and Laboratory Safety</td>
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| September 2  | Lecture: Alkalinity and Acid-Base Reactions
Experiment 1: Acid-Base Chemistry and Alkalinity Preparations | Prelab 1A             | Yeunook |
| September 9  | Experiment 1: Acid-Base Chemistry and Alkalinity            | Prelab 1B             | Yeunook |
| September 16 | Lecture: Statistical Treatment of Data and Calibration Curves
Experiment 2-Part 1: Adsorption to Activated Carbon         | Prelab 2              | Chao    |
| September 23 | Lecture: Field Sampling and Analysis
Experiment 2-Part 2: Adsorption using Columns                | Expt. 1 Deliverable   | Chao    |
| September 30 | Experiment 3-Part 1: Field Water Quality Testing and Sampling | Prelab 3              | Yeunook |
| October 7    | Experiment 3-Part 2: Laboratory Analysis of Field Samples   | Expt. 2 Deliverable   | Yeunook |
| October 14   | Lecture and Demonstration: Chemical Equilibrium Modeling Software Programs
Lecture: Metal Solubility                                    | Expt. 3 Full Class Report |         |
| October 21   | Lecture: Elemental Analysis
Experiment 4-Part 1: Metal Oxide Solubility and ICP-MS      | Prelab 4              | Chao    |
| *October 28  | Experiment 4-Part 2: Metal Oxide Solubility Measurements     |                       | Chao    |
| November 4   | Lecture: Quality Control Practices
Experiment 5-Part 1: Biological and chemical oxidation of organic compounds | Prelab 5              | Yeunook |
| November 11  | Experiment 5-Part 2: Biological and chemical oxidation of organic compounds | Expt. 4 Deliverable   | Yeunook |
| November 18  | Lecture: Oxidation-Reduction Reactions
Experiment 6: Iron Electrocoagulation                         | Prelab 6              | Chao    |
| December 2   | Experiment 6: Iron Electrocoagulation                        | Expt. 5 Deliverable   | Chao    |
| December 11  | 6:00-8:00 PM Final Exam                                     | Final Exam            |         |