CIVE 441 WATER QUALITY ANALYSIS AND TREATMENT

Lecture: M-W 1:00-1:50 pm Engineering B 02
Lab: W 2:00-4:50 pm or 3:00-5:50 pm, Scott 268
Spring 2015

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Office hours: e-mail for appointment

Course Description: This laboratory course covers basic physical, chemical and biological methods for the characterization of water and wastewater. The course format includes two lectures followed by the laboratory session providing students with hands-on experience.

Prerequisites: CIVE 440 or CIVE 438 or concurrent registration to either.

Course Objective:
- to build fundamental knowledge and skill in the characterization of water and wastewater and to apply these in hands-on design of basic water treatment processes.

Learning Objectives: Upon completion of this course students will be able to:
- conceptually explain and carry out various water quality analyses.
- design and evaluate the efficiency of a basic water treatment system.
- synthesize experimental results in the form of a professional report and oral presentation.

* Supplemental reading will be handed out in class or posted on RamCT.
* Students are required to purchase an appropriate lab notebook to record their data.

Safety in the Lab: Students should follow all safety instructions carefully. Appropriate attire is required for work in the lab. Shorts or cut-offs, short sleeved shirts and open toed shoes are not allowed in the laboratory. Many of the chemicals we will be working with are dangerous: goggles and gloves must be worn at all times when working in the lab.

Participation and Good Lab Citizenship: Active participation to this course is critical for success. You will be working with other students and sharing the lab, hence good citizenship is essential in the laboratory. Please keep your workspace clean and put away items and clean glassware as appropriate.

Grading:
- Lab Reports and Protocols – 35 %
- Final Report and Presentation – 20%
- Homework and Quizzes – 20%
- Midterm Exam – 20 %
- Participation and good citizenship/lab practices – 5%
Lab Reports and Protocols: For each week following the corresponding lecture, every student is required to read the assignments and write-up a step-by-step procedures/methods document for the week’s experiment. These write-ups will be checked prior to starting the Wednesday lecture. For each week following the corresponding experiment, each lab group is required to submit a lab report. The due dates for the procedures and lab reports are indicated in the schedule table attached at the end of the syllabus. The guidelines for these reports as well as the final report are indicated below.

Final Report and Presentation: Students will be assigned a design project and will design a basic water treatment system and test its efficiency by conducting experiments that were learned during the course of the semester. At this point it is expected that students have understood the physical/chemical/biological nature of various water quality constituents and can describe precisely how their treatment system addressed each of them and why (or why not) it improved each aspect of the water quality. Originality of the design will improve the grade of the report and presentation. After the experiments are completed, each group will prepare a professional final report (~10 pages (1 inch margins, double spacing, 12 point font size) excluding cover page and appendix, with a binder) and present their project (problem statement, design approach, findings, etc) on the last day of the class. Each group will prepare a 20 minute power point presentation. The presentation guidelines are indicated below as well.

*For this component of the class 40% of the grade will be obtained from the presentation and 60% will be obtained from the final report.

Report Guidelines: Each group is required to submit one report for each experiment, and one final report. The reports should be double spaced, with a font size of 12 points. This class also aims to improve students’ writing and communication skills and hence reports are expected to be written with good grammar and be free of spelling errors. Each report should contain:

- **Cover page:** Include the lab title, the dates, and group members’ names.
- **Introduction:** A brief background information section including purpose of the experiment and the effects of the tested water quality parameter(s) on the environment and human health. Also include application of the data you gathered and the typical values of the contaminants in water samples (surface, wastewater, drinking waters). References that correspond to the information given in the text should be cited appropriately.
  - For the **final report** a paragraph for problem statement should be included.
- **Materials and Methods:** Description of the materials (chemicals/glassware) used in the experiment and step-by-step procedure to conduct the experiment. Remember to report the method number that is used. This portion will be very similar to if not the same document you will prepare for each lab before conducting the experiment (as explained in lab reports and protocols section above). This section may also include the equations you may use to calculate the desired measurements.
  - For the **final report** a design approach should be included. i.e. how you came up with the design, expected performance, justification of the selected materials, etc. Physical equations (such as Darcy’s Law, Stoke’s Law) may be incorporated to explain the design process.
- **Results:** Prepare tables and/or graphs to summarize the “real” data (corrected for dilutions) you obtained during the experiment. Report the mean value, the standard deviation, and the outliers.
  - For the **final report** you will compare the results for the untreated and treated water. Also point out whether any water quality parameters were correlated (e.g. turbidity and solids). Try different plots of the data to analyze the data for different analyses. Pay attention to the scale of the graphs to report the findings in a representative manner.
• **Discussion:** Explain what the results mean, do they make sense, were they expected, whether there were experimental errors.
  o For the **final report** criticize how your treatment system performed giving evidence. Explain the problems encountered. Suggest ways to improve the system and address issues of sustainability issues for your system.
• **Conclusions:** In a few sentences point out what was done and the major findings.
• **References:** Alphabetically list the books, journal articles, manuals, webpages you have utilized during preparation of the report. Make sure you cite these references in text as well.
  o For webpages give complete address and the date it was accessed.
• **Appendix:** May include “raw” and extra data (for the untreated water in the final report) and sample calculations. May also be used to give detailed information.

**Presentation Guidelines:** Each group is required to prepare a 20 minutes long power point presentation. Each presentation should contain:
• **Title slide**
• **Introduction**
• **Problem Statement and Design Approach**
• **Materials and Methods**
  o mention sustainability and cost of the system
• **Results and Discussion**
  o with emphasis on the performance of the treatment system
• **Conclusions**

Make your presentation attractive by including pictures, schematics, tables and graphs. Pay attention to color and size of text, and background. Do not include a long text in one slide; try to make your points by summarizing them into bullets. The presentation will be evaluated based on:
• Clarity (what you did, why)
• Design and organization of the slides
• Creativity
• Analysis of design and performance of the treatment system
• Team effort (everyone has to present and contribute to presentation)
• Timeliness (finish within the allocated time – not shorter or longer)

*These six criteria will be weighted equally to determine the final score. The grade will be a combination of peer (25%), teaching assistant (25%), and professor (50%) review.

**Homework and Quizzes:** Several short (~15 minutes) quizzes and homework will be given during the semester. The quizzes will cover the lecture material, lab exercises and reading assignments/protocols. The quizzes will be administered during the Wednesday lectures. The due dates of the homework are a week after they are assigned unless otherwise specified.

**Midterm Exam:** One midterm exam will be given on **April 20th** during the lecture. It will include all the topics covered in class. It will be composed of problems and main concepts covered in the lectures, quizzes, homework and lab sessions.
**Grading scale:** Grades will be determined by the +/- grading system as described in the CSU catalog. The scale to be used: A+ ≥ 97; A ≥ 94; A− ≥ 90; B+ ≥ 87; B ≥ 84; B− ≥ 80; C+ ≥ 75; C ≥ 70; D ≥ 60; F < 60.
*Grades will be posted regularly in RamCT so that students may keep up to date with their standing in the course.

**Honor Code:** As developed and endorsed by the 38th Senate of the Associated Students of Colorado State University on Sept 10th 2008, “Academic Integrity Policy of the Colorado State University General Catalog (Page 7) and the Student Conduct Code” will be adopted by this course and the students are required the acknowledge and practice the honor code as stated below:

“As a student at Colorado State University, I recognize my active role in building a Campus of Character. This includes my commitment to honesty, integrity, and responsibility within the campus community. As such, I will refrain from acts of academic dishonesty. Furthermore, reflecting upon this commitment, I find it my prerogative to conduct myself in a dignified and inclusive manner, taking the initiative to do justice within my institution, be considerate to my peers, and persevere both academically and personally”

Also CSU standards regarding academic integrity may be found in the General Catalog, online at http://www.catalog.colostate.edu/front/policies.aspx.

**General Class Conduct/Remarks:**
- All the quizzes and exams are closed books and closed notes. Only FE approved basic calculators that have no programming and solver capabilities are allowed.
- Students have **one week** to discuss their quiz/exam/homework after they are returned.
- If a student has a conflict with the exam, the instructor should be notified at least **two weeks** prior to the exam date. Make-ups won’t be given for missed exams without a prior **notice and an official document**, or with an **official document for emergencies**.
- Students are highly encouraged to utilize the **office hours** to discuss any issues and difficulties with course material.
- Only the students who have participated in laboratory exercises may submit a report and hence receive a grade.
- No make-ups will be given for the missed lab sessions. However other assignments may be given to substitute a lab with **proper documentation** explaining the absence.
- Each member of the group should participate fully and fairly to conduct of the experiments and preparation of reports and presentation.
- Learning to work in teams is essential for success for this class and for your future careers. Be respectful to each other. However if issues arise that cannot be handled within the group, students should immediately notify the instructor.
- Please turn off your cell phone, CD or MP3 players during lecture.
- Talking to classmates and reading materials other than those appropriate for this class during lecture disrupts the normal learning environment and hence is not allowed.
- You may consume drinks during the lecture, but you may not have food. No food or drinks are allowed during the lab sessions.
- Course related announcements and reading materials will be posted on RamCT, hence students should check it regularly.
- E-mails regarding the course should contain ENVE 441 in the subject line, and a proper salutation in the main text of the e-mail.
### Tentative Class and Quiz/Report Schedule:

<table>
<thead>
<tr>
<th>Week</th>
<th>Date</th>
<th>Lecture</th>
<th>Lab Activity</th>
<th>Due (on Wednesdays)</th>
<th>Quiz (on Wednesdays)</th>
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</thead>
<tbody>
<tr>
<td>1</td>
<td>01/21</td>
<td>Introduction, Syllabus</td>
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<td>Good lab practices</td>
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<tr>
<td>2</td>
<td>01/22</td>
<td>Solids, Theoretical Oxygen Demand, and COD</td>
<td>Prepare Wastewater Solids Lab</td>
<td>Group names</td>
<td>Solids Protocol</td>
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<td>01/28</td>
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<td>3</td>
<td>02/02</td>
<td>TOC and DOC</td>
<td>COD Lab</td>
<td>Solids Lab Report</td>
<td>Solids Quiz</td>
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<td>02/04</td>
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<td>COD Protocol</td>
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<td>4</td>
<td>02/09</td>
<td>BOD</td>
<td>DOC Lab</td>
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<td>DOC Protocol</td>
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<td></td>
<td>02/11</td>
<td>Water Quality</td>
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<td>5</td>
<td>02/16</td>
<td>Nutrients</td>
<td>BOD Lab</td>
<td>COD and DOC Lab Report</td>
<td>COD, DOC and Theoretical Oxygen Demand Quiz</td>
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<td>02/18</td>
<td>Phosphorus</td>
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<td>COD Protocol</td>
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<td>6</td>
<td>02/23</td>
<td>Nitrogen</td>
<td>Read BODs</td>
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<td>Total P Lab</td>
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<td>7</td>
<td>03/02</td>
<td>Turbidity, Conductivity, pH and DO</td>
<td>N Labs</td>
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<td>BOD Quiz</td>
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<td>03/04</td>
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<td>BOD Lab Report</td>
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<td>03/09</td>
<td>Turbidity, Conductivity, pH and DO</td>
<td>N and P Lab Report</td>
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<td>03/11</td>
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<td>Turbidity, Conductivity, pH and DO Protocols</td>
<td>N and P Quiz</td>
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<td>X</td>
<td>03/14-22</td>
<td>Spring Break</td>
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<td>9</td>
<td>03/23</td>
<td>Alkalinity and the Carbonate System</td>
<td>Metals and Chlorine Lab</td>
<td>Turbidity, Conductivity, pH and DO Lab Report</td>
<td>Turbidity and Conductivity Quiz</td>
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<td>03/25</td>
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<td>03/30</td>
<td>Hardness</td>
<td>Alkalinity Lab</td>
<td>Metals and Chlorine Write-up</td>
<td>Redox and Chlorine Quiz</td>
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<td>04/06</td>
<td>Acid Base Chemistry</td>
<td>Hardness Lab</td>
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<td>Alkalinity Quiz</td>
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<td>12</td>
<td>04/13</td>
<td>Introduction to Water and Wastewater Treatment</td>
<td>Design construction</td>
<td>Alkalinity and Hardness Write-up</td>
<td>Hardness Quiz</td>
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<td>13</td>
<td>04/20</td>
<td>Design Competition</td>
<td>pH, Turbidity, Conductivity, DO / Set-up DOC</td>
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<td>Treated Water Analysis I</td>
<td>Treatment System</td>
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<td>MIDTERM (04/21)</td>
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<td>14</td>
<td>04/27</td>
<td>Treated Water Analysis II</td>
<td>Read DOC, Total N, P</td>
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<td>05/04</td>
<td>Presentations</td>
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<td>Final Report</td>
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* Please note that the class schedule is subject to change.