INSTRUCTOR: Dr. P.K. Andy Hong  
Office: 216 EMRO; 1-7232  
Email: hong@civil.utah.edu  
Hours: T, H 3-5

TEACHING ASSISTANT: Hua Xu  
Office Hours: T, H 5-6; 112 HEDCO


CLASS: Lecture, T 6-6:50, EMCB 112  
Laboratory, H 6-7:40, HEDCO 110

OBJECTIVES:  
This course will discuss important water quality parameters, and introduce basic quantitative and instrumentation techniques for water quality and environmental sample analyses. The basic principles of methods and their limitations in environmental laboratory analysis will be addressed. Skills in laboratory analysis, data analysis, and writing of formal technical reports will be developed and emphasized.

By completing this course, you will have ample opportunities to:  
1) understand the significance of key environmental quality parameters, which will allow you to communicate with other professionals in this field;  
2) understand how these parameters are measured, the strength and potential weaknesses of these procedures;  
3) perform basic laboratory analyses and obtain quality parameters following published procedures; and  
4) further develop and improve your skill in writing formal technical reports.

PREREQUISITES: CVEEN 3610 & 3620
# Schedule of Laboratory Experiments

<table>
<thead>
<tr>
<th>Week</th>
<th>Date</th>
<th>Experiment</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>8/25</td>
<td>Introduction /Orientation/Laboratory Safety</td>
</tr>
<tr>
<td>2</td>
<td>9/1</td>
<td>Turbidity</td>
</tr>
<tr>
<td>3</td>
<td>9/8</td>
<td>pH, Ionic strength, and Electroneutrality</td>
</tr>
<tr>
<td>4</td>
<td>9/15</td>
<td>Alkalinity Determination by Acidimetric-Potentiometric Titration</td>
</tr>
<tr>
<td>5</td>
<td>9/22</td>
<td>Hardness</td>
</tr>
<tr>
<td>6</td>
<td>9/29</td>
<td>Solid Determination by Gravimetric Analysis</td>
</tr>
<tr>
<td>7</td>
<td>10/6</td>
<td>Fall Break (10/7-8)</td>
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<tr>
<td>8</td>
<td>10/13</td>
<td>Chemical Oxygen Demand (COD) and Nitrogen Measurement</td>
</tr>
<tr>
<td>9</td>
<td>10/20</td>
<td>Biochemical Oxygen Demand (BOD)</td>
</tr>
<tr>
<td>10</td>
<td>10/27</td>
<td>Chlorine Disinfection and Chlorine Demand</td>
</tr>
<tr>
<td>11</td>
<td>11/3</td>
<td>Activated Carbon Adsorption-Adsorption isotherms</td>
</tr>
<tr>
<td>12</td>
<td>11/10</td>
<td>Gas Transfer and Kinetic Analysis</td>
</tr>
<tr>
<td>13</td>
<td>11/17</td>
<td>Analyses of Organics by Gas Chromatograph (GC/FID or GC/MS)</td>
</tr>
<tr>
<td>14</td>
<td>11/24</td>
<td>Thanksgiving Recess (11/25-26)</td>
</tr>
<tr>
<td>15</td>
<td>12/1</td>
<td>Determination of Trace Metals by Atomic Absorption Spectrophotometry (AA)</td>
</tr>
<tr>
<td>16</td>
<td>12/8</td>
<td>Determination of Inorganics by Ion Chromatograph with Conductivity Detector (IC/CD)</td>
</tr>
</tbody>
</table>

**Grade:** Laboratory participation in all sessions is required. Laboratory Practice (10%), Reports (40%), Homework (10%), and Midterms/Final Examinations (40%).

**Term Project Report on Experimental Design:**
1) Identify a quality parameter of interest for an environmental medium (water, soil, or air);
2) Design and lay out an experimental plan with detailed procedures to measure this parameter.

**Useful Tools for this course:**
- Computer software for Data Handling/Analysis: Excel, Axum, Mathcad, Maple, Matlab
- Statistical methods for Regression Analysis
TABLE OF CONTENTS

LABORATORY SAFETY

LABORATORY REPORT OUTLINE

HANDOUTS ON

Turbidity

pH, Ionic strength, and Electroneutrality

Alkalinity Determination by Acidimetric-Potentiometric Titration

Hardness

Solid Determination by Gravimetric Analysis

Chemical Oxygen Demand (COD) and Nitrogen Measurement

Biochemical Oxygen Demand (BOD)

Chlorine Disinfection and Chlorine Demand

Activated Carbon Adsorption-Adsorption isotherms

Gas Transfer and Kinetic Analysis

Analyses of Organics by Gas Chromatograph (GC/FID or GC/MS)

Determination of Inorganics by Ion Chromatograph with Conductivity Detector (IC/CD)

Determination of Trace Metals by Atomic Absorption Spectrophotometry (AA)

Other Appendices & Handouts
LABORATORY SAFETY

General Safety Rules

1. Know where the exits, fire extinguishers, overhead shower, and emergency eye wash stations are located.
2. Never work alone in the laboratory.
3. Wear protective goggles or eye glasses at all times in the laboratory. Contact lenses should not be worn under goggles.
4. Wear a full face shield if there is any danger of a hot liquid erupting from a container or from an exploding apparatus.
5. You must wear shoes in the laboratory.
6. Lab coats or aprons should be worn to protect your skin and clothing.
7. Protective gloves must be used when handling hot or cold equipment and for chemicals which can irritate the skin.
   a. Use elastic gloves when handling liquids or solids which are skin irritants.
   b. Use tongs or asbestos gloves to handle hot or very cold objects.
8. Use the fume hood when working with chemicals which give off dangerous or foul-smelling vapors. Fume hoods are not to be used as storage areas. Hoods must be kept clean and free excess combustibles.
9. Use care in heating solutions. Never heat a closed system. Aim heated test tubes away from all people. Always use 'Pyrex' glass or porcelain to hold substances which are to be heated.
10. Be cautious with all chemicals, especially concentrated acids and bases and toxic materials.
11. Clean up all spills immediately.
12. Read the label on any chemical container twice to prevent accidents.
13. Label all storage containers properly.
14. Take only the amount of chemical from the stock bottle that is needed. Do not return unused chemicals to their stock bottles.
15. Store chemicals in their proper place.
16. Check with supervisor for proper disposal of unwanted materials.
17. Clean up all spills immediately.
18. ALWAYS ADD THE ACID TO THE WATER!
19. At the end of the lab period, clean all glassware by washing with detergent solution, rinse several times with tap water, then once with distilled water.
20. Compressed gas cylinders should be secured at all times.
21. Mechanical pipetting aids should be used for all pipetting procedures.
22. The radioactive warning signs are for real. Do not open the marked refrigerator or fume hood cabinet without the instructor's permission. The levels of radioactivity are low and can only be a dangerous if accidentally spilled.
23. Wash hands after all laboratory operations and before eating.
24. Do not store foods or beverages in refrigerators in any laboratory area.
25. Discard broken glassware into waste container marked glass.
26. Do not attempt to catch glassware if it is dropped or knocked over.

Format of Full Laboratory Reports
Laboratory Training Form

The course instructor or teaching assistant has given me a briefing on safe laboratory practice and safety rules, and reminded my own responsibilities to promote and ensure safety within the laboratory.

This has included:

• Handout on laboratory safety and rules on the first day of class
• Briefing on laboratory safety and rules during the first day of class
• Reminders by course instructor or teaching/graduate assistant during laboratory sessions to the hazard of materials being handled and the continual use of proper protection, such as safety glasses, gloves.
• Knowledge of the types of hazardous materials being handled
• Knowledge of the location and type of emergency aids in the laboratory, such as eyewash and shower station
• Alertness to unsafe conditions and practices, so that corrective actions can be taken immediately

_______________________     _______________________
Student’s Name       Student’s Signature
Laboratory Report Format

1. **Title Page**
   - Course No. & Semester/Year
   - Experiment No. & Title
   - Name of Investigator
   - Names of Co-Investigators
   - Date
   - Table of Contents

2. **Abstract**
   - A concise summary of methods, results, and conclusions

3. **Introduction**
   - State of issue (parameter), objective, and scope of investigation
   - Background and Importance of (issue) parameter
   - Scientific principle

4. **Experimental**
   - Methods employed and materials used
   - Laboratory procedures (referencing handouts) and listing modifications
   - Methods of data analysis

5. **Results**
   - Present an overall description of the experiments (w/o repeating the experimental section)
   - Introduce Tables and Figures
   - Present Tables and Figures of Analyzed Results (not raw data)

6. **Discussion**
   - Discussion of results (principle, relationships, generalizations)
   - Point out exceptions, lack of correlation, unsettled points
   - Describe Technical problems encountered and solutions
   - Discuss interpretations, implications, and applications

7. **Conclusions**
   - State the conclusions from results and discussion
   - Summarize evidences for these conclusions

8. **References**
   - List significant references using a standard reference format, including: authors, date, titles, editors, publishers, publishing location, and pages used.

9. **Appendices**
   - Tables of Raw data
   - Calculations
   - Preliminary plots
   - Others relevant