## Lecture Schedule / Homework

<table>
<thead>
<tr>
<th>Date</th>
<th>Event</th>
<th>Chapter</th>
<th>Subject</th>
<th>Problems (Fourth Edition)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1/22</td>
<td>Lecture 1</td>
<td>1-4</td>
<td>Tools of analytical chemistry</td>
<td>1:8,11,12,14,16,18,21,22,24</td>
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<tr>
<td></td>
<td></td>
<td></td>
<td>Reagents and laboratory Equipment</td>
<td>2:1,4,6,9,10</td>
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<td>3:12,18</td>
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<td>4:13</td>
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<tr>
<td>1/29</td>
<td>Lecture 2</td>
<td>6</td>
<td>Titrimetry, Normality</td>
<td>6:1,10,12,13,14</td>
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<tr>
<td>2/5</td>
<td>Lecture 3</td>
<td>8,9</td>
<td>Acids Bases Buffers</td>
<td>8:1,3,5,6,7,9,11,14,19,21</td>
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<td>9:2,4,8,10,14</td>
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<td>2/12</td>
<td>Lecture 4</td>
<td>10, 11</td>
<td>Titrations, Acids &amp; Bases</td>
<td>10:6-9,11,12,13; 11:26</td>
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<td>2/19</td>
<td>Lecture 5</td>
<td>18</td>
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<td>18:2,6,7,11,13,15,17,20,21</td>
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<td></td>
<td>Turbidimetry</td>
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<tr>
<td>2/26</td>
<td>Lecture 6</td>
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<td>22:8,9,12,13</td>
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<tr>
<td></td>
<td></td>
<td>22</td>
<td>(pp. 459-469)</td>
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<td></td>
<td>Chromatography</td>
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<td></td>
<td></td>
<td>22</td>
<td>(pp. 481-491)</td>
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<td>3/5</td>
<td>Lecture 7</td>
<td>7</td>
<td>Gravimetry and Ion-</td>
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<td>Exchange Chromatography</td>
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<td></td>
<td></td>
<td>23</td>
<td>(pp.511-514)</td>
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<tr>
<td>3/12</td>
<td>Exam I (Scientific Calculators Only, Cell Phones Off Away from Body)</td>
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<tr>
<td>3/19</td>
<td>SPRING BREAK</td>
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<td>3/26</td>
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<td>Suppressed Ion Chromatography</td>
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<td>Suppressed Ion Chromatography</td>
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<td>4/16</td>
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<td>4/23</td>
<td>Exam II (Scientific Calculators Only, Cell Phones Off Away from Body)</td>
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<td></td>
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<td></td>
<td>THERE IS NO FINAL EXAM FOR THIS COURSE.</td>
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<tr>
<td>Chapter</td>
<td>Title</td>
<td>Sections</td>
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<tr>
<td>1</td>
<td>Chemical Measurements</td>
<td>1-1 SI Units and Prefixes&lt;br&gt;1-2 Conversion Between Units&lt;br&gt;1-3 Chemical Concentrations&lt;br&gt;1-4 Preparing Solutions&lt;br&gt;1-5 The Equilibrium Constant</td>
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<tr>
<td>2</td>
<td>Tools of the Trade</td>
<td>2-1 Safety, Waste Disposal, and Green Chemistry&lt;br&gt;2-2 Your Lab Notebook&lt;br&gt;2-3 The Analytical Balance&lt;br&gt;2-4 Burets&lt;br&gt;2-5 Volumetric Flasks&lt;br&gt;2-6 Pipets and Syringes&lt;br&gt;2-7 Filtration&lt;br&gt;2-8 Drying&lt;br&gt;2-9 Calibration of Volumetric Glassware&lt;br&gt;2-10 Methods of Sample Preparation</td>
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<td>3</td>
<td>Math Toolkit</td>
<td>3-1 Significant Figures&lt;br&gt;3-2 Significant Figures in Arithmetic&lt;br&gt;3-3 Types of Error&lt;br&gt;3-4 Propagation of Uncertainty&lt;br&gt;3-5 Introducing Spreadsheets</td>
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<td>4</td>
<td>Statistics</td>
<td>4-1 The Gaussian Distribution&lt;br&gt;4-2 Student’s t&lt;br&gt;4-3 A Spreadsheet for the t test&lt;br&gt;4-4 Grubbs Test for an Outlier&lt;br&gt;4-5 Finding the “Best” Straight Line&lt;br&gt;4-6 Constructing a Calibration Curve&lt;br&gt;4-7 A Spreadsheet for Least Squares</td>
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<td>5</td>
<td>Good Titrations</td>
<td>5-1 Principles of Volumetric Analysis&lt;br&gt;5-2 Titration of on Calculations&lt;br&gt;5-3 Chemistry in a Fishtank&lt;br&gt;5-4 Solubility Product&lt;br&gt;5-5 Titration of a Mixture&lt;br&gt;5-6 Titrations Involving Silver Ion</td>
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<td>6</td>
<td>Introducing Acids and Bases</td>
<td>6-1 What are Acids and Bases?&lt;br&gt;6-2 Relation Between [H⁺], [OH⁻], and pH&lt;br&gt;6-3 Strengths of Acids and Bases&lt;br&gt;6-4 pH of Strong Acids and Bases&lt;br&gt;6-5 Tools for Dealing with Weak Acids and Bases&lt;br&gt;6-6 Weak-Acid Equilibrium&lt;br&gt;6-7 Weak-Base Equilibrium</td>
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<td>7</td>
<td>Buffers</td>
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<td>8</td>
<td>Ion-Exchange Chromatography</td>
<td>8-1 What You Mix is What You Get&lt;br&gt;8-2 The Henderson-Hasselbach Equation&lt;br&gt;8-3 A Buffer in Action&lt;br&gt;8-4 Preparing Buffers&lt;br&gt;8-5 Buffer Capacity&lt;br&gt;8-6 How Acid-Base Indicators Work</td>
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<tr>
<td>9</td>
<td>Ion-Exchange Chromatography</td>
<td>9-1 What You Mix is What You Get&lt;br&gt;9-2 The Henderson-Hasselbach Equation&lt;br&gt;9-3 A Buffer in Action&lt;br&gt;9-4 Preparing Buffers&lt;br&gt;9-5 Buffer Capacity&lt;br&gt;9-6 How Acid-Base Indicators Work</td>
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<td>10</td>
<td>Acid-Base Titrations</td>
<td>10-1 Titration of Strong Base with Strong Acid&lt;br&gt;10-2 Titration of Weak Acid with Strong Acid&lt;br&gt;10-3 Titration of Weak Base with Strong Acid&lt;br&gt;10-4 Finding the End Point&lt;br&gt;10-5 Practical Notes&lt;br&gt;10-6 Kjeldahl Nitrogen Analysis&lt;br&gt;10-7 Putting Your Spreadsheet to Work</td>
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<td>11</td>
<td>Polyprotic Acids and Bases</td>
<td>11-1 Amino Acids are Polyprotic&lt;br&gt;11-2 Finding the pH in Diprotic Systems&lt;br&gt;11-3 Which is the Principal Species&lt;br&gt;11-4 Titrations in Polyprotic Systems</td>
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<td>12</td>
<td>Let There Be Light</td>
<td>12-1 Properties of Light&lt;br&gt;12-2 Absorption of Light&lt;br&gt;12-3 Practical Matters&lt;br&gt;12-4 Using Beer’s Law</td>
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<td>13</td>
<td>What is Chromatography</td>
<td>13-1 Principles of Chromatography&lt;br&gt;13-2 Types of Chromatography&lt;br&gt;13-3 Theory of Chromatography&lt;br&gt;13-4 Practical Aspects of Chromatography&lt;br&gt;13-5 Applications of Chromatography</td>
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<td>14</td>
<td>Gas Chromatography</td>
<td>14-1 Principles of Gas Chromatography&lt;br&gt;14-2 Types of Gas Chromatography&lt;br&gt;14-3 Theory of Gas Chromatography&lt;br&gt;14-4 Practical Aspects of Gas Chromatography&lt;br&gt;14-5 Applications of Gas Chromatography</td>
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<td>17</td>
<td>Ion-Exchange Chromatography</td>
<td>17-1 Principles of Ion-Exchange Chromatography&lt;br&gt;17-2 Types of Ion-Exchange Chromatography&lt;br&gt;17-3 Theory of Ion-Exchange Chromatography&lt;br&gt;17-4 Practical Aspects of Ion-Exchange Chromatography&lt;br&gt;17-5 Applications of Ion-Exchange Chromatography</td>
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<td>18</td>
<td>Analytical Chemistry</td>
<td>18-1 Principles of Analytical Chemistry&lt;br&gt;18-2 Types of Analytical Chemistry&lt;br&gt;18-3 Theory of Analytical Chemistry&lt;br&gt;18-4 Practical Aspects of Analytical Chemistry&lt;br&gt;18-5 Applications of Analytical Chemistry</td>
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<td>19</td>
<td>Ion-Exchange Chromatography</td>
<td>19-1 Principles of Ion-Exchange Chromatography&lt;br&gt;19-2 Types of Ion-Exchange Chromatography&lt;br&gt;19-3 Theory of Ion-Exchange Chromatography&lt;br&gt;19-4 Practical Aspects of Ion-Exchange Chromatography&lt;br&gt;19-5 Applications of Ion-Exchange Chromatography</td>
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<td>21</td>
<td>Ion-Exchange Chromatography</td>
<td>21-1 What is Chromatography? &lt;br&gt;21-2 Principles of Ion-Exchange Chromatography&lt;br&gt;21-3 Types of Ion-Exchange Chromatography&lt;br&gt;21-4 Theory of Ion-Exchange Chromatography&lt;br&gt;21-5 Practical Aspects of Ion-Exchange Chromatography&lt;br&gt;21-6 Applications of Ion-Exchange Chromatography</td>
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<tr>
<td>22</td>
<td>Gas Chromatography</td>
<td>22-1 Principles of Gas Chromatography&lt;br&gt;22-2 Types of Gas Chromatography&lt;br&gt;22-3 Theory of Gas Chromatography&lt;br&gt;22-4 Practical Aspects of Gas Chromatography&lt;br&gt;22-5 Applications of Gas Chromatography</td>
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<tr>
<td>23</td>
<td>Ion-Exchange Chromatography</td>
<td>23-1 Principles of Ion-Exchange Chromatography&lt;br&gt;23-2 Types of Ion-Exchange Chromatography&lt;br&gt;23-3 Theory of Ion-Exchange Chromatography&lt;br&gt;23-4 Practical Aspects of Ion-Exchange Chromatography&lt;br&gt;23-5 Applications of Ion-Exchange Chromatography</td>
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## Pre-Lab Schedule

<table>
<thead>
<tr>
<th>Pre-Lab</th>
<th>Section 01 Tues Due Date</th>
<th>Sections 02, 03 Wed Due Date</th>
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<tbody>
<tr>
<td>LEO-15</td>
<td>1/27</td>
<td>1/28</td>
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<tr>
<td>Acid/Base</td>
<td>2/10</td>
<td>2/11</td>
</tr>
<tr>
<td>Colorimetry</td>
<td>2/24</td>
<td>2/25</td>
</tr>
</tbody>
</table>

## Laboratory Schedule

Laboratory reports are due one week after the completion date of each laboratory. The completion dates are given on the lines in which the titles are marked with an asterisk (*). Laboratory reports will either be full (5-6 pages maximum) or short (1-2 pages maximum) as indicated below.

Note: The draft Alkalinity – I & II report is due the week following the completion of Alkalinity II.

The short report for Synthesis of Experimental Data is due on the last day of the lab with the presentation.

<table>
<thead>
<tr>
<th>Day #</th>
<th>Title</th>
<th>Subject</th>
<th>Section 01 Tues</th>
<th>Sec 02, 03 Wed</th>
<th>Report Due Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Check in; <strong>Safety Quiz; Integrity Document; Familiarization with Lab</strong> Follow Handout for Practice</td>
<td>Laboratory Safety – Washing of Glassware: Discussion of Lab Notebook: Practice Volumetric Glassware Practice Weighing</td>
<td>1/20</td>
<td>1/21</td>
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<tr>
<td>2</td>
<td>Suspended and Dissolved Particulate Matter</td>
<td>Sampling, filtration</td>
<td>1/27</td>
<td>1/28</td>
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<tr>
<td>3</td>
<td>Finish Lab # 2 (Weigh Dissolved Particulates)* &amp; Alkalinity – I</td>
<td>Indicator titration</td>
<td>2/3</td>
<td>2/4</td>
<td>*Full Susp 2/10 &amp; 2/11</td>
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<tr>
<td>4</td>
<td>Alkalinity – II* Spectrophotometric Det of Phosphate (Glassware Prep only)</td>
<td>pH titration – Glassware Acid Wash for Spectrophotometric Det of Phosphate</td>
<td>2/10</td>
<td>2/11</td>
<td><strong>Typed Draft Alk I&amp;II 2/17 &amp; 2/18</strong></td>
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<tr>
<td>6</td>
<td>Colorimetric (Spectrophotometric) Determination of Phosphat e*</td>
<td>Anions - I Phosphate</td>
<td>2/24</td>
<td>2/25</td>
<td>*Short Color 3/3 &amp; 3/4</td>
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<tr>
<td>7</td>
<td>Turbidimetric Det. of Sulfate*</td>
<td>Anions - II Sulfate (Make arrangements w/ instructor for receipt of reports before exam I)</td>
<td>3/3</td>
<td>3/4</td>
<td>*Short Turbid 3/10 &amp; 3/11</td>
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<tr>
<td></td>
<td>SPRING BREAK</td>
<td></td>
<td>3/17</td>
<td>3/18</td>
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<tr>
<td>10</td>
<td>Ion chromatography - Anions –II*</td>
<td>Anions - IV Halides et al</td>
<td>3/31</td>
<td>4/1</td>
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<tr>
<td>11</td>
<td>Complexometric titration – Analysis of Ca²⁺/Mg²⁺*</td>
<td>EDTA Titration of Calcium/Magnesium</td>
<td>4/7</td>
<td>4/8</td>
<td>*Full Complex 4/14 &amp; 4/15</td>
</tr>
</tbody>
</table>
| 13    | 1. Synthesis of Experimental Data* (Presentation + Short report due )  
2. Measurement of Dissolved oxygen (DO) In Passion Puddle*  
3. Check-Out (Wear proper Attire) | Data Synthesis Oral Presentation of Experimental Data, /Amperometry/  
Check out (Make arrangements w/ instructor for submission/receipt of reports before exam II) | 4/21 | 4/22 | 1.*Short (Synth. Exp. Data) 4/21 & 4/22  
2.* Short (DO) (due Thurs 4/23 during exam II) |
Material Covered on Exam 1
Understanding and Knowledge of the work involved in the lab and lecture. You need to show the work to get full credit.

1. Laboratory Safety
2. All material covered in the following Pre-Labs:
   - LEO-15
   - Acid/Base
   - Colorimetry
3. All material covered in the following Labs, Lab Procedures, and Lab Reports
   - Dissolved and Suspended Solids
   - Alkalinity (Indicator titration and pH titration)
   - Phosphate (Spectrophotometry)
   - Sulfate (Turbidimetry)
4. All material covered in the following Lectures
   - Lecture 1 Chemical Measurements, Tools of the Trade, Math, Statistics
   - Lecture 2 Titrimetry, Normality
   - Lecture 3 Acids Bases, Buffers
   - Lecture 4 Acid Base Titrations, Polyprotic Acids and Bases
   - Lecture 5 Spectroscopy, Turbidimetry
5. Concepts and Understanding of Assigned Homework Problems or Similar Problems, Quizzes, Review Problems, etc… Refer to the chapters in your textbook.
   - Chapter 1
   - Chapter 2
   - Chapter 3
   - Chapter 4
   - Chapter 5
   - Chapter 6
   - Chapter 7
   - Chapter 8
   - Chapter 9
   - Chapter 10
   - Chapter 11
   - Chapter 12

Material Covered on Exam 2
Understanding and Knowledge of the work involved in the lab and lecture. You need to show the work to get full credit.

1. Laboratory Safety
2. Basic Concepts Covered on the first exam
3. All material covered in the following Labs, Lab Procedures, and Lab Reports
   - Gravimetric Analysis of Chloride and Sulfate
   - Ion Chromatography - Anions
   - Complexometric Titration
   - Ion Chromatography - Cations
   - Measurement of Dissolved Oxygen
   - Synthesis of Experimental Data
4. All material covered in the following Lectures
   - Lecture 6 Separation Techniques, Chromatography
   - Lecture 7 Gravimetry and Ion Exchange Chromatography
   - Lecture 8 Anion Chromatography – Suppressed Ion Chromatography
   - Lecture 9 Complexometric Titrations
   - Lecture 10 Cation Chromatography – Suppressed Ion Chromatography
   - Lecture 11 Dissolved Oxygen – Data Synthesis
5. Concepts and Understanding of Assigned Homework Problems or Similar Problems, Quizzes, Review Problems, etc… Refer to the chapters in your textbook.
   - Chapter 21
   - Chapter 22
   - Chapter 7
   - Chapter 23
   - Chapter 13
   - Chapter 17
Chemistry 251 - Analytical Chemistry - Spring 2015

General Information

The material for this course is copyrighted and may not be posted on any other web site at or outside of Rutgers without permission. Any violation of this policy will be treated as an academic integrity violation and will be referred to the Office of Student Judicial Affairs for action.

LEARNING GOALS AS MEASURED BY PRELABS, POSTLABS, QUIZZES/EXAMS, OUR ASSESSMENT AND SAFETY ADHERENCE (Core Curriculum Goals e and f)

- Adherence to safety regulations
- To explore the principles of analytical chemistry in a safe and environmentally appropriate manner
- To relate the principles of analytical chemistry to the real world and other disciplines of science
- To motivate the students, to enhance creativity and problem solving skills
- To introduce students to Methods Development, both wet chemistry and instrumental
- To learn the theory and the practical aspects of the fundamental concepts in analytical chemistry including:
  - Review of Acids, Bases, Molarity, Buffer, and use of spreadsheet for calculation
  - Sampling and Sample Preparation
  - Calibration and Standardization
  - Titrimetry (indicator, potentiometric, complexometric)
  - Spectroscopy
  - Turbidimetry
  - Gravimetry
  - Separation Techniques
  - Ion Chromatography
  - Electrochemistry – amperometry
- To apply the above concepts to problems relevant to analytical chemistry
- To stimulate the ability to relate the concepts above to each other in ways that were not directly performed in the lab
- Data Synthesis, Statistical Analysis, Error Analysis and Oral Presentation

DESCRIPTION OF COURSE

Course Coordinator and Lecturer: Professor Setareh Marvasti
Email: Marvastis@aol.com

Stockroom Telephone Numbers: Lab 005 (848) 932-6160. Lab 001 (848) 932-9319
Course website: Sakai
Name of TA: ___________________________ E mail of TA ________________________________
Analytical Chemistry (01:160:251) - Spring 2015

SCHEDULE
Analytical Chemistry meets once a week, either on a Tuesday or Wednesday for laboratory depending on your section, in lab 005 of the Heldrich Science Building (HSB) (Douglass Chemistry) on the Douglass campus.

It also meets once a week for lecture in HSB 201 on Thursdays (5:35 – 6:55 PM). Details follow:

Sec 01 Lab meets on Tuesday mornings from 9:15 AM to 1:45 PM in HSB 005.
Sec 02 Lab meets on Wednesday evenings from 5:35 PM to 10:05 PM in HSB 005.
Sec 03 Lab meets on Wednesday mornings from 9:15 AM to 1:45 PM in HSB 005.

All students meet once a week for lecture on Thursdays from 5:35 PM to 6:55 PM in HSB 201.

REQUIRED COURSE/LABORATORY MATERIALS


Laboratory Notebook: A hardcover or soft cover notebook with numbered pages and tear out carbon-copy duplicate pages is required (Spiral/loose-leaf notebooks are not acceptable) for recording laboratory work. These notebooks are available in the Rutgers University Bookstore and the Douglass Co-op.

Safety goggles: To protect your eyes in the laboratory (must be face-fitting and form seal around eyes; ordinary glasses or other types of safety glasses including contact lenses worn under goggles are not acceptable). Goggles are available at bookstores.

Padlock: To be used for equipment drawer.

Scientific calculator: To be used for lab reports, homework problems and exams.

Lab Coat: Provided by the Stockroom, no need to buy. You must wear the lab coat when you are performing the experiments. Lab coat must be buttoned.
CLASSROOM MANAGEMENT SYSTEM (SAKAI): We will be using sakai (URL: http://sakai.rutgers.edu/) as a classroom management system. You should check this site regularly. If you check it now, you may find a number of documents posted. If you are registered and a Rutgers Student, you will automatically be a “member” of the online class. You will need your NetID to login. You should read the documents, especially the Syllabus, Grading Policies, the Announcements and other material very carefully. You will find instructions for the Laboratory Experiments, Pre-Labs, Safety Rules, Syllabus, Instructions for Acid Washing of Glassware, Announcements, and other important information. During the course additional documents will be posted on the web. This is where scores will be posted. If you are having trouble accessing sakai, see the course coordinator after class.

GRADING: The following is a rough estimation:

Lecture 40% - We will give two examinations, each worth 20% of the final grade. The exams will take place during the regular lecture periods. **A minimum score of 40% is required on the exams to pass the course.**

Laboratory Reports 46% - To complete the course successfully, students must hand in a laboratory report for each experiment the week following its completion at the beginning of the laboratory. **Late lab reports will not be accepted.** With the permission of the lab instructor and course coordinator, only one lab report may be accepted 2 days late with 20% penalty. Only **hard copy (on paper)** lab reports will be accepted. We do not accept lab reports by e mail or regular mail. Always keep a copy of your work in case paperwork is misplaced.

Pre-Labs 4% - Due at the beginning of the specified labs. Late pre-labs will not be accepted. Only **hard copy (on paper)** pre-labs will be accepted. Please do not e mail pre-labs.

Quizzes/Homework/Lecture/Lab Attendance/Performance/Other 10% - Instructors will assign grades to students based on attendance/performance in the Lecture and Laboratory etc.

**You need to pass both the lab portion and the theoretical portion to pass the course.**

If you have questions about the grading of lab reports/prelabs/exams etc… please contact us within one week of the day you receive your grade.

LABORATORY NOTEBOOK: You should record laboratory data in the specified notebook. Use pens with permanent ink. You cannot use pencils, flairs, magic markers that can spread. At the end of each laboratory period, tear out the carbons, staple them together, and turn them in to your laboratory instructor. In professional laboratories, notebooks often form the evidentiary basis for patent claims and hence have considerable financial and legal importance. While we will not insist that you observe all the formalities that industrial employers require, we ask that you follow a few rules.

* Reserve two or three pages at the beginning for a table of contents.
* Date and sign each page.
* Within reason, write as much explanatory and descriptive text as possible as you go along. You are very likely to find what you have written helpful when you write your lab report.
* Erasers and white-outs are not allowed. Don't erase or obliterate erroneous data; simply put a line through them and initial them. The notebook does not have to be attractive - although of course it's nice if you can make it so - it just has to be accurate and legible. Don't throw away the pages with mistakes. Much bitter experience shows that sometimes entries thought to be erroneous turn out to be useful in surprising ways.
PURPOSE AND APPROACH: The quantitative analyst seeks to answer the question, "How much of substance (x) is in material (y)? What are the tools used and how can one do the measurements?" In Analytical Chemistry you will study some of the important ideas in analytical chemistry and do quantitative measurements. By the end of the course we hope that you will have an improved understanding of:

* The distinction between the goals of qualitative and of quantitative determinations.
* Statistical methods for evaluating and interpreting data.
* Sources of error in chemical and instrumental analysis.
* Interferences in chemical and instrumental analysis.
* The concept of instrument calibration.
* The principles of chromatography and other methods of separation.
* The basic concepts of stoichiometry.
* The importance to quantitation of equilibrium theory.
* The concept of an analytical standard.

If this list seems dry to you, then you may be interested to learn that your sample for analysis during most of the semester will be approximately one gallon of seawater. Crew on a research vessel operated by the Rutgers' Department of Marine and Coastal Studies will have collected the sample shortly before you receive it. We chose seawater for two main reasons. First, the techniques and theory that you will learn for the analysis of seawater are generally applicable, not only to oceanography and the environmental sciences, but also to the various branches of chemistry and biochemistry.

Second, the sample is of interest beyond the classroom. The Department of Marine and Coastal Sciences has a project to monitor the properties of seawater from this location. If all goes well, you should be able to compare some of the results that you obtain in the laboratory with theirs and you may be in a position to contribute to ongoing research. It is our hope that in applying what you learn to samples of environmental and research significance, you will find a greater appreciation of the power of analytical chemistry. The laboratory experiments that you will do and much of the equipment that you will use to do them are new to Rutgers. Sizeable grants from the university and from the National Science Foundation have made it possible to acquire the equipment. We will do our best to see that the experiments work smoothly. As in any new venture, however, we expect to have to improvise along the way. We will need your cooperation, patience, and, perhaps at times, your help. If actual seawater is not available, we will provide artificial seawater.

COURSE POLICIES:

1. **Promptness:** Laboratory session will begin and end promptly as scheduled; students will not be allowed to work overtime or during off-hours. If a student arrives late to the lab, the instructor may not authorize the student to perform the experiment due to safety considerations. In any event, if a student arrives late to lab, he or she cannot stay longer after the lab is officially over. A record of late arrivals is kept.

2. **Lectures:** Attendance in lectures is essential in order for a student to do well in this course. Significant amounts of additional material, including modifications to the lab procedure is provided in the lecture. Much of the exam material as well as what is required in the lab report will be provided during the lecture for the course.
in conjunction with the textbook. Lab instructors will assume that students have attended the lecture and will not provide information that has already been provided in the lecture. Lectures also go over the theory.

3. **Make-up:** A missed lab period may be made up only for valid medical reason and with a note from the doctor and the dean’s office. The student is responsible for speaking with the stockroom personnel to find an open spot in another lab section. The authorization has to be approved by your lab instructor and course coordinator before a student will be allowed to make up a lab. The authorization will be given only when documentation for the excuse is provided (from a doctor and dean).

The lab reports must be marked clearly with student's name, lab instructor's name and section number and turned in to the lab instructor of the section you are making up the lab. That lab instructor will pass your lab reports to your lab instructor. This should be done ASAP within two weeks of the missed lab. It is your responsibility to make sure that your lab report gets to your assigned instructor.

4. **Absences:** For an absence to be excused, valid documentation MUST be provided within a week of the absence to your lab instructor and course coordinator. Otherwise, the absence will not be excused.
   - Three (3) unexcused absences will constitute an automatic failing grade for the course.
   - Anyone with 3 excused absences should drop the course and take it another time
   - **NOTE:** A student with 3 or more absences (valid or otherwise) will not pass the course.

Students are responsible for all the material from a missed lab and will be tested on it on exams.

5. **Weather and Other Emergencies:** Check the Rutgers website for any information concerning campus operations due to weather conditions or other emergencies. You can find information about the operating status by going to: http://uwide.rutgers.edu/status or by going to: http://www.rutgers.edu/about/operating-status

If classes are on schedule, then labs will be held as scheduled. If there is a delay in opening, as long as there are 2 hours remaining for the lab period, students should attend lab for the remaining time. Changes in schedule and other adjustments will be announced in the lecture. Students are still responsible for all the material from readings, homework problems and lecture even if a particular lab is cancelled due to weather emergency.

When announcements are made, campus status information will also be available through:
   - Rutgers University Facebook page
   - Rutgers University Twitter (@RutgersU)
• RU-info Channel on RU-tv 23.1
• RU-info Call Center at 732-445-INFO (4636)
• Texting the University at 732-662-2664

Campus status information will also be available through these media stations and their websites:

• News-12 New Jersey
• New Jersey 101.5 (FM)
• WCTC Radio (1450 AM)
• WCBS Radio (880 AM)
• WRNJ Radio (1510 AM, 104.7 and 92.7 FM)
• WRSU Radio (88.7 FM)

For more information on Emergency Management Adverse Weather Information, go to:
http://eap.oit-nbcs.rutgers.edu/eap.html

6. **Check-out for students** is required of all students who complete or withdraw from the course. Failure to check out will result in the assessment of a $50.00 fee, plus the cost of any equipment that needs to be replaced, and the withholding of grade (for those who complete the course).

7. **Laboratory Notebooks** are to be maintained according to the format described in this handout and the textbook.

8. **Written Exams** will be given on the specified dates during lecture period. The material for the exams will come from your lab experiments, lab reports, pre-labs, homework problems, textbook readings, quizzes and lecture material. **Make sure you solve all the homework problems. The homework may be randomly collected in the lecture or the lab.** No notes, whether on paper or electronic, will be permitted on the exam. Scientific calculators are allowed. If you have a cell phone, pager, iPod, or other electronic device during the exam, even if it is turned off, you will receive a zero on the test and fail the course. Turn off your cell phones/electronic gadgets and place them away from your body. Please bring a watch, you may not use your cell phone as a timekeeper.

9. **Quizzes:** A **safety quiz** will be given during the first week of the lab. You need to receive 80% on the safety quiz to be able to work in the lab. Another **scheduled quiz** will be given during the lab. Be prepared for **pop quizzes**.

10. **Preparation:** Adequate preparation before lab will reduce frustration and prevent accidents. Attempting to perform the experiment while reading the procedure for the first time is little more than a waste of time and can lead to hazardous mistakes. Part of the evaluation points assigned by your lab instructor will be determined on the basis of your preparation.
11. **Laboratory Safety:** All persons in the lab must observe the safety rules. Non-compliance with safety rules will result in expulsion from the lab and no make-up will be allowed. It is required to wear safety goggles and lab coats in the lab. Safety goggles should be worn over your eyes and not on your forehead.

12. **Breakage:** The student is responsible for all costs of breakages. If a student has a balance that needs to be paid when grades are assigned, the student will receive a TF. The TF will be changed to student’s actual grade only after the balance is paid at the cashier and receipt is shown to the Chemistry Department Main Office (WL-142).

13. **Laboratory Reports:** You must type or use a computer to print the text of all laboratory reports. We strongly urge you to use spreadsheet program for calculations and for graphing.

14. **Academic Integrity:** The material for this course is copyrighted and may not be posted on any other web site at or outside of Rutgers without permission. Any violation of this policy will be treated as an academic integrity violation and will be referred to the Office of Student Judicial Affairs for action.

You are being graded on the work you perform. If you have previously taken the course, you cannot use the old pre-labs or the lab reports. Use of pre-labs and lab reports from other students (past or present) is expressly forbidden. Both the lender and the borrower are subject to severe penalties. Some discussion about the labs is acceptable at the discretion of the lab instructor, but you must perform all the work (including the data analysis and answering of questions) yourself. The lab instructor is free to ask you at any point to explain what you are doing so that he/she can address any confusion that you may have and assist you. You are **NOT ALLOWED TO COPY ANSWERS FROM OTHER REPORTS OR FROM THE INTERNET OR TO USE DATA FROM OTHER STUDENTS. YOU ARE NOT ALLOWED TO LOAN YOUR LAB REPORTS TO CURRENT OR FUTURE STUDENTS.**

Academic honesty also applies to all exams/quizzes/pre-labs/labs and all aspects of this course. Students who suspect that other students are involved in actions of academic dishonesty should speak to the instructor and the course coordinator. Signing for another student (for example on an attendance sheet) is considered to be a violation of academic integrity.

You need to follow the instructions of the proctor during an exam for seating and other matters. Failing to do so is a violation of academic integrity.

Refer to the website for academic integrity information: http://academicintegrity.rutgers.edu/

The University’s policy on Academic integrity can be found at:

http://academicintegrity.rutgers.edu/academic-integrity-policy

**Attachments:**

1. Lab Safety Rules
2. Lab Notebook Keeping
3. Guidelines for Writing a Lab Report
4. Practice - Familiarization with the Lab Equipment - FOR THE FIRST DAY OF LAB - may be attached or provided separately; for future labs print from Sakai
5. Introduction to LEO-15 – PRELAB 1 DUE AT THE BEGINNING OF THE SECOND LAB - may be attached or provided separately; for future prelabs print from Sakai
6. Suspended and Dissolved Particulate Matter in Seawater – YOUR SECOND LAB - may be attached or provided separately; for future labs print from Sakai
Attachment 1 - LAB SAFETY RULES

In case of Emergency: Dial 911 From a university phone, get an outside line and Dial 911

1. You are not permitted to be in the laboratory when an instructor is not present.
2. Report all accidents and injuries, no matter how minor, to your instructor/lab personnel.
3. You are only allowed to do authorized experiments.
4. Horseplay in the lab is unacceptable behavior and is cause for immediate ejection.
5. **You must wear safety goggles over your eyes (Not on your forehead) in the lab at all times.**
   - Contact lenses (hard or soft) are not permitted: trapped chemicals may cause injury to the eye.
   - Know the location and use of the closest eyewash, safety shower, and fire extinguisher.
   If you get chemicals in the eye, immediately flush the eye with copious amounts of water from the eyewash. For other parts of your body, wash affected area thoroughly using the sink or safety shower.
6. Keep your book bags and other non-essential items at designated spaces only.
7. Wear your lab coats.
   Bare feet, legs, or midriffs are not allowed in a chemistry lab. Sandals, open-toed or open backed shoes, shorts, or halters are not enough protection. If you have long hair it must be tied back. Old clothing or a laboratory apron or coat is highly recommended. If you are not properly attired, you will not be admitted to the lab. If you miss the lab, or do not finish, you will not be permitted to make the lab up, and the absence will NOT be considered excused.
8. The vapors of a number of solutions are quite potent and can irritate or damage the mucous membranes of your nasal passages and throat. If you must smell a chemical, hold its container away from your face and waft its vapor gently toward your face with your hand. For reactions involving poisonous or noxious gases, use the hood by placing the container well within the marked lines. At Douglass, ALL WORK MUST BE DONE INSIDE THE HOODS!
9. Always keep burners under the hood. Never apply heat to the bottom of the test tube; always apply it to the point at which the solution is highest in the tube. A suddenly formed bubble of vapor may eject the hot and perhaps corrosive contents violently from the tube (an occurrence called “bumping”).
10. No eating, drinking, or smoking in the lab. You may not bring in anything consumable or bottled water, either. Water bottles (or other drink containers) are not permitted in the lab, even if they stay in your backpack.
11. Never taste chemicals or solutions—poisonous substances are not always so labeled.
12. Label all containers. Stock solutions must remain on the stock solution bench. Be sure to replace the same cap or stopper on the reagent bottles. Do not put medicine droppers or pipettes in the reagent bottles. Do not take too much stock solution. If you accidentally take more than you needed, do not return the excess back in the reagent bottle, try to give it to another student or dispose the excess as instructed. Grades may be reduced if instructions are not followed and materials are found where they should not be.
13. Consult with your instructor or the stockroom personnel regarding the type of gloves you should wear.
   We provide nitrile gloves for acid washing for certain experiments.
14. Make sure your sink is cleaned out before leaving the lab.
15. Beware of hot glass—it looks cool long before it may be handled safely.
16. You must wash your hands at the end of lab even if you have been wearing gloves. This will prevent you carrying something out on your hands, which you later might get in your eyes or onto food.
17. Inform your instructor if you have a medical condition that requires special consideration.
18. Housekeeping is very important and can prevent many accidents in the lab. Make sure you clean the balances after use and clean your work area at the end of the lab period.

**WHEN IN DOUBT, ASK YOUR INSTRUCTOR!**
Use of Hoods

We have two types of hoods that you will encounter: a low-flow laminar flow fume hood (called “traditional” hood from here on), and a canopy hood. Each is used in a different manner. You should understand both but know how to use the type of hood you have. Hoods are shared, so be courteous. Both types depend on air flow, so be careful not to block the vents.

**Canopy Hoods (NOT AVAILABLE IN HSB 005)**

These are older hoods, designed for student use. They are not designed to handle large amounts of very volatile compounds and provide no protection from spills or explosion. Essentially, they are air vents mounted over a portion of the work area. Whenever you are heating material or working with volatile compounds, you must use them.

To use them effectively, place the material inside the lines marked on your work area. The closer you get to the center of the hood, the more effective it is.

**“Traditional” Hoods**

These are newer hoods, and look like what most of us have come to think of as chemical hoods. They are metal boxes mounted on the bench-top. Our hoods have glass panels that slide left and right. In addition, the frame holding the panels slides up and down. They work by drawing air from the room into the box and out the top. They provide complete protection against exposure to volatile compounds under most conditions and, if used properly, provide some protection from spills, fire and explosions. You use them **WHENEVER** you are working with compounds. **ALL WORK SHOULD BE DONE INSIDE THE FUME HOODS.**

To use them, place the material inside the hood (see picture below). You may slide the front up to do this if you need to. Most hoods require that the front be down most of the way. These hoods will operate with the front at any height; however they are designed to operate best with the front **ALL the way down and the glass panels moved to allow access to the hood.** Slide the two panels on your side of the hood one in front of the other so that both panes of glass are between you and your work. You can reach around the panels to handle the materials. This offers you the most protection against spills, splattering, fire and explosion.
Attachment 2 - Lab Notebook Keeping


Use pens with permanent ink. You cannot use pencils, flairs, magic markers that can spread.

Preparation for the Lab ahead of time

Before you come to the lab, read the procedure in detail. In your lab notebook, prepare a summary of what you need to do and leave blank space for your data:

For example:

(1) Mass of Crucible with AgCl precipitate in g : ____________

(2) Mass of Crucible (empty) in g:                        ____________

   Mass of AgCl precipitate in g: (1-2)               ____________

Lab Temperature in ° C                    _______________

LABORATORY NOTEBOOK:

The lab notebook must state:

- What was done
- State what was observed
- Be understandable to someone else

You should record laboratory data in the specified notebook. At the end of each laboratory period, tear out the carbons, staple them together, and turn them in to your laboratory instructor. In professional laboratories, notebooks often form the evidentiary basis for patent claims and hence have considerable financial and legal importance. While we will not insist that you observe all the formalities that industrial employers require, we ask that you follow a few rules.

- Reserve two or three pages at the beginning for a table of contents.
- Date and sign each page.
- Within reason, write as much explanatory and descriptive text as possible as you go along. You are very likely to find what you have written helpful when you write your laboratory report.

- **Erasers and white-outs are not allowed.** Don't erase or obliterate erroneous data; simply put a line through them and initial them. The notebook does not have to be attractive - although of course it's nice if you can make it so - it just has to be accurate and legible. Don't throw away the pages with mistakes. Much bitter experience shows that sometimes entries thought to be erroneous turn out to be useful in surprising ways.

If you have a question, please don’t hesitate to ask.
Attachment 3 - Guidelines for Writing a Lab Report

Laboratory reports will either be full (5-6 pages maximum) or short (1-2 pages maximum).

You must type and use a computer to print the text of all laboratory reports. We strongly urge you to use spreadsheet program for calculation and for graphing. You should submit a hard copy of your lab report to your instructor on the due date. Only hard copy (on paper) lab reports will be accepted. We do not accept lab reports by e mail or regular mail.

Unless otherwise specified in the laboratory write-up, lab reports should contain the following sections:

1. Abstract. Maximum 100 words. A summary of the important findings. Report the average, do not report individual findings. Include the units.


3. Experimental methods. Maximum, 1/2 page. A catalog of the types of measurements made and the instruments used (if any).

4. Results and Discussion. The most important section of your report. Length will vary, but will usually be 1 to 4 pages. It need not be a book. Numerical results should be presented as tables or graphs.

A few general guidelines for all reports follow.

- Lab report should be typed.
- Consolidate all your raw data in one table for efficiency.
- Label tables and graphs carefully and be sure to include units. Graphs and tables should have a title. The axes of a graph should be carefully labeled. (Potential for serious points off here).
- Give each table and graph a number and a title. The text should introduce the reader to each table and graph by number with a statement such as, "The measurements needed for the calculation of the density are shown in Table 2."
- Compare results with literature where possible.
- Identify and comment on likely sources of error.
- Strive for brevity and clarity. Avoid like the plague the use of the word "this" without a noun to follow, e.g., "This explains why I got a value of 2.0." Even if you think it is repetitious, be specific, i.e., in this example write instead, "This clever use of the dilution factor explains why a value of 2.0 was obtained."