Instructor:

Dr. Haiping Liu  
402E ChemSci  
Phone: (906) 487-3451  
E-mail: hliu@mtu.edu

Course Schedule:

Laboratory: MWF 10:05 - 11:55 AM

Office Hours

Mondays, Wednesdays and Fridays 2:00 pm to 3:00 pm, Room 402E, Chemistry Building. Please send me an e-mail to schedule appointments at other times.

Prerequisite:

Chemistry 1120. A firm grounding in ionic equilibria is assumed and will be essential for success in this course. You should review the appropriate material from CH 1120 and Harris, Chapter 6.

Instructional Materials

1. Textbook:
   Daniel C. Harris,  
   Quantitative Chemical Analysis  
   8th Edition  
   Freeman

2. Scientific calculator.

3. Computer: A relatively modern computer would be helpful for spreadsheet use. Recent versions of Excel have graphics and statistics packages which are satisfactory for the problem solving and data reduction required in this course. Computers are available for student use in departmental computer lab with the necessary software.
4. There will be a web presence for this class. The course website can be found at
http://www.chemistry.mtu.edu/~hyliu/ch2212/

It includes:

- Material covered/what you should know.
- Selected book chapter problems and solutions.
- Exam schedule, coverage and practice problems.
- Links to resources on the web.

### Tentative Course Coverage

<table>
<thead>
<tr>
<th>Week</th>
<th>Starting date</th>
<th>Topic</th>
<th>Chapter</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>January 14, 2013</td>
<td>The Analytical Process</td>
<td>0</td>
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<tr>
<td></td>
<td></td>
<td>Measurements (each student is responsible for reviewing the material in this chapter)</td>
<td>1</td>
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<tr>
<td></td>
<td></td>
<td>Tools of the Trade (selected topics)</td>
<td>2</td>
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<tr>
<td></td>
<td></td>
<td>Experimental Error</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td><strong>Lab:</strong></td>
<td>Handling/storing chemicals responsibly in the lab</td>
<td>4</td>
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<tr>
<td></td>
<td></td>
<td>MSDS sheets/Right-to-know</td>
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<td></td>
<td></td>
<td>Balance Exercise</td>
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<td></td>
<td></td>
<td>Calibration of 50-mL buret</td>
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<td></td>
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<td>Titration Exercise</td>
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<tr>
<td></td>
<td></td>
<td>Use/Calibration of Volumetric Glassware</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>January 21, 2013</td>
<td>Statistics</td>
<td>4</td>
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<tr>
<td></td>
<td><strong>Lab:</strong></td>
<td>Demonstration of Statistics in Quantitative Analysis</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>January 28, 2013</td>
<td>Statistics</td>
<td>4</td>
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<tr>
<td></td>
<td></td>
<td>Spectrophotometry</td>
<td>18</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Calibration Methods</td>
<td>5</td>
</tr>
<tr>
<td></td>
<td><strong>Lab:</strong></td>
<td>Tutorial on Ocean Optics Spectrometer</td>
<td></td>
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<tr>
<td></td>
<td></td>
<td>Calibration Curves/Standard Addition</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>February 4, 2013</td>
<td>Review of Equilibrium Calculations</td>
<td>6</td>
</tr>
</tbody>
</table>
Lab: Photometric Determination of Phosphate
Manganese and Chromium by Spectrophotometry

5 February 11, 2013 Acid-Base Equilibria 9

Lab: Tutorial on Vernier Data Interface Buffer Preparation Evaluation of Acid-Base Indicators

6 February 18, 2013 Acid-Base Titrations 11

Lab: Direct Determination of Sodium Carbonate in Soda Ash


Lab: Determination of Sodium Carbonate in Soda Ash by Back-Titration

8 March 4, 2013 EDTA Titrations 12

Lab: Construction/Calibration of a Mariotte Bottle Constant Delivery Titration System.

Titration of an HCl/H$_3$PO$_4$ Mixture Using a pH Meter to Determine the End Points.

9 March 11, 2013 Spring Break 8

10 March 18, 2013 Activity and the Systematic Treatment of Equilibrium

Lab: Group project

11 March 25, 2013 Electrochemical Equilibria 14

Lab: Group project

12 April 1, 2013 Potentiometry 15

Lab: Determination of Iron in an Ore by Iodometric Titration

13 April 8, 2013 Redox Titrations 16

Lab: Group project

14 April 15, 2013 Electrogravimetric and Coulometric Analysis 17
Course Requirements

1. Attendance is VERY IMPORTANT to be successful in this course. Class participation, initiative, and attendance will be considered in the final course grade. You must keep up with the material as the semester progresses.

2. The student MUST study outside of class. Outside work should include reading assigned material, doing assigned questions and problems, reviewing lecture notes, correcting errors made in past work, etc. For every hour of lecture, three hours should be spent outside of class. However, all the hard work will pay off with a very satisfying grade.

Grading

1. Homework will be assigned and graded through Sapling Learning System. The homework will cover 150 points (25% of lecture points).

   The procedure to set up an account in Sapling Learning System is outlined as follows:
   1. Go to [http://saplinglearning.com](http://saplinglearning.com)
   2a. If you already have a Sapling Learning account, log in then skip to step 3.
   2b. If you have Facebook account, you can use it to quickly create a SaplingLearning account. Click the blue button with the Facebook symbol on it (just to the left of the username field). The form will auto-fill with information from your Facebook account (you may need to log into Facebook in the popup window first). Choose a password and timezone, accept the site policy agreement, and click "Create my new account". You can then skip to step 3.
   2c. Otherwise, click "create account". Supply the requested information and click "Create my new account". Check your email (and spam filter) for a message from Sapling Learning and click on the link provided in that email.
   3. Find your course in the list (you may need to expand the subject and term categories) and click the link.
   4. Select a payment option and follow the remaining instructions.

   Once you have registered and enrolled, you can log in at any time to complete or review your homework assignments. During sign up and throughout the term if you have any technical
problems or grading issues, send an email to support@saplinglearning.com explaining the issue. The Sapling support team is almost always more able (and faster) to resolve issues than your instructor.

2. Lecture tests:

<table>
<thead>
<tr>
<th>Exam No.</th>
<th>Date</th>
<th>Coverage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Exam 1 (100 pts)</td>
<td>Wednesday, Feb. 6</td>
<td>Material through Jan. 31</td>
</tr>
<tr>
<td>Exam 2 (100 pts)</td>
<td>Wednesday, March 6</td>
<td>Material through March 1</td>
</tr>
<tr>
<td>Exam 3 (100 pts)</td>
<td>Wednesday, April 3</td>
<td>Material through March 29</td>
</tr>
<tr>
<td>Final (150 pts)</td>
<td>Week 16</td>
<td>Comprehensive</td>
</tr>
</tbody>
</table>

3. Grading system:

- A: Excellent 100 - 90
- AB: Very good 89 - 85
- B: Good 84 - 80
- BC: Above average 79 - 75
- C: Average 74 - 70
- CD: Below average 69 - 65
- D: Inferior 64 - 60
- F: Failure 59 - 0

4. Point distribution:

<table>
<thead>
<tr>
<th></th>
<th>Points</th>
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</thead>
<tbody>
<tr>
<td>Lecture</td>
<td>600 pts</td>
</tr>
<tr>
<td>Laboratory</td>
<td>400 pts</td>
</tr>
</tbody>
</table>

Please note that there are no make-up exams and late problem set assignments are not accepted.

**Syllabus**

**Chemistry 2212 Quantitative Analysis Laboratory**

**Spring 2011 Quantitative Analysis Laboratory**

**Location:** VEICLE Lab (Building: ChemSci Room: 708)
Lab Hours: L-01; 9-11 am MWF
         L-02; 12-2 pm MWF

Instructors:

Position: Lab Supervisor Graduate Teaching Assistant (GTA)
Name: Jingtuo Zhang and Fei Xie
Lab Section: L-02 L-01

Email: jingtuoz@mtu.edu; feix@mtu.edu
Office hours: By arrangement (email works well)
2212 Website: http://chemistry.mtu.edu/~hyliu/ch2212/

Text: *Quantitative Chemical Analysis*, 7th or 8th Edition, Daniel C. Harris

Materials Needed: Bound notebook with carbonless copies
Three ring binder (1”-11/2” wide)
Safety Glasses
Lab coat (recommended, not required)

Prerequisite:
Chemistry CH1120. A firm grounding in ionic equilibria is assumed and will be essential for success in this course. You should review the appropriate material from CH 1120 and Harris, Chapter 6.

Resource materials:

Instructions for all the various exercises and experiments are available as PDFs on the laboratory’s website (indicated above). This site will be updated frequently to accommodate any necessary changes required during the semester.

Safety:

In this lab you will be handling a wide range of materials with a variety of health risk. You are required to be aware of the health risk involved with any of the chemicals handled in this lab by filling out a “Safety Sheet” (available on the handout section of the website). These safety sheets require time to evaluate and should be submitted one lab period prior to the experiment. These safety sheets will be returned to the students on the day of the experiment and need to be kept in a three ring binder. A grade will be assigned at the end of the semester on the promptness and completeness of the safety sheets.

In general you are required to wear closed toe shoes and full-length pants. Many of the
chemicals handled in this lab will ruin clothing immediately; therefore a lab coat is recommended but not required. Safety glasses need to be worn at all times when work is being done by anyone in the lab (other people’s accidents can cause you harm even if you are not handling chemicals). Also lightweight nitrile gloves will be available and should be used when deemed appropriate. Concentrated chemicals (such a concentrated acids/bases) should be handled in the fume hood with heavy weight nitrile glove and full sealed goggles. Any volatile solvents should also be handled in the fume hood. Violation of any of the above rules will be grounds of dismissal for the remainder of the lab period.

**Basic Structure of the Lab:**

This lab is composed of a variety of exercises, experiments and group projects. The exercises will used to become familiar with equipment and techniques required later on in experiments. Experiments are used to put the skills developed in the exercises to practical use, obtaining high quality results. There will be a total of three group projects. The first project is to familiarize one with the basic tools of the analytical lab. The last two projects are to develop independent thought and necessary problem solving.

Instructions appropriate to the lab experiment or exercise will be provided on the course web page. These instructions will be available on the VEICLE Lab computers; however, the time available for completing these labs are quite limited and in order to complete these labs you will need to be familiar with the procedure prior to coming to class. To insure preparedness you must create your own experiment instructions in your lab notebook before you come to lab.

**Prelab:**

Prelabs are required for all of the graded experiments and group project, but not for the lab exercises. Prelabs consist of a copy of the student prepared instructions and a copy of the solved preliminary calculations contained in the lab handouts. Both items must be done in the lab notebook on a page separate from the experimental procedure. A copy of the preliminary calculations and student prepared instructions must be turned in to the laboratory instructor prior to initiating the experiment. A grade will be assigned at the end of the semester on the promptness and completeness of the prelabs.

**Post Lab:**

Results will be submitted in one of two forms: 1) formal report 2) unknown report sheet. The three group projects will be graded upon the quality of a submitted report. The rest of the experiments will be graded on a submitted “Unknown report sheet”. Students will be given a week to complete formal reports for group projects. Unknown report sheets are due at the beginning of the second lab period following the normal scheduled end date of the experiment. That is to say, if a lab experiment is completed on a Monday the results are due at the beginning of Friday. Exceptions will be made for health and other valid reasons, but must be reported to your TA promptly. **Failure to turn your results in on time will result in a grade of zero for the experiment in question.**

Grading procedure for “Unknowns”: 
Unknown results will be graded in two parts. The first part will be based on a good-faith effort and completion of the experiment and will yield a grade no lower than 50 (of 100 possible). The second half of the grade will be based on the relative error contained in the reported value. That is (Your answer - right answer)/right answer. Failure to complete an experiment will get you a zero.

You may report any value you choose which is supported by your experimental results. Results must be submitted to the TA on the report slips provided. Results must be reported in the units (ppm, mg/ml, %, etc.) indicated in the experiment handout and will change depending on the experiment. If you have made a calculation error in your submission, you may re-calculate and submit with a thorough explanation. Two and only two re-calculations will be allowed for the semester.

**Formal Report Grading:**

As stated previously, there will be three group projects this semester. The first lab (Stats Lab) will have students grouped into pairs and the last two will involve groups of four. The report guidelines for the first project will be outlined in the lab handout. The last two will require students to write in a basic ACS style format (abstract, introduction, experimental, discussion, conclusion). Further instruction will be posted on the website.

**Lab Notebooks:**

Part of the message in this lab is to teach you to keep a proper analytical notebook. A bound notebook with carbonless copies is required. Complete guidelines have been published (“Notebook Format”, see the handout section of the website). A copy of all notebook pages involved with a particular experiment must be attached to the report sheet at the time your results are turned in. These pages will be evaluated (and graded) for adherence to the guidelines. Keep your notebook complete, readable, and up-to-date!

**Course Evaluation:**

Demonstration of Statistics in Quantitative Analysis........................................... 100
Standard Addition........................................................................................................ 50
Photometric Determination of Phosphate.............................................................. 100
Mn and Cr Detection by Spectrophotometry............................................................ 100
Buffer Preparation...................................................................................................... 100
Direct Determination of Sodium Carbonate in Soda Ash......................... 100
Determination of Sodium Carbonate in Soda Ash by Back-Titration......... 100
Titration of a HCl/H3PO4 Mixture.............................................................. 100
Using a pH Meter to Determine the End Points................................................. 100
Group Project I........................................................................................................ 200
Determination of Iron in an Ore by Iodometric Titration....................... 100
Group Project II.................................................................................................... 200
Lab Final................................................................................................................. 50
Notebook (Instructor’s Estimation) ................................................................. 200
Total Points Possible: 1500

Grades will be periodically posted on the bulletin board next to the door inside 708. Students will be identified by their assigned element as to keep their grade private.

Absence Policy:

There is not a lot of extra time in the lab schedule due to the large amount of work to be done in a short time. Making up a lab can be very challenging, however, special arrangements can be made in the case of an excused absence. Excused absences are not given to travel home or to attend a social event and only the Office of Student Affairs may grant an excused absence. If you know that you will have an official university excused absence that will cause you to miss a lab session, you are required to make arrangements as early as possible. Lab reports or unknown report sheets not turned in or turned in late due to an UNEXCUSED absence will be given a grade of zero. No makeup labs will be granted for unexcused absences.

Academic Integrity:

Any student caught knowingly submitting work not their own will be referred to the Dean of Student Affairs. It is assumed that in a group project the work is evenly distributed and the final report represents everyone, not just one or two members. Any work that is not the student’s needs to be properly cited.

MTU complies with all federal and state laws and regulations regarding discrimination, including the Americans with Disabilities Act of 1990 (ADA). If you have a disability and need a reasonable accommodation for equal access to education or services at MTU, please call Dr. Gloria Melton, Dean of Students at 487-2212.