

Syllabus for CH2550: Techniques in Laboratory Chemistry

Plymouth State University, Spring 2014

Class time: Thurs, 9:30 am – 12:15 pm

Credit: 2 hours

Class room: Boyd 209

Prerequisite: CH 2330 or 2335 (Gen Chem I)

Instructor: Dr. Jeremiah Duncan

Office Hours: Mon, Tues: 1:00-2:00 pm

Office: Boyd 122 **Phone:** 535-2289

Wed: 2:00-3:00 pm, Fri: 12:00-1:00 pm

e-mail: jsduncan@plymouth.edu

Course Websites: http://jupiter.plymouth.edu/~jsduncan/courses/2014_Spring/Techniques
 <http://go.plymouth.edu/moodle>

Description: "Techniques in Laboratory Chemistry" is a one semester course intended for students majoring in Chemistry or a closely related field to be taken in the first year of study. Students will develop technical skills needed to accurately carry out precise laboratory experiments, particularly those involving analysis. These skills are critical for laboratory workers and researchers in many areas of chemistry and related fields, and include mass and volume measurements, solution preparation, titration, analysis of mixtures and statistical data treatment. This course is a prerequisite for CH3400: Instrumental Analysis and is also required for students wishing to serve as student laboratory assistants.

Learning Outcomes. Students who successfully complete this course will be able to:

- Identify and demonstrate proficiency in the use of common laboratory instruments, equipment, and glassware, including: electronic balances, pH meters, volumetric glassware, burets, beakers and flasks.
- Utilize common laboratory instruments, equipment, and glassware to achieve their maximum precision
- Utilize the concepts of accuracy, precision, and significant figures in laboratory procedures and calculations involving experimentally-derived data
- Utilize a spreadsheet for common data analyses, including the use of basic statistical analysis
- Perform calculations and laboratory techniques to prepare, standardize, and dilute aqueous solutions
- Derive data (e.g., mass, volume, absorbance) from instruments and use them to calculate the concentrations of unknowns
- Follow the protocols for generating standard curves and standard addition curves
- Follow common practices for laboratory cleanliness and safety

REQUIRED MATERIALS

Textbook: *Exploring Chemical Analysis*, 5th edition (2012), by Daniel C. Harris; Publisher: W. H. Freeman; ISBN: 1429275030 [4th edition, ISBN: 1429201479 also acceptable; note changes to readings and homework]

Lab Notebook: *Scientific Lab Notebook, Carbonless Duplicate*; publisher: Hayden McNeil; ISBN: 1930882742, 1930882238, or 1930882505 (or other equivalent lab notebook with removable, carbonless duplicate pages).

Safety Glasses: Any style of laboratory safety glasses or goggles. Glasses may be purchased for \$5 in the Dept. of Atmospheric Science and Chemistry main office. See Marsi Wisniewski in 124 Boyd.

CLASS STRUCTURE

CH2550 is primarily a laboratory course. A typical class will consist of a 45 minute lecture followed by a 2 hour lab, both of which will be in the laboratory room. Prior to class each week, you must read the experiment and do the pre-lab work (generally writing the experiment number, title, purpose, references, and procedure for the experiment). A calculator, your textbook, safety glasses, and your notebook should be brought to each class. Due to the nature of the course, attendance is mandatory and no accommodations can be made for individual students who miss a class. However, the two lowest notebook report grades will be dropped, effectively granting students two "excused" absences. See the *Attendance and Preparation* section below for more details.

GRADING AND EVALUATION

Your grade in this course will be based on exams, laboratory notebook reports, laboratory performance, and a formal lab report. See below for a point scale and description of these course components.

Mid-term Exam	100 pts
Final Exam	150 pts
Lab Reports (9×60)	540 pts
Lab Performance	50 pts
Draft Formal Report	60 pts
<u>Final Formal Report</u>	<u>100 pts</u>
Total:	1000 pts

A	930 pts	C	730 pts
A-	900 pts	C-	700 pts
B+	870 pts	D+	670 pts
B	830 pts	D	630 pts
B-	800 pts	D-	600 pts
C+	770 pts	F	less than 600 pts

Exams. There will be 2 exams: a Mid-Term and a Final. The Mid-Term will be a **take-home exam** made available the Friday before Spring Break and **DUE 5pm the Tuesday after Spring Break** (see “*Schedule*” below). The Mid-Term will be open-note and open book, including your lab notebook. The Final exam will be **cumulative** and closed-book, but you will be allowed to bring and use ONE 3×5 notecard and your lab notebook on the Final. The notecard may be handwritten or typed using any size font you wish, and it may be double sided. You will be given constants and a periodic table for the exams, but you will NOT be given equations. A portion of the Final exam will involve practical lab techniques.

Lab notebook and reports. An important part of experimental work is the maintenance of a lab notebook; this is one of the critical skills you will learn and be graded on in this course. Consult the document "Keeping a Good Laboratory Notebook" on the course website. I will assume you have read these instructions and will grade your notebook accordingly. The majority of your grade in this course will come from your lab notebook and the reports you hand in. You are required to have a lab notebook with removable, duplicate pages. All your written work for the lab will be done in your notebook, including assigned homework problems. For each lab, you will hand in the duplicate pages as your lab report. Reports are generally **DUE at the beginning of the next laboratory period**, though the Grader's Report from the Peer Grading lab will be due by the end of that lab period. The two lowest lab report grades will be dropped in the calculation of your final grade.

Homework Problems. Please see the schedule at the end of this syllabus for homework assignments. Some of the problems each week are highlighted in bold; **these are required and must be done in your lab notebook as part of that week's report**. Problems that are NOT bolded are *suggested* only to help you master the concepts and prepare for the exam. Note that many of the problems assigned have answers in the back of the book; *in order to receive credit for required problems, you must show your work!* It is highly recommended that you keep current with the homework and check the answers to ensure that you understand the concepts. Homework problems will closely resemble exam problems and whether required or suggested are assigned to help you study and check your own understanding of fundamental principles necessary for analyzing the data you collect in lab.

Lab performance. The purpose of this course is to teach you good laboratory technique, and therefore, a portion of your grade will depend directly on your performance in lab. You will start the semester with 52 performance points, but only 50 of these will count toward your grade. In other words, you will have 2 "warning" points for the semester. Every instance of poor lab technique will result in points being deducted. Below is a short list of potential infractions and the resulting loss of points:

Technique likely to result in errors in the experiment:	1 pt
Use of equipment likely to result in breakage:	1 pt
Small spills that are not immediately cleaned:	1 pt
Large spills, particularly of toxic chemicals:	2+ pts
Breakage of small, inexpensive equipment:	1 pt
Breakage of expensive equipment:	2+ pts
Failure to follow safety rules	2+ pts
Failure to clean personal equipment	1 pt
Failure to clean shared equipment	2 pts
Cell phone ringing and/or usage in class	1 pt

This is NOT a comprehensive list, and I reserve the right to deduct points for other behaviors deemed unsafe or poor technique. Further, these values are minimums: I reserve the right to deduct more points depending on the

severity of the infraction or on repeat offenses. You will receive a written "citation" for every offense so you have a record of points I deduct. You may at any point in the semester request an accounting of your points.

Final Formal Lab Report. You will write one formal lab report based on the Lab 10 "Measuring Manganese in Steel". The procedure for this lab will occur over three lab periods: one to prep the sample and two to analyze the sample. A report draft will be DUE April 24, one week after the first analysis is performed. The analysis will be repeated two weeks after the first analysis, and a **final draft of the report will be DUE one week later, May 8**. A significant portion of the grade in this report will be based on the accuracy of your analysis. Therefore, you will have two periods dedicated to procedure to allow you to duplicate it work on calculations. Consult the document "Writing the Formal Lab Report" for guidelines and a grading rubric.

POLICIES AND MISC. NOTES

Attendance and Preparation. Attendance and participation in lab is required to pass this course. Your lab report grade in essence doubles as your attendance grade; the two lowest lab reports will be dropped, giving you two excused absences, no questions asked. Under no circumstances will make-up labs be arranged; use your excused absences wisely.

You are required to arrive to class on-time, with pre-lab work done, in proper clothing (including safety glasses) and prepared to do the experiment. You are required to be "signed-in" upon entering the lab by having the Instructor initial your pre-lab work. If you arrive late, this will be noted in your report, with concomitant loss of points. If you arrive unprepared, you will not be permitted in lab until you are prepared, and this will be noted in your report with concomitant loss of points.

Late Assignments. Unless otherwise specified, all assignments are DUE at the start of the next class. NO ASSIGNMENTS WILL BE ACCEPTED LATE unless you had to miss class for an unforeseen emergency. If you know you are going to miss class for anything less than a last-minute critical emergency, *you must hand the report in early or arrange for a classmate to bring it to class*. In the event of an emergency, your report is due as soon as humanly possible.

Laboratory Safety. Safety is the single most important consideration in the lab. Any unsafe behavior or failure to follow the basic standards for safety in lab will result in loss of Performance Points and possibly dismissal from the lab, with no provision to make up the work you miss. Below is a list of the *minimum* safety precaution rules:

1. SAFETY GOGGLES AND CLOSED-TOE SHOES ARE REQUIRED FOR EVERY EXPERIMENT. If you arrive to laboratory in inappropriate attire, you will be sent home to change.
2. No eating, drinking, or chewing gum in the lab. You may take occasional breaks to have food and drink kept outside of lab.
3. Never taste a chemical or put anything to you mouth in lab. This includes writing utensils!
4. Familiarize yourself with the location and use of all safety equipment (shower, eye wash fountain, fire extinguisher, etc).
5. Immediately notify the instructor of any chemical spill and clean it according to instructions.
6. Immediately notify the instructor of any injury.
7. Label all containers of chemicals if there is a chance you will set it down and walk away from it.
8. Use the hood for all noxious, fuming, or toxic chemicals and for all reactions that generate fumes or gas.
9. Properly dispose of all chemicals. *Never throw anything down the sink* unless instructed to do so. If you are not 100% sure about how to dispose of a chemical, ASK!
10. Dispose of all broken or used, disposable glass in the proper container immediately.
11. Thoroughly wash your hands before every time you walk out the door of lab.
12. Clean your work area before you leave.

You will be required sign a Safety Contract before the start of Lab 2, or you will not be allowed into the lab. The Safety Contract will be viewed and signed online in the Moodle site for the course.

Online resources and Electronic Communication. This course will utilize Moodle and the website extensively. You should regularly check these sites to access assignments, experiments, and rubrics and to check your grades. *It is your responsibility to learn how to access these resources and to seek help if you need it.*

I will extensively use email to communicate with you about this course. *IT IS YOUR RESPONSIBILITY TO REGULARLY CHECK YOUR E-MAIL!* A few points about e-mail:

1. Please use your plymouth.edu address to communicate with me. I assume any emails sent or received through plymouth.edu are secure (i.e. it really is you that I am communicating with). I assume any non-plymouth.edu addresses are not secure.
2. I will gladly answer student e-mails. During the week, you can expect a reply within 24 hours, but you should not expect an immediate reply. I will usually check my e-mail once during weekends, but it may happen that e-mails received after 5pm Friday will not receive a reply until Monday morning.
3. I request you consider e-mail correspondence with me a professional means of communication. E-mails should be written professionally—no text speak or twitter coding, please!—include a proper address (good: “Dear/Hi Prof. Duncan”, bad: “Yo, Duncan”) and sign your name with your contact information.

Cell Phones. If you bring a cell phone to class, turn it off for the duration of the lab period. If your phone rings or you are seen texting during class, you will have Performance Points deducted and may be asked to leave. If a situation requires you to be able to answer your cell phone during a class, please inform me.

Academic Integrity. All PSU policies regarding ethics and honorable behavior apply to this course. Academic dishonesty, including any form of cheating, is regarded as a very serious offense and will result in severe consequences, including zeros on assignments, labs, and exams, and/or a failing grade in the course (including a note in your transcript). Students are expected to abide by the PSU Code of Academic Integrity. I expect and encourage student to work together in this course, but any work you hand in must be your own and must be recognizably different from any other student's. See:

http://www.plymouth.edu/registrar/policies/academic_standing.html.

Academic Support. I want students to succeed in this course. If you are struggling with any aspect of the course, I strongly encourage you to attend office hours, ask questions before/after class or schedule an appointment with me. Limited drop in tutoring will be available through the Chemistry Resource Center (Boyd 138). The Center is staffed by students who have been successful in chemistry and are interested in helping other students learn chemistry. See the schedule posted outside Boy 138. In addition, if you require writing assistance, I encourage you to visit the Writing Center, located in the lower level of Lamson Library. The Writing Center serves all types of writers, from basic to high levels, in any discipline, at any point in the writing process.

Special Accommodations. Plymouth State University is committed to providing students with documented disabilities equal access to all university programs and facilities. If you think you have a disability requiring accommodations, you should immediately contact the PASS Office in Lamson Library (535-2270) to determine whether you are eligible for such accommodations. Academic accommodations will only be considered for students who have registered with the PASS Office. If you have a Letter of Accommodation for this course from the PASS Office, please provide the instructor with that information privately so that you and the instructor can review those accommodations. Any accommodations you require for an exam must be brought to your instructor's attention at least 5 days before an exam.

Course Schedule and Inclement weather policy. Please see the following page for the Course *Schedule*. All efforts will be made to stick to this schedule, but changes may be made throughout the semester and with limited notice. We will follow the University's lead on class cancellation during inclement weather. However, students are urged to use their best judgment when assessing road conditions and their ability to safely get to campus. Because this class only meets once a week, one canceled class will disrupt the course schedule. Please be flexible as we work to make up for the missed class time. Significant changes will be announced on Moodle, on the course website, and via email. Week 7 (March 13) is scheduled as a make-up lab in the event a lab is missed due to weather. If the make-up period is not needed, Lab 8 will start on March 13 and will continue on March 27.

CH2250: Techniques in Laboratory Chemistry Schedule

(Reading and homework assignments based on 5th edition of book)

Week	Date	Topic	Reading	Problems	Lab
1	Jan 30	Lab Notebooks; chemicals, glass, and equipment	Ch 1.1-2 p13-18 Ch 2.2 p36-37	Ch 1: 2, 4, 5 <i>See Lab Procedure for homework problems</i>	1. Check-in and Starting a Notebook
2	Feb 6	Measuring mass and volume. Significant figures.	Ch 2.3-6 p37-46 Ch 2.9 p48 Ch 3.1-2 p55-59	Ch 2: 2, 7, 8 , 9, 10, 11 , 12 Ch 3: 1 , 2, 3 , 4, 5	2a. Measuring Density 2b. Calibrating Glassware
3	Feb 13	Soln. preparation, concentration and pH	Ch 1.3-4 p18-26 Ch 8.1-4 p167-176	Ch 1: 7, 8 , 9, 11 , 12, 14, 15 , 16 Ch 8: 3 , 7 , 9	3. pH of Prepared Solutions.
4	Feb 20	Keeping a Good Lab Notebook			4. Peer Grading of Notebook Report (<i>no pre-lab</i>)
5	Feb 27	Titration and Standardization	Ch 6.1-3 p123-131 Ch 10.5 p221	Ch 6: 1 , 2 , 3, 4 , 5 , 7, 10 Ch 10: 26	5. Preparing and Standardizing an Acid
6	Mar 6	Acid/Base Titration; Errors	Ch 10.1 p207-210 Ch 10.4 p216-221 Ch 3.3-4 p59-68	Ch 10: 1, 4 , 6 , 21 , 24 Ch 3: 6 , 7, 9, 10, 11 , 22	6. Using a pH Electrode for an Acid-Base Titration
7	Mar 13	Lab Make-up period OR Begin Statistics and Introduction to Spreadsheets (See Week 8 for assignments)			
SPRING BREAK: March 15-23					
	Mar 25	Mid-Term Take-Home Exam DUE 5pm TUESDAY March 26			
8	Mar 27	Statistics; Introduction to Spreadsheets	Ch 4.1 p77-80, Ch 4.3-5 p83-90 Ch 3.5-6 p68-72	Ch 4: 1 , 2, 4 , 5, 6 , 7, 10 , 14 , 15 Ch 3: 23	7. Penny Statistics
9	Apr 3	Standard curves and Beer's Law Sample preparation	Ch 4.6-8 p90-97 Ch 18.1-4 p387-403 Ch 2.10 p49-51	Ch 4: 16 , 17, 19 Ch 18: 4 , 5 , 6, 11, 12 , 13, 14, 16	8. Spect. Determination of Fe in Vitamins
10	Apr 10	Bases	Ch 10.5 p221	Ch 6: 8 , 9 , 11 Ch 10: 7 , 23	9. Preparing and Standardizing a Base 10a. Sample prep
11	Apr 17	Standard addition	Ch 5.3 p111-115	Ch 5: 16, 17, 18, 20	10b. Measuring Manganese in Steel
12	Apr 24	Weak acids / bases Buffers	Ch 8.5-7 p176-185 Ch 9.1-5 p189-199	Ch 8: 10, 11 , 19, 21 , 28, 30 Ch 9: 1, 2, 3, 4, 6, 8 , 12a, 14 , 15 , 17 REPORT DRAFT DUE	11. Preparing and Testing a Buffer
13	May 1	Ensuring accuracy of your answers	Ch 4.1-4.7 p77-97	Review previous material on statistics and linear regression analysis	10b. Measuring Manganese in Steel (repeat for Report)
14	May 8	Solubility, Precipitation, Gravimetric analysis	Ch 2.7-8 p46-48 Ch 6.4 p131-134 Ch 7.1-3 p145-159	Ch 2: 4 ; Ch 6: 18, 20 Ch 7: 2, 4 , 5, 6, 7 , 10a FINAL REPORT DUE	12. Gravimetric Determ. of Calcium
FINAL EXAM: Tues, May 13, 11:00 am – 1:30 pm					

CH2250: Techniques in Laboratory Chemistry Schedule

(Reading and homework assignments based on 4th edition of book)

Week	Date	Topic	Reading	Problems	Lab
1	Jan 30	Lab Notebooks; chemicals, glass, and equipment	Ch 1.1-2 p19-25 Ch 2.2 p42-43	Ch 1: 2, 4, 5 <i>See Lab Procedure for homework problems</i>	1. Check-in and Starting a Notebook
2	Feb 6	Measuring mass and volume. Significant figures.	Ch 2.3-6 p43-51 Ch 2.9 p54 Ch 3.1-2 p 61-65	Ch 2: 1, 2, 6, <u>7</u> , 8, 9, <u>10</u> , 11 Ch 3: <u>1</u> , 2, <u>3</u> , 4, 5	2a. Measuring Density 2b. Calibrating Glassware
3	Feb 13	Soln. preparation, concentration and pH	Ch 1.3-4 p25-33 Ch 8.1-4 p171-181	Ch 1: 6, <u>7</u> , 8, <u>10</u> , 11,13, <u>14</u> , 15 Ch 8: <u>3</u> , <u>7</u> , 9	3. pH of Prepared Solutions.
4	Feb 20	Keeping a Good Lab Notebook			4. Peer Grading of Notebook Report (<i>no pre-lab</i>)
5	Feb 27	Titration and Standardization	Ch 6.1-3 p127-136 Ch 10.5 p227	Ch 6: <u>1</u> , <u>2</u> , 3, <u>4</u> , <u>5</u> , 7, 10 Ch 10: <u>26</u>	5. Preparing and Standardizing an Acid
6	Mar 6	Acid/Base Titration; Errors	Ch 10.1 p213-216 Ch 10.4 p222-227 Ch 3.3-4 p65-73	Ch 10: 1, <u>4</u> , <u>6</u> , <u>21</u> , 24 Ch 3: <u>6</u> , 7, 9, 10, <u>11</u> , 20	6. Using a pH Electrode for an Acid-Base Titration
7	Mar 13	Lab Make-up period OR Begin Statistics and Introduction to Spreadsheets (See Week 8 for assignments)			
SPRING BREAK: March 15-23					
	Mar 25	Mid-Term Take-Home Exam DUE 5pm TUESDAY March 26			
8	Mar 27	Statistics; Introduction to Spreadsheets	Ch 4.1-2 p82-90 Ch 4.4 p92 Ch 3.5-6 p74-77	Ch 4: <u>1</u> , 2, <u>3</u> , 4, <u>5</u> , 6, <u>9</u> , <u>13</u> , 14 Ch 3: 21	7. Penny Statistics
9	Apr 3	Standard curves and Beer's Law Sample preparation	Ch 4.5-7 p93-100 Ch 18.1-4 p393-409 Ch 2.10 p54-56	Ch 4: <u>15</u> , 16, 18 Ch 18: <u>3</u> , <u>4</u> , 5, 10, <u>11</u> , 12, 13, <u>15</u>	8. Spect. Determination of Fe in Vitamins
10	Apr 10	Bases	Ch 10.5 p228	Ch 6: <u>8</u> , <u>9</u> , <u>11</u> Ch 10: <u>7</u> , <u>23</u>	9. Preparing and Standardizing a Base 10a. Sample prep
11	Apr 17	Standard addition	Ch 5.3 p115-118	Ch 5: 16, 17, 18, 20	10b. Measuring Manganese in Steel
12	Apr 24	Weak acids / bases Buffers	Ch 8.5-7 p181-190 Ch 9.1-5 p195-206	Ch 8: 10, <u>11</u> , 19, <u>21</u> , 28, 30 Ch 9: 1, 2, 3, 4, 6, <u>8</u> , 12a, <u>14</u> , <u>15</u> , <u>17</u> REPORT DRAFT DUE	11. Preparing and Testing a Buffer
13	May 1	Ensuring accuracy of your answers	Ch 4.1-4.7 p82-100	Review previous material on statistics and linear regression analysis	10b. Measuring Manganese in Steel (repeat for Report)
14	May 8	Solubility, Precipitation, Gravimetric analysis	Ch 2.7-8 p52-54 Ch 6.4 p136-139 Ch 7.1-3 p150-164	Ch 2: <u>3</u> ; Ch 6: 18, <u>20</u> Ch 7: 2, <u>4</u> , 5, 6, <u>7</u> , <u>10a</u> FINAL REPORT DUE	12. Gravimetric Determ. of Calcium
FINAL EXAM: Tues, May 13, 11:00 am – 1:30 pm					