

SYLLABUS

Quantitative Analytical Chemistry Laboratory

CH201 - Fall 2016

Welcome to CH201 Quantitative Analytical Chemistry Lab. This course provides a one semester survey of quantitative laboratory techniques, instrumental methods, and approaches to data analysis used in quantitative analytical chemistry. Additionally, advanced topics relevant to upper-division chemistry and biochemistry courses are discussed. Students must have completed CH102 before taking this course.

By the end of the course the students will (i) be able to properly use analytical glassware and associated lab equipment, (ii) understand the basic principles and operation of absorption spectrophotometers, (iii) be able to use statistics and graphing software to analyze experimental data, (iv) understand the chemical principles behind various analytical methods including gravimetric analysis, acid/base titrations, buffers, and complex ions, and (v) have a good foundation in the process of scientific communication – preparing tables and figures, outlining an argument, and preparing a scientific report.

This syllabus is designed to answer many questions you may have. Please read it over and then keep it handy to use throughout the semester. Additionally, the first sections of the course lab manual contain detailed information about course policies.

Course Information and Policies

Course Staff

This course is given by Professor Binyomin Abrams:

Office Hours: Monday 5-6pm and Wednesday 4-5pm (in SCI 270B)
Communication: abramsb@bu.edu (e-mail, preferred) and 617.353.2480 (office phone, emergencies)
Course Website: <http://learn.bu.edu/>

The teaching fellows and learning assistants that will be teaching lab sections are:

Thomas Heavey	Office hours: Mon 3-4pm in SCI 344
Ronald Akiki	Office hours: Fri 12-1pm in SCI 344
Sarah Singh	Office hours: Tues 8-9pm in SCI 200B

All members of the course staff are available for consultation during their office hours (listed above) and by appointment. All students are welcome and encouraged to attend any of the office hours. Any questions that you may have about the course can be sent to ch201-questions@bu.edu. E-mails sent to this address will reach all of the course staff simultaneously. Personal and sensitive matters should be emailed directly to the course instructor.

Texts and Equipment

The materials for the course are available at the Boston University Bookstore:

1. Abrams, B. *Analytical Chemistry Lab Manual (2016-2017 edition)*; Kendall-Hunt: Dubuque, IA 2016.
2. Laboratory notebook, Hayden McNeil Publishing, ISBN 1-930882-23-8.
3. Lab coat and approved face-forming safety goggles (UVEX Futura)
4. Scientific (non-graphing, non-programmable) calculator (recommended: <http://goo.gl/uRZQ8K>)
5. *Recommended, but not required*: Harris, D. C. *Exploring Chemical Analysis, 5th ed.*; W. H. Freeman and Company.

All of the above items are required by all students, except for Harris. You must have procured these items *before* the first lab session. Harris is a good reference for analytical procedure and is highly recommended (either the 4th or 5th edition). Additionally, you may find it useful to have your general chemistry textbook available for reference.

Classroom response system and other electronic devices in lecture/discussion

We will be using Top Hat (www.tophat.com) in CH201 for in-class quizzes, pre-lecture work, and other assessment. You will be able to submit answers to in-class questions using Apple or Android smartphones and tablets. You can visit the Top Hat Overview (<https://goo.gl/2VmNnI>) within the Top Hat Success Center which outlines how you will register for a Top Hat account, as well as provides a brief overview to get you up and running on the system. The course join code for CH201 in Fall 2016 is **270756**, and your account for Top Hat must use your BU email address (ending in @bu.edu) in order for you to get credit for your work on Top Hat.

We will use Top Hat for classroom engagement, periodic attendance, and some quizzes; that said, recent studies (see: <http://goo.gl/F0YKJj>) have shown that taking notes with electronic devices (computers, tablets, etc.) leads to **lower performance** by students on exams. For this reason, we **require** that you take notes using the traditional pen and paper mode. Similarly, while you will use your cellphones or tablets for answering Top Hat questions, make sure to keep them down when they are not in use so that you might best benefit from the lectures.

E-mail Correspondence

Periodic e-mails will be sent to the entire class using the BU-link (registrar's online information system). Make sure that you check your BU e-mail address regularly so that you do not miss any important messages.

Course Schedule

The detailed course schedule can be found on the course website and at the end of this document. The course consists of two required components: lectures (Monday, 2-3pm in SCI 117) and labs (Thursday 8am-12noon or 5:30-9:30pm in SCI 160). You are required to attend **all** of the lab meetings of your **registered section** and all lectures (where important details that will not necessarily be disseminated at any other times will be discussed). Some recorded lectures will be posted to the *Echocenter* in the course blackboard website.

Safety, Pedagogy, and Course Policies

A discussion of lab safety guidelines, the course pedagogy, and course-specific policies can be found in the first part of your lab manual. All students are **required** to read through those sections and complete the "Course Policies Quiz and Safety Agreement" (on Top Hat) before the beginning of the first experiment. Additionally, helpful guidelines for preparing course assignments and laboratory notebooks are presented in Appendix B of the lab manual. All students are responsible for following the course policies and regulations at all times.

Academic Conduct

All students at Boston University are expected to maintain high standards of academic honesty and integrity. Details about academic integrity, including specific details about laboratory courses, are presented in the first part of the course lab manual. All students are **required** to read through those sections and complete the "Academic Conduct Quiz" (posted on Top Hat) before the beginning of the first experiment.

Copyright Laws and Protection

The syllabus, course descriptions, lab manual, and all handouts created for this course, and all class lectures, are copyrighted by the course instructor. The materials and lectures may not be reproduced in any form or otherwise copied, displayed or distributed, nor should works derived from them be reproduced, copied, displayed or distributed without the written permission of the instructor. Infringement of the copyright in these materials, including any sale or commercial use of notes, summaries, outlines or other reproductions of lectures, constitutes a violation of the copyright laws and is prohibited. Please note in particular that distributing, receiving, selling, or buying class notes, lecture notes or summaries, or similar materials both violates copyright and interferes with the academic mission of the College, and is therefore prohibited in this class and will be considered a violation of the student code of responsibility that is subject to academic sanctions.

Lab Components and Assessments

Pre-lab Assignments

Pre-lab assignments are at the end of the each lab in the lab manual. The completed sheets should be removed from the lab manual and must be submitted to the supervising TF *before* the beginning of the lab section. In general, pre-lab assignments will typically consist of a few calculations, or questions, that are relevant to the lab that is about to be performed. Doing well on these assignments is a good indicator of preparedness for the lab – make sure to work on them in advance (and it is advisable to keep copies of your work for reference when doing the post-lab).

Lab Notebooks

Use of the lab manual in class is not permitted. All work in the lab must be done directly from your notebook - the correct academic, and industrial, lab practice. The duplicate notebook pages must be submitted before leaving the lab, and the use of proper lab notebook technique will be part of your assessments. **Detailed instructions** for preparing lab notebooks to be used in lab can be found in the Appendix of the lab manual.

Post-lab Assignments

Post-labs are submitted on Blackboard and are due 2 hours before the beginning of your scheduled lab period¹ of the following week (unless otherwise announced). These assignments will be either (1) a series of questions related to the lab and your data, or (2) a formal lab report. Detailed instructions and guidelines for preparing post-lab assignments can be found in the Appendix of the lab manual. Students names and section numbers need to be included on all pages of the submission.

Writing Scholarly Papers

A detailed guide to writing successful science research papers is found at the end of your lab manual. We will not use the entire guide, but will reference individual sections in the first several chapters as the course proceeds. The remaining chapters are useful reference, but will not be assigned.

Lab quizzes and Final Exam

At least three written quizzes/exams will be given and will cover the material covered in pre-lab lecture, the lab manual, in the assigned textbook readings, and in the laboratory (including post-lab assignments and writing assignments). The final exam will be held during the final exam period and will be announced later.

Lab Practical

The lab practical is a special in-lab exercise designed to evaluate you on your learning of proper lab techniques, basic statistical analysis, and analytical thinking. Details will be supplied at a later date.

Grading

Your grade in CH201 will be determined *approximately* as follows:

Component	Points
Labs	650
Performance	100
Exams and Quizzes	250
Total	1000

¹In many cases, the system will take submissions after the due date. Late submissions will either not be graded or will receive a substantial penalty.

Letter grades **are not** assigned to individual labs. Typical experiments will be graded based on some, or all, of the following components: pre-lab assignment, notebook pages, data, and post-lab assignment. Exact breakdowns will be lab-dependent.

Course letter grades are assigned based on your total score for the course. Do not expect “High School”-type scores; in other words, an “A” is not a 93, an “A-” is not a 90, etc... Moreover, there can be a relatively steep learning curve when starting analytical chemistry. The most important thing is that you should work as hard as you can and strive to continually improve your **learning** and performance throughout the course. In general, an “A” grade represents excellence and consistently meeting the expectations of the course on assignments; a “B” corresponds to a good mastery of the material and mostly meeting the course expectations; a “C” represents being consistently below expectations; and a “D” corresponds to insufficient mastery of the course material.

Individual Labs

Typical experiments will be graded based on some, or all, of the following components: pre-lab assignment, notebook pages, data, and post-lab assignment. Exact breakdowns will be lab-dependent.

Performance

Your performance during the labs will be evaluated by your lab instructor (TF). These assessments will include proper lab etiquette, following course policies, demonstrating proficiency with techniques that are taught, and instrumentation use. It is important to remember that you should work efficiently and safely at all times. Exceptional performance will lead to an increased assessment score. Infractions in lab safety and etiquette will result in a lowered assessment score. Repeated infractions may result in your ejection from the lab.

Note: not following explicit instructions of a TF or LA, or talking back to them, is completely unacceptable. Students not following the instructions of their TF will be ejected from the lab. This is unsafe and irresponsible. If you feel that your TF is wrong/incorrect: have them contact the course instructor immediately.

Questions Regarding Grades

Any question concerning the grading of a lab must be brought to the attention of the grading TF within a reasonable amount of time (usually 1 week) of when it is returned to you; material will not be accepted for regrading after a long delay. If, after having met with grading TF you are still uncertain about your grade, you should bring the graded work to the lab course instructor. Be sure that you have made no alterations in your work.

Tips and Hints

This course is designed to walk a student through the basics of analytical chemistry and quantitative analysis for students who have already completed an introductory chemistry sequence (CH101 and CH102). Since CH101/CH102 are pre-requisite courses, and since there will not be a great deal of time to review basic chemical theory in lecture, only those aspects of theory that are directly relevant to the experiment at hand will be covered. Students are expected to review topics from CH101/102 as necessary to give more complete background. There is an expectation of basic lab techniques, but they will be reviewed and built-up quickly during the course.

Make sure to use the course staff (and their office hours) and study groups to get the answers to any questions that you have. The best approach is to always make sure that you know what you are doing, and why you are doing it, and if you don't understand something then ask questions.

In the past, students have best been able to manage their workload with good time management. Students should be reading the textbook and lab manual before their lecture on Mondays. Pre-lab assignments, and notebook pages, are best completed soon after lecture in order to be prepared for lab. Break-up working on the post-lab assignment: consider doing the data analysis before the Monday lecture, and then polishing/completing the assignment in the days leading up to the lab section.

Tutorial sessions (a.k.a. office hours)

You are strongly encouraged to attend office hours frequently. They are a great opportunity to work through problem in groups, get support from course instructors, and ask questions. **Note:** you do not need to have a question or an appointment to attend these open hours. Rather, come frequently and maximize your effort by getting support.

These tutorial sessions are helpful for all students.

An important note about getting answers to your questions: e-mail is not a replacement for office hours. While instructors will certainly respond to personal, private, and urgent matters by email, they will not be regularly answering content-related questions by email. To get answers from instructors, please attend any of the office hours listed above.

Tentative Course Schedule

Date	Details	Harris Reading Section (pages*)
T 9/6	Classes begin	
R 9/8	Lab check-in and orientation	
M 9/12	<i>Review</i> Measurements and units Tools: waste, lab notebook, buret Preparing effective exhibits (Writing #2)	Ch. 1 (13-21b, 23-30) 2-1, 2-2, 2-4 (35-37m, 40b-42)
R 9/15	Lab #1: Excel tutorial / Lab notebooks Quizzes on Policies and Academic conduct due before lab	3-5, 3-6 (68-72)
M 9/19	Review videos on basics of acid-base chemistry <i>Review</i> acid/base chemistry Acid-base titrations Titrations with pH meters Titrations Polyprotic acids/bases	Ch. 8 10-1, 10-2, 10-3 10-4 (217b-220) 6-1, 6-2 (123-127) 11-4 (246-249)
R 9/22	Lab #16: Potentiometric titrations of acids (First part of post-lab, including figures, due R 9/29)	
M 9/26	Tools: pipets, filtration, drying Gravimetric Analysis	2-6 (44-45t), 2-7, 2-8 (46-48) 7-1, 7-2 (145-146t, 147b-149, 151b, 154)
R 9/29	Lab #16: part 2	
M 10/3	Math tools: significant figures, types of error Basic stats: mean, standard deviation, RSD More stats: Student's <i>t</i> , Grubbs The 'Real' rule for significant figures	3-1, 3-2, 3-3 (55-62) 4-1 (77-80t) 4-3 (83-85t), 4-5 (89-90t) (66m-68t)
R 10/6	Lab #3: Gravimetric determination of calcium (Post-lab for lab #3 is due 10/13 at the start of lab)	
M 10/10	No classes	
T 10/11	Tuesday is Monday's schedule Graphical Representation of Argument (Writing #3) Tools: volumetric flasks Titrations with iodine	2-5 (43-44) 16-3 (358-362)
R 10/13	Quiz #1 in lab (labs 1, 16, 3) Lab #3: Work on argument for results of lab #3 (argument assignment due at end of lab) Prepare for Lab #18: develop procedure	

*Page number details: b = bottom, m = middle, and t = top; PDFs posted on blackboard.

Date	Details	Harris Reading Section (pages*)
M 10/17	Light and spectroscopy Spectrophotometers Abridged scholarly papers (Writing #4)	18-1, 18-2, 18-3 (387-399t) 19-1 (409-411)
R 10/20	Lab #18: Redox titrations with iodine (Data analysis, and abridged report, for lab #18 is due 10/27)	
M 10/24	Review particle-in-a-box, molecular spectroscopy	19-4 (420-425)
R 10/27	Lab #18 writing conference in lab Lab #4: Introduction to molecular spectroscopy (Tutorial due on 11/3)	
M 10/31	Colorimetry, complex ions Linear regression, calibration curves Uncertainty from linear regression	4-6 (90-93), 4-8 (95b-97m) 4-7, 4-8 (93-97m)
R 11/3	Lab #7: Colorimetric determination of iron (Analysis for lab #7 due on 11/10)	
M 11/7	Atomic spectroscopy Standard Additions	20-1 (435-437t), 20-5 (446) 5-3 (111b-112t, 114m-115t)
R 11/10	Lab #8: Iron in breakfast cereal by AAS	
M 11/14	Acid/base indicators <i>t</i> -tests and <i>F</i> -tests	9-6 (200-203) 4-2, 4-3 (80-87)
R 11/17	Lab #15: Investigating acid/base indicators	
M 11/21	Quiz #2 in lecture (labs 18, 4, 7)	
W-F	Thanksgiving recess	
M 11/28	UV/Vis of mixtures, isosbestic points Preparing buffers	19-2 (415-418m) 9-1, 9-2, 9-3, 9-4)
R 12/1	Lab #17: Determining pK _a of an acid/base indicator	
M 12/5	Review, discussing lab practical	
R 12/8	Lab practical during lab period	
M 12/12	Quiz #3 in lecture (labs 8, 15, 17) Last day of classes (M)	
M 12/19	Final Exam during exam period (2-4pm in HAR 304)	

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This is a tentative syllabus and is subject to change at any time. Students are expected to conform to these instructions and any other instructions given throughout the semester.