
CHEM 2401 / QUANTITATIVE CHEMICAL ANALYSIS (QCA)

Instructor:

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Section 002 (Mon and Wed)**Section 001 (Mon and Wed)****Room / Times**

| | | |
|----------|--------------------|------------------|
| CB 1.122 | 8:00 - 9:15 a.m. | 1:30 - 2:45 p.m. |
| BE 3.102 | 9:30 - 10:30 a.m. | 3:00 - 4:00 p.m. |
| BE 3.314 | 10:30 - 11:45 a.m. | 4:00 - 5:15 p.m. |

TA: **Mr. Ben** Lund
brl022000@utdallas.edu

TA: **Ms. Ana** Opina
aco051000@utdallas.edu

Office Hour (BE 3.502) _____

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Objectives:

This course emphasizes the theory, applications, and calculations involved in the methods of analysis; and the theory and practice of volumetric, gravimetric, and spectrophotometric methods of analysis. By the end of the semester, you should be able to:

- master stoichiometric and other analytical calculations
- demonstrate a capability to carry out quantitative volumetric, photometric, and potentiometric determinations
- understand the necessity for and use of error estimates and statistical methods
- master the use of spreadsheets like Excel
- achieve a level of good laboratory practice including safety and cleanliness
- keep a professional-level lab notebook
- prepare a professional-level lab reports
- be aware of quantitative sampling procedures
- be able to apply chemical reasoning to analytical chemistry measurements

Prerequisites: CHEM 1312 and CHM 1112

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Safety:

IMPORTANT: In accordance with University and Chemistry Department safety rules, **any time anyone** (student, TA, instructor, or visitor) **is in a lab, Z87-rated safety eyewear must be worn.** The first violation in the semester will result in a warning and removal from the lab until the safety eyewear is in-place. The second violation in the semester will result in dismissal from that lab period with no extra time being allowed for make-up of the work scheduled for that lab period. Similar penalties will apply if any other safety rules are violated. In summary, all students are responsible for all information inside the undergraduate safety manual; it is located at:

<http://www.utdallas.edu/nsm/chemistry/resources.safety.html>

In addition, please refer to the supplemental handout concerning optical and electrical safety issues.

Required Material:

Book: “Quantitative Chemical Analysis, 6th ed.” by Daniel C. Harris.

www.whfreeman.com/qca

Notebook: “Cold Springs Harbor Research Laboratory Notebook”

This 8.5”x11” notebook was chosen since it has carbon-copy pages.

Students are financially responsible for any item checked out of the stockroom.

Other course materials may be recommended or required.

Experiments

| <u>Harris Exp #</u> | <u>Title</u> | <u>PDF Page #</u> |
|---------------------|---|-------------------|
| 1. | Calibration of Volumetric Glassware | 2 |
| 5. | Statistical Evaluation of Acid-Base Indicators | 15 |
| 6. | Preparing Standard Acid and Base | 18 |
| 7. | Using a pH Electrode for an Acid-Base Titration | 19 |
| 8. | Analysis of a Mixture of Carbonate and Bicarbonate | 22 |
| 15. | Potentiometric Halide Titration with Ag ⁺ | 40 |
| 11. | EDTA Titration of Ca ²⁺ and Mg ²⁺ in Natural Waters | 29 |
| 19. | Spectrophotometric Determination of Iron in Vitamin Tablets | 48 |
| 22. | Spectrophotometric Analysis of a Mixture: Caffeine & Benzoic Acid | 54 |
| 26. | Properties of an Ion-Exchange Resin | 66 |

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Lab Reports

Each student must prepare his or her own Lab Report for all 10 experiments based on the guidelines described in the 2401-Handout "Writing a Laboratory Report". The Lab Report for Exp. 1 will be evaluated but it will not count towards your grade. Each Lab Report will be worth 5 pts. Your 8 best Lab Reports will be summed for your Lab Report Score (40 pts. Total).

Please refer to the Class Calendar for all Lab Report Due Dates. Lab Reports are due at the beginning of class. Late Lab Reports will be penalized at a deduction rate of 21% per week.

Make-up of lab periods/experiments missed (for valid medical or emergency reasons) will be attempted based on the constraints of apparatus, BE 3.314, and instructor/TA availability.

Lab NoteBooks

Each student must bring his or her Lab Notebook to Berkner every Monday and Wednesday. Each student must keep his or her own neat and orderly Lab Notebook using ink. Please put your name and a date on every Notebook page you use. In addition, be sure to include data labels and units on all tables and graphs. Drawing chemical structures and balanced chemical reactions in your Notebook (and in your Lab Reports) is highly encouraged. Additional tips for keeping a professional Notebook can be found on page 25 of your textbook.

Your Notebook must be signed and dated by your TA at the end of any day you spend working in the lab. A photo- or carbon-copy of Notebook pages must be given to the TA at the completion of every Experiment. The Notebook pages for Exp. 1 will be evaluated but they will not count towards your grade. The Notebook pages for the remaining 9 Experiments will each be worth 1 pt. (9 pts. Total). Late NoteBooks (i.e., NoteBooks not turned-in at the end of an Exp.) will be evaluated but will not earn points.

Lab Technique

After Exp. 1, each student will be evaluated with respect to their: adherence to good safety practices, laboratory technical skills, and laboratory etiquette/professionalism. The evaluations will be made by your TA (with the instructor) at the end of each Experiment (9 pts. Total). If you do not attend a lab, you can not earn Technique Points for that lab.

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Quizzes*

The majority of quizzes will be administered after the Midterm Exam and before the Cumulative Final. There will not be make-up quizzes; a missed quiz equates to 0 pts. There will also be 1 Take-Home Statistics Quiz.

Midterm Exam (Wednesday, October 12th)*

The Midterm Exam will focus on Equilibrium, Acids and Bases, pH and pKa Calculations, Buffers, and Titration Curves. There will not be a make-up Midterm Exam; a missed Midterm Exam equates to 0 pts.

Cumulative Final (Monday, November 28th)*

There will not be a make-up Cumulative Final; a missed Final equates to 0 pts.

Course Grading <Sections 002 "AM" & 001 "PM" will be graded separately>

| | <u>Pts.</u> |
|------------------|-------------|
| Lab Reports | 40 |
| Lab NoteBook | 9 |
| Lab Technique | 9 |
| Quizzes | 6 |
| HomeWork | 0 |
| Midterm Exam | 12 |
| Cumulative Final | 24 |

* *Quizzes, the Midterm, and the Final will be different for each Section..*

Academic Dishonesty:

The faculty expects from its students a high level of responsibility and academic honesty. Because the value of an academic degree depends upon the absolute integrity of the work done by the student for that degree, it is imperative that a student demonstrate a high standard of individual honor in his or her scholastic work.

Scholastic dishonesty includes, but is not limited to, statements, acts or omissions related to applications for enrollment or the award of a degree, and/or the submission as one's own work of material that is not one's own. As a general rule, scholastic dishonesty involves one of the following acts: cheating, plagiarism, collusion and/or falsifying academic records. Students suspected of academic dishonesty are subject to disciplinary proceedings.

<Source: The 2004-2006 UTD Catalog >

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| Meeting | Lecture and/or Activity | Lab Exp.# | Due Dates |
|----------------|--|------------------------------|------------------|
| 01 M 8/22 | Welcome to the World of Analytical Chemistry / Excel & Word / Lab Safety | | |
| 02 W 8/24 | Linear Regression + Excel | Drawer Check-In | |
| 03 M 8/29 | Experiment #1 / Lab NoteBooks | Exp. 1 | |
| 04 W 8/31 | Exp. #1 / Lab Reports / Class Schedule / Grading | ----- | |
| M 9/05 | Holiday | | |
| 05 W 9/07 | Experiment #5 / Statistics Lectures | Exp. 1 (if necc.) | |
| 06 M 9/12 | Acids, Bases, Buffers, Titrations | Exp. 5 | |
| 07 W 9/14 | Acids, Bases, Buffers, Titrations | Exp. 5 | |
| 08 M 9/19 | Acids, Bases, Buffers, Titrations | Exp. 6 | |
| 09 W 9/21 | Acids, Bases, Buffers, Titrations | Exp. 6 | Exp.5 |
| 10 M 9/26 | Acids, Bases, Buffers, Titrations | Exp. 7 | |
| 11 W 9/28 | Acids, Bases, Buffers, Titrations | Exp. 7 | Exp.6 |
| 12 M 10/03 | Acids, Bases, Buffers, Titrations | Exp. 8 | |
| 13 W 10/05 | Electrochemistry | Exp. 8 | Exp.7 |
| 14 M 10/10 | Electrochemistry / Review for Exam #1 | ----- | |
| 15 W 10/12 | Exam #1 | ----- | |
| 16 M 10/17 | EDTA Titrations | Exp.15 | Exp.8 |
| 17 W 10/19 | EDTA Titrations | Exp.15 | |
| 18 M 10/24 | Spectrophotometry and Calibrations | Exp.11 | |
| 19 W 10/26 | Spectrophotometry and Calibrations | Exp.11 | Exp15 |
| 20 M 10/31 | Spectrophotometry and Calibrations | Exp.19 | |
| 21 W 11/02 | Spectrophotometry and Calibrations | Exp.19 | Exp11 |
| 22 M 11/07 | Analytical Separations | Exp.22 | |
| 23 W 11/09 | Analytical Separations | Exp.22 | Exp19 |
| 24 M 11/14 | Analytical Separations | Exp.26 | |
| 25 W 11/16 | TBD | Exp.26 | Exp22 |
| 26 M 11/21 | TBD | ----- | |
| 27 W 11/23 | Review for Final | Clean Lab / Drawer Check-Out | |
| 28 M 11/28 | Course Review / Cumulative Final Exam | ----- | Exp26 |

Revised 8/28/05