CH 561-A/U

Instrumental Methods of Analysis

Department of Chemistry and Chemical Biology

Spring 2023

Instructor: **Professor Michael Cutrera**

Course Schedule: **Thursdays 6:30 – 9:00 pm**

Contact Info: **mcutrera@stevens.edu**

Office Hours: **Thursdays 5:00 – 6:00 pm**

Prerequisite(s): **None**

Corequisite(s): **None**

COURSE DESCRIPTION

Primarily an applied laboratory course, with introductory lectures presenting the principles and applications of contemporary instrumental analytical methods, with a focus on spectroscopy and separations.

Laboratory practice explores titrimetry, ultraviolet, visible and infrared spectrophotometry, atomic absorption spectrometry, spectrofluorometry and gas-liquid and high-performance liquid chromatography. These instrumental techniques are utilized for quantitative and qualitative analyses of organic, inorganic, biological and environmental samples.

STUDENT LEARNING OUTCOMES

After successful completion of this course, students will be able to:

- Describe principles and applications of contemporary instrumental analytical methods.
- Understand the theory of spectroscopy, spectrophotometry and chromatographic separations.
- Execute basic experiments in the following widely-used instrumental techniques:
    - titrimetry
    - ultraviolet, visible and infrared spectrophotometry
    - atomic absorption spectrometry
    - spectrofluorometry
    - gas-liquid and high-performance liquid chromatography

These instrumental techniques are used for quantitative and qualitative analyses of organic, inorganic, biological and environmental samples.

COURSE REQUIREMENTS

COURSE FORMAT AND STRUCTURE

This course is on-campus, to be held Thursday Evenings 6:30 – 9:00 pm. For more information about course access or support, contact the Technology Resource and Assistance Center (TRAC) by calling 201-216-5500.

Course Logistics

The course employs lectures, laboratory experiments, and an individual PowerPoint presentation project. Please refer to the CH 561 Laboratory Manual (posted on Canvas) and the Course Schedule (below).

Where to submit Pre-Laboratory and Final Laboratory Reports

For most assignments, you should upload your Reports to Canvas. In a few cases, there will be other instructions that will be listed with the assignment (See Due Dates below for more information).

Length of Pre-Laboratory and Final Laboratory Reports

Please refer to the example Reports posted on Canvas and other important details included in the Laboratory Manual. Please cite any references you used in preparing your Report. Reports should be in your own words; do not just "cut and paste" from a source. **Plagiarized work will receive a "0" score.**

Homework due dates

<u>The Pre-Lab Report is due by midnight (ET) the Sunday of each week prior to the experiment</u>.
<u>The Final Lab Report is due by midnight (ET) the Friday of each week following the experiment</u>.

Points will be deducted for late Assignments.

If you have any questions about the assignment you should email me directly. I do check my email daily and will respond quickly.

Instructor's Availability

The best way to reach me is through Stevens email. I monitor my email frequently and will endeavor to respond within 24-48 hours or sooner.

Etiquette Guidelines

General etiquette rules apply to our course. We certainly wish to foster lively discussion, but I insist that all discourse be respectful. You are encouraged to comment, question, or critique ideas, but do not attack an individual. Your cooperation in this is greatly appreciated.

CH 561 Spring Semester 2023 COURSE SCHEDULE (Rev 1)

(Note: This schedule may change based on the availability of equipment and possible overlaps. Changes will be announced in class and posted on Canvas).

Wk #	Date of Class	Topic(s)	Reading Assignments	Report Assignments (May be Subject to Change; see weekly Canvas Postings for Details)
1	Jan 19	Overview and Introduction to Instrumental Analysis ▪ Course Outline ▪ Report Formats ▪ Laboratory Safety ▪ Data Integrity ▪ Measurement Error ▪ Introduction to Validation	▪ Laboratory Manual	No Homework
2	Jan 26	Background Theory ▪ Spectroscopy ▪ Chromatography Details of Method Validation		Pre-Lab for Unit 0 due Sunday 11:59 pm
3	Feb 02	▪ Laboratory Check-In		Pre-Lab for Unit 1 due Sunday 11:59 pm

		Unit 0 "Volumetric Redox Titration"		Lab Report for Unit 0 due Friday Feb 10 11:59 pm
4	Feb 09	Unit 5 – Polarimetry ▪ Experiment 5.1 – Determination of Sucrose		Pre-Lab for Unit 5 due Sunday 11:59 pm Lab Report for Unit 5 due Friday Feb 17 11:59 pm
5	Feb 16	Unit 3 – FTIR Spectroscopy ▪ Experiment 3.1 – Characterization of Organic Compounds as Thin Films ▪ Experiment 3.3 – Quant. Determination of MEK ▪ Experiment 3.4 IR Spectrum of Benzoic Acid		Pre-Lab for Unit 3 due Sunday 11:59 pm Lab Report for Unit 3 due Friday Feb 24 11:59 pm
6	Feb 23	Unit 2 – UV-VIS Spectroscopy ▪ Experiment 2.1 – Determination of Ascorbic Acid in Vitamin C Tablets ▪ Experiment 2.2 - Quant. Analysis of Multi-Comp. Samples		Pre-Lab for Unit 2 due Sunday 11:59 pm Lab Report for Unit 2 due Friday Mar 03 11:59 pm
7	Mar 02	Midterm Exam (1 hour)		
8	Mar 09	Unit 4 – Spectrofluorometry ▪ Experiment 4.1 – Determination of Quinine in Tonic Water		Pre-Lab for Unit 6 due Sunday 11:59 pm Lab Report for Unit 4 due Friday Mar 24 11:59 pm
March 12-19: Spring Break – No Classes				
10	Mar 23	Unit 6 – Gas Chromatography ▪ Experiment 6.1 – GC of Hydrocarbons		
11	Mar 30	Unit 6 – Gas Chromatography (continued) ▪ Experiment 6.2 – GC of Gases ▪ Experiment 6.3 – Ethanol in Beverages		Pre-Lab for Unit 7 due Sunday 11:59 pm Lab Report for Unit 6 due Friday Mar 21 11:59 pm

12	Apr 06	Unit 7 – HPLC ▪ Experiment 7.1 – Separation of a Mixture of Compounds ▪ Experiment 7.2 – Determination of Caffeine		Pre-Lab for Unit 1 due Sunday 11:59 pm Lab Report for Unit 7 due Friday April 14 11:59 pm
13	Apr 13	Unit 1 – Atomic Absorption Spectrometry ▪ Experiment 1.1 – Determination of Cu by Linear Calibration ▪ Experiment 1.2 – Determination of Ca by Linear Calibration		
14	Apr 20	Unit 1 – Atomic Absorption Spectrometry (continued) ▪ Experiment 1.2 – Determination of Ca by Linear Cal. (continued) ▪ Experiment 1.3 – Determination of Cu by Standard Addition		Lab Report for Unit 1 due Friday Apr 28 11:59 pm
14	Apr 27	Class Power Point Presentations (10 min each)		
15	May 04	Final Exam		

Notes:

1. The best way to reach me is via email: mcutrera@stevens.edu

COURSE MATERIALS

Textbook: **CH 561-A/U Laboratory Manual (posted on Canvas)**

TECHNOLOGY REQUIREMENTS

Baseline technical skills necessary:

Basic computer and web-browsing skills

- Navigating Canvas

Required Equipment

- Computer: current Mac (OS X) or PC (Windows 7+) with high-speed internet connection

Required Software

- Microsoft Word
- Microsoft Excel
- Microsoft PowerPoint

GRADING PROCEDURES

GRADING POLICIES

- Fifty percent (50%) of your final grading will be based on quizzes and exams from lectures and experiments.
- Fifty percent (50%) of your final grading will be based on your laboratory session grades.

GRADING FOR LECTURES

Lectures: Grading Scheme

At least two random spot quizzes will be given.

Spot Quiz 1	125 pts
Spot Quiz 2	125 pts
Total (Quizzes)	250 pts
Mid-Term	200 pts
Final Exam	300 pts
Lecture TOTAL	**750 pts**

GRADING FOR LABORATORY

Laboratory: Grading Scheme

Grading (per unit)

	Points
Pre-Lab Report submitted on time. (Due the Sunday before the DAY of the experiment.)	2
Pre-Lab Report contents	8
TA Evaluation	5
Final Lab Report. (Due one week after the experiment)	40
Post-lab questions	15
No Excel sheet	Minus 5
Late Submissions • **Late submissions of Pre-Lab Reports and Final Lab Reports will not be accepted under any circumstances.** • **E-mailing of Lab Reports will not be accepted unless through prior approval of the TA.** • **Missing sections, such as Abstract or Excel Sheets will not be accepted at a later date. The Reports will be graded as received.**	
Total per unit	**70**

Final Grading for Lab Work

Seven Units (70 x 7)	**490**
Lab Notebook. **(Submit all lab notebooks to your TA on or before December 3rd, 2019)**	**100**
TA Evaluations	**60**
Oral Presentation	**100**
Laboratory Total	**750**

The Tentative Last day for your Final Lab Report is Friday, April 28, 2023 (this will be fully established later in the Semester).

Total (Lecture + Lab) = 1500 points

Late Policy

Reports will be accepted late, but points will be deducted.

If you have a legitimate problem (e.g. illness, family crisis) with a due date, please email me before the due date with an explanation, and we will work something out.

Academic Integrity

Undergraduate Honor System

Enrollment into the undergraduate class of Stevens Institute of Technology signifies a student's commitment to the Honor System. Accordingly, the provisions of the Stevens Honor System apply to all undergraduate students in coursework and Honor Board proceedings. It is the responsibility of each student to become acquainted with and to uphold the ideals set forth in the Honor System Constitution. More information about the Honor System including the constitution, bylaws, investigative procedures, and the penalty matrix can be found online at http://web.stevens.edu/honor/

Links to an external site.

The following pledge shall be written in full and signed by every student on all submitted work (including, but not limited to, homework, projects, lab reports, code, quizzes and exams) that is assigned by the course instructor. No work shall be graded unless the pledge is written in full and signed.

"I pledge my honor that I have abided by the Stevens Honor System."

Reporting Honor System Violations

Students who believe a violation of the Honor System has been committed should report it within ten business days of the suspected violation. Students have the option to remain anonymous and can report violations online at www.stevens.edu/honor

Links to an external site..

Graduate Student Code of Academic Integrity

All Stevens graduate students promise to be fully truthful and avoid dishonesty, fraud, misrepresentation, and deceit of any type in relation to their academic work. A student's submission of work for academic credit indicates that the work is the student's own. All outside assistance must be acknowledged. Any student who violates this code or who knowingly assists another student in violating this code shall be subject to discipline.

All graduate students are bound to the Graduate Student Code of Academic Integrity by enrollment in graduate coursework at Stevens. It is the responsibility of each graduate student to understand and adhere to the Graduate Student Code of Academic Integrity. More information including types of violations, the process for handling perceived violations, and types of sanctions can be found at https://my.stevens.edu/provost/grad-academics-and-student-success

Links to an external site..

Special Provisions for Undergraduate Students in 500-level Courses

The general provisions of the Stevens Honor System do not apply fully to graduate courses, 500 level or otherwise. Any student who wishes to report an undergraduate for a violation in a 500-level course shall submit the report to the Honor Board following the protocol for undergraduate courses, and an investigation will be conducted following the same process for an appeal on false accusation described in Section 8.04 of the Bylaws of the Honor System. Any student who wishes to report a graduate student may submit the report to the Dean of Graduate Academics or to the Honor Board, who will refer the report to the Dean. The Honor Board Chairman will give the Dean of Graduate Academics weekly updates on the progress of any casework relating to 500-level courses. For more information about the scope, penalties, and procedures pertaining to undergraduate students in 500-level courses, see Section 9 of the Bylaws of the Honor System document, located on the Honor Board website.

EXAM CONDITIONS

The following procedures apply to quizzes and exams for this course. As the instructor, I reserve the right to modify any conditions set forth below by printing revised Exam Conditions on the quiz or exam.

1.
    1. Students may use the following materials during quizzes and/or exams. Any materials that are not mentioned in the list below are not permitted.

        - Laboratory Reports

LEARNING ACCOMMODATIONS

Stevens Institute of Technology is dedicated to providing appropriate accommodations to students with documented disabilities. The Office of Disability Services (ODS) works with undergraduate and graduate students with learning disabilities, attention deficit-hyperactivity disorders, physical disabilities, sensory impairments, psychiatric disorders, and other such disabilities in order to help students achieve their academic and personal potential. They facilitate equal access to the educational programs and opportunities offered at Stevens and coordinate reasonable accommodations for eligible students. These services are designed to encourage independence and self-advocacy with support from the ODS staff. The ODS staff will facilitate the provision of accommodations on a case-by-case basis.

For more information about Disability Services and the process to receive accommodations, visit https://www.stevens.edu/student-diversity-and-inclusion/disability-services

Links to an external site.. If you have any questions please contact: Phillip Gehman, the Director of Disability Services Coordinator at Stevens Institute of Technology at pgehman@stevens.edu or by phone 201-216-3748.

Disability Services Confidentiality Policy

Student Disability Files are kept separate from academic files and are stored in a secure location within the Office of Disability Services. The Family Educational Rights Privacy Act (FERPA, 20 U.S.C. 1232g; 34CFR, Part 99) regulates disclosure of disability documentation and records maintained by Stevens Disability Services. According to this act, prior written consent by the student is required before our Disability Services office may release disability documentation or records to anyone. An exception is made in unusual circumstances, such as the case of health and safety emergencies.

INCLUSIVITY

Name and Pronoun Usage

As this course includes group work and class discussion, it is vitally important for us to create an educational environment of inclusion and mutual respect. This includes the ability for all students to have their chosen gender pronoun(s) and chosen name affirmed. If the class roster does not align with your name and/or pronouns, please inform the instructor of the necessary changes.

Inclusion Statement

Stevens Institute of Technology believes that diversity and inclusiveness are essential to excellence in academic discourse and innovation. In this class, the perspective of people of all races, ethnicities, gender expressions and gender identities, religions, sexual orientations, disabilities, socioeconomic backgrounds, and nationalities will be respected and viewed as a resource and benefit throughout the semester. Suggestions to further diversify class materials and assignments are encouraged. If any course meetings conflict with your religious events, please do not hesitate to reach out to your instructor to make alternative arrangements.

You are expected to treat your instructor and all other participants in the course with courtesy and respect. Disrespectful conduct and harassing statements will not be tolerated and may result in disciplinary actions.

MENTAL HEALTH RESOURCES

Part of being successful in the classroom involves a focus on your whole self, including your mental health. While you are at Stevens, there are many resources to promote and support mental health. The Office of Counseling and Psychological Services (CAPS) offers free and confidential services to all enrolled students who are struggling to cope with personal issues (e.g., difficulty adjusting to college or trouble managing stress) or psychological difficulties (e.g., anxiety and depression). Appointments are can be made by phone (201-216-5177).

EMERGENCY INFORMATION

In the event of an urgent or emergent concern about the safety of yourself or someone else in the Stevens community, please immediately call the Stevens Campus Police at 201-216-5105 or on their emergency line at 201-216-3911. These phone lines are staffed 24/7, year round. For students who do not reside near the campus and require emergency support, please contact your local emergency response providers at 911 or via your local police precinct. Other 24/7 national resources for students dealing with mental health crises include the National Suicide Prevention Lifeline (1-800-273-8255) and the Crisis Text Line (text "Home" to 741-741). If you are concerned about the wellbeing of another Stevens student, and the matter is *not* urgent or time sensitive, please email the CARE Team at care@stevens.edu. A member of the CARE Team will respond to your concern as soon as possible.