Mass Spectrometry
CHEM:5212:0001
Spring 2017

I. Logistics

Instructor  Professor Betsy Stone
Chemistry Building W376
(319) 384-1863
betsy-stone@uiowa.edu

Class Location and Time
C139 PC
Mondays and Wednesdays at 3:30-4:45 PM

Office Hours
Mondays and Wednesdays at 4:45-5:30 PM
Tuesdays 5:00-6:30 PM and by appointment

II. Course Description and Objectives

Description  Mass spectrometry (MS) will be examined in terms of basic theory, instrumentation, qualitative and quantitative analysis, and its application to the environmental and biological sciences. Topics will be explored through a combination of scientific readings, case studies, and independent projects.

Learning Goals and Objectives

• Develop an understanding of the physicochemical principles of mass spectrometry, methods of ionization, and the behavior of charged molecules.
• Gain practical knowledge of mass spectrometry instrumentation, including ionization sources, mass selectors, detectors, and vacuum systems.
• Develop a working knowledge of emerging trends in mass spectrometry, including ultrahigh-resolution and tandem techniques.
• Interpret data from mass spectrometers for the purpose of qualitative and quantitative analysis, method development, and validation.
• Understand state-of-the art applications of mass spectrometry in research areas of proteomics (and related fields), pharmacology, toxicology, environmental analysis, and organic chemistry
• Understand the advantages and limitations of various mass spectrometric techniques and their applicability.
III. Course Content and Resources

Topics

1. Introduction to Mass Spectrometry
   a. Terminology
   b. Formation and acceleration of ions
   c. Behavior of ions in electric and magnetic fields
   d. Ion focusing
   e. Resolution and accuracy

2. Interpretation of mass spectra
   a. Isotopes and ion abundances
   b. Molecular ions and adducts
   c. Fragmentation patterns
   d. Qualitative analysis
   e. Quantitative analysis

3. Instrumentation
   a. Ionization sources: Electron impact, Chemical ionization, Electrospray ionization, Ambient ionization sources, Other sources: MALDI, ICP, etc.
   b. Mass selectors: Quadrupole, magnetic sector, Time-of-flight, Ion traps, LIT, FTICR, Orbitrap, Tandem mass spectrometers (MS/MS)
   c. Detectors, data acquisition, vacuum systems: Faraday cup, Electron multipliers and conversion dynodes, Multi-channel plates, Vacuum technologies, Signal-to-noise

4. Applications
   a. –Omics (proteomics, metabolomics, etc.)
   b. Pharmacology/Toxicology
   c. Environmental Monitoring/Analysis
   d. Organic chemistry

Textbook

Mass Spectrometry: A Textbook by Jurgen H. Gross
ISBN: 978-3-642-10709-2 (print) 978-3-642-10711-5 (online)

Additional Readings

Additional readings will be assigned that are drawn from other textbooks, online resources, and scientific journals.

Course Website

The course website is posted on ICON (http://icon.uiowa.edu). Login with your username and password. Announcements, syllabus, assignments, and readings will be posted here. All assignments and written work must be submitted through the ICON drop box. Please visit this website frequently for announcements and updates that may contain pertinent and/or clarifying information.
IV. Grading

Grading Scheme

| Assignments (3) | 15% or 75 points |
| Article reviews (2) | 10% or 50 points |
| Exams (2) | 40% or 200 points |
| Final project | 25% or 125 points |
| Participation | 10% or 50 points |

Final letter grades will be based upon points earned in the above categories. Letter grades and corresponding percentages of points earned are: A 90-100%; B 80-89%; C 70-79%; D 60-69%, F < 59%. Plus or minus grades will be appended to letter grades. The grade of A+ will be awarded only in extraordinary circumstances.

Three assignments will cover a) ion formation and behavior, b) interpretation of mass spectral data, and c) instrumentation.

Two article reviews will involve a written summary and critique of journal articles on mass spectrometry.

Two exams will be take-home; dates exams will be assigned and due are listed below.

The final project consists of a written, original proposal that involves either the development or application of mass spectrometry instrumentation or methodology and an oral presentation to the class on the proposed project.

Course participation will be assessed through student engagement in classroom activities and discussions, asking/answering questions, attendance at and preparedness for class, and quizzes.

Re-grading

Adjustments to grades will only be considered within one week after an assignment or exam is returned. The re-grade request must be accompanied by a written, detailed description of the grading concern. Re-grading will involve re-assessment of the entire assignment and may increase or decrease of the grade.

Attendance

Attendance at class is mandatory for exams and student presentations. If you have to miss class on one of these days, notify the instructor in advance by completing the Explanatory Statement for Absence form and submitting it electronically through the ICON Dropbox.
Key Dates

| Exam 1                  | Assigned March 1, due March 6 |
| Exam 2                  | Assigned April 5, due April 10 |

Final Project Deadlines

- Summary and Aims: April 3
- Proposal: April 21
- Presentations: April 24 and 26; May 1 and 3; final exam date (TBD)

Collaboration

The homework for this course is designed to help you master your knowledge related to mass spectrometry. As such, students may initially discuss their approach to homework assignments with their peers. The work you turn in should be unique, meaning additional collaboration is not allowed. Do not share your work with others or ask others to see their completed assignments because both are considered academic misconduct. If you need help, please meet with the instructor. Students are responsible for understanding this policy; if you have questions, ask for clarification.

V. Administrative Details

Chemistry Center

Chemistry Building E225, (319) 335-1341

Department of Chemistry Office

James Gloer, Departmental Executive Officer
Chemistry Building E331, (319) 335-1350

Administrative Home

The College of Liberal Arts and Sciences is the administrative home of this course and governs matters such as the add/drop deadlines, the second-grade-only option, and other related issues. Different colleges may have different policies. Questions may be addressed to 120 Schaeffer Hall, or see the CLAS Academic Policies Handbook at http://clas.uiowa.edu/students/handbook.

Electronic Communication

University policy specifies that students are responsible for all official correspondences sent to their University of Iowa e-mail address (@uiowa.edu). Faculty and students should use this account for correspondences (Operations Manual, III.15.2, k.11).

Accommodating Disabilities

The University of Iowa is committed to providing an educational experience that is accessible to all students. A student may request academic accommodations for a disability (which includes but is not limited to mental health, attention, learning, vision, and physical or health-related conditions). A student seeking academic accommodations should first register with Student Disability Services and then meet with the course instructor.
privately in the instructor's office to make particular arrangements. Reasonable accommodations are established through an interactive process between the student, instructor, and SDS. See http://sds.studentlife.uiowa.edu/ for information.

**Academic Honesty**

All CLAS students or students taking classes offered by CLAS have, in essence, agreed to the College's Code of Academic Honesty: "I pledge to do my own academic work and to excel to the best of my abilities, upholding the IOWA Challenge. I promise not to lie about my academic work, to cheat, or to steal the words or ideas of others; nor will I help fellow students to violate the Code of Academic Honesty." Any student committing academic misconduct is reported to the College and placed on disciplinary probation or may be suspended or expelled (CLAS Academic Policies Handbook).

**CLAS Final Examination Policies**

The final examination schedule for each class is announced by the Registrar generally by the fifth week of classes. Final exams are offered only during the official final examination period. **No exams of any kind are allowed during the last week of classes.**

All students should plan on being at the UI through the final examination period. Once the Registrar has announced the date, time, and location of each final exam, the complete schedule will be published on the Registrar's web site and will be shared with instructors and students. It is the student's responsibility to know the date, time, and place of a final exam.

**Making a Suggestion or a Complaint**

Students with a suggestion or complaint should first visit with the instructor (and the course supervisor), and then with the departmental DEO. Complaints must be made within six months of the incident (CLAS Academic Policies Handbook).

**Understanding Sexual Harassment**

Sexual harassment subverts the mission of the University and threatens the well-being of students, faculty, and staff. All members of the UI community have a responsibility to uphold this mission and to contribute to a safe environment that enhances learning. Incidents of sexual harassment should be reported immediately. See the UI Office of the Sexual Misconduct Response Coordinator for assistance, definitions, and the full University policy.

**Reacting Safely to Severe Weather**

In severe weather, class members should seek appropriate shelter immediately, leaving the classroom if necessary. The class will continue if possible when the event is over. For more information on Hawk Alert and the siren warning system, visit the Department of Public Safety website.

*These CLAS policy and procedural statements have been summarized from the web pages of the College of Liberal Arts and Sciences and The University of Iowa Operations Manual.*