

Spring Semester, 2015 (1/12-2/28)

Mass Spectrometry: basic concepts, techniques and analytical applications

Instructor: Dr. Siming Wang
Office: Science Annex 505
Phone: 404-413-5558
MS Facility: NSC 438A
Phone: 404-413-5494
Email: swang@gsu.edu

Course Description:

This two credit course will 1) introduce basic concepts and principles of mass spectrometry; 2) introduce and demonstrate mass spectrometers commonly used in chemical and biological applications; 3) help to develop the skills to analyze and interpret mass spectral data; 4) provide practical information and consideration on how to apply MS methodologies and how to select different instruments and techniques for different applications; 5) present applications with real life examples; 6) provide opportunities on operating different MS instruments in the MS facility.

Text book: Fundamentals of Contemporary Mass Spectrometry

(optional) Author: Chhabil Dass
Edition: 2007
Publisher: Wiley Interscience
ISBN:978-0-471-68229-5

Time: Tuesday & Thursday 10:00-11:40 AM, 1/12/2014-2/28/2014

Location: 423 Sparks Hall

Office Hours: I will stay for questions after each class. If extra help is needed, please contact me by e-mail or before/after class to set up a meeting time.

Exams: There will be one final exam.

Homework Sets:

Because a major goal of this course is to provide students with the skills necessary to analyze mass spectrometric data for a variety of experiment types and solve research problems with the MS techniques, there will be 5 homework problem sets for students to practice data analysis using the skills and concepts learned in the class.

PowerPoint lecture note:

Presentations from each class and the homework problems will be made available to registered students.

***IMPORTANT - This information is confidential and the material provided should not be distributed because some of the contents are copyrighted.

Grading Policy:

- Final exam will count for 40% of the final grade.
- Homework sets collectively will count for 50% of the final grade.
- Lab reports will count for 10% of the final grades

Standard grading scale of 95-100 = A, 90-94=A-, 85-89 = B+, 80-84 (B) 75-79 = C+, 70-74 (C); 65-69 = D+; 60-64 (D) and below 60 = F will be used.

Grading curves to tests and homework sets may be applied, but there will not be an automatically defined curve.

Listed below is an approximate and tentative chronological schedule for the course:

Class	Date	Contents	Homework, Exam &labs
1	Tuesday January 13	General introduction; course description and outline; syllabus explanation; Introduction of basics of mass spectrometry, mass spectrometers and mass spectra; mass definition General applications.	Homework set 1 delivery
2	Thursday January 15	Introduction of different types of mass spectrometers; Anatomy of mass spectrometers and principles on how mass spectrometers work—sample inlets and Chemical mechanism of ionization ; Principles on how mass spectrometer works: Ion source and ionization (EI, CI)	(sign up for lab 1 and 2) Demonstration of the MS instruments in the MS facility at NSC 438A;
3	Tuesday January 20	Principles on how mass spectrometer works: Ion source and ionization (EI, CI, ESI)	Homework set 1 due; Homework set 2 delivery
4	Thursday January 22	Principles on how mass spectrometer works: Ion source and ionization (ESI, APCI, FAB, MALDI and others) Principles on how mass spectrometer works: analyzers (Magnetic-Sector, Quadrupole, Time-of-Flight, Ion-trap, FT-ICR), and detectors.	
5	Tuesday January 27	Principles on how mass spectrometer works: analyzers (Magnetic-Sector, Quadrupole, Time-of-Flight, Ion-trap,	Homework set 2 due; Homework

		FT-ICR), and detectors. Analyzers evaluation: mass range, resolution, accuracy, sensitivity	set 3 delivery
6	Thursday January 29	Analyzers evaluation: mass range, resolution, accuracy, sensitivity ---continues Tandem MS (MSMS): instrument configurations; Tandem MS (MSMS): Fragmentation: organic molecules	
7	Tuesday February 3	Proteomics by MS with LTQ-Orbitrap, instrument, method and application on Protein and Glycoprotein Identification, PTM and sequencing	Homework set 3 due; Homework set 4 delivery
8	Thursday February 5	Nucleosides and nucleotides fragmentation; Hyphenated MS Hyphenated MS: GC-MS, LC-MS, NanoLC-MS, CE-MS	
9	Tuesday February 10	Quantitative analysis: selective ion monitoring; selective reaction monitoring; method development and validation.	Homework set 4 due, Homework set 5 delivery
10	Thursday February 12	MS—Real life applications	
11	Tuesday February 17	ESI and MALDI Lab	
12	Thursday February 19	ESI and MALDI Lab	Homework set 5 due
13	Tuesday February 24	ESI and MALDI Lab	
14	Thursday February 26	Final exam	Lab reports due

*******Class attendance is mandatory.*******

PowerPoint presentations from each class and the homework problems will be made available.

All additional reading materials for the course will also be made available. I will let everyone know what reading material is recommended for each upcoming class. Reading is not required for each class but highly recommended.

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Learning outcomes

Upon course completion students will be able to

1. Display a good understanding of basic concepts and principles of mass spectrometry, working knowledge of various types of mass spectrometers that allows the students to make appropriate selections of instruments and techniques for analyzing different types of samples and for different applications.
2. Demonstrate the skills needed for identifying and characterizing the structures of chemical and biological molecules.
3. Design MS experiments using different MS techniques and interpret mass spectra.
4. Understand basic operation of the MS, msms and LCMS analysis.

The above outcomes will be assessed by homework, in class questions, laboratory practice, and final examinations.

Statements required by University Policies and Regulations

Please note, the course syllabus provides a general plan for the course; deviations may be necessary.

It is required that we refer to the Policy on Academic Honesty (Section 409). The university's policy on academic honesty is published in the Faculty Affairs Handbook and the On Campus: The Undergraduate Co-Curricular Affairs Handbook and is available to all members of the university community. The policy represents a core value of the university and all members of the university community are responsible for abiding by its tenets. Lack of knowledge of this policy is not an acceptable defense to any charge of academic dishonesty. All members of the academic community -- students, faculty, and staff -- are expected to report violations of these standards of academic conduct to the appropriate authorities. The procedures for such reporting are on file in the offices of the deans of each college, the office of the dean of students, and the office of the provost.