



Special Topics in Chemistry - Mass Spectrometry

CHEM 4980/6340/8340

The University of Toledo
Department of Chemistry and Biochemistry

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Office Hours:	M, W: 3-4 pm or by appointment	Lab Location:	NA
Office Location:	BO 1086F	Lab Day/Time:	NA
Instructor Phone:	419-530-5523	Credit Hours:	4
Offered:	Spring 2022		

CATALOG/COURSE DESCRIPTION

The principles and applications of mass spectrometry in chemistry, biochemistry, and related disciplines.

STUDENT LEARNING OUTCOMES

The students will learn about mass spectrometry (MS) topics shown in the table in the end of this syllabus. Successful learning of these topics and understanding of in-class demonstrations will help students in future mass spectrometry-related research and their scientific careers.

By the end of the course, the students are expected to understand mass spectrometry concepts and techniques needed for their involvement in mass spectrometry-related research and MS data interpretation. The students will also gain the knowledge about the development and applications of modern ionization sources and mass spectrometers, which will help them to execute various MS, tandem MS (MS/MS) and multistage MS/MS (MSⁿ) experiments and perform structural characterization and quantification of molecules.

PREREQUISITES AND COREQUISITES

Admitted to the graduate program

REQUIRED INSTRUCTIONAL MATERIALS (TEXTS AND ANCILLARY MATERIALS)

E. de Hoffmann, V. Stroobant, *Mass Spectrometry: Principles and Applications*, John Wiley & Sons, 2007. ISBN: 978-0-470-03310-4.

Other Recommended Textbooks

F. W. McLafferty, *Interpretation of Mass Spectra*, 4th Edition, University Science Books, 1993. ISBN 0-935702-25-3.

Hillenkamp, F, Katalinic, J. (eds.), *MALDI-MS: A Practical Guide to Instrumentation, Methods and Applications*, Wiley, Weinheim, Germany, 2014. ISBN 978-3-527-33331-8.

Cole, R. B. *Electrospray and MALDI Mass Spectrometry Fundamentals, Instrumentation, Practicalities and Biological Applications*, 2nd Edition, Wiley, ISBN 978-0-471-74107-7

J. B. Lambert, H. F. Shurvell, D. A. Lightner, and R. G. Cooks *Organic Structural Spectroscopy*, Prentice Hall, 1998 (reprinted in 2001). ISBN 0-13-258690-8.



D. C. Harris, *Quantitative Chemical Analysis*, 9th Edition, W. H. Freeman Company, 2015. ISBN-13: 1-4641-3538-5

D. A. Skoog, S. R. Crouch, F. J. Holler, *Principles of Instrumental Analysis*, 6th Edition, Brooks/Cole, 2006. ISBN: 0495012017

Blackboard (<http://www.dl.utoledo.edu/>) is the course website featuring: (1) all course materials (syllabus, assignments, lecture outlines, other handouts) so that a student can print out a copy; (2) announcements; and (3) students' current course grade points (see details about points later).

UNIVERSITY POLICIES

Policy Statement on Non-Discrimination on the basis of Disability (ADA). The University is an equal opportunity educational institution. Please read [The University's Policy Statement on Nondiscrimination on the Basis of Disability Americans with Disability Act Compliance](#).

Academic Accommodations

The University of Toledo is committed to providing equal access to education for all students. If you have a documented disability or you believe you have a disability and would like information regarding academic accommodations/adjustments in this course, please contact connect with the office by calling 419.530.4981 or sending an email to StudentDisability@utoledo.edu.

ACADEMIC POLICIES

Students who will not be able to take an exam at the scheduled time due to an irresolvable conflict with a *major responsibility* must provide some **written** documentation to verify the conflict. This situation may occur for student on official university business, including athletes. The exam will be given at another arranged time. *Approval must be obtained before the scheduled test date.*

Students who do not take an exam due to illness, car accident or similar extreme circumstance should inform their instructor of their difficulties as soon as possible. These difficulties must also be documented by a physician's note, an accident report, etc. A telephone call within 24 hours of the exam is expected to Chemistry Department (419-530-2698). Students must complete an Absence Report Form in all cases of missed examinations. These can be obtained from the secretary in the Chemistry Office, BO2022. Documentation supporting your excuse must be attached to the form. In all other circumstances, a missed exam will result in a grade of 0. If an excuse is acceptable, missed exam grade will be computed based on the average of the hour exams.

The students are urged to refer to the university's policy on Academic Dishonesty found at <http://www.utoledo.edu/dl/students/dishonesty.html>. Violation of this policy can result in a course grade of F with additional university sanctions possible.

COURSE EXPECTATIONS

Lecture sessions are designed to clarify the concepts covered and provide examples of what is expected of you in this course. Attendance is required and you are responsible for all material and problems covered in the class. **Lecture Outlines** will be posted on blackboard and used in class to help with note taking. Please arrive on time and silence your cell phone. **Exams** will be taken during lecture time. The recommended textbooks and scientific papers are also an important part of this course. It is recommended that you *read them before the lecture*.



Examination dates are given on the schedule. **Make-up for the exams will not be given at any circumstance.** Excused absences will be given only to students who miss an exam under the conditions mentioned above. You may use a **non-programmable calculator.** Use of programmable calculators and cell phones is not allowed during exams. You may not have a cell phone or smart watch on your desk, arm, chair or any pocket. Doing so may result in a grade of zero.

Attendance is mandatory. A student must notify me prior to the start of the class by email or voicemail for an absence to be excused in accordance with the University Missed Class Policy. Please arrive on time, as there would be no excuses for tardiness. In the case of **COVID-19 symptoms, your absence will be excused.** Please **read and follow** the instructions shown below in the section **SPECIAL COURSE EXPECTATIONS DURING COVID-19.**

OVERVIEW OF COURSE GRADE ASSIGNMENT

Three exams will be given in the course. Each of these exams will count for 30% of student's final grade. All exams will be based on the lecture notes, assigned problems, and readings (textbooks and journal articles). A written paper describing a specific MS methodology or an application of mass spectrometry not covered in the class will need to be submitted and presented by each student, and will account for 10% of student's final grade. The topic should be chosen upon consultation with the instructor. Additionally, in order to facilitate their presentation in the class, the students will demonstrate the ability to identify and review pertinent literature on a mass spectrometry topic of interest. Doctoral level students will also identify, explain and demonstrate the use of a MS database or software tool. Participation in the class is strongly encouraged.

The following is the distribution of possible points in the course:

Exams, 3 @ 100 point each	300 pts.	90.0 %
Literature review project and in-class presentation		10.0 %
	Total:	100 %

Grade Scale These are **the percentages of total points needed** to receive the indicated grade.

A	89%	A-	86%		
B+	82%	B	78%	B-	74%
C+	70%	C	66%	C-	62%
D+	58%	D	54%	D-	50%

The cut-off percentages for the letter grades may be readjusted, but will never be higher than shown above.

SPECIAL COURSE EXPECTATIONS DURING COVID-19

Maintaining a safe campus during the ongoing COVID-19 pandemic remains a top priority. UToledo continues to follow the guidance of the U.S. Centers for Disease Control and Prevention and Ohio Department of Health to keep our campus safe. <https://www.utoledo.edu/coronavirus/>

ATTENDANCE The University of Toledo has a missed class policy. Before coming to campus each day, students should take their temperature and complete a self-assessment for symptoms of COVID-19, such as cough, chills, fatigue or shortness of breath. Anyone with a temperature at or above 100.0 degrees Fahrenheit or who is



experiencing symptoms consistent with COVID-19 **should not come to campus** and contact their primary care physician or the University Health Center at 419.530.5549. For more information on the symptoms of COVID-19, please go to <https://www.cdc.gov/coronavirus/2019-ncov/symptoms-testing/symptoms.html>

COVID-19 testing for sick students is available on both Main Campus and Health Science Campus. Call 419.383.4545 for an appointment. Absences due to COVID-19 quarantine or isolation requirements **are** considered excused absences. Students should notify their instructors and follow the protocols summarized in this document on <https://www.utoledo.edu/offices/provost/docs/covid-19/COVID%20student%20flow%20chart.pdf>

COURSE SCHEDULE

Week	Date	Topic
1	01/19	Origin of Ions, Principles & History of MS
2	01/24	Ion Sources (EI, CI, LDI, MALDI, ESI, DESI, APCI, ICP...)
	01/26	Ion Sources (continued)
3	01/31	Mass Analyzers and Detectors
	02/02	Tandem MS (MS/MS) and MS ⁿ
4	02/07	Isotope Distribution and Elemental Composition
	02/09	Interpretation of MS &MS/MS spectra
5	02/14	Interpretation of MS &MS/MS spectra
	02/16	Review
6	02/21	Exam 1
	02/23	GC and LC-MS
7	02/28	SDS-PAGE, CE and IMS-MS
	03/02	Proteomics & Bioinformatics
8	03/07	Spring Break (no class)
	03/09	Spring Break (no class)
9	03/14	Lipidomics and Metabolomics
	03/16	MS of Synthetic Polymers
10	03/21	Quantification by MS
	03/23	Review
11	03/28	Exam 2
	03/30	Quantification by LC-MS and GC-MS
12	04/04	MS Imaging
	04/06	Biomarker discovery & Drug Analyses
13	04/11	Isotopic Labeling, H/D Exchange
	04/13	MS of Nanoparticles and Microorganisms; MS in Safety and Food Analyses
14	04/18	In-Class Presentations
	04/20	In-Class Presentations
15	04/25	In-Class Presentations
	04/27	Review
Final week	05/02	Exam 3 (10:15am-12:15 p.m.)

Make sure that your travel and business plans do not interfere with this schedule