CHEM 423 – Experimental Methods in Chemistry
Fall 2019

Instructor: Dr. Davis Oldham
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Office hours: M, W, F 9 – 10 am, M, W 12 – 1 pm
Course Information:
Lecture: 11:00-11:50 am MWF Jepson 451
Lab: 9:30 am – 12:15 pm, Jepson 416

Required materials:

- Pavia, Lampman, Kriz, and Vyuvan, *Introduction to Spectroscopy*, 5th
- Pretsch, Buhlmann, and Badertscher, *Structure Determination of Organic Compounds: Tables of Spectral Data*, 4th edition.
- Coghill, and Garson, *ACS Style Guide, 3rd edition*
- Lab coat
- Lab notebook
- Goggles
- Calculator
- Sharpie

Other resources:

- Hofmann, *Scientific Writing and Communication*
- Silverstein, *Spectrometric Identification of Organic Compounds*, 7th or 8th edition
- Klein, *Organic Chemistry, 2nd edition*
- Mohrig, *Techniques in Organic Chemistry*

Course objectives:

This course covers the spectroscopic, chromatographic, and chemical functional group techniques used in characterizing chemical systems. It will include a review of spectroscopic techniques learned in introductory organic chemistry (IR spectroscopy, mass spectrometry, and NMR spectroscopy). After completing the course, students should be able to:

- Match spectroscopic data (MS, IR, and NMR) to a specific molecule
- Use spectroscopic data to deduce the structure of an unknown
- Search for spectroscopic data in the organic literature
- Write lab reports in the style of common organic chemistry publications (e.g. *Journal of Organic Chemistry*, *Organic Letters*, or *Organic Syntheses*)

Additionally, this class is writing intensive. As such, students will:

- (Ideas): demonstrate satisfactory knowledge of the varying strategies to convey arguments, main ideas and support/evidence.
- (Organization): demonstrate satisfactory knowledge of the varying patterns of composition organization and development.
- (Rhetorical Situation): demonstrate satisfactory knowledge of the audience, the role of the writer, and rhetorical strategies.
- (Editing): Students will demonstrate satisfactory knowledge of writing conventions and correctness.

Grading:

In-class exams (3 exams)	40%
Lab reports	25%
Homework / Writing assignments	10%
Class discussion	5%
Final exam	20%

A: > 93% A-: 90-92%
B+: 87-89% B: 83-86% B-: 80-82%
C+: 77-79% C: 73-76% C-: 70-72%
D+: 67-69% D: 60-66%
F: < 60%

Exams:

Three in-class exams this semester will cover the material presented in the lecture notes, assigned reading from the textbook, and lab experiments. No make-up exam will be given without notification by the end of the class period prior to the exam. The three exam dates, with likely exam coverage, are:

Exam 1: Friday, 9/18. Tentative material: Molecular formula, MS
Exam 2: Friday, 10/16. Tentative material: IR, ^{1}H NMR
Exam 3: Friday, 11/20. Tentative material: ^{1}H NMR, ^{13}C NMR, 2D NMR

Final exam: Wednesday, 12/11 12:00 pm – 2:30 pm

Regardless of attendance, all assignments are due on the scheduled date. **No late assignments will be accepted without my prior consent.**

Homework: Problem sets will be assigned either from Pavia, or posted on Canvas. These sets will be completed individually and turned in at the beginning of class. **NO CREDIT WILL BE GIVEN FOR LATE ASSIGNMENTS.**

Other possible assignments which will be weighted with homework assignments include literature searches, journal article summaries, in-class discussions and in-class presentations.

Class discussion:

Periodically the class will review organic chemistry papers, focusing on the analysis of the characterization methods employed in a particular paper. You will be graded on the quantity and quality of the participation during these sessions. In the event that these discussions never take place, your grade will still be determined based on participation in lecture and team-based problem-solving activities.

Reading: Reading of the appropriate sections of the textbook should be done *before* coming to class. You will be responsible for this material, *even if it is not covered in lecture.*

Attendance: Attendance will not be taken during this class, and is not a component of your grade. However, lectures are more than simply a recitation of the textbook. The lectures will demonstrate how to solvent problems, and in-class activities. As attendance is not required, there is no penalty for being late. However, repeated tardiness and absences reflect a lack of interest in the class and an unwillingness to take studies seriously.

Classroom etiquette: Cell phones or other electronic devices are not to be used in class or in lab. They must be turned off during class sessions. Laptops and tablets are only permitted in class for note-taking purposes. The adverse effect of multi-tasking on learning is well known in the learning community; a recent study suggests this effect extends to <u>those seated around you</u>! (Sana, F., Weston, T., and Cepeda, N.J. *Computers and Education*, **2013**, *24-31*) Computers, phones, tablets or headphones WILL NOT BE ALLOWED in the lab. You will not need them, and the lab is not a safe place for them. Please make sure they are stored away from your work area so they are not damaged by reagents or solvents. It is a policy of the chemistry department that headphones are not to be worn in the laboratory at any time.

Please respect your instructor and fellow students by showing up to class on time. Do not interrupt your instructor or fellow students. This is an upper-level class, and I expect participation from everybody. There are no stupid questions.

Academic Dishonesty: In accordance with the University's Honor Code, <u>all work submitted for grading must be your own</u> and be pledged as such by signing the complete honor pledge at the top of the assignment. Academic dishonesty in any shape or form will not be tolerated.

Suspected violations of the Honor Code will be addressed according to the policy established by the Honor Council. Please familiarize yourself with the University's policies on academic dishonesty: ignorance is not an excuse!

Disability Resources: Students who require or feel they may require accommodations due to a disability should visit the Office of Disability Resources online (http://academics.umw.edu/disability/) for information about available resources. You will need to request appropriate accommodations through this office as soon as possible and then make an appointment to see your instructor to discuss your approved accommodation needs (you will need the letter issued you by the office at this meeting). If you have allergies to any chemicals or other emergency medical information, or have any other special needs, please notify your instructor ASAP.

If you have allergies to any chemicals or other emergency medical information, please notify me as soon as possible.

Title IX statement: University of Mary Washington faculty are committed to supporting students and upholding the University's *Policy on Sexual and Gender Based Harassment and Other Forms of Interpersonal Violence.* Under Title IX and this Policy, discrimination based upon sex or gender is prohibited. If you experience an incident of sex or gender based discrimination, we encourage you to report it. ***While you may talk to your instructor, understand that as a "Responsible Employee" of the University, they must report to UMW's Title IX Coordinator what you share***. If you wish to speak to someone confidentially, please contact the below confidential resources. They can connect you with support services and help you explore your options. You may also seek assistance from UMW's Title IX Coordinator. Please visit http://diversity.umw.edu/title-ix/ to view UMW's *Policy on Sexual and Gender Based Harassment and Other Forms of Interpersonal Violence* and to find further information on support and resources.

Classroom recording statement: Classroom activities in this course may be recorded by students enrolled in the course for the personal, educational use of that student or for all students presently enrolled in the class only, and may not be further copied, distributed, published or otherwise used for any other purpose without the express written consent of the course instructor. All students are advised that classroom activities may be taped by students for this purpose. Distribution or sale of class recordings is prohibited without the written permission of the instructor and other students who are recorded. **Distribution without permission is a violation of copyright law**. This policy is consistent with UMW's Policy on Recording Class and Distribution of Course Materials.

Week	Monday	Wednesday	Friday
1	8/26 What is organic spectroscopy?	8/28 Molecular formulas (1,3.6-3.7)	8/30 Molecular formulas (1,3.6-3.7)
2	**NO CLASS LABOR DAY**	9/4 Molecular formulas (1,3.6-3.7)	9/6 Mass spec review (3.1-3.5)
3	9/9 Mass spec review (3.1-3.5) **HOMEWORK 1 due**	9/11 Fragmentation patterns (4)	9/13 Fragmentation patterns (4) **DROP DATE**
4	9/16 Fragmentation patterns (4) **HOMEWORK 2 due**	9/18 Mass spec problem solving day (8)	9/20 **EXAM 1**
5	9/23 IR theory review (2)	9/25 IR theory (2)	9/27 IR problem session (2)
6	9/30 ^{1}H theory (3)	10/2 **LAB PREP**	10/4 ^{1}H theory (3)
7	10/7 Magnetic anisotropy(5)	10/9 CSE / Magnetic equivalence (5)	10/11 Chemical shift prediction **HOMEWORK 3 due**
8	**10/14 FALL BREAK**	10/16 ^{1}H NMR problem solving (3,5)	10/18 **EXAM 2**
9	10/21 Origin of spin-spin splitting	10/23 Types of coupling (5)	10/25 Tree method (5) **W DEADLINE**
10	10/28 Literature discussion **HOMEWORK 4 due**	10/30 Hoye method (5)	11/1 Hoye method (5)
11	11/4 (6) NMR problem solving	11/6 ^{13}C NMR (4)	11/8 ^{13}C NMR (4,10)
12	11/11 Problem solving / advanced topics	11/13 Problem sovling / advanced topics OR literature	11/15 **EXAM 3**
13	11/18 Problem solving / advanced topics	11/20 2D NMR (10)	11/22 2D NMR (10)
14	11/25 2D NMR (10)	**11/27 THANKSGIVING**	**11/29 BREAK**
15	12/2 Integrated spectroscopy	12/4 Integrated spectroscopy	12/6 Integrated spectroscopy
Finals		**FINAL EXAM 12:00 pm – 2:30 pm**	

TENTATIVE LAB SCHEDULE

8/29	Lab station check-in, organic literature
9/5	Experiment 1: Synthesis and purification of fluorenone
9/12	Experiment 1: Synthesis and purification of fluorenone
9/19	Experiment 2: Separation and identification of unknowns
9/26	Experiment 2: Separation and identification of unknowns
10/3	Experiment 3: Reduction of benzoin
10/10	Experiment 3: Reduction of benzoin
10/17	Experiment 3: Reduction of benzoin
10/24	Planning for projects
10/30	Experiment 4: Diels-Alder stereochemistry puzzle
11/7	Experiment 4: Diels-Alder stereochemistry puzzle
11/14	Experiment 5: Project
11/21	Experiment 5: Project
11/28	**THANKSGIVING BREAK – no lab**
12/5	Project presentation, clean up