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CHMY 421.00: Advanced Instrumental Analysis

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Chemistry 421

Advanced Instrumental Analysis

Spring Semester 2022

Professor: Mike DeGrandpre, Chemistry Bldg 317, phone: 243-4118, email: michael.degrandpre@umontana.edu, also <http://hs.umn.edu/chemistry/people/default.php?s=DeGrandpre> for additional information. Office hours 9:10-12:00 Mon. and Tues. or by Zoom appointment. **Please go through my lab door, Room 317, to get to my office (not through 318).** I might be in the lab (Room 004) from 9-10 a.m. for the lab introductions.

TA: Wade Permar (wade.permar@umconnect.umn.edu)

Lab: Room 004. Open 8 a.m. to 5 p.m. Mon. – Fri.

Texts: Required: *Principles of Instrumental Analysis*, 7th ed (2018) Skoog, Holler, and Crouch. Also, *Quantitative Chemical Analysis* by Harris, or any other Quantitative Analysis textbook, is a helpful resource.

Prerequisites: CHMY 311 or its equivalent is a prerequisite. Please talk to me if you have not taken this course. I assume you have good wet chemistry skills, e.g. ability to use volumetric glassware/pipettes, analytical balances, perform dilution calculations, make up calibration standards, etc. Familiarity with Excel and basic data analysis, e.g. simple statistics, linear regressions, etc. is essential.

Course objectives: In this course you will **1)** obtain a solid foundation of the theory and practice of instrumental methods used in modern chemical laboratories and **2)** improve your laboratory, data interpretation and technical writing skills. The goal of this course is to develop your lab and instrument (and problem solving!) skills to a point where you can work with confidence in a modern chemical laboratory. To achieve this goal, you will work more independently than you have in previous lab courses. Most experiments are structured to first illustrate the basic operating principles of each instrument followed by analysis of an unknown sample. You will complete the semester with a forensic analysis project where you must identify and quantify an unknown contaminant.

Course logistics: To allow individual access to instruments, it is necessary to run the lab outside of the 6 lab hours scheduled for each section and to team up with a classmate. All students must work in groups of two¹. The lab will be open from **8 am - 5 pm Mon-Fri**. This open schedule requires that you be self-disciplined and well-organized (**and safe, see Lab Safety below**). During each lab introduction, it is critical that you take good notes when I explain how to operate an instrument so that you can perform the experiments later without repeating explanations or making mistakes. **However, if you are uncertain about a procedure please ask – personal injury or equipment damage may result if proper procedures are not followed.**

¹ However each person must analyze their own unknown. Lab group multi-tasking, e.g. one person preparing standards while another does the analyses is not allowed. All lab mates must participate in every aspect of the lab.

Lab notebooks and reports: A bound lab notebook with numbered pages is required. Your lab notebook must be present and open in lab for recording procedures, data, and observations. The notebook and lab report formats are described below. A laboratory report will be turned in for each lab. Hardcopies are required (no electronic versions). **All laboratory reports are due in my mailbox at 5 pm on the Tuesday of the week following completion of each lab.** Late reports lose 10% each day thereafter.

Lab Safety: Safety goggles or safety glasses are required. Open toed shoes, food and beverages are not allowed. Working in the lab outside of designated lab hours is not allowed. Corrosive, toxic, and flammable chemicals are used in this class. You must use good judgment when handling all chemicals, e.g. use the hoods when working with volatile substances or gloves when using toxic chemicals. Specific hazards regarding the chemical instrumentation are presented in each lab handout. Please note locations of the eyewash and shower stations. Cleanliness is also an important aspect of a safe laboratory. Please keep the lab clean. **Not following safe lab practices will result in up to a 5% grade reduction.**

Other Stuff: You will need some sort of data storage device (e.g. USB flash drive) for saving data files. Do not rely on the lab computers for storage. Files may be inadvertently deleted. Lastly, we appreciate your help maintaining the lab. Please keep the printers loaded with paper, throw away (or recycle) used paper, fill distilled water (DW) bottles, etc.

Grading: Grades will be on the +/- scale (A, A-, B+, etc) with the following breakdown:

Homework assignments 5%
Lab safety and class participation 5%
Labs (7) 45% Grading rubric: 20 pts organization, 20 pts data presentation, 25 pts results and discussion (including 10 pts for the unknown accuracy, if applicable)
Semester exams (2) 20%
Independent project 10%
Final Exam 15%

Graduate increment: An additional problem will be included for graduate students on each exam

COVID-related items

- Mask use is required within the classroom and laboratory
- Students should not congregate outside the classroom before and after class
- Specific seating arrangements will be used to ensure social distancing and support contact tracing efforts
- Drinking liquids and eating food is not permitted within the classroom or laboratory
- Stay home if you feel sick and/or if exhibiting COVID-19 symptoms
- Up-to-Date COVID-19 Information from the University of Montana
- UM Coronavirus Website: <https://www.umt.edu/coronavirus>
- See this link for the quarantine and close contact info as of January 2022.
https://www.umt.edu/coronavirus/communications/jan_6_2022_comms.php

Chemistry 421– Advanced Instrumental Analysis Schedule			
General topics	Dates	Specific labs	Reading (focuses on chapters related to your current lab)
Check-in	1 week Jan 24 – Jan 28	Course intro; lab check in	Chapters: 1, 2A1-3, 2B-3, 3A, 3B, 3C-1, 4, 5, 22A-C, 23A-D, 23G-H
Topic 1: General lab instrumentation; potentiometry (pH)	2 weeks Jan 31 – Feb 11	Electronics and LabView programming; Computer interfacing and pH measurements	same as above
Topic 2: Spectrochemical methods	5 weeks** Feb 14 - Mar 18	UV/VIS, fluorescence and atomic absorption spectrophotometry	Ch. 6, 7A-H, 8, 9A-D, 10A1-3, 10C-1, 13, 14A-D-2, 15
Topic 3: Chemical separations and mass spectrometry	3 weeks** Mar 28 – Apr 15	GC-MS and liquid chromatography	Ch. 20, 26, 27, 28, 11A-D
Topic 4: Independent project	3 weeks Apr 18 – May 6	N/A	above chapters
Finals Week	3:20-5:20 May 12	N/A	all course material

**Holidays Feb 21 (President's Day), March 21-25 (Spring Break)