Chemistry 370 **Instrumental Analysis Syllabus** Fall 2015

Instructor
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Office Hours: MWF 9 – 11 am; W 1:30 – 2:30 pm; R 11:30 am – 12:30 pm

Course Meeting Times
MWF 12:15 – 1:20 pm
Rohr Science 13

Laboratory
Varied meeting times MWR
Sator Hall 216
See separate *Lab Syllabus* for details

Textbook
Harris, *Quantitative Chemical Analysis*, 8th or 9th Edition.

Additional readings from the current literature will routinely be assigned; these can be found on the course website.

Course Website
https://canvas.pointloma.edu/ Course: **CHE370-1 FA15 - Instrumental Analysis**

Additional readings, practice problems, exam keys, and extra copies of class handouts will be available *only* on the course website. In addition, you will make occasional use of the wiki function.

Group Literature Presentations
A major objective for this course is for you to be able to think critically about real-world applications of chemical instrumentation. With this goal in mind, the class will conduct group discussions of journal articles describing recent applications in chemical instrumental analysis.

During each presentation day, as a *participant*, you'll receive credit for coming prepared to class and actively participating in the discussion. Once during the semester, as *presenters*, your group will receive credit for leading the discussion (including giving an 8-10 minute group presentation introducing the paper, leading a brief discussion of the instrumental method and relevant issues it brings up, and turning in a 1-2 page abstract).

Introduction Problems
A few short Introduction Problems will be assigned daily and will often be used to begin class discussion. The questions will be based on that day's reading assignment and will cover new material. You will work on these problems outside of class. Answers to Intro Problems will be collected to verify *participation* and *effort*.

Recommended Practice Problems
Periodically, sets of recommended problems will be provided to give you an opportunity to practice applying concepts from class and to give an idea of what you can expect on course exams. These problems are optional and will not be graded; the solutions will be posted on the course website.

Exams
There will be two exams (one hour each). See the course schedule for the dates of the exams.

Makeup examinations will be given only for excused absences. In such cases, appropriate documentation must be provided within two working days of the end of the excused absence.

Laboratory
Carefully-selected laboratory exercises will give you an opportunity to apply both theoretical and technical aspects of chemical instrumental analysis. You will also have the rare experience of being

the *very first* users of several new pieces of equipment, acquired with the new science building! Patience, critical thinking, and intellectual independence will serve you well in this laboratory!

Attendance
Regular attendance is absolutely essential to success in Chem 370. Students who miss class for any reason are ultimately responsible for anything covered in that class (including announcements). Students who miss 20% of the total class meetings (4 meetings) may be dropped from the course.

Grades
Your final grade will be determined as follows:

Group Literature Presentations	20%
Intro Problems	10%
Laboratory	30%
Exams (2)	40%
Total	**100%**

Academic Integrity
All students enrolled in this course are expected to adhere to the highest standards of academic integrity. If you are uncertain of the legitimacy of a particular action, you should contact the course instructor and request clarification.

- Collaboration with other students on the experiment, data collection, and data analysis for laboratory reports is encouraged, but the report should be your own.
- Use of any unauthorized aids, or aiding other students on exams is prohibited.
- Improper use of sources on lab reports and/or group literature abstracts is both illegal and unethical, and is grounds for a failing grade. (Note that it is possible to commit plagiarism even while citing the source. For clarification, see the instructor.)
- Assignments and exams from this course may not be committed to dorm repositories or otherwise be used to help future students.

Violations of academic honesty – including cheating, plagiarism, falsification, aiding academic dishonesty, and malicious interference – will be prosecuted to the full extent of university policy.

Academic Accommodations
While all students are expected to meet the minimum academic standards for completion of this course as established by the instructor, students with disabilities may require academic accommodations. At Point Loma Nazarene University, students requesting academic accommodations must file documentation with the Disability Resource Center (DRC), located in the Bond Academic Center. Once the student files documentation, the Disability Resource Center will contact the student's instructors and provide written recommendations for reasonable and appropriate accommodations to meet the individual needs of the student. This policy assists the university in its commitment to full compliance with Section 504 of the Rehabilitation Act of 1973, the Americans with Disabilities (ADA) Act of 1990, and ADA Amendments Act of 2008, all of which prohibit discrimination against students with disabilities and guarantees all qualified students equal access to and benefits of PLNU programs and activities.

CHE370 Goals	CHE370 Outcomes
Students will:	Students will be able to:
1. learn how to select an appropriate instrumental method	a. identify strengths and limitations of instrumental methods (including UV-Vis absorption spectroscopy, atomic absorption and emission spectroscopy, IR spectroscopy, atomic and molecular mass spectrometry, and gas- and liquid-chromatography) b. compare instrumental methods with respect to precision, detection limit, linear range and selectivity c. employ standards in instrumental analyses, including internal and external standards, and the method of standard addition
2. understand the relationship between signal and noise	a. identify sources of noise (both general and method-specific) and strategies for reducing each type b. calculate the signal-to-noise ratio for a particular data set c. calculate the number of scans required to improve signal-to-noise ratio by a specified amount
3. understand the theory behind chemical instruments	a. draw a diagram to represent the energy changes during various types of spectroscopy b. convert between wavelength, frequency, wavenumbers, and energy of electromagnetic radiation c. describe the chemical phenomenon responsible for a particular signal d. convert between absorbance and % transmittance e. determine the concentration of an unknown sample using Beer's Law f. describe sources of deviation from Beer's Law and strategies for preventing or correcting the deviation g. using UV-vis, IR, and/or mass spectral data, predict the structure of an unknown molecule h. using experimental data, determine the column efficiency and resolution for a chromatographic separation
4. learn the components of chemical instruments	a. identify the major components in several types of chemical instrumentation and explain how they work b. draw a block diagram for a particular instrument or configuration c. justify the choice of a particular component, configuration, or experimental condition in an instrumental method
5. apply knowledge of instrumental analysis to real-world problems	a. perform UV-vis, ICP-OES, and IR spectroscopy; and gas- and liquid-chromatography and analyze the resulting data b. present an article from the recent chemical literature highlighting the instrumental method used, and write a brief abstract summarizing the key points from the article you presented c. write a concise and clear report describing the background, experimental procedure, results, data analysis, and conclusions of an instrumental analysis

Program Learning Outcomes: CHEM PLO 2 (HPLC) and ENVS PLO 3 (HPLC, ICP, IR, UV-vis) will be assessed directly by faculty laboratory instructors' observation of students' use of instruments.

Chemistry 370 **Instrumental Analysis *Tentative* Schedule** Fall 2015

		Date	Topic	Reading* (Harris 8e)	Special Events	Lab
1	T	Sept 1	Introduction to chemical instrumentation			
2	W	Sept 2	Intro to spectrophotometry: Beers Law, absorbance, and transmittance	δ17-1, 17-2		*No Lab*
3	F	Sept 4	Absorption and Emission	δ17-3, 17-6, 17-7		
	M	*Sept 7*	*Labor Day – no class*			
4	W	Sept 9	Applications of UV-Vis spectroscopy	δ17-4, 17-5, 18-1 thru 3		*In lab: UV-Vis*
5	F	Sept 11	Reading and writing about instrumental chemistry	Journal articles TBA	*Sample GLP: UV-vis; Develop lab rubric*	
6	M	Sept 14	Spectrophotometers: configurations and sources	δ19-1, 2 (through p. 451)		*In lab: IR*
7	W	Sept 16	Spectrophotometers: wavelength selectors and detectors	δ19-2 (pp. 452-454), 19-3 (through p. 457)	GLP topic selection deadline	UV-Vis Lab Due†
8	F	Sept 18	Infrared spectroscopy instrumentation	δ19-3 (p. 459), 19-4(pp. 463-465), 19-5		
9	M	Sept 21	FTIR, noise, and intro to atomic spectroscopy	δ19-6, 20-1		*In lab: ICP*
10	W	Sept 23	Atomic spectroscopy: sources	δ20-2, 20-3; Journal article TBA	*GLP 1: IR*	IR Lab Due†
11	F	Sept 25	Exam 1*(UV-Vis, IR)*	Chapters 17-19		
12	M	Sept 28	Atomic spectroscopy: wavelength selectors and detectors	δ20-4, 20-5, 19-3		*In lab: GC*
13	W	Sept 30	Introduction to mass spectrometry	δ20-7; Journal article TBA	*GLP 2: AS*	ICP Lab Due†
14	F	Oct 2	Mass spectrometry instrumentation	δ21-1 thru 3		
15	M	Oct 5	Applications of mass spectrometry	δ21-4, 21-5		*In lab: LC*
16	W	Oct 9	Introduction to chromatography	δ22-2 thru 4; Journal article TBA	*GLP 3: MS*	GC Lab Due†
17	F	Oct 9	Gas chromatography (GC)	δ22-5, 23-1 thru 3		
18	M	Oct 12	High performance liquid chromatography (HPLC)	δ24-1, 24-2		*No lab*
19	W	Oct 14	Guest speaker: Isaiah Cedillo (Isis Pharmaceuticals, Inc.)			LC Lab Due†
20	F	Oct 16	Applications of HPLC	Journal article TBA	*GLP 4: GC/LC*	
21	M	Oct 19	Exam 2 *(AS, MS, GC, LC)*	Chapters 20-24		

* The assigned readings shown here are tentative. A more up-to-date reading assignment can be found at the top of each day's Intro Problems.

† Lab reports are due at the start of the lab on your lab day.