

Chromatography
Syllabus and Course Information
2 Credits
Fall 2016

COURSE: CHEM 517 Chromatography

INSTRUCTORS: Brian Clowers, Ph.D.

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OFFICE HOURS: Tuesdays
9:00—10:00 am

COURSE TIME: Monday and Wednesdays
9:10—10:00 am

TEXT:

1. Reading assignments accessible through learn.wsu.edu
2. Hand-outs, review articles, and other information as provided by the instructor and posted on learn.wsu.edu

GOALS AND LEARNING OBJECTIVES: To address modern challenges across the chemical, biological, and physical sciences it is often necessary to isolate and examine chemical and biological species as pure substances. The fundamentals and application of chemical separations remain at the core of these endeavors. It is for these reasons that this class aims to develop a student's understanding of chromatographic separations and the range of modern solutions that exists for compounds isolation and analysis. In addition to the traditional lecture format, the topics covered in this course will be supplemented by classical and modern readings primarily derived from the peer-reviewed literature. The selection of these resources is designed to offer a classical understanding the technical challenges that are now embodied in many of the mature chromatographic approaches now in routine use.

Learning Objectives Table

Upon successful completion of this course students will:

Student Learning Outcome	Evaluation of Outcome
<ul style="list-style-type: none"> • Become familiar with fundamental concepts of partition coefficients at their role in achieving separations across different types of chromatography. <ul style="list-style-type: none"> • This includes development of an understanding of the mechanisms of elution and separation optimization. 	In-class quizzes Take Home Exam
<ul style="list-style-type: none"> • Develop the core skills to parse existing chromatographic protocols and identify the key factors influencing a chromatography experiment. 	In class discussions, presentations and written critiques of contemporary literature.
<ul style="list-style-type: none"> • Understand the underlying assumptions of the most common chromatographic separation techniques and approaches to method validation. 	In-class quizzes and participation in class discussions.

GRADED ACTIVITIES:

Quizzes	40%	100 points
Take Home Exam	20%	50 points
Class Presentation	10%	25 points
Special Topic Report	20%	50 points
Class Participation	10%	25 points

GRADING SCALE:

A: >=90%	A-: 85-89.9%	B+: 80-84.9%	B: 75-79.9%	B-: 70-74.9%
C+: 65-69.9%	C: 60-64.9%	C-: 55-59.9%	D: 50-54.9%	F: <50%

Quizzes—10 points each

- **10 of 13 quizzes will be counted towards the final grade**

Throughout the semester thirteen 7 minute quizzes will be administered at the beginning of class. Of these 13 only 10 will count towards the final grade. Each quiz will cover the material presented in the previous class period. There will be no make-up quizzes and the dates of each quiz will be announced via learn.wsu.edu or in-class. When possible quizzes will be administered using electronically via socrative (<http://www.socrative.com/>). It is the responsibility of each student to

bring a Wi-Fi enabled laptop, phone, or tablet. Login details for CHEM 517 will be provided when necessary.

Take-Home Exam—50 points

A single take-home exam will be assigned during the 16th week of the class. Focusing on the fundamentals, applications, and topics presented by fellow students, this exam is to be completed independently, however, electronic and textual resources may be utilized provided sources of solutions are provided. Solutions to this exam are to be submitted electronically as a PDF no later than end of the final exam period as designated by the WSU Office of the Registrar.

Special Topic Report—50 points

- **10 points for the initial proposal**
- **40 points for the written report**

During the 8th week of class students will be tasked with providing a presentation project proposal (up to 2 pages) focusing the modern fundamentals or applications of chromatography to address technological challenges. This topic proposal is due at the beginning of class on the Wed of the 8th week. The special topic assignment for CHEM 517 is a targeted and critical evaluation of a modern application of chromatography. In addition to the evaluation of the fundamentals of the underlying technique, the student is required to provide an assessment regarding the benefits of a particular separation scheme to the target application. The report is not limited to concepts and topics covered in the course, however, each project proposal must be approved by the instructor. Topics include efforts towards miniaturization, field-deployment, instrumentation, novel sampling and sample preparation schemes, data analysis approaches, and even optimization efforts. Students are encouraged to think broadly. However, the special topic report and accompanying presentation must encompass the research efforts from a minimum of two independent research groups with at least one peer-reviewed publication since 2000. The report must contain a minimum of 10 references and provide a perspective on the current state of the art and prospects for the future.

The following paper format must be followed:

- A minimum of 7 pages with a maximum of 10 (Arial, 12 point font) with a spacing of 1.5 and 1" margins. This page total excludes references and any figures deemed appropriate to convey the topic clearly
- Sections to include:
 - Report title, author name and affiliation.
 - Abstract: This must be a summary with a 200 to 250 word count. The abstract must contain quantitative information that relates to your report. For example, figures of merit and/or performance data that quantitatively (i.e., analytically) describes the state-of-the-art for the topic.

- Introduction and Background: Describe the technology topic you have selected and why you selected it. Be sure to, include the chemical analysis needs and challenges being addressed.
- Experimental and Technology Summary: Describe in sufficient detail the core assumptions and theory of the target method (with references). For example, if it is a new stationary phase design, go into the dimensional and compositional details and relate as much as possible to concepts presented in the course. Include and discuss salient data results (e.g., figures and tables, citing source references) for how the new technology performs.
- Future Directions: What are the challenges and/or shortcomings that still need to be addressed by the technology? Is there room for improvement, and if so, how?
- References: List references cited in text using numbers.

Class Presentation—25 points

- **One 20 minute presentation**

Following the 3rd week of class the dates for each individual presentation will be assigned. Should this presentation date conflict with a legitimate conflict a schedule adjustment will be permitted. Students are encouraged to inquire with other students to identify a date should the original assignment prove unworkable. The format of the presentation will be 15 minutes of actual presentation followed by 5 minutes of questions and answers. Note, that all presentations must be finished prior to the start of class and delivered electronically to the instructor in a pdf form. With the final grading assessment resting on the instructor feedback with respect to clarity of presentation, rigor of analysis, and overall quality will also be provided by fellow students. This information will be provided in written form from all students in the audience to the instructor. Students presenting will be expected to provide a maximum of 8 minutes for an introduction to the topic, followed by 7 additional minutes outlining a detailed rationale for the approach selected and interpretation of the result. A series of curated questions will be provided to each presenter for which an answer is to be posted on learn.wsu.edu. This final task must be completed before a final grade is provided for this assignment.

Class Participation—25 points

- **Electronic/Written Assessment of Presentation**
- **Formulation and Asking of Questions**

All students will be called upon to ask a question of the presenter during the course of the presentation class periods. Students will **not** be informed prior to date of presentation when this will occur but the order will be selected using a random number generator. Each topic proposal, once approved, will be posted on learn.wsu.edu to provide the student audience with a brief introduction to the topic at hand. Additionally, all student audience members will be required to provide

insightful feedback and additional questions to the presenter. Constructive feedback is encouraged. Feedback of simply “good” or “bad” will result in 0 points assigned for a given presentation feedback form. Clarifying and insightful questions are encouraged. Given that the selection of questions to be asked orally at each presentation class period are to be selected at random it is suggested that a question be formulated as soon as possible.

OUTLINE OF CLASS SCHEDULE:

Week	Date	Topic
1	8/22/16	Chromatographic Fundamentals
	8/24/16	Dynamics of Chromatography & BB Theory
2	8/29/16	Band Broadening in Chromatography
	8/31/16	Analytical Impacts of Band Broadening
3	9/5/16	Modes of Chromatography
	9/7/16	Gas Chromatography
4	9/12/16	GC Detectors and Case Studies
	9/14/16	Liquid Chromatography
5	9/19/16	No Class
	9/21/16	No Class
6	9/26/16	General Elution Problem, RP/NP Case Study
	9/28/16	LC Detectors and Case Studies
7	10/3/16	Multidimensional Separations
	10/5/16	GC x GC and LC x LC Case Studies
8	10/10/16	Preparative Chromatography and SFC
	10/12/16	PC and SFC in Pharmaceutical and Environmental Analysis
9	10/17/16	Ion Chromatography
	10/19/16	IC Instrumentation and Case Studies
10	10/24/16	Capillary Electrophoresis: Part 1
	10/26/16	Capillary Electrophoresis: Part 2
11	10/31/16	Ion Mobility Spectrometry
	11/2/16	SEC, PAGE and 2D Gels
12	11/7/16	Applications of Chromatography: Pharmaceutical/GLP
	11/9/16	Applications of Chromatography: Pharmaceutical/GLP
13	11/14/16	Applications of Chromatography: Pesticide Analysis
	11/16/16	Computational Tools for Chromatography Simulations
14	11/21/16	Case Study: Optimization of Separation Parameters
	11/23/16	Student Presentations
15	11/28/16	Case Study: Peak Picking and Deconvolution
	11/30/16	Student Presentations
16	12/5/16	Student Presentations
	12/7/16	Student Presentations
Notes:	Week 10 we welcome Dr. Ivory from Chemical Engineering	
	Week 12 we are fortunate to have an industrial perspective on LC-MS from Dr. Needham from Alturas Analytics	
	Week 13, Day 1 is a presentation by Dr. Vince Hebert from WSU-TC regarding GC-MS applications	

ATTENDANCE POLICY: Attendance will not be taken during each class period, however, presentation dates are not to be missed. An unexcused absence will result in no credit. Students should make all arrangements to NOT miss their selected presentation dates. Anticipation of missing an assigned presentation period should be discussed in advance with the instructor to make alternative plans.

ACADEMIC INTEGRITY: Cheating or plagiarism of any form will not be tolerated. Cheating includes, but is not limited to: copying work or allowing your work to be copied; use of unauthorized material at exams, any communication between students during an exam, and actively looking at another student's paper during an exam. All incidences of cheating may be reported to the Office of Student Affairs. The first incidence of cheating will result in a score of zero for that assignment or exam, a second incident of cheating will result in an F for the course and possible dismissal from the University. Definitions and the processes to be used for handling complaints related to academic dishonesty are presented at <http://conduct.wsu.edu/AI>.

ACCOMMODATIONS: Reasonable accommodations are available for students with a documented disability. If you have a disability and need accommodations to fully participate in this class, please either visit or call the Access Center (Washington Building 217; 509-335-3417) to schedule an appointment with an Access Advisor. All accommodations MUST be approved through the Access Center. For more information contact a Disability Specialist at 509-335-3417, <http://accesscenter.wsu.edu>, or Access.Center@wsu.edu. Accommodations are also available for students whose course activities fall on days that are objectionable because of religious beliefs. Request for accommodations should be made at least a week before the accommodation is required.

SAFETY: Washington State University is committed to enhancing the safety of the students, faculty, staff, and visitors to the Pullman campus. It is highly recommended that you review the Campus Safety Plan (<http://safetyplan.wsu.edu/>) and visit the Office of Emergency Management web site (<http://oem.wsu.edu/>) for a comprehensive listing of university policies, procedures, statistics, and information related to campus safety, emergency management, and the health and welfare of the campus community. The campus-wide alert system is at <http://alert.wsu.edu/>.