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Lecture MWF 11:45-12:35

Office hours: MW. 1-3 PM

BIOT A108

Faculty Huddle E1B

Instructor:

Tim Whitehead, timothy.whitehead@colorado.edu

Office: JSCBB E1B32

TAs:

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Required Text: Bioseparations Science and Engineering (2nd Edition)

Harrison, Todd, Rudge, and Petrides

Oxford University Press.

I found this book freely available from the CU Library – try your luck!

What this course is about: In this course, we will explore a variety of means that are used to purify molecules made using biotechnology. Some of the topics that will be addressed include cell lysis, flocculation, filtration and ultrafiltration, precipitation, crystallization, chromatographic separations, and drying.

Background knowledge: Bioseparations are conducted by taking advantage of special properties of biomolecules to purify them. We will mention how these special attributes get used, but we will assume that you have some basic background in biochemistry and biology. We will also assume a basic familiarity with separations, kinetics, thermodynamics and mass transfer.

Why might you be interested? Separations are a critical part of industrial bioprocesses. Especially in biopharmaceutical arena, engineers who can design efficient separation processes are in high demand. Separations techniques used in biotechnology, while based on the same principles as those used in other industrial separations processes, tend to be specialized to handle the demands of **ultra-high purity** separations of labile (**easily destroyed**) molecules.

Grades: The grades for CHEN 4820 will be assigned based on the following weighting:

Class Participation: 8%

Homework: 20%

Reading Quizzes: 7%

Midterms: 2x 20% (or 0%*)

Final 25% (or 65%*)

Class Participation: A holistic measure of classroom attendance and participation. We will not be using clickers or taking attendance, but the class is small enough that I will know who shows up and engages with the material during lecture.

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Homework: Assignments will be due at 11:59 PM on Gradescope (online). Homework can be done in groups of **no more than three** people. Only one assignment needs to be turned in per group; all group members should sign homework acknowledging that they contributed to the assignment. No late homework will be accepted.

Reading Quizzes: Reading quizzes will be available on Canvas starting a week before the due date. Quizzes will close at 9:00 a.m. on the quiz due date.

Midterms: There will be two midterms during the semester. Both will be held 7-9 PM in JSCBB.

Final: The final will be comprehensive. If you score higher on the final than your midterm average, I will weight your final as 65% of your final course grade, and your midterms to 0% – this is to your benefit, but please don't slack off on the midterms.

Schedule (Subject to Modification):

Week		Subject	Reading	Notes
Week 1 Aug 26, 28,30		Bioseparations- what's different? Basic definitions, methods survey	Reading: Chapters (1)&2	
Week 2 Sept 4,6	HW1 Due Sep 4	Cell lysis, flocculation	Ch 3 Reading Quiz 1 due Sep 4	Labor Day Sep 2 Note- due to Labor Day, Reading quiz is due on Wed this week
Week 3 Sep 9,11,13	HW2 Due Sep 11	Filtration	Ch 4 Reading Quiz 2 due Sep 9	
Week 4 Sep 16,18, 20	HW3 Due Sep 18	Sedimentation	Ch 5 Reading Quiz 3 due Sep 16	
Week 5 Sep 23,25, 27	HW4 Due Sep 25	Extraction, Aqueous 2-phase systems	Ch 6 Reading Quiz 4 due Sept 23	
Week 6	HW5 Due Oct	Chromatography		

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Sept 30, Oct 2, 4	2	Adsorption Equilibrium Fixed bed mass balance	Ch7.1- 7.3.2 Reading quiz 5 due Sept 30	
Week 7 Oct 7,9, 11	HW6 Due Oct 9	Chromatography / Plate Models for chromatography	Ch 7.4 Reading quiz 6 due Oct 7	
Week 8 Oct 14,16, 18	Thursday 10/17 Exam I 7:00-9:00	Exam review Oct 16		Exam location: JSCBB A108 T.A.W. out of town Oct 14 th (no class)
Week 9 Oct 21, 23, 25	HW7 Due Oct 23	Chromatography / Moment analysis, Dispersion, chromatography resins	Ch 7.7- 7.10 Reading Quiz 7 due Oct 21	
Week 10 Oct 28, 30, Nov 1	HW8 Due Oct 30	Precipitation	Ch8 Reading Quiz 8 due Oct 28	T.A.W. may be out of town Oct 28- 30 th
Week 11 Nov 4, 6, 8	HW9 Due Nov 6	Crystallization – Nucleation,	Ch 9 Reading Quiz 9 due Nov 4	
Week 12 Nov 11, 13, 15	HW10 Due Nov13	Batch Crystallization Evaporation	Ch 10 Reading Quiz 10 due Nov 11	T.A.W. out of town Nov 13 th
Nov 18, 20, 22	HW11 Due Nov 20	Drying / Spray Drying	Ch 11 Reading	

Week 13 Nov 25, 27, 29			Equilibrium Moisture curves	Quiz 11 due Nov 18	
		Thanksgiving			
Week 14 Dec 2, 4, 6		THURS Dec 5 Exam II 7:00-9:00	Drying / Lyophilization / Freezing, ice nucleation, Ostwald ripening Glass transitions	Handout	
Week 15 Dec 9, 11, 13		HW 12 Due Dec 11	Virus Purification		
Sunday Dec 15		1:30-4:00	FINAL		

The fine print:

Classroom Behavior

Students and faculty are responsible for maintaining an appropriate learning environment in all instructional settings, whether in person, remote, or online. Failure to adhere to such behavioral standards may be subject to discipline. Professional courtesy and sensitivity are especially important with respect to individuals and topics dealing with race, color, national origin, sex, pregnancy, age, disability, creed, religion, sexual orientation, gender identity, gender expression, veteran status, political affiliation, or political philosophy.

For more information, see the [classroom behavior policy](#), the [Student Code of Conduct](#), and the [Office of Institutional Equity and Compliance](#).

Requirements for Infectious Diseases

Members of the CU Boulder community and visitors to campus must follow university, department, and building health and safety requirements and all public health orders to reduce the risk of spreading infectious diseases.

The CU Boulder campus is currently mask optional. However, if masks are again required in classrooms, students who fail to adhere to masking requirements will be asked to leave class. Students who do not leave class when asked or who refuse to comply with these requirements will be referred to Student Conduct & Conflict Resolution. Students who require accommodation because a disability prevents them from fulfilling safety measures related to infectious disease will be asked to follow the steps in the “Accommodation for Disabilities” statement on this syllabus.

For those who feel ill and think you might have COVID-19 or if you have tested positive for COVID-19, please stay home and follow the [further guidance of the Public Health Office](#). For those who have been in close contact with someone who has COVID-19 but do not have any symptoms and have not tested positive for COVID-19, you do not need to stay home.

Accommodation for Disabilities, Temporary Medical Conditions, and Medical Isolation

[Disability Services](#) determines accommodations based on documented disabilities in the academic environment. If you qualify for accommodations because of a disability, submit your accommodation letter from Disability Services to your faculty member in a timely manner so your needs can be addressed. Contact Disability Services at 303-492-8671 or dsinfo@colorado.edu for further assistance.

If you have a temporary medical condition or required medical isolation for which you require accommodation, contact the professor to work out any needed arrangement. Also see [Temporary Medical Conditions](#) on the Disability Services website.

Preferred Student Names and Pronouns

CU Boulder recognizes that students' legal information doesn't always align with how they identify. Students may update their preferred names and pronouns via the student portal; those preferred names and pronouns are listed on instructors' class rosters. In the absence of such updates, the name that appears on the class roster is the student's legal name.

Honor Code

All students enrolled in a University of Colorado Boulder course are responsible for knowing and adhering to the [Honor Code](#). Violations of the Honor Code may include but are not limited to: plagiarism (including use of paper writing services or technology [such as essay bots]), cheating, fabrication, lying, bribery, threat, unauthorized access to academic materials, clicker fraud, submitting the same or similar work in more than one course without permission from all course instructors involved, and aiding academic dishonesty.

All incidents of academic misconduct will be reported to Student Conduct & Conflict Resolution: honor@colorado.edu, 303-492-5550. Students found responsible for violating the [Honor Code](#) will be assigned resolution outcomes from the Student Conduct & Conflict Resolution as well as be subject to academic sanctions from the faculty member. Visit [Honor Code](#) for more information on the academic integrity policy.

SEXUAL MISCONDUCT, DISCRIMINATION, HARASSMENT AND/OR RELATED RETALIATION

CU Boulder is committed to fostering an inclusive and welcoming learning, working, and living environment. University policy prohibits [protected-class](#) discrimination and harassment, sexual misconduct (harassment, exploitation, and assault), intimate partner violence (dating or domestic violence), stalking, and related retaliation by or against members of our community on- and off-campus. These behaviors harm individuals and our community. The Office of Institutional Equity and Compliance (OIEC) addresses these concerns, and individuals who believe they have been subjected to misconduct can contact OIEC at 303-492-2127 or email cureport@colorado.edu. Information about university policies, [reporting options](#), and support resources can be found on the [OIEC website](#).

Please know that faculty and graduate instructors have a responsibility to inform OIEC when they are made aware of incidents related to these policies regardless of when or where something occurred. This is to ensure that individuals impacted receive an outreach from OIEC about their options for addressing a concern and the support resources available. To learn more about reporting and support resources for a variety of issues, visit [Don't Ignore It](#).

Religious Holidays

Campus policy regarding religious observances requires that faculty make every effort to deal reasonably and fairly with all students who, because of religious obligations, have conflicts with scheduled exams, assignments or required attendance. In this class, Please let me know as soon as possible if you have any such conflicts. See the [campus policy regarding religious observances](#) for full details.

Mental Health and Wellness

The University of Colorado Boulder is committed to the well-being of all students. If you are struggling with personal stressors, mental health or substance use concerns that are impacting academic or daily life, please contact [Counseling and Psychiatric Services \(CAPS\)](#) located in C4C or call (303) 492-2277, 24/7.

Free and unlimited telehealth is also available through [Academic Live Care](#). The Academic Live Care site also provides information about additional wellness services on campus that are available to students.

