Biochemical Engineering

CHEN E4660

Generalized/Tentative Syllabus

Summary of Course:

Application of engineering principles to biological systems. The design, development, and analysis of processes using biocatalysts will be explored. Processes of interest include those that are involved in the formation of desirable compounds and products or in the transformation or destruction of unwanted or toxic substances.

Educational Objectives:

1. Understand the data requirements, analysis, and interpretation for kinetic, thermodynamic, and stoichiometric calculations used for biochemical engineering
2. Assess the biological factors that are important for the design, operation, and performance of a biotechnology process
3. Formulate how to apply kinetic calculations and mass balance analysis for biological reactor design and operation
4. Describe some of the contributions (and potential) of biochemical engineering to society
5. Communicate biochemical engineering concepts through images, writing, and presentation

Instructor: Prof. Allie Obermeyer

Time and Location: TBD

Prerequisites: CHEN E3230 (Reaction kinetics and reactor design) or equivalent. May be taken concurrently or with permission from the instructor.

Textbook:

Shuler and Kargi *Bioprocess Engineering Basic Concepts, 3rd Ed.* Prentice Hall 2017

Diversity & Inclusion:

I would like to create a learning environment that supports a diversity of thoughts, perspectives and experiences, and honors your identities (including race, gender, class, sexuality, religion, ability, etc.) To help accomplish this: (1) if you have a preferred name and/or set of pronouns that differs from what is presented on Courseworks, please let me know; (2) if you feel like your performance in the class is being impacted by your experiences outside of class, please do not hesitate to talk with me; (3) if something was said in class (by me or anyone) that made you feel uncomfortable, please feel like you can talk to me about it. I want to be a resource for you and want to make sure that everyone has the opportunity to succeed in the course.

Examination and Grading Policies:

In class problem solving: We will work problems together during class time. Students will work in small groups on the problems and the instructor will circulate amongst the groups. We will then come back together and you may be randomly called on to lead the discussion of the problem. But, before anyone is called on you will have had the opportunity to work in your small groups on the problem. Students will turn in scanned copies of the worked problems on Courseworks by midnight ET on the day that problems were worked in class.

Participation in online quizzes: In conjunction with the asynchronous video lectures, there will be check-in quizzes on Courseworks. These brief quizzes need to be completed prior to class to receive credit.

Paper Reflections: Over the course of the semester we will read 12 pre-selected research articles, perspectives, and reviews and then discuss them in class. To help facilitate our in-class discussions, everyone will need to fill out a reflection on the article prior to the beginning of class. These reflections are posted as quizzes on Courseworks, but are graded based on completion.

Paper Presentation: Students will take turns presenting one of the pre-selected papers to the class. Students will work in small groups to provide a brief overview of the paper prior to the class discussion. This should be in the format of a PowerPoint presentation that includes relevant background, a summary of the article, and schematics/figures from the paper. Guidance on giving a good presentation will be covered in the second lecture in addition to the Instructor's example presentation of Paper 1.

Exams: There will be a final exam to be completed at the end of the semester. It will be open book and open note. You are strongly encouraged to make a 1-2 page cheat sheet as a study guide and exam tool as the exams will be timed. The final exam is to be completed independently without the help of your classmates, peers, or the internet. Academic dishonesty will not be tolerated on exams (or any other assignments) in the course.

Policy on late assignments: Students are allowed one unexcused late submission of an assignment (excluding the final exams). If you are concerned about turning in assignments on time reach out to the instructor **prior** to the assignment being late to make accommodations. Additional accommodations may be made on a case-by-case basis for students personally impacted by COVID19.

Participation: Attendance in class is strongly recommend and active participation in class may be taken in to account in your final grade, particularly if your grade falls near a letter grade cutoff.

Your overall grade in the course will be determined as follows:

In class problems:	22%
Online quizzes:	10%
Paper reflections:	11%
Paper presentation:	22%
Final exam:	35%

Academic Integrity: On each assignment, I ask you (implicitly or explicitly) to commit to Columbia's policy on academic integrity. Any violations will be reported to proper administration officials and can result in disciplinary action as well as a zero on the assignment or a reduction in your final course grade. It is never worth it to cheat, even if the alternative is doing poorly on an assignment. Please review Columbia's policy on academic integrity carefully:
https://bulletin.engineering.columbia.edu/policy-conduct-and-discipline.

I look forward to facilitating your learning of biochemical engineering throughout the semester. Your comments on the course are appreciated at any point during the semester. Good luck with the course!

Tentative Schedule for CHEN E4660

Week	#	Topic	Reading	Activity
1	1	Introduction to biochemical engineering	pg 1-11	-
2	2	Fundamental biological concepts	pg 13-58, 113-139	Paper 1
	3	Enzyme kinetics	pg 61-71	In-class problems
3	4	Enzyme inhibition, pH and T effects	pg 71-83	Paper 2
	5	Immobilized enzyme kinetics	pg 86-98	In-class problems
4	6	Immobilized enzyme kinetics	pg 86-98	Paper 3
	7	Microbial growth	pg 169-184	In-class problems
5	8	Stoichiometry of growth	pg 227-236	Paper 4
	9	Microbial growth kinetics	pg 191-208	In-class problems
6	10	Continuous culture	pg 208-219	Paper 5
	11	Bioreactor design	pg 275-297	In-class problems
7	12	Bioreactor design	pg 275-297	Paper 6
	13	Bioreactor design	-	In-class problems
8	14	Mass transfer	pg 184-191, 331-337	Paper 7
	15	Mass transfer	pg 184-191, 331-337	In-class problems
9	-	**Election Holiday**	-	-
	16	Sterilization of media and air	pg 356-365	Paper 8
10	17	Animal cell culture	pg 431-449	In-class problems
	18	Genetic modification of organisms	pg 471-506	Paper 9
11	19	Genetic modification of organisms	pg 471-506	In-class problems
	20	Cellular and metabolic engineering	pg 506-514	Paper 10
12	21	Recovery and purification	pg 371-382, 395-420	In-class problems
	-	**Thanksgiving Holiday**	-	-
13	22	Recovery and purification	pg 371-382, 395-420	Paper 11
	23	Recovery and purification	pg 371-382, 395-420	In-class problems
14	24	Catch-up	-	Paper 12
	25	In-class Jeopardy review	-	-
15	26	**FINAL EXAM**	-	-