



CBE 560 Biochemical Engineering (3.0 credits, elective course)

Fall 2022

Class meetings Tu Th 1:00-2:15 pm in 2239 Engineering Hall

Course website <https://canvas.wisc.edu/courses/310795>

Instructional mode in-person, classroom instruction, masks optional

How credit hours are met: 150 minutes of classroom or direct faculty instruction and a minimum of two hours of out of class student work each week over approximately 14 weeks.

Instructor Prof. John Yin

Office Hours Tuesdays, 2:30-3:30pm, 3633 Engineering Hall
or by appointment (john.yin@wisc.edu)

Official Course Description

Properties of biological molecules; enzyme kinetics, enzyme reactors, and enzyme engineering; metabolic engineering; microbial growth kinetics; bioreactor design; bio-separations. Enroll Info: CBE310; CBE320; ZOO151 or ZOO153; or consent of instructor.

Online textbooks (see link for "Files" at course website)

S. Katoh, J. Horiuchi, F. Yoshida ("Katoh")

Biochemical Engineering: A Textbook for Engineers, Chemists and Biologists, 2nd Ed (2015)

J. Villadsen, S.Y. Lee, J. Nielsen, G. Stephanopoulos, Editors ("Villadsen")

Fundamental Bioengineering (2016)

Useful reference books on reserve at Steenbock Library (to update)

J.E. Bailey & D.F. Ollis, *Biochemical Engineering Fundamentals, 2nd Ed.* (1986)

C. Branden & J. Tooze, *Introduction to Protein Structure, 2nd Ed.* (1999)

P.M. Doran, *Bioprocess Engineering Principles* (1995)

H.W. Blanch & D.S. Clark, *Biochemical Engineering* (1997)

M.L Shuler & F. Kargi, 2nd Ed, *Bioprocess Engineering* (2001)

I. Tinoco, et al., *Phys. Chem.: Principles and Applications in Biological Sciences, 4th Ed.* (2002)

Homework policies

Due at the start of class 1pm. Late HW (even by 5 minutes) will receive a grade of zero. Use only one-side of each page, and feel free to use the clean side of recycled paper. To the extent learning the material is advanced by discussions with your classmates, you should feel free to consult with them or Prof. Yin. However, before you do so, you should have put in a significant effort on your own. Your HW should be **your own work**; you may be called on to explain your work.

Grading (max 100)

Team work and Homework assignments (25)

Midterm Exam (30)

Class participation (10)

Final Exam (35)

Course Learning Outcomes (CLOs) By the end of the term you will:

1. **understand and apply principles of chemical engineering** in the analysis and design of industrial biochemical processes,
2. **appreciate the role chemistry plays** in understanding how bio-molecules and bio-molecular systems work,
3. **grasp how chemical engineering principles can contribute** to an integrated understanding of biological systems,
4. **extract, understand, communicate and critique** key idea(s) from any work of the current technical literature, and
5. **identify opportunities for biochemical engineering** to address societal needs in (e.g., energy, health, materials, food, and the environment).

RULES, RIGHTS & RESPONSIBILITIES

ACADEMIC INTEGRITY

By enrolling in this course, each student assumes the responsibilities of an active participant in UW-Madison's community of scholars in which everyone's academic work and behavior are held to the highest academic integrity standards. Academic misconduct compromises the integrity of the university. Cheating, fabrication, plagiarism, unauthorized collaboration, and helping others commit these acts are examples of academic misconduct, which can result in disciplinary action. This includes but is not limited to failure on the assignment/course, disciplinary probation, or suspension. Substantial or repeated cases of misconduct will be forwarded to the Office of Student Conduct & Community Standards for additional review. For more information, refer to <https://conduct.students.wisc.edu/academic-integrity/>.

ACCOMMODATIONS FOR STUDENTS WITH DISABILITIES

McBurney Disability Resource Center syllabus statement: "The University of Wisconsin-Madison supports the right of all enrolled students to a full and equal educational opportunity. The Americans with Disabilities Act (ADA), Wisconsin State Statute (36.12), and UW-Madison policy (Faculty Document 1071) require that students with disabilities be reasonably accommodated in instruction and campus life. Reasonable accommodations for students with disabilities is a shared faculty and student responsibility. Students are expected to inform the instructor of their need for instructional accommodations by the end of the third week of the semester, or as soon as possible after a disability has been incurred or recognized. I will work either directly with you or in coordination with the McBurney Center to identify and provide reasonable instructional accommodations. Disability information, including instructional accommodations as part of a student's educational record, is confidential and protected under FERPA." <http://mcburney.wisc.edu/facstaffother/faculty/syllabus.php>

DIVERSITY & INCLUSION

Institutional statement on diversity: "Diversity is a source of strength, creativity, and innovation for UW-Madison. We value the contributions of each person and respect the profound ways their identity, culture, background, experience, status, abilities, and opinion enrich the university community. We commit ourselves to the pursuit of excellence in teaching, research, outreach, and diversity as inextricably linked goals.

The University of Wisconsin-Madison fulfills its public mission by creating a welcoming and inclusive community for people from every background – people who as students, faculty, and staff serve Wisconsin and the world." <https://diversity.wisc.edu/>

Term schedule (subject to change)

WEEK OF		TOPIC
SEPT	5	Introduction
	12	Intro (cont.), Enzyme Kinetics
	19	Enzyme Engineering, Directed Evolution
	26	Applied Enzymology
OCT	3	Metabolic Stoichiometry and Energetics
	10	Metabolic engineering
	17	Genome engineering
	24	Systems and Synthetic Biology, Midterm Exam (in class Oct 27)
	31	Bioreactor analysis and design
NOV	7	Product recovery, 10Nov2022: Tour Illumina (524 Genomic Dr., Madison)
	14	Molecular engineering for recovery
	21	Transport in bioprocess systems
	28	Molecular systems engineering
DEC	5	Synthetic cells
	12	Course wrap up
Midterm Exam		in class, Thursday, <u>October 27</u>
Final Exam		2:45-4:45pm, Wednesday, <u>December 21</u> , location to be announced