

INTRODUCTION TO BIOCHEMICAL ENGINEERING (CBE:3205); SPRING 2023

General Course Policy

This course is given by the College of Engineering. This means that class policies on matters such as requirements, grading, and sanctions for academic dishonesty are governed by the College of Engineering (see <https://www.engineering.uiowa.edu/current-students/undergraduate-students/academic-advising/academic-policies-and-procedures/academic>). Students wishing to add or drop this course after the official deadline must receive the approval of the Dean of the College of Engineering.

Classroom Expectations

Students are expected to comply with University policies regarding appropriate classroom behavior as outlined in the [Code of Student Life](#). While students have the right to express themselves and participate freely in class, it is expected that students will behave with courtesy and respect for fellow students and instructors. Failure to follow behavior expectations as outlined in the [Code of Student Life](#) may be addressed by the instructor and may also result in discipline under the [Code of Student Life](#) policies governing E.5 Disruptive Behavior or E.6 Failure to Comply with University Directive.

Free Speech and Expression

The University of Iowa supports and upholds the First Amendment protection of freedom of speech and the principles of academic and artistic freedom. We are committed to open inquiry, vigorous debate, and creative expression inside and outside of the classroom. For information on the university's policies on free speech and academic freedom, see <https://freespeech.uiowa.edu>.

Accommodations for Students with Disabilities

The University is committed to providing an educational experience that is accessible to all students. If a student has a diagnosed disability or other disabling condition that may impact the student's ability to complete the course requirements as stated in the syllabus, the student may seek accommodations through [Student Disability Services](#) (SDS). SDS is responsible for making Letters of Accommodation (LOA) available to the student. The student must provide a LOA to the instructor as early in the semester as possible, but requests not made at least two weeks prior to the scheduled activity for which an accommodation is sought may not be accommodated. The LOA will specify what reasonable course accommodations the student is eligible for and those the instructor should provide. Additional information can be found on the [SDS website](#).

Absences for Religious Holy Days

The University is prepared to make reasonable accommodations for students whose religious holy days coincide with their classroom assignments, test schedules, and classroom attendance expectations. Students must notify their instructors in writing of any such Religious Holy Day conflicts or absences within the first few days of the semester or session, and no later than the third week of the semester. If the conflict or absence will occur within the first three weeks of the semester, the student should notify the instructor as soon as possible. See [Operations Manual 8.2 Absences for Religious Holy Days](#) for additional information.

Mental Health

Students are encouraged to be mindful of their mental health and seek help as a preventive measure or if feeling overwhelmed and/or struggling to meet course expectations. Students are encouraged to talk to their instructor for assistance with specific class-related concerns. For additional support and counseling, students are encouraged to contact University Counseling Service (UCS). Information about UCS, including resources and how to schedule an appointment, can be found at counseling.uiowa.edu. Find out more about UI mental health services at: mentalhealth.uiowa.edu.

1. Time and Place of Course

Lecture: 11:30 a.m. – 12:20 p.m. on Mondays, Wednesdays, and Fridays in 3630 Seamans Center (SC)

Discussion (Problem Solving Session): 8:30 - 9:20 a.m. on Tuesdays in 3505 SC

Laboratory: Times to be determined in 3244 SC

2. Course Web Site

Course information can be found on the course web site that is found on the ICON system (<http://icon.uiowa.edu>).

3. Instructor

David W. Murhammer (david-murhammer@uiowa.edu)

Walk-In Hours: Th 1:30-2:30 p.m. & F 8:30-9:30 a.m. in 4132 SC

Zoom meetings will be scheduled upon request.

4. Teaching Assistants

Nicholas Brunn (Nicholas-brunn@uiowa.edu)

Kiana Resch (kiana-resch@uiowa.edu)

Darrell Smith (darrell-smith@uiowa.edu)

2040 SC is reserved on Tuesdays and Thursdays 6:00 to 8:00 p.m. for problem solving and this will serve as the teaching assistants' office hours.

5. Student Consulting Team

A team consisting of three or four student volunteers will meet with Professor Murhammer periodically to discuss approaches to improving course delivery, etc. Students who have suggestions to improve the course can either talk to Professor Murhammer directly or to one of the students on the consulting team.

6. Textbook

No required textbook, but book chapters are available on the course website that cover the material discussed in class. Additional References include:

- "Bioprocess Engineering: Basic Concepts," 3rd ed., Shuler & Kargi, 2017, Prentice Hall, Inc.
- "Biochemistry: A Short Course," 3rd ed., Tymoczko, Berg & Stryer, 2015, MacMillan.

7. Course Learning Goals

By the end of the course, the student will:

- Have a fundamental understanding of cell chemistry, cell metabolism (including yield coefficients and metabolic quotients), recombinant DNA methods, and cell structure and function.
- Be able to choose and apply the simple models of enzyme kinetics, cell growth, and product formation that yield accurate results for the problem under consideration, including the Michaelis-Menten Equation with and without inhibition and the Monod growth equation.
- Have a fundamental understanding of chemostats and their applications and be able to perform the corresponding calculations.
- Be able to formulate a medium for a specific application and to design the corresponding sterilization process.
- Have a fundamental understanding of mixing and oxygen transport in agitated bioreactors and be able to perform corresponding calculations.
- Be able to scale up agitated bioreactors based on various criteria.
- Have a basic understanding of the major issues and techniques involved with purifying biologics and be able to perform corresponding calculations.
- Be able to collect and analyze experimental data.
- Have a fundamental understanding of batch and continuous processes involved in producing fermentation (e.g., antibiotics and biofuels) and recombinant products (i.e., recombinant proteins).
- Have had opportunities to further their professional development through practicing written communication skills.

8. Guidelines on Academic Conduct

- Homework: academic misconduct on homework will result in a zero for the homework portion of the course. Academic misconduct on homework includes (i) using internet sites such as Chegg.com and CourseHero.com or solution manuals to obtain homework solutions, (ii) using previous years' homework solutions, and (iii) copying another person's homework. Collaboration on homework is highly encouraged and includes discussing problems, comparing final answers¹, and generally assisting each other to understand the proper solution approach (much more important than the correct answer!). Note that the purpose of homework is to learn the material, and this will not be accomplished if you simply copy another person's paper.
- Quizzes and Exams: academic misconduct on quizzes or exams will result in a zero for that portion of the course (i.e., all quizzes or all exams). Academic misconduct on quizzes and exams includes (i) looking at the exam or quiz of others (even if nothing is copied), (ii) using an electronic device to communicate with others or store information, and (iii) sharing papers or calculators during an exam.
- Company Reports and Laboratory Reports/Worksheets: academic misconduct on written reports will result in a zero for the specific report portion of the course. The most common type of academic misconduct on written reports is plagiarism (see https://www.engineering.uiowa.edu/sites/www.engineering.uiowa.edu/files/wysiwyg_uploads/ctc_guide_avoiding_plagiarism.pdf for approaches to avoid plagiarism). Note that the use of artificial intelligence (AI) tools such as ChatGPT is another form of plagiarism and therefore its use constitutes academic misconduct. Students are strongly encouraged to get feedback from others regarding their reports, especially from the Hanson Center for Technical Communication.
- Project: academic misconduct on completing the project will result in a zero for the project grade. The most common type of academic misconduct on projects is plagiarism (see relevant comments above for *Company Reports and*

¹Note that other faculty may not agree with this policy.

Laboratory Reports/Worksheets). Students are strongly encouraged to get feedback from others regarding the project report.

9. Homework and Quizzes

Weekly homework assignments will usually be due on Fridays (see tentative course outline for exceptions). A hardcopy of your homework solutions should be handed in at the beginning of class. A penalty of 10%/day will be assessed for late homework. A total of 12 quizzes (15-20 minutes) will usually be on Mondays (see tentative course outline for exceptions) and will cover material from class lecture and from the previous Friday's homework. Only the top 10 quiz scores will count towards the student's final grade. You are encouraged to work together on homework assignments, however, individual solutions must be handed in.

10. Laboratory Component/Schedule

There will be laboratory experiments conducted in groups, including recombinant DNA/protein purification via chromatography, GMO identification via PCR, CRISPR demonstration, and bioreactor experiments in which cell growth/metabolism and oxygen consumption and transport are determined. Each experiment will include individual pre-lab and final reports in the form of worksheets.

<u>Topic(s)</u>	<u>Pre-Lab Due</u>	<u>Date Performed</u>	<u>Report Due Date</u>
pGLO/GMO/CRISPR	March 6	March 6-10	Wednesday, March 22 nd
Chromatography/Bioreactors	April 24	April 24-28	Wednesday, May 3 rd

11. Project Report (Due Friday, May 5th)

Group (2 or 3 students) projects, details to come.

12. Examination Schedule

	<u>Material Covered</u>	<u>Date (Tentative)</u>	<u>Place</u>
Midterm Exam 1	Jan. 18 th – Feb. 24 th Lectures	Wednesday, March 1 st , 6:30-8:30 p.m.	3655 SC
Midterm Exam 2	Feb. 27 th – April 14 th Lectures	Wednesday, April 19 th , 6:30-8:30 p.m.	3655 SC
Final Exam	All Materials Covered in Course	TBD	TBD

No excuses for missed exams will be accepted other than certified medical excuses. If you cannot take the exam at the scheduled time, then please contact Professor Murhammer at least one week prior to that date so that an alternative exam time can be scheduled.

13. Grading

Letter grades will be assigned on a curve with the weighting of the various course components approximately as follows:

(a) Attendance	100 points
(b) Homework	100 points
(c) Quizzes	250 points
(d) Company Report	50 points
(e) Pre-Lab Reports	50 points
(f) Lab Reports	50 points
(g) Project	150 points
(h) Midterm Exams (2)	200 points
(i) Final Exam	<u>200 points</u>
TOTAL	1150 points

14. Tentative Course Outline

<u>Date</u>	<u>Topic</u>
Tu, Jan. 17 th	Guest Presenter Kari Kozak Will Discuss Literature Review/Syllabus Review/Company Report Discussion
W, Jan 18 th	Introduction
F, Jan. 20 th	Introduction/History of Biotechnology/Cell Chemistry/ Company Report Due
M, Jan. 23 rd	Cell Chemistry
Tu, Jan. 24 th	Homework 1 Discussion
W, Jan. 25 th	Cell Chemistry/Cell Structure and Function
F, Jan. 27 th	Cell Structure and Function/ Homework 1 Due
M, Jan. 30 th	Cell Structure and Function/ Quiz 1
Tu, Jan. 31 st	Homework 2 Discussion
W, Feb. 1 st	Cell Metabolism
F, Feb. 3 rd	Cell Metabolism/ Homework 2 Due

Date	Topic
M, Feb. 6 th	Cell Metabolism/ Quiz 2
Tu, Feb. 7 th	Homework 3 Discussion
W, Feb. 8 th	Cell Growth & Product Formation
F, Feb. 10 th	Cell Growth & Product Formation/ Homework 3 Due
M, Feb. 13 th	Cell Growth & Product Formation/ Quiz 3
Tu, Feb. 14 th	Homework 4 Discussion
W, Feb. 15 th	Media Formulation & Sterilization
F, Feb. 17 th	Media Formulation & Sterilization/ Homework 4 Due
M, Feb. 20 th	Media Formulation & Sterilization/Midterm Exam 2 Discussion/ Quiz 4
Tu, Feb. 21 st	Homework 5 Discussion
W, Feb. 22 nd	Strain Development & Recombinant DNA Technology
F, Feb. 24 th	Strain Development & Recombinant DNA Technology/ Homework 5 Due
M, Feb. 27 th	Strain Development & Recombinant DNA Technology/ Quiz 5
Tu, Feb. 28 th	Midterm Exam 1 Discussion
W, March 1 st	Laboratory Discussion/Enzymes & Enzyme Kinetics
W, March 1st	Midterm Exam 1, 6:30-8:30 p.m. in 3655 SC
F, March 3 rd	Enzymes & Enzyme Kinetics
M, March 6 th	Enzymes & Enzyme Kinetics
Tu, March 7 th	Homework 6 Discussion
W, March 8 th	Enzymes & Enzyme Kinetics
F, March 10 th	Common Fermentations & Biofuels Production/ Homework 6 Due/Quiz 6
M-F, March 13-17	Spring Break
M, March 20 th	Common Fermentations & Biofuels Production
Tu, March 21 st	Homework 7 Discussion
W, March 22 nd	Common Fermentations & Biofuels Production
F, March 24 th	Chemostats/ Homework 7 Due
M, March 27 th	Chemostats/ Quiz 7
Tu, March 28 th	Homework 8 Discussion
W, March 29 th	Chemostats
F, March 31 st	Chemostats/ Homework 8 Due
M, April 3 rd	Transport in Bioreactors/ Quiz 8
Tu, April 4 th	Homework 9 Discussion
W, April 5 th	Transport in Bioreactors
F, April 7 th	Transport of Bioreactors/ Homework 9 Due
M, April 10 th	Bioreactor Scaleup and Design/ Quiz 9
Tu, April 11 th	Homework 10 Discussion
W, April 12 th	Bioreactor Scaleup and Design
F, April 14 th	Introduction to Bioseparations/ Homework 10 Due
M, April 17 th	Introduction to Bioseparations/ Quiz 10
Tu, April 18 th	Midterm Exam 2 Discussion
W, April 19 th	Introduction to Bioseparations
W, April 19th	Midterm Exam 2, 6:30-8:30 p.m. in room TBD
F, April 21 st	Laboratory Discussion/ Animal & Plant Cell Culture/Product Formation
M, April 24 th	Animal & Plant Cell Culture/Product Formation
Tu, April 25 th	Homework 11 Discussion
W, April 26 th	Animal & Plant Cell Culture/Product Formation
F, April 28 th	Animal & Plant Cell Culture/Product Formation/ Homework 11 Due
M, May 1 st	Special Topics and/or Makeup/ Quiz 11
Tu, May 2 nd	Homework 12 Discussion
W, May 3 rd	Special Topics and/or Makeup
F, May 5 th	Special Topics and/or Makeup/ Homework 12 Due/Quiz 12/Project Due
Date TBD	Final Exam, Time TBD