

Bioprocess Engineering and Bioseparations

ECH 6937 Section 22664

Class Periods: Tuesdays, 4:05-7:05 PM, Periods 9-11

Location: MAEB 211

Academic Term: Fall 2023

Instructor: Dr. Whitney Stoppel

Contact Prof. Stoppel on canvas, using the canvas messaging system with subject line "ECH 6937"

Whitney.stoppel@ufl.edu (use only for sending documents or other things that can't be sent on canvas)

352.392.6205

Office Hours: TBD based on Qualtrics survey out to students, ~2 hrs a week.

Course Description

Study of chemical engineering problems identified by the students and instructor.

For this course, students will learn the key concepts of bioprocess engineering and bioseparations needed for chemical engineers to succeed in the pharmaceutical industry, the food/beverage industry, and bio-based processes for energy production. We will cover a basic biology introduction, enzymes and enzyme kinetics, growth rates, fermentation, batch processing and batch reactors, and bioactive molecule separation (filtration, gel electrophoresis, chromatography, and other forms of bioseparations for cell therapies, protein therapies, gene therapies, antibody therapies, and viral therapies).

Course Pre-Requisites / Co-Requisites

Ideally some background in biology will help the student succeed, in addition to knowledge of general kinetics and kinetic models and reactors.

Course Objectives

- 1. Connect core concepts in mass transport, reaction kinetics, reactor design, and separations with applications in the biotechnology field**
- 2. Improve students' ability to communicate about core concepts as they apply to biological problems and processes**
- 3. Attain mastery of enzyme kinetics**
- 4. Attain mastery of growth kinetics**
- 5. Apply reactor design principles to biological applications**
- 6. Introduce concepts in bioseparations and trouble shooting bioseparations**
- 7. Introduce fermentation concepts**
- 8. Introduce bioseparations concepts**

Required Textbooks and Software

Bioprocess Engineering: Basic Concepts, 3rd Edition by Michael L. Shuler, Fikret Kargi, and Matthew DeLisa

<https://www.pearson.com/en-us/subject-catalog/p/bioprocess-engineering-basic-concepts/P200000000611/9780137459469>

**print editions will not be required for any exams. You will need access to the textbook to complete your homework assignments, read key concepts before class, and to use to study for exams and supplement in-class lectures. Thus, please feel free to get this textbook in any format you like.

Recommended Materials for catching up on your Biology Background

Lehninger Principles of Biochemistry, 8th Edition, by David L. Nelson and Michael M. Cox (or the 6th or 7th editions):

<https://store.macmillanlearning.com/us/product/Lehninger-Principles-of-Biochemistry/p/1319228003>

Khan Academy: site that can help you cover basic fundamental biology concepts with video lectures

<https://www.khanacademy.org/science/biology>; Lots of topics available, depending on where you think your gaps in vocabulary and understanding might be.

Course Schedule

Class Date	Method of Instruction	Topic	Deadlines	Reading associated with lecture material
Tuesday, August 29, 2023	In class lecture, MAEB 211	Introduction, Biology Refresher, DNA-RNA-Proteins, Metabolic Regulation and Cell Transport		1.3-1.4, 2.1-2.3, 4.1-4.5, 5.1
Tuesday, September 5, 2023	In class lecture, MAEB 211	Enzyme Kinetics and Enzyme Immobilization	HW 1 Due	3.1-3.5
Tuesday, September 12, 2023	In class lecture, MAEB 211	Major Metabolic Pathways, Cell Growth, Stoichiometry of Cell Growth	HW 2 Due	7.1-7.2, 5.1-5.4
Tuesday, September 19, 2023	In class lecture, MAEB 211	Microbial Growth, Continuous Culture and Modifications to Continuous Culture	HW 3 Due	6.1-6.3, 9.1-9.3
Tuesday, September 26, 2023	In class lecture, MAEB 211	Batch Culture, Fermentation, Heat and Mass Transfer in Bioreactors	HW 4 Due	1.3, 5.10, 10.1-10.2,
Tuesday, October 3, 2023	Swamp Head Brewery- meet there by 4:10 PM; 3650 SW 42nd Ave, Gainesville, FL 32608; carpools will be arranged	Visit to Swamp Head Brewery for a tour and discussion of fermentation	HW 5 Due	
Wednesday, October 4, 2023 or Sunday, October 8, 2023	Via zoom, Midterm review			
Tuesday, October 10, 2023	Midterm, MAEB 211	Midterm Exam		
Tuesday, October 17, 2023	In class lecture, MAEB 211	Mammalian Cells as Therapeutics or as Therapeutic Producers (CHO cells)		12.1-12.5, 14.2-14.3,
Tuesday, October 24, 2023	In class lecture, MAEB 211	Introduction to Bioseparations; Group Project Introductions	HW 6 Due	11.1-11.4
Tuesday, October 31, 2023	Via zoom, virtual visit	Virtual visit from Lauren Jansen, PhD, Sr. Director of Process Development, Avenge Bio; Group Project Introductions	HW 7 Due	
Tuesday, November 7, 2023	No Class, AIChE			
Tuesday, November 14, 2023	In person Visit to Resilience, INC; 13200 NW, Nano Ct, Alachua, FL 32615; carpooling will be set up	Resilience, INC visit with Dylan Turpeinen, PhD, Scientist II in the Technical Research and Development Division		
Tuesday, November 21, 2023	In class lecture, MAEB 211	Bioseparations Lecture- Filtration	HW 8 Due	
Tuesday, November 28, 2023	In class lecture, MAEB 211	Bioseparations Lecture- Chromatography		
Tuesday, December 5, 2023	In class lecture, MAEB 211	Group Oral Final Presentations		
Thursday, December 14, 2023	On canvas	Individual Paper Due at time of Final		

Attendance Policy, Class Expectations, and Make-Up Policy

Attendance is required. Course lectures will not be recorded. Homework is due via canvas. A mid-term exam and final project (written and oral component) will account for the bulk of the grade. Make-up policy follows university rules.

To accommodate students and stressful situations, the lowest homework grade will be dropped. One absence for course lectures won't be included. Two 48 hour extensions for homeworks will be granted to each student upon request during the semester, no questions asked. Students must request the extension 12 hours prior to the deadline for the assignment via a canvas message to ensure that Dr. Stoppel can adjust canvas to provide the extension.

Requirements for class attendance and make-up exams, assignments, and other work in this course are consistent with university policies. Click here to read the university attendance policies:

<https://catalog.ufl.edu/UGRD/academic-regulations/attendance-policies/>

Evaluation of Grades

Assignment	Assignment Points	Contribution	Percentage of Final Grade
Attendance for Visits (3)	3	9	6%
Attendance for Class (10)	2	16	10.7%
Homework Sets (8)	5	35	23.3%
Midterm Exam	30	30	20%
Group Paper	30	30	20%
Group Presentation	30	30	20%
Totals		150	100%

Grading Policy

Percent	Grade	Grade Points
93.4 - 100	A	4.00
90.0 - 93.3	A-	3.67
86.7 - 89.9	B+	3.33
83.4 - 86.6	B	3.00
80.0 - 83.3	B-	2.67
76.7 - 79.9	C+	2.33
73.4 - 76.6	C	2.00
70.0 - 73.3	C-	1.67
66.7 - 69.9	D+	1.33
63.4 - 66.6	D	1.00
60.0 - 63.3	D-	0.67
0 - 59.9	E	0.00

More information on UF grading policy may be found at:

<https://catalog.ufl.edu/ugrad/current/regulations/info/grades.aspx>

Students Requiring Accommodations

Students with disabilities who experience learning barriers and would like to request academic accommodations should connect with the disability Resource Center by visiting <https://disability.ufl.edu/students/get-started/>. It is important for students to share their accommodation letter with their instructor and discuss their access needs, as early as possible in the semester.

Course Evaluation

Students are expected to provide professional and respectful feedback on the quality of instruction in this course by completing course evaluations online via GatorEvals. Guidance on how to give feedback in a professional and respectful manner is available at <https://gatorevals.aa.ufl.edu/students/>. Students will be notified when the evaluation period opens, and can complete evaluations through the email they receive from GatorEvals, in their Canvas course menu under GatorEvals, or via <https://ufl.bluera.com/ufl/>. Summaries of course evaluation results are available to students at <https://gatorevals.aa.ufl.edu/public-results/>.

In-Class Recording

Students are allowed to record video or audio of class lectures. However, the purposes for which these recordings may be used are strictly controlled. The only allowable purposes are (1) for personal educational use, (2) in connection with a complaint to the university, or (3) as evidence in, or in preparation for, a criminal or civil proceeding. All other purposes are prohibited. Specifically, students may not publish recorded lectures without the written consent of the instructor.

A “class lecture” is an educational presentation intended to inform or teach enrolled students about a particular subject, including any instructor-led discussions that form part of the presentation, and delivered by any instructor hired or appointed by the University, or by a guest instructor, as part of a University of Florida course. A class lecture does not include lab sessions, student presentations, clinical presentations such as patient history, academic exercises involving solely student participation, assessments (quizzes, tests, exams), field trips, private conversations between students in the class or between a student and the faculty or lecturer during a class session.

Publication without permission of the instructor is prohibited. To “publish” means to share, transmit, circulate, distribute, or provide access to a recording, regardless of format or medium, to another person (or persons), including but not limited to another student within the same class section. Additionally, a recording, or transcript of a recording, is considered published if it is posted on or uploaded to, in whole or in part, any media platform, including but not limited to social media, book, magazine, newspaper, leaflet, or third party note/tutoring services. A student who publishes a recording without written consent may be subject to a civil cause of action instituted by a person injured by the publication and/or discipline under UF Regulation 4.040 Student Honor Code and Student Conduct Code.

University Honesty Policy

UF students are bound by The Honor Pledge which states, “We, the members of the University of Florida community, pledge to hold ourselves and our peers to the highest standards of honor and integrity by abiding by the Honor Code. On all work submitted for credit by students at the University of Florida, the following pledge is either required or implied: “On my honor, I have neither given nor received unauthorized aid in doing this assignment.” The Honor Code (<https://sccr.dso.ufl.edu/process/student-conduct-code/>) specifies a number of behaviors that are in violation of this code and the possible sanctions. Furthermore, you are obligated to report any condition that facilitates academic misconduct to appropriate personnel. If you have any questions or concerns, please consult with the instructor or TAs in this class.

Commitment to a Safe and Inclusive Learning Environment

The Herbert Wertheim College of Engineering values broad diversity within our community and is committed to individual and group empowerment, inclusion, and the elimination of discrimination. It is expected that every person in this class will treat one another with dignity and respect regardless of gender, sexuality, disability, age, socioeconomic status, ethnicity, race, and culture.

If you feel like your performance in class is being impacted by discrimination or harassment of any kind, please contact your instructor or any of the following:

- Your academic advisor or Program Coordinator
- Director of Human Resources, 352-392-0904
- HWCOE Associate Dean of Student Affairs
- Toshikazu Nishida, Associate Dean of Academic Affairs, 352-392-0943, nishida@eng.ufl.edu

Software Use

All faculty, staff, and students of the University are required and expected to obey the laws and legal agreements governing software use. Failure to do so can lead to monetary damages and/or criminal penalties for the individual violator. Because such violations are also against University policies and rules, disciplinary action will be taken as appropriate. We, the members of the University of Florida community, pledge to uphold ourselves and our peers to the highest standards of honesty and integrity.

Student Privacy

There are federal laws protecting your privacy with regards to grades earned in courses and on individual assignments. For more information, please see: <https://registrar.ufl.edu/ferpa.html>

Campus Resources:

Health and Wellness

U Matter, We Care:

Your well-being is important to the University of Florida. The U Matter, We Care initiative is committed to creating a culture of care on our campus by encouraging members of our community to look out for one another and to reach out for help if a member of our community is in need. If you or a friend is in distress, please contact umatter@ufl.edu so that the U Matter, We Care Team can reach out to the student in distress. A nighttime and weekend crisis counselor is available by phone at 352-392-1575. The U Matter, We Care Team can help connect students to the many other helping resources available including, but not limited to, Victim Advocates, Housing staff, and the Counseling and Wellness Center. Please remember that asking for help is a sign of strength. In case of emergency, call 9-1-1.

Counseling and Wellness Center: <https://counseling.ufl.edu>, and 392-1575; and the University Police Department: 392-1111 or 9-1-1 for emergencies.

Sexual Discrimination, Harassment, Assault, or Violence

If you or a friend has been subjected to sexual discrimination, sexual harassment, sexual assault, or violence contact the **Office of Title IX Compliance**, located at Yon Hall Room 427, 1908 Stadium Road, (352) 273-1094, title-ix@ufl.edu

Sexual Assault Recovery Services (SARS)

Student Health Care Center, 392-1161.

University Police Department at 392-1111 (or 9-1-1 for emergencies), or <http://www.police.ufl.edu/>.

Academic Resources

E-learning technical support, 352-392-4357 (select option 2) or e-mail to Learning-support@ufl.edu.
<https://lss.at.ufl.edu/help.shtml>.

Career Connections Center, Reitz Union, 392-1601. Career assistance and counseling; <https://career.ufl.edu>.

Library Support, <http://cms.uflib.ufl.edu/ask>. Various ways to receive assistance with respect to using the libraries or finding resources.

Teaching Center, Broward Hall, 392-2010 or 392-6420. General study skills and tutoring.
<https://teachingcenter.ufl.edu/>.

Writing Studio, 302 Tigert Hall, 846-1138. Help brainstorming, formatting, and writing papers.
<https://writing.ufl.edu/writing-studio/>.

Student Complaints Campus: <https://sccr.dso.ufl.edu/policies/student-honor-code-student-conduct-code/>;<https://care.dso.ufl.edu>.

On-Line Students Complaints: <https://distance.ufl.edu/state-authorization-status/#student-complaint>.