

Bioprocess Engineering and Bioseparations

ECH 4905 Section 25517

Class Periods: MWF 3-3:50 PM, Period 8

Location: Wertheim 360 (Wertheim Lab for Engineering Excellence)

Academic Term: Fall 2022

Instructor:

Dr. Whitney Stoppel

Contact Prof. Stoppel on canvas, using the canvas messaging system with subject line "ECH 4905"

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. We will cover a basic biology introduction, enzymes and enzyme kinetics, fermentation, batch processing and batch reactors, protein separation (gel electrophoresis, chromatography, and other forms of bioseparations).

Course Pre-Requisites / Co-Requisites

Ideally some background in biology will help the student succeed but isn't required for the way this course will be taught in Fall 2022.

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 batch kinetics**
- 5. Apply reactor design principles to biological applications**
- 6. Introduce fermentation concepts**
- 7. 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
Wednesday, August 24, 2022	In class lecture	Introduction		1.3-1.4, 2.1
Friday, August 26, 2022	In class lecture	Biology Refresher-Microbiology		2.1-2.3
Monday, August 29, 2022	In class lecture	Biology Refresher-DNA-RNA-Proteins	HW 1 due	4.1-4.4
Wednesday, August 31, 2022	In class lecture	Metabolic Regulation and Cell Transport		4.5, 5.1
Friday, September 2, 2022	Recorded lectures for viewing, time for student catch up with Khan Academy, complete Quiz 1 on their own time		Quiz 1 Due	
Monday, September 5, 2022	HOLIDAY, Labor Day			
Wednesday, September 7, 2022	Attendance at the UF ChE GRACE Symposium (related to HW 2)			
Friday, September 9, 2022	In class lecture	Enzyme Kinetics	HW 2 Due	3.1-3.2
Monday, September 12, 2022	In class lecture	Enzyme Kinetics		3.1-3.2
Wednesday, September 14, 2022	In class lecture	Enzyme Immobilization		3.3-3.5
Friday, September 16, 2022	In class lecture	Enzyme Immobilization	HW 3 Due	3.3-3.5
Monday, September 19, 2022	In class lecture	Major Metabolic Pathways	Quiz 2 Due: Enzymes	7.1-7.2, 5.1-5.4
Wednesday, September 21, 2022		Stoichiometry of Batch Growth		7.1-7.2, 5.1-5.4
Friday, September 23, 2022		Fermentation-1		1.3, 10.2, 5.10
Monday, September 26, 2022		Fermentation-2		1.3, 10.2, 5.10
Wednesday, September 28, 2022	No Class, Career Showcase		HW 4 due	
Friday, September 30, 2022	Recorded lectures for viewing, time for student catch up with Khan Academy, complete Quiz 3 on their own time		Quiz 3 Due: Fermentation	
Monday, October 3, 2022	Review Session			
Wednesday, October 5, 2022	In class Midterm			
Friday, October 7, 2022	Homecoming HOLIDAY			
Monday, October 10, 2022	In class lecture	Genetic Engineering		8.1, 8.3
Wednesday, October 12, 2022	In class lecture/Guest Lecture	Batch Growth Kinetics-1 (Bacteria)		6.1-6.2
Friday, October 14, 2022	In class lecture	Batch Growth Kinetics-2		6.1-6.2
Monday, October 17, 2022	In class lecture	Batch Growth Technology	HW 5 Due	9.1-9.2

Wednesday, October 19, 2022	In class lecture	Continuous Growth Technology	Quiz 4: Batch Growth Kinetics	6.3, 9.2
Friday, October 21, 2022	In class lecture	Bioreactor Design and Optimization-1		10.1-10.2
Monday, October 24, 2022	In class lecture	Bioreactor Design and Optimization-2		10.1-10.2
Wednesday, October 26, 2022	In class lecture	How Cells Grow-Mammalian Cells	HW 6 Due	12.1-12.2
Friday, October 28, 2022	In class lecture	Mammalian Cell Growth Kinetics	Quiz 5: Bioreactor Design	12.3-12.5
Monday, October 31, 2022	In class lecture	Mammalian Cell Growth Kinetics-2		12.3-12.5
Wednesday, November 2, 2022	In class lecture	CHO Cells and Protein Production		14.2-14.3
Friday, November 4, 2022	In class lecture	Bioreactor Considerations for Mammalian Cells		12.3-12.5, 14.2-14.3
Monday, November 7, 2022	In class lecture/Guest Lecture	Introduction to Bioseparations	HW 7 due	11.1-11.2
Wednesday, November 9, 2022	In class lecture/Guest Lecture	Introduction to Bioseparations-2		11.3-11.4
Friday, November 11, 2022	No Class, Veteran's Day			
Monday, November 14, 2022	Recorded Lecture, Introduction to Bioseparations-3			11.4
Wednesday, November 16, 2022	Group Project- work at your own pace		Quiz 6 due	11.4
Friday, November 18, 2022	Group Project- work at your own pace			11.4
Monday, November 21, 2022	Group Project- work at your own pace			11.4
Wednesday, November 23, 2022	No Class, Thanksgiving			
Friday, November 25, 2022	No Class, Thanksgiving			
Monday, November 28, 2022	Presentation Groups 1-2		Project Written Reports Due, Project Slides Due	
Wednesday, November 30, 2022	Presentation Groups 3-4			
Friday, December 2, 2022	Presentation Groups 5-6		Group work/teamwork assessments due	
Monday, December 5, 2022	Review Session			
Wednesday, December 7, 2022	Special Topics Lecture			
Wednesday, December 14, 2022	Final Exam			

Attendance Policy, Class Expectations, and Make-Up Policy

Attendance is not required, but strongly encouraged. Course lectures will be recorded for select situations where a student is sick or traveling for a university approved absence to ensure that learning is equitable. Quizzes will be given over canvas and will focus on the content in the homework. A mid-term exam and final exam will be given. A group project will also be assigned. Make-up policy follows university rules.

To accommodate students and stressful situations, the lowest quiz grade will be dropped. Two 48 hour extensions for quizzes and/or homeworks will be granted to each student upon request during the semester, no questions asked. Student must request the extension 4 hours prior to the deadline for the assignment via a canvas message to ensure that Dr. Stoppel can adjust canvas to provide the extension.

General deadlines for quizzes will be adjustable by class discussion should a major conflict be identified that impacts most of the class. Dr. Stoppel reserves the right to delay the dates listed for quizzes (push them back) as a function of the progress through the course material.

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	Total Points	Percentage of Final Grade
Homework Sets (7)	50 each	18%
Quizzes (6-1)	100 each	25%, drop lowest
Midterm Exam	300	15.5%
Final Exam	300	15.5%
Group Paper	350	18%
Group Presentation	150	8%
Totals	1950	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.ua.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.ua.ufl.edu/public-results/>.

In-Class Recording

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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 Graduate Program Coordinator
- Jennifer Nappo, Director of Human Resources, 352-392-0904, jpennacc@ufl.edu
- Curtis Taylor, Associate Dean of Student Affairs, 352-392-2177, taylor@eng.ufl.edu
- 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>.