ECH 4905 - Spec Prob in Chem Eng: Pharmaceutical Bioengineering

ECH 4905 Sections 28667 | NML9
Class periods: T | Period 4-5 (10:40 AM - 12:35 PM) | MAT0005
R | Period 5 (11:45 PM – 12:35 PM) | CSEE220
Location: MAT0005 & CSEE220 (in person) | Zoom (TBD)
Academic Term: Spring 2024

Instructor:
Prof. Piyush K. Jain
(Feel free to call me Dr. Jain)
jainp@ufl.edu 352-294-7012
(email is the preferred mode of communication. Please use ECH4905 in the subject line for a quicker response.)

Office Hours*:
M (12:00-1:00 PM) in CGRC 463 or via zoom
F (12:00-1:00 PM) in CGRC 463 or via zoom
*Please note that the office hour timings/locations are subject to changes to accommodate everyone.

To join the meeting on zoom, please use this link below:
https://ufl.zoom.us/j/98214224980
Password: A password to join the meeting will be provided on Canvas.
Meeting ID: 982 1422 4980

Teaching Assistant/Peer Mentor/Supervised Teaching Student:

- TBD

Course Description
(3 Credits) – Introduction to concepts, challenges, and technologies focused on pharmaceutical/biotechnology industry and laboratory research. Pharmaceutical Bioengineering is being offered for the second time in the curriculum of Chemical Engineering. This course will introduce you to basic concepts, technologies, engineering, and challenges in the modern pharmaceutical industry and laboratory focused on biologics (drugs derived from living organisms). The basic concepts you learn in this course might be a refresher to you if you have taken biotechnology-related courses. However, you will be introduced to range of latest technologies and associated challenges that you may revisit in finer detail in other courses. Therefore, it is essential that you work hard to master the material, because these basics will lay the foundation if you work or interact with the researchers in the pharmaceutical or biotechnology industry. While the class sessions and office hours will be online, you are encouraged to work and study in groups and help each other as much as possible (in compliance with principles of academic honesty; see below).

Course Pre-Requisites / Co-Requisites
ABE 2062 (Biology for Engineers) or BSC 2010 (Integrated Principles of Biology 1)
CHM 2046 (General Chemistry)

Course Objectives
Each lecture will have specific learning objectives that will be announced at the beginning of that lecture. Broadly, at the end of this course, a student should be able to do the following:

1) Understand basic structure, function, production, purification, and analysis of biologics including peptides, recombinant proteins, nucleic acids, vaccines, and cell-based therapies.

2) Define and understand physicochemical, pharmacokinetics, and pharmacodynamics parameters and apply them in the context of peptides and proteins based drugs.
3) Understand and analyze the common challenges such as manufacturing bioequivalence, stability, drug delivery, and immunogenicity associated with different biologics and propose creative solution(s) to solve these issues.

In addition to these learning objectives, the assignments and projects will be implemented that will be based on real world problems or case studies and will facilitate following skills:

1) Read, interpret, and analyze information from the textbook as well as external literature.
2) Use resources to find information beyond the assigned textbook and basic search engines.
3) Brainstorm and work in a group in a constructive manner.
4) Illustrate and present data and findings in front of the class.

Materials and Supply Fees
None

Relation to Program Outcomes (ABET):
Not Applicable

Required Textbooks and Software
None

Recommended Materials
- Pharmaceutical Biotechnology: Fundamentals and Applications
  - **Authors:** Crommelin, Dann J. A., Sindelar, Robert D., Meibohm, Bernd
  - **Year, Edition:** 2019, 5th edition
  - **ISBN:** 978-3030007096
- Methods in Biotechnology
  - **Authors:** Seung-Beom Hong, M. Bazlur Rashid, Lory Z. Santiago-Vázquez
  - **Year, Edition:** 2016, 1st Edition
  - **ISBN:** 978-1-119-15678-9
- Lehninger Principles of Biochemistry
  - **Authors:** David L. Nelson; Michael M. Cox
  - **Year, Edition:** 2017, 7th Edition (8th Edition coming soon in 2021)
  - ISBN: 9781464187957 (8th Edition: 9781319322342)

Course Schedule

Wk	Wk begins	# Hours	Concepts*	Remarks/ Assignments Due
1	01/09 01/11	2 1	• Syllabus • Intro to biomolecules/biopharmaceuticals • Central dogma of life	01/09: First day of the class
2	01/16 01/18	2 1	• Cells: structure and function	**Holiday (01/15)**
3	01/23 01/25	2 1	Structure & function of: • Amino acids, peptides, proteins • Nucleic acids • Lipids and carbohydrates	**HW 1** (due on 01/25)

4	01/30 02/01	2 1	Physicochemical properties: • pH-pKa concept • pI of peptides • Molecular forces & binding	Note: Career showcase (01/29-02/02) **HW 2** (due on 02/01)
5	02/06 02/08	2 1	• Recombinant DNA technology • Protein expression • Protein purification techniques	**Guest/recorded lecture** **Quiz 1** (02/08)
6	02/13 02/15	2 1	• Protein engineering/formulation: • Protein analysis techniques, • Protein folding using AI, and structure visualization using Chimera	**Guest/recorded lecture** **Guest/recorded lecture**
7	02/20 02/22	2 1	• Enzyme kinetics, • Pharmacokinetics (PK) • Pharmacodynamics (PD)	Groups for project will be announced **HW 3** (due on 02/22)
8	02/27 02/29	2 1	• PCR • DNA Sequencing • Catch-up	
9	03/05 03/07	2 1	RNA engineering/therapies: • RNAi • Antisense • Ribozymes	**Quiz 2** (03/07)
10	03/12 03/14	0 0	---	**Spring Break (03/09-03/17)**
11	03/19 03/21	2 1	Immune engineering/therapies • Immune system • Antibodies and their applications • Immunotherapy for cancer & beyond	**Guest/recorded lecture** **Guest/recorded lecture**
12	03/26 03/28	2 1	• Viruses • Vaccine engineering: COVID-19 & beyond • Gene therapy/gene delivery	**HW 4** (due on 03/28)
13	04/02 04/04	2 1	• Genetic engineering • CRISPR/Cas systems • Novel tools for gene editing	**Quiz 3** (04/04) **Extra credit** (04/05)
14	04/09 04/11	2 1	• Microbial engineering • Cellular/Tissue/Organism engineering • Regulatory consideration of biologics	**HW 5** (due 04/11)
15	04/16 04/18	2 1	Group project presentations/catch-up	**Final project** (due 04/16)
16	04/23 04/25	2 0	Course and exam review	 **Reading days (04/25-04/26)**
17	04/30	0	Exam Week	**Final Exam: 05/01/2024 7:30 AM - 9:30 AM (Location: TBD)**

*Some concepts may be covered by invited guest speakers or conducted online on zoom.

Attendance Policy, Class Expectations, and Make-Up Policy

You are required to attend all lectures in-person (or virtually with instructor's permission), but it is on the honor system and I will not record attendance.

Cell phones, laptops and other electronics are allowed as educational devices only. Please do not distract others by using electronics for other purposes during class. There can be technical issues/challenges while conducting a HyFlex class recording, please be patient. While attending a zoom lecture, please turn off your audio on zoom. Please do not multitask (check phones, texts, emails, etc.) while attending lectures. If you a miss a class, try to watch the recorded videos as soon as possible.

Make-up policy

Make-up work will be considered on a case-by-case basis, commensurate with your circumstances in a manner that is fair to you and your classmates. There will be no make-up assignments for unexcused absences.

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 (5)	20 each	20%
Quizzes (3)	50 each	30%
Final Exam	150	30%
Group project	100	20%
		100%

Final Exam: 150 points

Final exam will be 150 points, with a total time limit of two hours. Exam questions are meant to assess your ability to understand and analyze problems. During the exam, you are permitted to use a calculator (any model without communication ability; you may not share), but are not permitted to refer to books or notes.

Note: Make-up exams will be considered on a case-by-case basis for documented, excused absences or emergencies. However, once you begin an exam, you may not granted an excused absence for any reason.

Quizzes: 3 Total, 150 points; 50 Points Each

Each quiz will occur during lecture time, and will consist of a few multiple choice, true/false, or short answer questions, and totaling 50 points. During quizzes, you are not permitted to use a calculator (no complex calculations included), books, or notes.

Quiz questions will be easier (generally) and more conceptual than exam questions, and will assess your comprehension of lecture material and ensure that you keep up-to-date. Therefore, they may be announced or unannounced but you will can get a rough idea from the schedule as listed. Unannounced quizzes are not graded or counted towards the points. Online platforms such as Socrative or similar webtools may be incorporated for conducting in-class quizzes.

Team-Based Project: 100 Points

In the class project, you will work in groups of four-five to determine a challenges in biological systems process of your choice and propose solution(s). You will prepare a short video presentation and upload it

on zoom for everyone in class. Groups will be assigned, but you might get an option to choose one of your teammates. Topics will be claimed on a first-come, first served basis, and no duplicate topics are allowed. A component of peer review will be incorporated.

More details will be given when the project is assigned in October.

Homework: 5 Total, 100 points; 20 points Each
Homework will be assigned approximately once per week, and will consist of 3-5 problems to submit. The submitted problems will be graded on the following basis:

Not attempted – 0% points
Attempted but not completed – 20-25% points
Completed but incorrect – 40-50% points
Completed and correct – 100% points

You should plan to spend at least 3 hours per week on homework (if not more). You are permitted to discuss the problems and problem-solving strategies with your colleagues, but you may not breach the Academic Honesty Course Policy (see below).

Homework is to be completed on the assignment document (see Canvas page) in neat handwriting (without excessive erasures or cross-outs) or typed in word on standard-size (8.5" x 11") paper, without frayed edges, folds or excessive wrinkling. Homework can be uploaded on Canvas using a scanner software or an app. You are responsible to making sure that the homework is uploaded on Canvas.

Homeworks (except HW5) are due at 5 PM on Wednesdays of the week. To incentivize you to finish homework assignments early, homework submitted 48 hours before the due date (that is by 5 PM on the Monday) will receive **two automatic bonus points**. However, your total homework score may not exceed 100 points. You may also submit homework via e-mail any time prior to the due date, however, Canvas is preferred. **Late homework will not be accepted without prior documentation and approval.**

Extra Credit: 20 Points Possible
You will have the opportunity to earn a maximum of 20 extra-credit points. The deadline to turn in extra credit is one week prior to the last lecture (i.e. you cannot submit extra credit after you see your final exam grade). More details will be provided in early November.

Grading Policy

Point Value	Percent Value (%)	Letter Grade*
470-500	94-100	A
460-469	92-93.9	Gray
445-459	89-91.9	A-
435-444	87-88.9	Gray
425-434	85-86.9	B+
420-424	84-84.9	Gray
405-419	81-83.9	B
395-404	79-80.9	Gray
380-394	76-78.9	B-

370-379	74-75.9	Gray
350-369	70-73.9	C+
335-349	67-69.9	Gray
310-334	62-66.9	C
300-309	60-61.9	Gray
275-299	55-59.9	C-
0-274	0-54.9	D/F (Gray)

*Depending on the performance of the class, grades may be curved uniformly at the discretion of the instructor.

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 varied perspectives and lived experiences within our community and is committed to supporting the University's core values, including the elimination of discrimination. It is expected that every person in this class will treat one another with dignity and respect regardless of race, creed, color, religion, age, disability, sex, sexual orientation, gender identity and expression, marital status, national origin, political opinions or affiliations, genetic information, and veteran status.

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
- HWCOE Human Resources, 352-392-0904, student-support-hr@eng.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 suppor*t*, 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/getting-help/; *https://distance.ufl.edu/state-authorization-status/#student-complaint*.