

Biomolecular Engineering

EGN 6937

BME 3406

Class Periods: MWF Period 9 (4:05 – 4:55)

Location: CSEE 220

Academic Term: Fall 2021

Instructor:

Name: Carl Denard

Email Address: cdenard@ufl.edu

Office Phone Number: 352-294-6370

Office Hours: Tuesday: 4-5 PM, Zoom: 372 824 0199

Course Description

Introduces chemical engineering students interested in bio-related careers to the chemical engineering discipline. Emphasizes the link between biology and chemical engineering and the interface between them.

Course Pre-Requisites / Co-Requisites

BSC 2010 or ABE 2062

Course Objectives

Biomolecular Engineering has become an integral part of industrial biotechnology and enables several advances in biomedicine, biomaterials, biochemical engineering, and synthetic biology. The following course objectives will be met:

- Introduce students to the core principles and technologies of molecular biotechnology.
- Discuss and highlight the expansive role of chemical engineers in the field of biomolecular engineering.
- Engage students in discussions about the latest technologies and advances in the diverse fields that intersect with and empower biomolecular engineering.
- Provide students with the tools and knowledge to pursue an industry or academic career in Biotechnology.
- Discuss the regulations and ethical concerns in the fast-growing field of Biomolecular Engineering.

Required Textbooks: There is no single required textbook for the course. Instructor notes/slides will be posted before class. Recommended readings include:

- 1) Molecular Biotechnology by Bernard Glick and Jack Pasternak, 5th Edition (quasi-textbook)
- 2) Chapters 2, 3, 4, and 7 in Molecular Cell Biology by [Harvey Lodish](#), [David Baltimore](#), [Arnold Berk](#), [S. Lawrence Zipursky](#), [Paul Matsudaira](#), 4th Edition, 1999.
- 3) Chapters 1, 2, 5, and 6 in Metabolic Engineering: Principles and Methodologies by Gregory N. Stephanopoulos, Aristos A. Aristidou, Jens Nielsen, 1998.
- 4) Synthetic Biology – A primer (revised Edition) by Baldwin, Bayer, Dickinson, Ellis, Freemont, Kitney, Polizzi and Stan – ISBN: 978-1-78326-879-5

Tentative course schedule

	<i>Course material</i>	<i>Reading material</i>	<i>Other items</i>
23-Aug	Intro to Biomolecular Engineering		
25-Aug	Chemical Foundations, Architecture of the Cell		
27-Aug	Central Dogma of Molecular Biology		
30-Aug	Foundational technologies - Recombinant DNA technology- Intro		
1-Sep	Foundational technologies - Recombinant DNA technology - Cloning methods		
3-Sep	Foundational technologies - Recombinant DNA technology - Latest advances (CRISPR-Cas, TAL effector nucleases, Zinc-finger nucleases)		
<i>6-Sep</i>	<i>Labor day</i>		
8-Sep	Foundational technologies - Genomics and Proteomics		
10-Sep	Foundational technologies - Genomics and Proteomics		
13-Sep	<i>Journal article discussion</i>		Lightning talk
15-Sep	Protein structure and function		
17-Sep	Exploring proteins: purification, detection, and characterization		Lightning talk
20-Sep	Protein Engineering, I: rational design		
22-Sep	Protein Engineering, I: rational design		Lightning talk
24-Sep	<i>(HW1 due): Catchup and Review</i>		
27-Sep	<i>Journal article discussion</i>		Lightning talk
29-Sep	<i>Exam I</i>		
1-Oct	Protein Engineering II: Directed Evolution - Principles and Methods		Lightning talk
4-Oct	Protein Engineering II: Directed Evolution - Examples and applications - Antibody Engineering		
6-Oct	Protein Engineering: Protein composability and protein-protein interactions - Synthetic, chimeric cell receptors		Lightning talk
8-Oct	<i>Protein Engineering II: Directed Evolution - Latest advances</i>		
11-Oct	Cellular Metabolism		Lightning talk
13-Oct	Tools to rewire cell metabolism - Intro to gene circuits		
15-Oct	Tools to rewire cell metabolism -		Lightning talk

18-Oct	Metabolic Engineering		
20-Oct	Metabolic Engineering		Lightning talk
22-Oct	Molecular diagnostics		
25-Oct	Journal article discussion - CRISPR-based diagnostics and COVID-19		Lightning talk
27-Oct	Therapeutic agents		
29-Oct	Therapeutic agents		Lightning talk
1-Nov	(HW2 due): Synthesis of commercial products by recombinant microorganisms		
3-Nov	Microbial insecticides		Lightning talk
5-Nov	Bioremediation and Bioenergy		
8-Nov	Large scale production of proteins from recombinant microorganisms		Lightning talk
10-Nov	Journal article discussion		Lightning talk
12-Nov	Exam II		
15-Nov	Transgenic plants		Lightning talk
17-Nov	Transgenic plants		
19-Nov	Transgenic animals		
22-Nov	(HW3 due) Patenting and regulating biotechnology		
24-Nov	Oral presentation		
26-29-Nov	Thanksgiving Break		
1-Dec	Oral presentation		
3-Dec	Oral presentation		
6-Dec	Oral presentation		
8-Dec	Oral presentation		

Attendance Policy, Class Expectations, and Make-Up Policy

The course will be taught in person, unless anything changes during the semester, and we are forced to switch to an online format. No attendance will be recorded, but attendance is strongly encouraged as this is a small class size. This is the first instance this course will be taught, there will undoubtedly be changes to assignments, exam dates and deadlines. These will be communicated in a timely manner on Canvas. The course will be HyFlex, meaning it will be taught simultaneously in person and online.

COVID-19

- You are expected to always wear approved face coverings during class and within buildings even if you are vaccinated.
- If you are sick, stay home and self-quarantine. Please visit the UF Health Screen, Test & Protect website about next steps, retake the questionnaire and schedule your test for no sooner than 24 hours after your symptoms began. Please call your primary care provider if you are ill and need immediate care or the UF Student Health Care Center at 352-392-1161 (or email covid@shcc.ufl.edu) to be evaluated for testing and to receive further instructions about returning to campus.
- If you are withheld from campus by the Department of Health through Screen, Test & Protect, you are not permitted to use any on campus facilities. Students attempting to attend campus activities when withheld from campus will be referred to the Dean of Students Office.
- UF Health Screen, Test & Protect offers guidance when you are sick, have been exposed to someone who has tested positive or have tested positive yourself. Visit the [UF Health Screen, Test & Protect website](#) for more information.
- Please continue to follow healthy habits, including best practices like frequent hand washing. Following these practices is our responsibility as Gators.

Homework:

- Assignments are due at the beginning of class on the due date. Assignments received within 24 hours of the start of class will have grades reduced by 50%. After 24 hours, no credit will be given.
- You may work together on homework; in fact, it is highly encouraged. However, simply copying solutions from someone else is not allowed (i.e. splitting problems to be worked by individuals and pooling solutions in the end; doing one week's homework and copying the next week's from your partner). Evidence of such will be treated as cheating. Solutions will be available on Canvas.

Exams:

- Exams may include material covered in lecture, in assigned readings, in handouts and in oral presentations.
- Lectures and problem sets should give an indication of what is most important. In other words, there will not be exam questions regarding some obscure passage in the text.
- If you miss an exam without either a certified medical excuse or prior approval from the instructor, no makeup test will be given. You will receive a zero for that exam. Tests missed with certified medical excuses or prior approval will be dealt with individually.

Excused absences must be consistent with university policies in the Graduate Catalog (<https://catalog.ufl.edu/graduate/regulations>) and require appropriate documentation. Additional information can be found here: <https://catalog.ufl.edu/UGRD/academic-regulations/attendance-policies/>

Journal article discussion:

- Every so often, a journal article will be discussed in class. This article will be assigned a week prior to class to give enough time for students to read and formulate their questions. The article will build upon elements covered in class.
- These classes are designed for discussion, and your participation is key to their success. Elements from these discussions may appear on your exams.

Lightning talks:

- Starting on **September 13, 2021**, there will be a lightning talk session in the beginning of each lecture. There will be 2 presentations in each session and each student will give a brief introduction (1-2 slides, no more than 3 min) on a company or an academic lab of his or her choice. In the presentation, the student needs to address the following key questions:
 1. What does this company or academic lab work on?
 2. What is the most significant product (for the company) or publication (for the lab)? How is it related to this course?
 3. Why do you select this company or lab?

These presentations will be given in an alphabetical order based on the students' last names. The students must send their slides to Dr. Denard at least 24 hours in advance. In addition, a score (0-5 points) will be assigned to each presentation.

Final project:

The final project will consist of two parts: writing a report on a self-selected research topic (see additional handout for a list of suggested topics) and giving an oral presentation. The project will be done in teams of two to three students. The choice of topic should be communicated to the instructor no later than **October 13th**.

The report (one hard copy and one electronic copy) will be due at 5:00pm on **December 13, 2021**. Reports received after the deadline will receive no credit. The report should be no more than 8 single-spaced printed pages in length including all references, diagrams, and drawings. The font should be 12-point. In the report, you should clearly address questions such as what the topic is about, why it is important, how it works, and what has been done.

The team will give a 20-minute presentation plus 5 min for questions in front of the whole class on your report. All three members of a team will receive the same score. It is up to you as to how the work will be split. Grading on the presentation will be done by the instructor.

Grading on the report will be done by the instructor in two steps. (1) A group score will be assigned based on grading by the instructor. (2) For individual score, 80% of the group score and 20% of the peer score will be used. A "Peer Evaluation" form will be required from each student (see additional handout). The purpose of this form is to ensure that each team member gets full credit (or takes full responsibility) for their level of participation (or lack thereof).

Evaluation of Grades (tentative)

Assignment	Percentage of Final Grade (EGN 6937)	Percentage of Final Grade (BME 3406)
Homework Sets (3)	10%	15%
Hourly Exam 1	20%	22.5%
Hourly Exam 2	20%	22.5%
Lightning talks	5%	5%
Final project (a) research report	35%	25%
(b) Oral presentation	10%	10%
Total	100%	100%

Grading Policy

The following is given as an example only.

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:

<http://gradcatalog.ufl.edu/content.php?catoid=10&navoid=2020#grades>

Final Project Peer Evaluation Form

Please evaluate all members of your team, including yourself, according to their contribution to the final project and influence on team morale.

Things to consider when giving a score – Did each member do what was expected/needed of him/her? Did they show up for meetings on time and were well-prepared? Did he/she take the project seriously? What was the quality of his/her contribution to the team conversations, research and solution? Did they complete their portion of work responsibly and on time? Did the student work well with and cooperate with other team members?

- Assign each member of your team a grade between 0 and 100.
- You cannot assign 100 points to yourself and 0 points to the rest. If you do so, the form will be considered incomplete.

Last Name	Score (0-100)	Reason
1. Self		
2.		
3.		
4.		

Other comments:

Name

Signature and Date

- **Name and signature are required. If they are missing, the evaluation will be presumed to be incomplete.**
- **An incomplete form will receive no credit!**

A Partial List of Suggested Research Topics

1. Bioremediation
2. Biofuels
3. Gene therapy
4. DNA vaccine
5. Membrane bioreactor
6. Genetically engineered crops
7. Stem cell research
8. Lab on a chip
9. Protein chip
10. DNA chip
11. Riboswitch
12. Ribozymes
13. DNazymes
14. siRNA
15. Antisense oligonucleotides
16. Novel DNA sequencing techniques
17. AIDS vaccines/therapeutics
18. Tissue engineering
19. Bio-MEMS
20. Cell surface display
21. Genomics
22. Proteomics
23. Metabolomics
24. Bioinformatics
25. Gene delivery
26. Biomaterials
27. Controlled drug release
28. Immunotherapy
29. Cancer vaccines
30. Biocatalysis
31. Biosynthesis
32. Bioentrepreneurship
33. Synthetic biology
34. Induced pluripotent stem cells (iPS)
35. Genome engineering
36. Genome-scale modeling
38. Biosimilars
39. TAL transcription like effector nucleases (TALENs)
40. CRISPR-Cas9
41. Optogenetics
42. CAR-T therapy
43. Single cell analysis
44. Liquid biopsy
45. DNA synthesis and assembly
46. Genetically encoded materials

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 Conduct 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. 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 Resource 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: <http://www.distance.ufl.edu/student-complaint-process>.