14:155:210 Biological Foundations of Chemical Engineering, Spring 2025

Lectures: Mondays and Wednesdays, 3:50–5:10 PM
Pharmacy (PH) Building, Room 111.

Instructor: Prof. Gregory Dignon
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Study groups start 3rd week of the semester
SG1: Tuesdays 2:00-3:20 PM, TIL 111M
SG2: Wednesdays 10:20-11:40 AM, SERC 104

Prerequisite Courses: 640:152 (Calc II) and 160:307 (Organic Chem I)

Web Page: Canvas will be the hub for online course activities.
- Class announcements will be sent via Canvas, so make sure to enable notifications for this course.
- Assignments will be submitted through Canvas.
- Canvas IT help is available at https://canvas.rutgers.edu/canvas-help/.

Textbooks and Lecture Notes:
- The following textbook is strongly recommended, but not required: *Essential Cell Biology*, Alberts et al., 5th Edition (ECB5). The 4th edition is acceptable as well.
- You are responsible for the content of the lectures and lecture notes. The notes will be posted before class. You may use the textbook to supplement the lecture notes and fill in gaps in your knowledge.
- We will draw from other resources as well, which will be referenced in class, including *Lehninger Principles of Biochemistry* (by Nelson and Cox).

Technology:
- Make sure to bring a device to class that can connect to the internet. Each class will include multiple choice questions to be submitted through ClassQuestion, a polling service you can access online. In-class quizzes will be administered via Canvas.
- You will occasionally need to use MATLAB or Excel to solve problems. Computational skills are necessary for engineering careers and are reinforced in most CBE classes.

Class Participation:
Students are responsible for all information covered in class. Questions and participation are highly encouraged. You should notify the instructor in advance if you must miss several lectures due to illness.

Overall Educational Objective:
This course provides background in cell biology, biochemistry, molecular biology, and biophysics for chemical engineers. Content includes biochemistry and biophysics of proteins and nucleic acids; cellular composition and metabolism; tools for manipulating cells; and an introduction to biotechnology products and processes. This course provides background necessary to understand essential properties of biological products in industry and serves as a foundation for the Biochemical Engineering course.

Student Learning Outcomes:
Students successfully completing this course should

- Develop familiarity with the basic components of biology that are relevant to chemical engineers, including proteins, nucleic acids, lipids, and carbohydrates.
- Develop familiarity with quantitative analysis of biological systems. This includes but is not limited to enzyme kinetics, receptor-ligand binding, and metabolism.
- Understand the capabilities and principles behind basic techniques of molecular biology.
- Understand the requirements for growth and maintenance of prokaryotic and eukaryotic cells.
- Identify a range of products of biotechnology and be familiar with bioprocessing techniques.

Tips on How to Study for This Class:
This course has qualitative and quantitative components, plus some memorization too. Please speak with the instructor if you need help developing your study skills. For qualitative concepts, you should focus on conceptual understanding (rather than memorizing) so that you can apply the concepts to new scenarios on quizzes, exams, and in your future employment or education.

Assessment:
This class will assess your understanding in a variety of ways. The breakdown is as follows:
1. Clicker questions: 5% - bonus credit
2. Homework: 15%
3. Discussions: 10%
4. In-class quizzes (~every other week): 15%
5. Exams (Two of them: 15% each): 30%
6. Project (Three parts; 10% each): 30%

Clicker questions will be submitted through ClassQuestion during lectures. You can sign up for ClassQuestion here, and join this class using the course code PRRHG. When prompted for your Student ID, enter your NetID (not your RUID) as this will ensure your grades are properly accounted for. During each lecture, there will be multiple choice questions to test your understanding of concepts being taught. A correct answer will receive full credit, an incorrect answer will receive 80% credit, and no answer will receive no credit.

Homework will be assigned every week on Wednesday and will be due Thursday the next week. These will focus on 1) problem solving 2) searching for information & communicating/presenting information in your own words 3) use of software such as Excel and MATLAB. These will be assigned on Canvas, and you should submit written/typed work as a PDF or Word Document (.pdf or .docx extensions), computational work as MATLAB code or Excel spreadsheets (.m or .xlsx extensions), or presentation slides, as Powerpoint presentations or PDF files (.pptx or .pdf extensions). There will be a total of ~10 homework assignments, and **your lowest score on a single homework assignment will be dropped**.

Discussions will be assigned every other week (alternating weeks with homework assignments), and you will have two weeks to complete each one. For these, you will receive a discussion prompt on Canvas, and will be asked to write a short paragraph based on the prompt and then reply to a post from one of your classmates to continue the discussion. There will be a total of ~6 discussion assignments.

In-class quizzes will be held roughly every 2-3 weeks and will take about 20 minutes at the end of the lecture. The questions will serve as useful practice for exams and will cover the material from the previous several lectures.

Two Exams will be given, one roughly halfway through the semester, and one near the end. The exams will be in the classroom on paper and will be closed book, closed notes. You will be allowed to bring one page of handwritten notes, which you will turn it at the end of the exam.

A Project will be assigned at the beginning of the semester. Each student will select one from a list of six "kitchen" experiments, carry out the experiment, and record and write up their results. This project is divided into three parts due at different times throughout the semester:

1. Individual reports: Simply carry out the protocol, record results and write a short (3-page) report.
2. Group experiment design & reports: You will then be grouped into groups of 4. Together you will design and carry out follow-up experiments based on each of your previous results. You will submit a short memo to the Professor and receive feedback on your newly designed experiments. Then conduct the new experiments and write it up into a longer (~6-page) report. You will also submit peer evaluations of your teammates, which will be factored in to the final grade.
3. Scientific communication: The groups will finally work together to make a video or a presentation to communicate what you have learned to the public (people without a background in STEM).

- **Late policy:** For homework and discussion assignments, there will be 25% off for each day late.
- **Regrade policy:** If you believe a regrade is truly necessary, you must request the regrade within 3 days of the assignment being returned to you.
- **Grading scale:** On average, A = 90-100%, B+ = 85-90%, B = 80-85%, etc. However, these cutoffs vary from year to year. It will not be changed unless it is in your favor.

Academic Integrity:

- Rutgers students are expected to maintain the highest level of academic integrity. By enrolling in this course, you assume responsibility for familiarizing yourself with the Academic Integrity Policy and the possible penalties (including grade penalties, suspension, and expulsion) for violating the policy. As per the policy, suspected violations will be reported to the Office of Student Conduct. Academic dishonesty includes (but is not limited to) cheating, plagiarism, aiding others in committing a violation, and failure to cite sources.
- Posting course materials to external sites without the instructor's permission may be a violation of copyright and may result in the same penalties as cheating.
- Several assignments in this course require you to consult the scientific literature. **Cite your references!** You may use the American Chemical Society citation style. In almost all circumstances, you should use your own words rather than directly quoting from your source.
- With the increasing popularity (and ever-changing nature) of generative artificial intelligence (AI) applications such as ChatGPT, it is important to note the usefulness as well as the limitations of using them. The most appropriate use of such tools within the course would be to help you study. **For writing assignments, you should not attempt to pass off work written by generative AI as your own as this constitutes plagiarism.**

Learning Etiquette:

- **Be respectful** of your instructor, instructional assistants, and classmates.
- **Communication/email policy.** The goal of the instructor and is to help students learn and succeed in this course. The best way to do that is through conversation. Whenever possible and appropriate, ask your questions during class, after class, or at office hours – rather than by email. The instructor and TA will do their best to reply to email inquiries within 48 hours.
- **Be professional**. University coursework is a professional activity and professional conduct in this course prepares you for professional conduct in your future endeavors. Your communications in person and online should be clear, concise, and courteous.

Religious holidays:

Please let the instructor know in advance of any religious holiday that conflicts with a class, or prevents you from completing an assignment, so that we may accommodate for it. Let us know by **the second week of class (Jan. 31)** to allow enough time to plan.

Disability Accommodations:

Rutgers University welcomes students with disabilities. If you require accommodations, please consult with the Office of Disability Services (ODS) and discuss with the instructor as soon as possible. You can read more about ODS and apply for accommodations at https://ods.rutgers.edu/.

Student Resources:
The faculty and staff at Rutgers are committed to your success. Students who are successful tend to seek out resources that enable them to excel academically, maintain their health and wellness, prepare for future careers, navigate college life and finances, and connect with the RU community. Resources that can help you succeed and connect with the Rutgers community can be found at https://success.rutgers.edu, and many services and resources are available remotely.

Course schedule (tentative):

Date		Topic	Reading	Assignment Due (HW on Thursdays)
Wed	22-Jan	Biochemistry and molecular biology	Ch. 1	
Mon	27-Jan	Chemical components of cells	Ch. 2	D1
Wed	29-Jan	Cell growth and metabolic diversity	Ch. 3	HW1
Mon	3-Feb	Biotech & biochemical engineering	Slides	
Wed	5-Feb	Biochemical thermodynamics	Ch. 3	HW2
Mon	10-Feb	Proteins I	Ch. 4	D2
Wed	12-Feb	Proteins II	Ch. 4	HW3
Mon	17-Feb	No class		
Wed	19-Feb	Proteins III	Ch. 4	HW4
Mon	24-Feb	Carbohydrates	Panel 2-4	Project part 1 & D3
Wed	26-Feb	Enzymes and enzyme kinetics-guest	Ch. 4	HW5
Mon	3-Mar	Metabolic Pathways	Ch. 3 & 13	
Wed	5-Mar	Review		HW6
Mon	10-Mar	Exam 1		
Wed	12-Mar	Diffusion in biology & biochemistry	Slides	No HW due
Mon	17-Mar	*spring break*		
Wed	19-Mar	*spring break*		
Mon	24-Mar	Lab techniques in biochemistry	Ch. 10	D4
Wed	26-Mar	Lipids and membranes	Ch. 11	HW7
Mon	31-Mar	Computational techniques	Slides	Project p2 memo
Wed	2-Apr	Nucleic acids (DNA, RNAs)	Ch. 5	HW8
Mon	7-Apr	DNA replication	Ch. 6	D5
Wed	9-Apr	Transcription	Ch. 7	HW9
Mon	14-Apr	Translation & gene expression	Ch. 8	
Wed	16-Apr	Recombinant DNA I	Ch. 10	HW10
Mon	21-Apr	Recombinant DNA II	Ch. 10	Project part 2 & D6
Wed	23-Apr	Viruses and coronavirus	Slides	HW11
Mon	28-Apr	Immunology and applications	Slides	
Wed	30-Apr	Review		HW12
Mon	5-May	**Exam II**		
	May 8-14	Finals week (No final for this course)		Project part 3

Note: Homework assignments will be due on Thursdays at 11:59 PM, following the Wednesdays listed on the table. While due dates may be changed, nothing will be moved to an earlier date.