Biochemical Engineering (155:411)

Senior Course for Department of Chemical and Biochemical Engineering

Fall Semester, 2020

Instructors:

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Dr. Shishir Chundawat Email: shishir.chundawat@rutgers.edu

TA:

Bhargava Nemmaru Email: bn156@scarletmail.rutgers.edu

Class Timing: Mon/Wed 1:40 pm-3:00 pm

Virtual Class Location: To be held synchronously via Rutgers WebEx. All lectures will be recorded and posted on Canvas. But students are highly encouraged to attend all live synchronous lectures for active participation in course related materials (e.g., interactive discussions, polls, pop-quizzes). Lectures will be led by Dr. Zhang or Dr. Chundawat as indicated in the course schedule below. Please login to either instructors Personal WebEx Channel based on the course schedule.

https://rutgers.webex.com/meet/hz247 (for Dr. Zhang's lectures)

https://rutgers.webex.com/meet/spc120 (for Dr. Chundawat's lectures)

Instructor Office Hour:

Wed 3 to 4 pm

For Dr. Zhang 9/2 – 10/7, 11/11 – 11/23 (same webex link for virtual class)

For Dr. Chundawat: 10/12-11/4, 12/2-12/11 (same webex link for virtual class)

TA office Hour:

Fri 4-5 pm

https://rutgers.webex.com/meet/bn156

Course Description:

Introduction to basics of biochemistry, biology, and microbiology with applications in biochemical engineering. Understanding how biochemical engineering is used for the analysis, control, and development of diverse biological, biochemical, and industrial relevant bioprocesses. Quantitative and problem-solving approach will be emphasized to solve biochemical engineering problems.

Course Objectives:

In this course, students will learn the basics of biochemical engineering, and apply this knowledge to answer the following types of questions:

- What are the major components of cells? How do they transfer genetic information?
- How do various industrially relevant cells grow (e.g., bacteria, yeast, mammalian)?
- How do metabolic pathways impact formation of small and large biomolecules?
- How to engineer cells genetically and re-route metabolic pathways?
- How to design and engineer proteins (or enzymes) relevant to cell engineering?
- How can bioprocesses be established and scaled up?

Tentative Course Schedule & Lecture Instructor (subject to change):

Lec. No.	Date	Lecture Topic	Instructor	Textbook chapter(s)	HW assign	HW due
1	9/2/2020	Introduction	HZ/SC	1, 2		
2	9/8/2020	Overview of Cell Biology	HZ	2		
3	9/9/2020	Enzyme	HZ	3		
4	9/14/2020	Cell Metabolic Pathways and Cell Growth 1	HZ	5,6		
5	9/16/2020	Cell Growth 2	HZ	6	Hw 1	
6	9/21/2020	Cell Growth 3	HZ	6		
7	9/23/2020	Stoichiometry of Growth	HZ	7		Hw 1
8	9/28/2020	Cell growth regulation	HZ	4	Hw 2	
9	9/30/2020	Genetic Alteration 1	HZ	8		
10	10/5/2020	Genetic Alteration 2	HZ	8		Hw 2
	10/7/2020	Exam 1: Dr. Zhang Lectures 1-10	HZ			
11	10/12/2020	Enzyme Immobilization	SC	3.4	Hw 3	
12	10/14/2020	Cell Culture and Bioreactors 1	SC	9		
13	10/19/2020	Cell Cultures and Bioreactors 2	SC	9		
14	10/21/2020	Cell Culture Scale up	SC	10		Hw 3
15	10/26/2020	Sterilization	SC	10.4	Hw 4	
16	10/28/2020	Bioseparations 1	SC	11		
17	11/2/2020	Bioseparations 2	SC	11		
18	11/4/2020	Bioseparations 3	SC	11		Hw 4
	11/9/2020	Exam 2: Dr. Chundawat Lectures 11-18	SC			
19	11/11/2020	Using Genetically Engineered Microbes 1	HZ	14	Project 1, 2	
20	11/16/2020	Using Genetically Engineered Microbes 2	HZ	14		
21	11/18/2020	Metabolic engineering & Mixed Cell Cultures	HZ	14.8 and 16		
22	11/23/2020	Animal Cell Engineering	HZ	12		
	11/25/2020	*No class: Wednesday=Friday. Happy Thanksgiving!*	-			
23	11/30/2020	Group Project Presentations I	HZ			Project 1
24	12/2/2020	Protein Design and Engineering 1	SC	Special Notes		
25	12/7/2020	Protein Design and Engineering 2	SC	Special Notes		
26	12/9/2020	Protein Design and Engineering 3	SC	Special Notes		
	12/11/2020	Group Project Presentations II	SC			Project 2

Required Textbook:

Bioprocess Engineering-Basic concepts (2nd Edition) M.L. Shuler/F. Kargi OR Bioprocess Engineering-Basic concepts (3rd Edition) M.L. Shuler/F. Kargi/M. DeLisa https://www.pearson.com/us/higher-education/program/Shuler-Bioprocess-Engineering-Basic-Concepts-3rd-Edition/PGM30283.html

Required Software (for Chundawat Lectures Only):

Pymol (for protein visualization) and FoldIt (for protein design and modeling) are free software available for students that can be downloaded directly to your personal laptops. Please register online to download Pymol (https://pymol.org/edu/?q=educational/) and FoldIt (https://fold.it/student). SuperPro Designer software for bioprocess simulations (https://www.intelligen.com/superpro_overview.html) is now available via remote VPN access to ECS lab computers.

Grading Policy:

All homework and projects will be posted on the Canvas course webpage.

Total Grade 100%: Homework & Pop-Quizzes (30%); Exam 1 (20%); Exam 2 (20%); Project 1 (15%); Project 2 (15%)

Homework should be submitted via Canvas before the beginning of the class on the designated date. There is a 30% penalty for late submission. Homework submitted one week after the due day will NOT be graded. All students are required to participate in both projects at the end of the semester.

Course Material Copyright Policy:

All course material posted on the Canvas course website is copyrighted and may not be posted on any other web site at or outside of Rutgers without permission from the course instructor. Noncompliance with this policy will be treated as a violation of the Code of Student Conduct and will be referred to the Office of Student Conduct for action.

Academic Integrity Policy:

Students are expected to familiarize themselves with and adhere to the University policy on academic integrity at: http://academicintegrity.rutgers.edu/policy-on-academic-integrity.

It is understood that a student's name on any individual homework assignment, quiz, or exam indicates that he/she neither gave nor received unauthorized aid. On individual homework assignments, *authorized* aid includes discussing: 1) interpretation of the problem statement, 2) concepts involved in the problem, 3) approaches for solving the problem. Anything beyond this constitutes unauthorized aid and violates the academic integrity policy.

A student's name on a group assignment indicates that he/she contributed to the assignment. Quizzes and exams are tests of individual performance. The student is not permitted to obtain assistance from any other person (or persons) during quizzes or exams. The student must adhere strictly to the instructions provided by the professor regarding what is permissible to be used during the exam. Use of lecture notes, computers, laptops, and cell phones for quizzes or exams without prior authorization of instructor is **PROHIBITED**.

Students caught cheating on homework, quizzes, projects, or exams will be reported to the undergraduate program director for disciplinary action in accord with the university policy on academic integrity!