BIM 264: Synthetic and Systems Engineering of Cells

Prerequisites	ENG6, MAT22B, CHEM2C, BIS2A, or consent of instructor Students should have basic knowledge of molecular biology, especially gene expression, cell signaling, and cell-cell communication. Students should also know certain experimental techniques, including molecular cloning, cellular transformation, and cellular imaging. In addition, students should know the solution of ordinary differential equations.
Course Description	Synthetic biology is an emerging discipline that aims to engineer and control biological systems for biotechnological applications and biological studies. This course will cover basic principles and analysis of synthetic biological systems using mathematical tools, including differential equations, stochastic models, and nonlinear dynamics. The course will introduce concepts of synthetic and systems biology through their applications in studies of cell fate decision (cell cycle and differentiation). Furthermore, the course will discuss applications of synthetic cells in bio-computation, disease treatment, cancer-cell identification, and production of bio-commodities.
Required Text	N/A
References	1. Prof Tan 2. An Introduction to Systems Biology: Design Principles of Biological Circuits, Uri Alon 3. A first course in systems biology, Eberhard Voit
Course Objectives	1. Students will learn to formulate quantitative biological experiments for the study of cellular systems 2. Students will learn to create and simulate models of cellular systems 3. Students will learn to apply fundamental concepts of synthetic biology in cellular engineering 4. Students will learn the impact of synthetic biology on the society
Topics	Section 1: Cellular decision in cell cycle and development. Network and gradient-based controls of cellular decision. Section 2: Precision, robustness, and modularity of cellular networks. Section 3: Biocomputing, biofuel, and bioremediation Section 4: Biomedicine, diagnosis, and therapeutic treatment
Grading	Midterm exam 30% Project 30% Homework 30% Participation 10%
Exam	Midterm exam
Class Policies	1. No late work is accepted. **NO SCORE** for a missed assignment. 2. Make up exams are granted on a case-by-case basis. Arrangements must be made before the exams. **NO SCORE** for a missed exam except in exceptional circumstances.

3. Exam grading policy: Total final scores will be curved accordingly.
4. Exam re-grading policy: A graded exam will be regarded in its entirety at the student's request. Points could be **SUBTRACTED or ADDED** based on the re-assessment.
5. Students are expected to follow class ethics. No texting/video/gaming/cell phone. Punctuality is an expected virtue.
6. No video recording during classes. Class materials cannot be shared online without the consent of the instructor.

Code of Academic Conduct

This class adheres to the **UCD Code of Academic Conduct** which requires that "all ACADEMIC members of the academic community are responsible for the academic integrity of the Davis campus" (http://sja.ucdavis.edu/cac.htm). Plagiarism will lead to **NO SCORE** for an assignment. Additional **PENALTIES** will be considered for serious cases of violation. Questions about plagiarism can be answered by visiting the website for Student Judicial Affairs. (http://sja.ucdavis.edu/avoid.htm). The followings are typical, but not all inclusive, examples of violation of academic conduct:
1. Cheating during exams
2. Copying of homework/exam solutions from fellow students
3. Copying of online materials for class projects and homework. Exceptions could be granted by Prof. Tan for certain materials (videos and figures).

Students with Disabilities

UC Davis is committed to ensuring equal educational opportunities for students with **DISABILITIES**. Students must request academic accommodations prior to or at the beginning of each quarter by visiting the Student Disability Center (160 South Silo) and completing an SDC Accommodation Request Form. The University is not required to provide any academic accommodation that would result in a fundamental alteration of the academic program. Please note that it can take up to two weeks to process accommodation requests, so it is very important to submit the request form early. If classroom or examination accommodations are approved, the student will receive an accommodation letter with instructions regarding notifying instructors of the accommodations authorized.

Potential Course Overlap

The course is an advanced version of BIM161 and BIM143 for graduate students. It is a multidisciplinary course that emphasizes the tight integration of mathematical tools and biological engineering. It draws examples from recent publications in the field of synthetic biology. Instruction prepares students to design synthetic biological constructs for the engineering and control of biological systems. It also educates students on temporal and spatial controls of biological systems. Although some elements of the course are offered in specialized courses across campus, the integration of mathematics and biological engineering is unique in this course, and is not offered by other courses.