425mcd2018

Master Course Description for EE-425 (ABET sheet)

Title: Laboratory Methods in Synthetic Biology

Credits: 4

UW Course Catalog Description

Coordinator: Georg Seelig, Professor, Electrical and Computer Engineering

Learning Objectives: At the end of this course, students will be able to:

1. *Culture* bacteria.
2. *Manipulate* DNA with restriction, ligation, PCR and gel electrophoresis.
3. *Transform* bacteria with recombinant DNA and screen for successful transformants.
4. *Design* genetic regulatory networks at the level of the DNA sequence.
5. *Extract* DNA from cells and *prepare* it for sequencing.
6. *Perform* fluorescence and growth assays with a fluorescence plate reader.
7. *Use* a fluorescence microscope to capture single cell behavior in time.
8. *Analyze* experimental data and fit it to mathematical models.
9. *Understand* the risks and ethical considerations of synthetic biology.

Textbook: None.

Prerequisites by Topic:

1. Introduction to synthetic biology (or similar)
2. Differential equations
3. Linear algebra
4. General chemistry
5. Familiarity with the use of Matlab
6. NOTE: No biochemistry background is required.

Topics:

1. The applications, risks and ethics of synthetic biology and sterile technique
2. Lab safety
3. Basic lab techniques including pipettes
4. Bacterial cultures and growth curve
5. Design of experiments and controls
6. Extraction of plasmid DNA from E. coli
7. Recombinant DNA techniques include restriction digests, gel purification, ligation, and PCR based methods

8. Sequencing for the purposes of debugging constructs
9. Fluorescence reporters and methods for measuring cell activity using fluorescence
10. Time lapse fluorescence microscopy
11. The application of differential equations and stochastic processes to predicting the behavior of synthetic biochemical networks
12. Parameter estimation and system identification

Course Structure: The class meets for one lecture a week (Mondays) followed by two three-hour lab sessions each week. Laboratories are done in groups of two. There will be weekly prelab quizzes and then lab reports. A final design project is due at the end of the quarter. The course uses MATLAB for homework problems. The students complete an average of 3 hours of computer work per week.

ABET Student Outcome Coverage: This course addresses the following outcomes:

H = high relevance, M = medium relevance, L = low relevance to course.

(1) *An ability to identify, formulate, and solve complex engineering problems by applying the principles of engineering, science, and mathematics* **(M)** An ability to apply knowledge of mathematics, science, and engineering to the design of biochemical networks for specific applications.

(2) *An ability to recognize ethical and professional responsibilities in engineering situations and make informed judgments, which must consider the impact of engineering solutions in global, economic, environmental, and societal contexts* **(H)** An understanding of professional and ethical responsibilities related to introducing new genetic material into the ecosystem.

(3) *An ability to function effectively on a team whose members together provide leadership, create a collaborative and inclusive environment, establish goals, plan tasks, and meet objectives* **(H)** Lab work is done in teams.

(4) *An ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions* **(H)** Students will generate and analyze data from their own experiments.

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