Winter 2013
MCB 263: Biotechnology Fundamentals and Application
Fridays, 2:10-4:00 / Room (TBA)

Course Outline

Instructors:
Professor Karen McDonald
Chemical Engineering and Materials Science
3008 Bainer Hall, 2-8314
kamcdonald@ucdavis.edu
Office Hours: Th 2-3 pm

Professor Ray Rodriguez
Molecular and Cellular Biology
1139 Plant Reproductive Biology Building, 2-3263
rlrodriguez@ucdavis.edu
Office Hours: Th 1-2 pm

Course Goals: MCB 263 is designed to train graduate students interested in careers in biotechnology research and development. In addition to lectures and guest seminars, the course will also emphasize student-directed team projects. MCB 263 will:

1) Present core concepts in biotechnology (molecular biology, recombinant DNA technology and bioprocess engineering)
2) Focus on Cross-disciplinary Team Science by drawing on instructors from both the biological and engineering disciplines
3) Provide opportunities to practice Cross-disciplinary team science by assigning students with project groups where they design and present projects as a team
4) Introduce basic principles of bioentrepreneurship and issues associated with enterprise development, bioethics and regulatory affairs

Curriculum:
50% of the course is the Team Project, which includes at least one engineer/physical scientist and one biologist. Projects are designed to reinforce the learning process by broadening the scope of topics covered in the formal lectures while providing students the opportunity to delve more deeply into specific topics. Other features of the project include:

- A two-sentence or one minute "elevator pitch" introduction for each presentation
- Incentives will be offered to students to be entrepreneurial and develop projects practical and/or commercial potential. Teams with the best projects will be referred to the Big Bang Business Plan competition in the following school year.

50% of the course is focused on core concepts in molecular biology and bioprocess engineering along with 1-2 special topics presented by guest speakers. Recent breakthroughs and development in biotechnology (“hot topics”) will also be covered in the MCB/ECH 294 “Current Progress in Biotechnology” series.
A. Molecular Biology: Expression of Recombinant Proteins of Medical, Industrial and Environmental Importance

1. Identifying and capturing gene sequences of interest and strategies for their expression in foreign hosts (e.g., bacteria, yeast, plants and mammalian cells) as well as cell free systems.
2. Strategies for optimizing recombinant protein expression
3. Addressing issues of post-translational modification and protein stability
4. Discussion of issues of public perception/acceptance and basic principles of risk communication

B. Bioprocess Engineering: Upstream and Downstream Processing, Biomanufacturing Facilities and Regulatory Compliance

1. Upstream Processing: Bioreactor designs, operational strategies, quantitative modeling, scale-up, and impact of host cell/expression system on upstream processing.
2. Downstream processing: Unit operations and design principles for the recovery, purification, formulation and fill/finish of biotech products, impact of host cell/expression system on downstream processing.
3. Steps involved in bringing a biopharmaceutical to the market, economic considerations for the large-scale production of biologics, new biomanufacturing technologies (e.g. single use systems), and regulatory requirements (current Good Manufacturing Practice or cGMP).

C. Guest speaker or webinars on: current topic, biotech company idea generation, hot topics such as metabolic engineering, use of bioinformatics and statistics in data management and analysis.

Grading: Letter grades will be based on one midterm exam (50% total), a written project proposal (10%), and a team oral presentation (40%). For the team project, the class will be divided into teams of approx. 3-5 students. Based on the concepts, methodologies and strategies discussed in class (or found in the literature), the teams will propose, describe and analyze a biotechnological approach for producing a specific product(s) in a biological host. Project proposals will be submitted to the course instructors for review and approval. Each team will make an oral presentation on their project to the class and instructors near the end of the quarter.

Course materials available on SmartSite: MCB 263 001 WQ 2013

Reference Texts (on Reserve at Library):
(Tentative) Lecture Schedule

Jan. 11, R Rodriguez, Basics of Biotechnology: An Introduction
Jan. 18, R Rodriguez, Basics of Biotechnology: Methodologies
Jan. 25, R. Rodriguez, Basics of Biotechnology: Overexpression
Feb. 1, K. McDonald, Upstream Bioprocessing
Feb. 8, K. McDonald, Downstream Bioprocessing
Feb. 15, K. McDonald, Case Studies and New Applications
Feb. 22, Midterm Exam (comprehensive)
Mar. 1, Guest Speaker (TBA) followed by Team Meetings to work on Presentations
Mar. 8, Student Presentations
Mar. 15, Student Presentations
Mar 22 (Final Exam Time Slot): Student Presentations