

SYLLABUS
OAKLAND UNIVERSITY
Department of Biological Sciences
BIO 441
Microbial Biotechnology
Winter 2017

Course Description: This course will cover broad topics relevant to industrial and applied microbiology. Topics will include molecular microbiology, strain development, metabolic engineering, federal regulation of biologics and GRAS ingredients, bioreactor design, downstream processing and industrial case studies.

Purpose: Green chemistry has gained traction due to the economic and environmental costs of using fossil fuels. Microorganisms are often attractive alternatives to petroleum-based chemistry as their metabolism is incredibly diverse and many microbes have been discovered to undergo difficult biotransformations. This course will explore topics central to the use of microbes to produce industrial and pharmaceutical products from start to finish.

Prerequisite(s): BIO 341 or BIO 319

Days	Time	Room	Credits	
TR	3:30-5:17 PM	386 MSC	4	
Name	Email (@oakland.edu)	Office Phone	Office	Office Hours
Sara Blumer-Schuette	blumerschuette	370-3168	331 MSC	TR 2-3 PM

Recommended Textbook: This course will pull from a variety of textbooks including:

- Molecular Biotechnology. 2010. Glick, Pasternak and Patten. 4th Ed.
- Bioprocess Engineering. Shuler and Kargi. 2nd Ed.
- Biochemical Engineering: A Textbook for Engineers, Chemists and Biologists. 2009. Katoh and Yoshida. 1st ed.
- Bioprocess Engineering Principles. 2013 Doran. 2nd ed.

None of these textbooks are required to be purchased for this course. Readings from these textbooks will be provided.

- You will need to check in on our Moodle page weekly for quizzes and reading assignments.
- We will use the website: <https://kahoot.it/#/> for in class quiz games

Student Outcomes: Microbial biotechnology incorporates engineering principles applied to biological systems. As such, the following outcomes will be covered in our class:

- (a) an ability to apply knowledge of mathematics, science, and engineering
- (c) an ability to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability
- (d) an ability to function on multidisciplinary teams
- (f) an understanding of professional and ethical responsibility
- (g) an ability to communicate effectively
- (j) a knowledge of contemporary issues
- (l) applying principles of engineering, biology, human physiology, chemistry, calculus-based physics, mathematics (through differential equations), and statistics
- (m) solving bio/biomedical engineering problems, including those associated with the interaction between living and non-living systems
- (n) analyzing, modeling, designing and realizing bio/biomedical engineering devices, systems, components, or processes systems

Grading:

Class Participation: 100 pts total (full credit for >80% response rate)

This includes:

- In class quiz games (*via* Kahoot.it)
- Active participation in journal article discussions

Reading Quizzes: 200 pts total

Reading quizzes for BIO 441 will be administered via Moodle. These are multiple-choice quizzes aimed at helping you identify the pertinent parts of the reading material.

Assignments: 400 points total

- 50 pts Molecular Cloning Exercise
- 50 pts Patent Literature Search
- 50 pts Biotechnology Stock Portfolio Exercise
- 100 pts Virtual Bioprocess Design Experiment (In Groups)
- 50 pts Selection of Primary Literature for In Class Presentation
- 100 pts In Class Presentation (In Groups)

Content Tests: 100 pts each

Two tests focused on content will be administered roughly 1/3 and 2/3 through the course. Due to the nature of the material we are covering, expect the tests to be comprehensive, as topics will build upon one another through the course.

Final Exam: 100 pts

The final exam will cover roughly the last 1/3 of the course and carry the same weight as a content test.

Course Schedule (tentative):

Dates	"Week"	Topics
Unit I: Molecular Microbiology		
01/05 & 01/10	1	Central Dogma of Molecular Biology
		Research highlight: Crick, F. 1970. "Central Dogma of Molecular Biology." <i>Nature</i> 227(5258): 561-563.
01/12 & 01/17	2	Recombinant DNA
		Research Highlight: Celie PH, Parret AH, Perrakis A. 2016. "Recombinant cloning strategies for protein expression." <i>Curr Op Struct Biol</i> 38:145-154.
01/19 & 01/24	3	Gene Expression in Prokaryotes and Eukaryotes
		Research highlight: Hansen MMK, et al. 2016. "Protein Synthesis in Coupled and Uncoupled Cell-Free Prokaryotic Gene Expression Systems." <i>ACS Synth Biol</i> . Doi: 10.1021/acssynbio.6b00010
01/26 & 01/31	4	Functional Genomics
		Research highlight: De Filippis F, et al. 2016. "Metatranscriptomics reveals temperature-driven functional changes in microbiome impacting cheese maturation rate." <i>Sci Rep</i> 6. Doi: 10.1038/srep21871
02/02 & 02/07	5	Protein Engineering

		Research Highlight: Khanal A, et al. 2015. "Differential Effects of a Mutation on the Normal and Promiscuous Activities of Orthologs: Implications for Natural and Directed Evolution." <i>Mol Biol Evol</i> 32:100–108.
02/09 & 02/14	6	Systems and Synthetic Biology
		Research Highlight: Pardee K, et al. 2016. "Rapid, Low-Cost Detection of Zika Virus Using Programmable Biomolecular Components." <i>Cell</i> 165:1255–1266.
02/16		Exam 1
Unit II: Principles of Bioprocessing / Bioengineering		
02/28 & 03/02	7	Bioprocessing – Growth Kinetics & Fermentation
		Chapter 4, Cell Kinetics. Biochemical Engineering by S Katoh & F Yoshida
03/07 & 03/09	8	Bioprocessing – Bioreactor Design(s)
		Chapter 17, Large-Scale Production of Proteins from Recombinant Microorganisms. Molecular Biotechnology by Glick, Pasternak and Patten
03/14 & 03/16	9	Bioprocessing – Downstream Processing
		Chapter 11, Recovery and Purification of Products. Bioprocess Engineering by Shuler and Kargi
03/21 & 03/23	10	Bioengineering : GRAS Microorganisms & GMP
		FDA Regulation: http://www.fda.gov/Food/IngredientsPackagingLabeling/GRAS/ Robinson D. 2000. Good Manufacturing Practices, Ullmann's Encyclopedia of Industrial Chemistry. Wiley-VCH Verlag GmbH & Co. KGaA.
03/28		Exam 2
Unit III: Industrial Microbiology		
03/30	11	Pharmaceuticals - Vaccines
		BIO 441 Presentations
04/04 & 04/06	12	Pharmaceuticals - Recombinant
		BIO 441 Presentations
04/11 & 04/13	13	Microbial AgBioTech and Biopolymers
		BIO 441 Presentations
04/18	14	Biofuels and Bio-based Chemicals
		BIO 441 Presentations
04/20		Final Exam 12:00 to 3:00 pm

Oakland University Policies

Academic Conduct Policy:

As members of an academic community, students are expected to conform to a high standard of honesty and integrity in their academic work and behavior. Cheating on exams, falsifying reports/ records and unauthorized collaboration, modifying computer programs etc., are all considered serious breaches of academic conduct. The Oakland University Policy on academic conduct will be strictly followed with no exceptions. For further information please review the policy in the Oakland University catalog under Academic Policies and Procedure. <http://catalog.oakland.edu/content.php?catoid=11&navoid=483>

Incomplete Grades (I):

Biology Department policy is that an Incomplete (I) grade may be granted to students only under extreme circumstances. Every effort should be made to either complete the course or to complete a withdrawal (drop) from the course.

Withdrawal:

Students who officially withdraw must do so by **March 15, 2017** to receive a W grade. Withdrawals must be done at the Registrar's office. Dates are available at oakland.edu/registrar.

Special Considerations:

Students with disabilities who may require special considerations should make an appointment with the campus Disability Support Services and bring their needs to the attention of the professor as soon as possible. By the second week of class I should be aware of any special needs that students have so we can make arrangements to accommodate them. oakland.edu/dss

Excused Absence Policy:

The University excused absence policy applies to participation as an athlete, manager or student trainer in NCAA intercollegiate competitions, or participation as a representative of Oakland University at academic events and artistic performances approved by the Provost or designee. For the excused absence policy, see <http://www.oakland.edu/?id=6850&sid=175>.

If a student has an excused absence for the date of a quiz or exam then an appropriate make up assignment will be made available to the student.

Veterans Support Services:

Oakland University dedicates staff to helping students sort through federal regulations that govern college benefits earned while serving their country, ensuring that veterans can take advantage of benefits in a timely manner. If you are a veteran, please see oakland.edu/veterans/ for more information

Student Preferred Names and Pronouns:

If you do not identify with the name that is listed with the Registrar's Office, please notify the instructor so that it may be appropriately amend the records. In addition, if you prefer to go by a different pronoun, please let the instructor know as well.