

# CHE 380 – Introduction to Biotechnology

## Spring Semester 2018

### 1. Logistics

Instructor:

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973-596-5729

Class Time: Mondays and Thursdays: 8:30AM – 9:55AM

Class Location: KUPF 106

Office Hours: Tuesdays: 1:00 – 3:00 P.M. Room 387, Tiernan Hall

**Textbook:** Introduction to Biotechnology (3rd Edition) by William J. Thieman and Michael A. Palladino  
ISBN: 9780321766113. Also, hand-outs, lecture notes and presentations will be available on Moodle

Communication: A Moodle website for the course provides assignments, required materials, and a schedule of lectures. Other than normal office hours, you can meet me anytime by appointment.

### 2. Course Overview

The course will cover basic scientific knowledge and its application in biotechnology. We will start with an introduction to molecular biology (cells, proteins, DNA) and its practical applications with some historical examples. The fundamentals of Chemical engineering processes will be used to provide sufficient tools and basic knowledge to understand biotechnology. During the course, some simple formulas for calculations related to molecular biology useful in biotechnology will be introduced as and when possible. We will discuss in details the emerging areas of biotechnology, for example plants, forensics, sequencing, bioreactors, Regulatory pathways and agencies. In addition, ethical, legal and social issues related to some provocative themes and issues in Biotechnology like genetically modified (GM) food or organisms (GMO), genetic testing among others will be discussed.

Course Objectives:

The anticipated knowledge, skills and/or attitude to be developed by the student are:

- Understand what “biotechnology” means and what it encompasses
- Appreciate the diversity of molecular biology; from eukaryotic and prokaryotic cells, to the concept of gene, nucleotide structure, type of RNA and replication process.
- Develop an appreciation of the different molecular biology techniques from recombinant DNA technology to proteomics
- Have fundamental understanding and be able to broadly categorize biotechnological processes based on the products formed and/or the process or substrates used
- Have an understanding of the common methods of application and significance of biotechnology and its resultant industries from medicine to human genome project
- Appreciate the multidisciplinary nature of biotechnology
- Have an awareness of the regulatory framework regarding biotechnology and some of the current and future ethical issues surrounding biotechnology

Prerequisites:

Undergraduate classwork in CHEM 122 – Fundamentals of Chemical Principles or CHEM 126 – General Chemistry II

Besides the technical objectives (Instructional Objectives) that will be distributed weekly, the Learning Objectives of CHE 380 are as follows:

Outcomes	Assessed
Apply knowledge of math, science, and chemical engineering to biotechnology	Homework and exams
Identify, formulate, and solve biotechnology problems	Homework and exams
Gain understanding of professional and ethical responsibility	Homework and exams
Communicate effectively	Homework and exams
Understand the impact of engineering solutions in a global and societal context.	Homework and exams
Acquire knowledge of contemporary issues	Homework and exams
Integrate engineering and biological sciences	Homework, exams, and project

Goals:

The course aims to fulfill several academic and professional goals.

- Address students' research needs
- Improve scientific communication. Cultivate critical thinking
- Allows students to understand, relate and appreciate the field of biotechnology.

### 3. Schedule of Classes, Assignments

	Topic	Reading/HW
	<b><i>Section 1: Fundamentals of Biotechnology</i></b>	
	The Biotechnology century and its Workforce	1.1, 1.2, 1.3 and 1.4
	Genes and Genome, The molecules of Life	
	• Eukaryotic and Prokaryotic cells	2.1
	• Cell structure, definition	2.1
	• Concept of gene as genetic materials	2.2
	• Structure of nucleotide	2.3
	• Type of RNA and protein Synthesis	2.4
	• Mutations, causes and consequences	2.5
	<b>Homework 1</b>	
	Recombinant DNA technology	
	• Restriction Enzymes, Plasmid DNA	3.1
	• Bacterial Transformation	3.1
	• Polymerase Chain Reaction	3.3
	<b>Homework 2</b>	
	<b>Exam 1</b>	
	Application of Recombinant DNA technologies	
	• Gel electrophoresis	3.4
	• DNA sequencing	3.4, 3.5
	• Whole Genome Sequencing	3.5
	• Bioinformatics	3.5
	• Human Genome Project	3.5
	<b>Homework 3</b>	
	<b>Exam 2</b>	

	<b>Topic</b>	<b>Reading/HW</b>
	Proteins and Products	
	<ul style="list-style-type: none"> <li>• What is Protein?</li> </ul>	4.1
	<ul style="list-style-type: none"> <li>• Structure of Protein</li> </ul>	4.2
	<ul style="list-style-type: none"> <li>• Protein as product</li> </ul>	4.3
	<b>Homework 4</b>	
	<b><u>Section 2: Biotechnology Industry</u></b>	
	Microbial Biotechnology	
	<ul style="list-style-type: none"> <li>• Gram positive and Gram negative bacteria - Structure</li> </ul>	Class Notes, 5.1
	<ul style="list-style-type: none"> <li>• Enzyme – Structure and properties</li> </ul>	5.2
	<ul style="list-style-type: none"> <li>• Fermentation process and industry</li> </ul>	5.3
	<ul style="list-style-type: none"> <li>• Antibiotics and Vaccine</li> </ul>	5.3, 5.4
	Bioreactor and Enzyme Kinetics	
	<ul style="list-style-type: none"> <li>• Michaelis Menten kinetics</li> </ul>	Class Notes
	<ul style="list-style-type: none"> <li>• Inhibition</li> </ul>	Class Notes
	<ul style="list-style-type: none"> <li>• Microbial kinetics</li> </ul>	Class Notes
	<ul style="list-style-type: none"> <li>• Basics of Bioreactor design</li> </ul>	Class Notes
	Forensics	
	<ul style="list-style-type: none"> <li>• DNA fingerprinting</li> </ul>	8.1, 8.2, 8.3
	<ul style="list-style-type: none"> <li>• DNA profiling, paternity testing</li> </ul>	8.5, 8.5, 8.6
	Bioremediation	
	<ul style="list-style-type: none"> <li>• Environmental pollution and clean up strategies</li> </ul>	9.1-9.4
	<ul style="list-style-type: none"> <li>• Case studies</li> </ul>	9.5, Class Notes
	<b>Homework 5</b>	
	<b>Final Exam</b>	
	<b><u>Section 3: Class Discussion topics in the Biotechnology Industry</u></b>	
	Ethical Constraints in Biotechnology	13.1-13.3
	The Biotechnology Legal Framework	
	<ul style="list-style-type: none"> <li>• Patents</li> </ul>	12.6
	<ul style="list-style-type: none"> <li>• Regulatory Framework</li> </ul>	12.1-12.5

*Note: The professor reserves the right to change the syllabus as needed. Where necessary, the reading from the book will be supplemented by class notes, reading assignments and other literature.*

#### **4. Course Policies**

##### **GRADING**

Homework:	15%
Exam 1:	20%
Exam 2:	20%
Final Exam:	20%
Class Participation:	10%
Final Project:	15%

#### **5. Class Expectations**

- Attendance is important. There is a high correlation between failure and poor class attendance
- There will be no eating, drinking, use of cell phone, cameras or laptops in the class unless you are permitted by the instructor
- All class assignments are expected to be submitted timely
- You are expected to behave professionally and show respect to fellow students and the instructor. Exhibit a conduct that is attributable to a professional engineer

## **6. Statement of Academic Integrity**

*Academic integrity is fundamental to the activities and principles of a university. All members of the academic community must be confident that each person's work has been responsibly and honorably acquired, developed, and presented. Any effort to gain an advantage not given to all students is dishonest whether or not the effort is successful. The academic community regards breaches of the academic integrity rules as extremely serious matters. Sanctions for such a breach may include academic sanctions from the instructor, including failing the course for any violation, to disciplinary sanctions ranging from probation to expulsion. When in doubt about plagiarism, paraphrasing, quoting, collaboration, or any other form of cheating, consult the course instructor.*

## **7. Plagiarism and Academic Integrity**

The approved “[University Code on Academic Integrity](#)” is currently in effect for all courses. Should a student fail a course due to a violation of academic integrity, they will be assigned the grade of “XF” rather than the “F” and this designation will remain permanently on their transcript.

All students are encouraged to look over the [University Code on Academic Integrity](#) and understand this document. Students are expected to uphold the integrity of this institution by reporting any violation of academic integrity to the [Office of the Dean of Students](#).

The identity of the student filing the report will be kept anonymous. NJIT will continue to educate top tier students that are academically sound and are self-disciplined to uphold expected standards of professional integrity. *Academic dishonesty will not be tolerated at this institution.*

## **8. Student Disability Services**

NJIT is committed to providing students with documented disabilities equal access to programs and activities. If you have, or believe that you may have, a physical, medical, psychological, or learning disability that may require accommodations, please contact Student Disability Services. Information on the self-identification, documentation and accommodation process can be found on the webpage at: <http://www.njit.edu/counseling/services/disabilities.php>.

## **9. Getting Help - General**

The IST Helpdesk is the central hub for all information related to computing technologies at NJIT. This includes being the first point of contact for those with computing questions or problems.

There are three ways to contact the Helpdesk:

1. Call 973-596-2900, Monday - Friday 8 am - 7 pm.
2. Go to Student Mall Room 48. Monday - Friday 8 am - 7 pm
3. Log a Help Desk Service Request online – <https://ist.njit.edu/support/contactus.php>.

## **10. Getting Help - Moodle**

In addition to the Helpdesk, NJIT has a number of resources available to help you learn/use Moodle. Please be aware of the following:

1. Getting Started Using Moodle (Student Course): <http://njit.mrooms.net/course/view.php?id=6204>
2. Student Moodle Tutorials: <http://moodle.njit.edu/tutorials/students/index.php>
3. Student Moodle FAQs: <http://moodle.njit.edu/tutorials/students/faq.php>