CHE 380 – Introduction to Biotechnology
Fall Semester 2017

1. Logistics

Instructor:
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973-596-5729
Class Time: MW: 11:30AM – 12:55PM
Class Location: CKB 217
Office Hours: W: 1:30 – 3:30 P.M. Room 387, Tiernan Hall

Text: Introduction to Biotechnology (3rd Edition) by William J. Thieman and Michael A. Palladino
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 Information

Description:
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, Regulatory pathways and agencies. Towards the end of the course, we will see how the application of Nanotechnology and Electronics is changing the face of the biotechnology industry from cancer detection to wearables. In addition to that, ethical, legal and social issues related to some provocative themes and issues in Biotechnology like genetically modified (GM) food or organisms (GMO), genetic testing, stem cells among others will be touched on.

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
An 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
A 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	Readings/HW
Section 1: Fundamentals of Biotechnology	
The Biotechnology century and its Workforce	Section 1.1, 1.2, 1.3 and 1.4
Genes and Genome, The molecules of Life	
• Eukaryotic and Prokaryotic cells	Section 2.1
• Cell structure, definition	Section 2.1
• Concept of gene as genetic materials	Section 2.2
• Structure of nucleotide	Section 2.3
• Type of RNA and protein Synthesis	Section 2.4
Homework 1	
Recombinant DNA technology	
• Mutations and DNA Cloning	Section 3.1
• Restriction Enzymes, Plasmid DNA	Section 3.1
• Bacterial Transformation	Section 3.1
• Polymerase Chain Reaction	Section 3.3
First Mid-Term	
Homework 2	

Experiment Demonstration 1: Identifying Genomic and Plasmid DNA Sequences in E.coli by Colony PCR	
Application of Recombinant DNA technologies • Gel electrophoresis • DNA sequencing • Whole Genome Sequencing • Bioinformatics • Human Genome Project	 Section 3.4 Section 3.4, 3.5 Section 3.5 Section 3.5 Section 3.5
Experiment Demonstration 2: The Length of DNA Molecule using Restriction Nuclease Mapping of DNA	
Homework 3	
Second Mid-Term	
Proteins • What is Protein? • Structure of Protein • Protein as product	 Section 4.1 Section 4.2 Section 4.3
Experiment Demonstration 3: Serum Proteins and the Western Press-Blot	
Homework 4	
Section 2: Biotechnology Industry Microbial Biotechnology • Gram positive and Gram negative bacteria - Structure • Fermentation process and industry • Enzyme – Structure and properties • Vaccine Bioreactor and Enzyme Kinetics • Michaelis Menten kinetics • Inhibition • Microbial kinetics • Basics of Bioreactor design Forensics • DNA fingerprinting • DNA profiling, paternity testing Bioremediation • Environmental pollution and clean up strategies • Case studies	 Class Notes Class Notes Section 5.2 Section 5.4 Class Notes Class Notes Class Notes Class Notes Section 8.2 Section 8.4, 8.5 Section 9.1-9.4 Section 9.5, Class Notes
Homework 5	
Experiment Demonstration 4: Tissue Printing and the ELISA Immunoassay	
Section 4: Class Discussion topics in the Biotechnology Industry Ethical Constraints in Biotechnology The Biotechnology Legal Framework • Patents • Regulatory Framework • Future	 Section 13.1-13.3 Section 12.6 Section 12.1-12.5

Section 5: Applications of the Biotechnology Industry Plant Biotechnology • Protoplast fusion, • Chloroplast engineering, • Transformation • GM plants – ethical, political and scientific issues. Animal Biotechnology • Animal model as applied to human • Cloning • Human Antibody and Animals Aquatic Biotechnology • Fisheries and environment • Aquaculture Forensic Biotechnology • DNA Fingerprinting • DNA and Y chromosome Analysis Microbial Biotechnology • Vaccines and antibodies • Application of microbes Bioremediation • Environmental applications • Challenges	**Project Assignments from this section to be presented during class**

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

Problem Sets:	25% (5 Homework sets, each 5 points)
Exam 1 and Exam 2: (Mid-Term 1)	20% (Best of 1 Mid-Term)
Exam 3: (Finals)	25%
Class Participation:	10% (pop quizzes, lab and in class assignments)
Final Project:	20%

CLASS PARTICIPATION

Your participation grade will take into account:

- The quality of questions to and responses to questions from course instructor
- Preparation for, and interaction with, instructor on specialty topics
- Use of Moodle and participation in discussion board topics as assigned
- Punctuality, attendance, and prior negotiation of approved absences for causes other than illness
- ***Pop quizzes, in class assignments*** will be given randomly throughout the semester. Students who read the assigned readings will have no problems passing the quizzes.

HOMEWORK

1. Homework assignments will be uploaded on Moodle. Typically, it will be a mix of problems: reading assignments, perform calculations, and literature search.
2. Late Problem Sets will not be accepted. Problem Sets are considered late if received later after Moodle closes. No extensions, since you have all of the assignments on Moodle.
3. Problem Sets should be turned with your name, assignment number on the top to get the credit.

4. Any question that requires diagrams, graphs, etc. has to be made by you. Do NOT copy and paste a figure from a digital source. However feel free to draw it using any software.
5. If you use a reference (published paper, textbook, website) to find information, including diagrams, graphs, etc., list the source as a reference at the end of the problem you used it in. Use AIChE style for referencing. Not including a reference where a reference is needed will carry a penalty of a 1 point.
6. Students are encouraged to work together on homework assignments, but you must turn in your own solutions. Also, you must list your collaborators name on the first page of the Problem Set.
7. Each problem will be graded according to the homework guidelines.
8. Lastly, if I or the TA cannot read your handwriting, I will give your sets a zero. Make sure you write neatly so I can give you the grade you deserve.

Homework Grading Guidelines (will be provided to all Teaching Assistants), the score will be awarded using the following guidelines (adapted from the Chemical Engineering Department at the University of Colorado, Boulder):

10. Problem completely correct as intended, or completely correct based on an interpretation that could be correctly inferred from the problem statement
9. Substantially complete and correct - but with one minor error like arithmetic
8. Substantially complete and correct - but with multiple minor errors or one major error such as a bad assumption
7. Demonstrates acceptable understanding of the problem, and knowledge of the proper method of solution; but solution is neither complete nor correct
6. Minimum passing grade - appears to understand the problem and have a general idea of the correct method of solution
5. Indication of understanding of the problem, but wrong approach to solution
4. Indication of understanding of the problem. No solution attempted
3. Indication of incomplete understanding of the problem. No solution or completely wrong approach.
2. Something on papers such as a diagram or equation not provided in the problem statement
1. Nothing on paper that was not provided in the problem statement

EXAM

The exam questions will range in difficulty from easy to challenging. There will be an appropriate mix of questions from multiple objective type, true/false questions to summary questions. Some questions will involve mathematical computations. I will take improvement during the course into account in the final grade determination. The exam will be cumulative and will be taken during a class period. There will be no make-up tests for students who miss an exam unless there is a legitimate excuse.

FINAL PROJECT

Please refer to the project information document on Moodle.

GRADES

The grades will be based on the following grading scale:

93.00 – 100.00% A
85.00 – 92.99% B+
75.00 – 84.99% B
62.00 – 74.99% C+
50.00 – 61.99% C
40.00 – 49.99% D
<39.99% F

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.

4. 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.***

5. 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.

6. 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.

7. 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