Texas Tech University
Center for Biotechnology and Genomics

Spring 2016 Course Syllabus

Course Number:	BTEC 5311 – 001
Course Name:	Protein Engineering
Course Instructors:	J. N. Tripathy, Ph.D., M.B.A.
	Chiquito Crasto, Ph.D.
Office:	EXPSC Room 103
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Office hours:	by appointment
Course Schedule:	Wednesday, 10.00 – 12.50 PM, EXPSC, Room 201
	Thursday, 2 – 4:50 PM, EXPSC, Room 120
	(April 14, 21, 28 and May 5 only)

Course Description:

This is an elective course designed for students in the biotechnology graduate program. However, it is open to anyone who is interested in earning a deeper knowledge of protein molecules: how to engineer and design protein with novel properties and how to express and characterize the newly designed protein.

Protein engineering is an exciting and highly multidisciplinary field. This course introduces the strategies, methods and techniques used to engineer and design proteins with novel properties for scientific, medical, industrial and agricultural use. Two important strategies: diversity oriented (directed evolution) protein engineering and computational protein design (rational design) will be discussed.

The first part of the course will focus on diversity oriented protein engineering. The techniques used for generation of protein diversity, the high throughput protein engineering platforms for selection of novel proteins and case studies of proteins that are successfully engineered for therapeutics, enzymes, biomaterials and other biotechnological applications will be discussed.

The second part of the course will focus on rational design, also known as computational protein design by modeling. Many computational tools such as- Modeler for homology modeling, AutoDock Vina for protein-ligand docking, HEX for protein-protein docking, GROMACS for molecular dynamics simulation will be introduced for designing of novel

proteins. The case studies of successful engineered proteins will be discussed to reinforce the concepts, knowledge and skills.

Prerequisites:

A sound background in recombinant DNA technology, molecular biology and organic chemistry is preferred but not required. But "willing to learn" is an absolute requirement.

Recommended Text:

Protein Engineering and Design, Edited by Sheldon J. Park and Jennifer R. Cochran. CRC Press, 2010

Protein Engineering Handbook, Volume 3. Edited by Stefan Lutz and Uwe T. Bornscheuer. Wiley-VCH, 2013

Proteins: structure and Function. David Witford. Wiley, 2005

Additional reading: Journal articles (will be provided in advance)

Course Objectives and Expected Learning Outcomes:

At the end of the course, the fully prepared students should be able to:

1. Illustrate the protein structure
2. Explain how protein structure dictate it's function
3. Describe strategies to engineer and design novel proteins
4. Demonstrate the skills and techniques to engineer and design novel protein
5. Explain the role of individual amino acid determining protein structure
6. Design mutagenic primers to introduce site-specific mutation
7. Describe techniques to create diversity in protein
8. Describe the use of high-throughput screening platforms to screen library
9. Use various computational tools to design protein
10. Give examples of proteins that are engineered for diverse application
11. Discuss challenges and opportunities in computational protein design
12. Write review and critiques of scientific article
13. Give scientific presentation

Assessments:

Learning outcome will be assessed by following criteria:
Midterm examination: 20%
Take home final examination: 30 %
Writing summary and critiques: 20%
Presentation – 20%
Class participation - 10%

Examination:

Exam questions will be based on topics discussed in lecture, book chapters and assigned reading materials. Exams will cover multiple choice, short answer, fill in the blanks types of questions.

Class Participation:

You are expected to engage in learning in the class by actively taking notes, sharing your thoughts and ideas, participating in-class discussion, asking and answering questions and debating with each other respectfully.

Grading:

A final letter grade will be determined by performance on the above criteria, 90% and above – "A", 80 to 89.9% - "B", 70 to 79.9% - "C" and 69 to 69.9% - "D" and below 60% - "F". A grade of "I" (Incomplete) will be awarded by the instructor prior to the end of the semester only when failure to complete the work has been due to causes beyond the student's control and when class performance has been satisfactory. Texas Tech regulations require that a form explaining the reason for the incomplete and the method to be used to make up the missed work be submitted, after being signed by both the student and instructor, to the Registrar. Incomplete grades that are not replaced by an A, B or C grade within one year are automatically replaced by an F.

Attendance:

Lectures will include certain facts and discussion that may not be in the assigned text or handouts. It is therefore necessary and expected that you will attend and participate in every scheduled class. There are no makeup classes. If there is a reason for missing a class you must contact me as soon as possible to make necessary arrangements to discuss the outcome of the absence. You may need to provide a note from your physician excusing your absence if you are absent from a class more than a day due to an illness.

Academic Integrity:

It is the aim of the faculty of Texas Tech University to foster a spirit of complete honesty and a high standard of integrity. Each student shall be responsible for his/her conduct. Students are expected to abide by all of the rules for academic integrity, as specified by the TTU Student Affair Hand Book (http://www.depts.ttu.edu/studentjudicialprograms/academicinteg.php).The attempt of students to present as their own any work not honestly performed is regarded by the faculty and administration as a most serious offense and renders the offenders liable to serious consequences, possibly suspension.

Special Conditions:

Any student who, because of a disability, may require special arrangements in order to meet the course requirements should contact the instructor as soon as possible to make any necessary arrangements. Students should present appropriate verification from Student Disability Services (Access TECH) when they meet the course instructor. No requirement exists that accommodations be made prior to completion of this approved university process.

Religious Holy Day:

A student who intends to observe a religious holy day should make that intention known to the instructor prior to the absence. A student who is absent from classes for the observance of a religious holy day shall be allowed to take an examination or complete an assignment scheduled for that day within a reasonable time after the absence.

Lecture Schedules:

Lecture	Topics	Date
	Section A: Reviews	
1	Introduction and overview of the course, Protein engineering concepts	1/27
2	Review: Protein Chemistry and structure, Enzyme kinetics	2/3
	Protein Folding – Molecular Energy and Forces	2/10
II.	Section B: Protein Engineering Strategies and Techniques	
3	Protein Engineering Strategies: Directed evolution and Rational design (Computer modeling)	2/17
4	Protein Engineering Techniques, Library Construction	2/24
5	High-throughput Protein Engineering Platform Midterm exam	3/2
6	Individual study day	3/9
	Spring Vacation week	3/16
7	Examples of engineered proteins Introduction to Rational Design	3/23
	Section C: Examples of engineered proteins – Case studies	
8	Student Presentation	3/30
9	Student Presentation	4/6
	Section D: Computational Protein Design	
10	Rational Design (Computer Modeling)	4/14
11	Rational Design (Computer Modeling) contd...	4/21
12	Rational Design (Computer Modeling) contd...	4/28
13	Review for Finals	5/4
14	Rational Design (Computer Modeling) contd...	5/5
	Exam#2 Take Home Final, due May 13, 5:00 PM	

Dr. Chiquito, Thursday 2 to 4:50 PM at Room 120, EXPSC building