Georgia Institute of Technology/School of Biology

**PROTEIN BIOLOGY**

**(3 credit hours)**

**Instructor - Professor Yury Chernoff**

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Office hours - Wed 1-2 PM (prior notification by E-mail is recommended), or by appointment

Class days/time/place – T/Th 3:05-4:25 PM (Room 320 Cherry Emerson building)

**Recommended Textbook:**

Lesk A. M.(2010) Introduction to Protein Science: Architecture, Function, and Genomics, 2d edition (Oxford University Press).

**Additional sources:**

Lodish et al. (2008) *Molecular Cell Biology*, 6th or 7th edition (W. H. Freeman & Co)

Other books, reviews, and papers indicated in lecture notes and/or posted on T-square.

NOTE: Most lectures use outside sources in addition to (or instead of) the textbook.

**Grading:**

Exams (typically two in-class exams and one final exam) – 75%

In class activity, quizzes and assignments (including, but not limited to: questions to lectures and presentations; presentations in the “flipped classroom” format; two best quizzes out of 3-4 surprise quizzes offered in the class; homework on scientific papers in the field) – 25%.

**Attendance:**

Periodical attendance polls will be taken without prior notice. 5-10% (depending on the size of the class) of students showing maximal attendance will receive extra-points.

**Prerequisites:**

BIOL 1510 Minimum Grade of D or BIOL 1511 Minimum Grade of D.

**Goal:**

This course will cover and integrate genetic, cell biological, biochemical and proteomic approaches to studying proteins, and will explain protein functions and protein-based pathologies within the broad biological framework.

**Learning Objectives:**

Upon completion of this course, students will be able to:

1. Describe the processes involved in protein biosynthesis, processing, folding and degradation.
2. Become familiar with theoretical foundations of the major technical approaches involved in protein analysis.
3. Understand molecular and cellular foundations of the protein assembly disorders and their impact on human health.
4. Get exposure to the integrative interdisciplinary approaches to major biological problems,
5. Develop skills that are necessary for scientific discussion and for the analysis of current scientific literature.

**Overview:**

Biological view of proteins, including: protein biosynthesis, processing, modifications, folding, trafficking, interactions, degradation, natural and directed evolution, protein assembly diseases, amyloids, prions and protein-based inheritance.

**Description:**

Proteins are major building blocks and catalytic machineries of life. Understanding biological roles of proteins requires integration of the genetic, cell biological, biochemical and computational approaches. Protein assembly disorders, caused by misfolded protein (amyloids and prions), represent one of the major challenges for humankind. As these disorders are usually age-dependent, their importance is going to increase with the increase in human life span. Protein-based heritable systems control epigenetic phenomena in microorganisms and possibly in higher eukaryotes. Directed protein evolution techniques have been applied to engineering new proteins for technological and medical purposes. Understanding of the biological control and roles of proteins is crucial for modern specialists dealing with various aspects of science, medicine and technology.

This course covers protein “life span” from “birth” (biosynthesis) to “death” (degradation), with implications for natural and directed protein evolution, and special emphasis on protein assembly disorders, amyloids, prions, and protein-based heritable and epigenetic phenomena. This course includes lectures, selected paper presentations on the course topics, and discussions that review presented materials. To broaden the student perspective, the course will occasionally incorporate guest lectures, given by professors from departments other than School of Biology and organized through the Center for Nanobiology of the Macromolecular Assembly Disorders (NanoMAD).

**Academic Integrity:**

Academic dishonesty will not be tolerated. This includes cheating, lying about course matters, plagiarism, or helping others commit a violation of the Honor Code. Some exams (when specifically announced in class) allow the use of self-prepared supporting information (one sheet of paper, either typed or handwritten, could be double-sided); no other support materials are allowed at tests. Plagiarism includes reproducing the words of others without both the use of quotation marks and citation. Students are reminded of the obligations and expectations associated with the Georgia Tech Academic Honor Code and Student Code of Conduct, available online at www.honor.gatech.edu.

**Learning Accommodations**:

If needed, we will make classroom accommodations for students with documented disabilities. These accommodations must be arranged in advance and in accordance with the ADAPTS office (<http://www.adapts.gatech.edu>).

**Schedule of Topics:**

Week 1: Introduction

Genes and proteins

Week 2: Ribosome

Translation initiation

Week 3: Translation elongation and termination I, II

Week 4: Protein processing, splicing and translocation

Protein modifications

Week 5: Mass spectrometry and proteomics

Discussion session

Week 6: EXAM I (covers weeks 1-5)

Protein interactomics

Week 7: Protein folding I,II

Week 8: Chaperones and stress response

Approaches to studying protein structure and folding I

Week 9: Approaches to studying protein structure and folding II

Protein misfolding and aggregation

Week 10 Protein ubiquitination and degradation

Discussion session

Week 11: SPRING BREAK

Week 12: EXAM II (covers weeks 6-10)

Protein evolution I

Week 13 Protein evolution II

Mammalian prions

Week 14 Protein assembly disorders I, II

Week 15: Protein assembly disorders III

Yeast prions and protein-based inheritance I

Week 16: Yeast prions and protein-based inheritance II

Discussion session

Finals week FINAL EXAM (covers weeks 12-16)