# CHEN E4800
# Protein Engineering

**Professor**: Scott Banta  sbanta@columbia.edu
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**Teaching Assistant:** TBA

**Office Hours**:
By Appointment

**Prerequisites:**  CHEN E4230 Reactor Kinetics and Reactor Design or equivalent. May be taken concurrently, or by permission.

**Course Description**:  Course is aimed at senior undergraduate and graduate students. Introduces fundamental tools and techniques currently used to engineer protein molecules.  Covers the methods used to analyze the impact of these alterations on different protein functions with specific emphasis on enzymatic catalysis.  Uses case studies to reinforce the concepts covered, as well as to demonstrate the wide impact of protein engineering research.  Applies basic concepts in the chemical engineering curriculum (reaction kinetics, mathematical modeling, thermodynamics) to specific approaches utilized in protein engineering.

**Course Significance**:  Protein engineering is a young and exciting interdisciplinary field where engineering principles and practices are utilized to generate molecules with novel properties. The applications of this technology can be found in diverse areas including: drug discovery, industrial chemical synthesis, transgenic animal research, and nanotechnology.  Chemical engineers will continue to contribute significantly to this important discipline.  As the worldwide impact of biotechnology increases, it is important to continually offer new and cutting edge instruction in these subject areas.

**Textbook**:
Witford, David *Proteins, Structure and Function* Wiley 2005
Text is not required, but it is recommended.  Manuscripts will be used for assigned readings and homeworks.  A general biochemistry book, such as Stryer, or Garrett and Grisham, will be a valuable resource throughout the semester.

Branden, Carl & John Tooze *Introduction to Protein Structure, 2nd Ed* Garland 1999
Also recommended, and many of the images used in the lectures are from this book

**Molecular Modeling:**
We will use the PyMol molecular visualization software, which is available for free download through the Columbia libraries.

**Lecture Notes**:
Lectures will be presented using Power Point. The lecture files will be placed on the Courseworks website at least 24 hours before the lecture.

**Grading**:

| | |
|---|---|
| Homework | 10% |
| Midterm exam | 30% |
| Final exam | 30% |
| Protein Projects | 30% |

**Other Points:**
- Homework will be due the week after it is assigned. Late homework will receive a 25% deduction.
- Midterm and final exams will be open book and open notes.
- Two individual protein engineering projects will be assigned. Additional information will be provided during the semester.
- Courseworks system will be used for course maintenance and information dissemination.

**Approximate weekly schedule**

| Meeting | Topic |
|---|---|
| 1 | Introduction, Protein structure and folding |
| 2 | Protein structure and folding, Modeling, First Project |
| 3 | Protein expression and purification |
| 4 | Catalysis, Enzyme kinetics |
| 5 | Protein modifications |
| 6 | Post translational modifications, Take Home Midterm |
| 7 | Antibody Engineering |
| 8 | Metabolic Engineering, Second Project |
| 9 | Nanotechnology, Other topics |
| 10 | Other Biocatalysis |
| 11 | Ethics, Economics |
| 12 | Final review and Projects Due |
| TBD | Final Exam |