



Syllabus for BIOE130-01: Biothermodynamics

Fall 2018

Instructor: Chih-Wen Ni

Designation: Biothermodynamics

Catalog Description: Thermodynamics is the study of processes done on or performed by the system, and explains how the macroscopic parameters change. The subject of statistical mechanics is concerned with expressing thermodynamics and the macroscopic behavior in terms of the microscopic properties of its constituent particles (molecules). Thermodynamics and statistical mechanics, therefore, are essential for explaining the forces that drive various chemical and biochemical reactions, ligand binding, protein structures, the behavior of biological macromolecules, and many other biological phenomena (processes). A good understanding of biothermodynamics will help in the design and engineering of molecules (e.g. drugs) and devices that interact with living organisms.

Text Books and Other Required Materials: Molecular Driving Forces: Statistical Thermodynamics in Biology, Chemistry, Physics, and Nanoscience, Ken Dill and Sarina Bromberg, Garland Science, 2010

Course Objectives/ Student Learning Outcomes: By the end of this course, students will be able to:

1. explain the basic concepts of thermodynamics such as system, state, state postulate, equilibrium, process, and cycle.
2. understand the concept of heat, work, and basic principles of thermodynamics.
3. know the molecular origins of the Boltzmann distribution, the Arrhenius rate law, and entropic forces. They will understand how thermal motion constrains in biological systems.
4. understand the thermodynamic background for diffusion, chemical reactions and chemical kinetics in biological systems.
5. apply the mathematical framework of thermodynamics to understand basic processes of self-assembly, binding and recognition for biological systems.
6. Students will be able communicate information and their knowledge in biothermodynamics.

Learning Outcomes will be assessed through quizzes, exams, and classroom discussion.

Program Learning Outcomes:

Prerequisites by Topic: BIO 002 CHEM 010, CHEM 008, MATH 032

Course Policies: Grading 80% Exams (two midterm exams 25% each and one final exam 30%)
20% Homework, Classroom discussion & Quizzes 100 % Total

Academic Dishonesty Statement:

- a. Each student in this course is expected to abide by the University of California, Merced's Academic Honesty Policy. Any work submitted by a student in this course for academic credit will be the student's own work.
- b. You are encouraged to study together and to discuss information and concepts covered in lecture and the sections with other students. You can give "consulting"

Designation:	<p>Biothermodynamics</p> <p>help to or receive "consulting" help from such students. However, this permissible cooperation should never involve one student having possession of a copy of all or part of work done by someone else, in the form of an e mail, an e mail attachment file, a diskette, or a hard copy. Should copying occur, both the student who copied work from another student and the student who gave material to be copied will both automatically receive a zero for the assignment. Penalty for violation of this Policy can also be extended to include failure of the course and University disciplinary action.</p> <p>c. During examinations, you must do your own work. Talking or discussion is not permitted during the examinations, nor may you compare papers, copy from others, or collaborate in any way. Any collaborative behavior during the examinations will result in failure of the exam, and may lead to failure of the course and University disciplinary action.</p>
Disability Statement:	<p>Accommodations for Students with Disabilities: The University of California Merced is committed to ensuring equal academic opportunities and inclusion for students with disabilities based on the principles of independent living, accessible universal design and diversity. I am available to discuss appropriate academic accommodations that may be required for student with disabilities. Requests for academic accommodations are to be made during the first three weeks of the semester, except for unusual circumstances. Students are encouraged to register with Disability Services Center to verify their eligibility for appropriate accommodations.</p>
Topics:	<p>Week 1 Introduction Probability Week 2 Equilibrium States Week 3 Heat, Work and Energy Week 4 Math Tools Week 5 Entropy and Boltzmann's Law and Midterm 1 Week 6 Thermodynamic Driving Forces Week 7 Free Energies Week 8 Maxwell's Relations Week 9 Statistical Mechanics Week 10 Chemical Potential and Midterm 2 Week 11 Physical Kinetics Week 12 Chemical Kinetics Week 13 Intermolecular Interactions Week 14 Water Week 15 Polymers</p>
Class/laboratory Schedule:	Lecture, TR 3:00-4:15 PM Discussion R 5:30-5:20PM
Midterm/Final Exam Schedule:	Final exam: Dec 10, 6:30-9:30 PM
Course Calendar:	<p>Week 1 Introduction Probability Week 2 Equilibrium States Week 3 Heat, Work and Energy Week 4 Math Tools Week 5 Entropy and Boltzmann's Law and Midterm 1 Week 6 Thermodynamic Driving Forces Week 7 Free Energies Week 8 Maxwell's Relations Week 9 Statistical Mechanics</p>

Designation: Biothermodynamics
Week 10 Chemical Potential and Midterm 2
Week 11 Physical Kinetics
Week 12 Chemical Kinetics
Week 13 Intermolecular Interactions
Week 14 Water
Week 15 Polymers

Professional Component:

Assessment/Grading Policy: Grading
80% Exams (two midterm exams 25% each and one final exam 30%)
20% Homework, Classroom discussion & Quizzes
100 % Total

Coordinator:

Contact Information: phone: 209-228-4308
email: cni3@ucmerced.edu

Office Hours: T, 4:30-6:30PM