

**University of Hawaii at Manoa  
Department of Mechanical Engineering**

**ME 612 Introduction to Statistical Thermodynamics (3 Credits) Fall 2018**

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**Instructor**

Yi Zuo                      Email: [yzuo@hawaii.edu](mailto:yzuo@hawaii.edu)  
Office: POST-207C      Phone: 956-9650  
Office Hours: Tuesday 3-4 pm or by appointment

**Course description**

This course introduces fundamentals of statistical thermodynamics. Main topics include entropy, Boltzmann law, thermodynamic driving forces, Maxwell relations, statistical mechanics, chemical equilibria, solutions and mixtures, and applications of statistical thermodynamics in biology, chemistry, physics, and nanoscience. By the end of this course, students are expected to gain basic knowledge about statistical thermodynamics.

**Prerequisites**

ME 311 or ME 611 or instructor's consent.

**Schedule**

TH 1:30-2:45 pm      Classroom TBD

**Textbooks (Required)**

K.A. Dill, and S. Bromberg, *Molecular Driving Forces: Statistical Thermodynamics in Biology, Chemistry, Physics, and Nanoscience*, 2<sup>nd</sup> edition, Garland Science, 2012, ISBN: 9780815344308

**Supplemental textbooks**

- H.B. Callen, *Thermodynamics and an Introduction to Thermostatistics*, 2nd ed., John Wiley & Sons, New York, 1985.
- D. Kondepudi, and I. Prigogine, *Modern Thermodynamics. From Heat Engines to Dissipative Structures*, 2<sup>nd</sup> edition, Wiley, 2015
- T.L. Hill, *An Introduction to Statistical Thermodynamics*, Dover, 1986.

**Exams and grading**

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|-------------------------------------|-----|
| • Homework                          | 30% |
| • Midterm exam                      | 30% |
| • Term project (class presentation) | 20% |
| • Term project (written report)     | 20% |

## **Topics to be covered**

### **Part I. Fundamental Thermodynamics**

Chapter 0. Review of Classical Thermodynamics  
Chapter 4. Math Tools: Multivariate Calculus  
Chapter 6. Thermodynamics Driving Forces  
Chapter 7. The Logic of Thermodynamics  
Chapter 8. Laboratory Conditions and Free Energies  
Chapter 9. Maxwell's Relations and Mixtures

*HW#1. Fundamental Thermodynamics*

### **Part II. Statistical Thermodynamics**

Chapter 1. Principles of Probability  
Chapter 2. Extremum Principles Predict Equilibrium  
Chapter 3. Heat, Work, and Energy  
Chapter 5. Entropy and the Boltzmann Law  
Chapter 10. The Boltzmann Distribution Law

*HW#2. Fundamental Statistical Thermodynamics*

### **Part III. Applications in Biology, Chemistry, Physics and Nanoscience**

Chapter 14. Equilibria between Liquids, Solids, and Gases  
Chapter 15. Solutions and Mixtures  
Chapter 16. Solvation and the Transfer of Molecules between Phases

*HW#3. Applied Statistical Thermodynamics*

**\* The following chapters will be covered only when time permits.**

Chapter 11. The Statistical Mechanics of Simple Gases & Solids  
Chapter 12. What is Temperature? What is Heat Capacity?  
Chapter 13. Chemical equilibria

Chapter 24. Intermolecular Forces  
Chapter 25. Phase Transitions  
Chapter 29. Bio and Nano Machines  
Chapter 30. Water  
Chapter 31. Water as a Solvent