

Course Name: **Advanced Thermodynamics**

Instructor: Chi-Chung Hua, Professor Engineering Building II, Rm 412
Ext. 33412
Email: chmcch@ccu.edu.tw)

Textbook: Herbert B. Callen, 1985, “Thermodynamics and Introduction to Thermostatistics”, 2nd ed., John Wiley & Sons, Inc.

Year 2021/Fall

Course Outline:

I. Classic Thermodynamics:

- Basic Concepts and Principles (Chaps. 1, 2, 3)
- Thermodynamic Potentials and Lagrange Transformations (Chaps. 5, 6, 7)
- Stability, Phase Transitions, and Critical Phenomena (Chaps. 8, 9, 10)
- Applications to Material Properties (Chaps. 13)

II. Statistic Thermodynamics:

- Statistic Ensembles and Energy Representations (Chaps. 15, 16, 17)
- Fluctuations and the Relationships to Thermal Quantities (Chap. 19)
- Some Applications of Statistic Mechanics (Chaps. 17, 18)

Grading: Homework (20 %)
 Two Exams (80 %)

Teaching Assistants: 林豐震 (Rm 413; Ext 33413)、顏志憲 (Rm 414; Ext 23482)

Chapter I. Basic Concepts and Principles (Chaps. 1, 2, 3) (two weeks)

- Thermodynamic Equilibrium and Postulate I (pp. 11-13)
- The Entropy Maximum and Postulates II & III (pp. 27)
- Intensive Parameters and Equations of State (pp. 35-39)
- The Euler Equation and the Gibbs-Duhem Relation (pp.59-62)

Chapter II. Thermodynamic Potentials and Legendre Transformations (Chaps. 5, 6, 7) (three weeks)

- Legendre Transformations (pp. 137-145)
- The Legendre Transformed Functions and Thermodynamic Potentials (pp. 146-148)
- Minimum Principles for the Potentials (pp. 153-157)
- The Helmholtz and Gibbs Potentials (pp. 157-159; 167-171)
- Maxwell Relations and Some Applications (pp. 181-202)

Chapter III. Stabilities, Phase Transitions, and Critical Phenomena (Chaps. 8, 9, 10) (three weeks)

- Stability Conditions for Thermodynamic Potentials (pp. 203-209)
- Le Chatelier's Principle and Effects of Fluctuations (pp. 211-214)
- First-order Phase Transitions in Single-Component Systems (pp. 215-222; 223-240)
- Thermodynamic States near Critical Points (pp. 225-263)

(Mid-term exam)

Chapter IV. Applications to Material Properties (Chap. 13) (two weeks)

- Small Deviations from Ideality—The Virial Expansion (pp. 297-298)
- Law of Corresponding States for Gases (pp. 299-302)
- Applications to Dilute Solutions—the van't Hoff Relation and the Raoult's law (pp. 302-304)

Chapter V. Statistic Ensembles and Energy Representations (Chaps. 15, 16, 17) (three weeks)

- The entropy representation—the Boltzmann's law (pp. 329-332)
- Partition Functions and the Probability Distributions (pp. 349- 354; 360-361)
- Generalized Canonical Formulations (pp. 379-382; 385-390)

Chapter VI. Some Applications of Statistic Mechanics (Chaps. 17, 18) (three weeks)

- Classic Particles (pp. 364-377)
- Quantum Particles (pp. 393-422)

(Final exam)