

PHY437/537: Intermediate Thermodynamics and Introduction to Statistical Physics (4 credits)

OVERVIEW

The goal of the course is to introduce the formal (i.e., theoretical or mathematical) framework for thermodynamics and statistical physics in preparation for careers or graduate work in physics and related fields. PHY437/537 will provide a rigorous introduction to thermodynamics including the first, second, and third laws; thermodynamic potentials; phase transitions; and illustrative applications of thermodynamics. PHY437/537 will also provide a rigorous introduction to statistical mechanics including the ensemble approach to equilibrium statistical thermodynamics, phase transitions, and quantum statistics.

Prerequisite: PHY291. Pre- or co-requisite: PHY341 or permission of instructor.

Advising note: PHY437 is part of a four-course advanced sequence that makes up the Physics BS curriculum core. The others are classical (PHY451) and quantum mechanics (PHY491), and electromagnetism (PHY461). If you are a Physics BS major, I recommend taking PHY437 your senior year as advised in the sample curriculum found at the Department website. All other majors, see me if you require advice on whether it is appropriate to take PHY437 now.

Related course: PHY421(Introduction to Biophysics); PHY423(Materials Physics); PHY642(Advanced Kinetic Theory and Statistical Mechanics); CHM351/352(Physical Chemistry for Chemistry Majors); CHM471(Physical Chemistry); CHM472(Biophysical Chemistry); MME/PCE314(Engineering Thermodynamics).

REQUIRED TEXT

- R. Bowley and M. Sánchez. *Introductory Statistical Mechanics*. 2nd ed. Oxford Science Publications (1999).
- R.P. Feynman, R.B. Leighton, and M. Sands. *The Feynman Lectures on Physics*. Addison-Wesley. 1964. Chapters 39-46.

RECOMMENDED/SUPPLEMENTAL TEXTS

- H. Callen. *Thermodynamics and an Introduction to Thermostatistics*, 2nd Edition. Wiley (1985).
- D. Chandler. *Introduction to Modern Statistical Mechanics*. Oxford (1986).
- F. Reif. *Fundamentals of Statistical and Thermal Physics*. McGraw-Hill (1965).
- M.D. Sturge. *Statistical and Thermal Physics*. A. K. Peters (2003).
- J.M. Yeomans. *Statistical Mechanics of Phase Transitions*. Oxford (1992).

Topic	Feynman Lectures	B&S.
A. Intermediate Thermodynamics.		
Thermal Processes: First law of thermodynamics.	39, 44.	1.
Thermal "dynamics": Second law of thermodynamics.	44.	2.
Formal aspects of thermodynamics.	45.	handouts.
Applications of thermodynamics.	45.	handouts.
Equilibrium and stability. Phase transitions I.	45.	11.
B. Introduction to Statistical Physics.		3, 4.
Probability and statistics. Ideas of statistical mechanics.		
Microcanonical ensembles and entropy.		4.
Canonical ensemble.	40, 41, 42, 46.	5.
Identical particles.		6.
Density of states. Maxwell distribution.	39, 40, 41, 42.	7.
Planck's distribution. Einstein and Debye models.	39, 41, 42.	8.
Grand canonical ensemble.	42, 43.	9.
Fermi and Bose statistics.		10.
Phase Transitions II. Continuous phase transitions. Ising models. Landau Theory.		12, 13.