

PHYS G4023- Thermal & Statistical Physics

Instructor: Professor Tim Halpin-Healy, healy@phys.columbia.edu,
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Lecture: 1:10-2:25 TuTh, 329 Pupin.

Synopsis: A stripped-down introduction to fundamentals and applications of thermodynamics & statistical mechanics, with an unapologetic emphasis upon the latter. Random Walks & Brownian motion. Binomial, Gaussian & Poisson Distributions. Energy vs. Entropy. Temperature. Helmholtz & Gibbs Free Energy. Microcanonical, Canonical, & Grand Canonical Ensembles; Partition Function=Sacred Object. Boltzmann, Bose-Einstein, & Fermi-Dirac Statistics. Astrophysical, Solid-State, & Condensed Matter applications; additional topics- SAWs; DPRM; percolation, lattice animals & fractals; DLA; phase transitions, cooperative phenomena & renormalization group; self-organized criticality; quantitative finance.

Required Text:

An Introduction to Thermal Physics, Daniel Schroeder [ISBN 0-201-38027-7] (2000)
<http://physics.weber.edu/thermal/overview.htm>

Supplementary:

Reif- *Fundamentals of Statistical & Thermal Physics* [ISBN 0-07-051800-9] (1965)
Kittel & Kroemer- *Thermal Physics* [ISBN 0-7167-1088-9] (1980)
Thermal Physics, Ralph Baierlein [ISBN 0-521-65838-1] (1999)

Rough Plan:

Sept 5,7: RWs; Binomial, Gaussian, Poisson PDFs
Sept 12,14: Schroeder, ch1- ENERGY
Sept 19,21: S2- ENTROPY
Sept 26,28: S3- Thermal, Mechanical, & Diffusive Equilibrium

October: 9 classes

Special Topic I (RWs, or Fridge/Engines). midterm= Oct 10
S5-Free Energy & Chemical Thermodynamics: 5 lectures.
S6- Maxwell-Boltzmann Statistics: 2 lectures (10/26, Halloween)

November: 7 classes

S7- Quantum Statistics: 5 lectures (Bosons vs. Fermions, Degenerate Fermi Gases;
Blackbody Radiation, Debye Solids, Bose-Einstein Condensation)
>Thanksgiving
S8- Interacting Particles: 2 lectures (Imperfect Gases, Ising Ferromagnetism)

December: 2 classes- Special Topics II & III.

Grading: Midterm 16%, HW 44%, Final 40%, approximately....