Energy and Entropy

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Semester 1 2015, Year 2 (FHEQ level 5)

Synopsis:

Review of Thermodynamics: Extensive and intensive variables, thermodynamic systems, functions of state, zeroth and first laws of thermodynamics, adiabatic, isothermal and isobaric processes, heat capacities, Clausius statement of second law, entropy, reversible and irreversible processes, equilibrium, principle of equipartition, thermodynamic potentials – Helmholtz free energy and the grand potential, ideal gas.

Basics of Statistical Physics: Probability basics, Microstates, equal a priori probability, Boltzmann's entropy expression, microcanonical ensemble, state counting, Stirling's approximation, Gibbs' entropy, information theory and missing information.

Canonical Ensemble: Boltzmann factor, Boltzmann Distribution, Maxwell velocity distribution, partition function, derivation of equipartition, two level system, harmonic oscillator heat capacity, heat capacity of gases, Einstein's model of heat capacity of a solid, mode counting, Debye model of heat capacity, Fluctuations.

Grand Canonical Ensemble: Chemical potential, Gibbs factor, Grand partition function, Identical particles, quantum concentration, Fermi-Dirac and Bose statistics, Quantum gases, Bose-Einstein condensation, Fermi gas.

Phase transitions: Classical phase transitions, first and second order transitions, order parameters, ferromagnetism phase transition, β-brass phase transition, Landau theory.

Recommended Reading:

Bowley and Sanchez, Introductory Statistical Mechanics, Oxford, 1996.

David Goodstein, Thermal Physics, CUP, 2015.

Ian Ford, Statistical Physics: An Entropic Approach, Wiley 2013.

Background Reading:

Herbert B. Callen, Thermodynamics and an introduction to thermostatistics, Wiley 1960.

Stephen Blundell and Katherine M. Blundell, Concepts in thermal physics, OUP, 2010.

A. M. Glazer and J. S. Wark, Statistical mechanics: a survival guide, OUP, 2001.

C. B. P Finn, Thermal physics, Chapman & Hall, 1993.