

THERMODYNAMICS AND STATISTICAL MECHANICS

Physics III Lecture Course, first semester 2006

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Contents

Lecture 1 : Laws of Thermodynamics

Classical thermodynamics: The Laws of thermodynamics; Thermodynamic variables; Specific heats and expansion coefficients; The equation of state; Appendix A: Rules Partial Differentiation; Exercise Set 1.

Lecture 2 : Thermodynamic Variables

Absolute temperature and entropy: Dependent and independent variables; Partial Differentiation; Exercise Set 2.

Lecture 3 : Maxwell Distribution: Ideal Gases

The Maxwell Distribution; Thermodynamics of an Ideal Gas; The Entropy of an Ideal Gas; Exercise Set 3.

Lecture 4 : State Functions

The four state functions; Maxwell relations; Exercise Set 4.

Lecture 5 : Open Systems

The chemical potential; The thermodynamic potential; The chemical equilibrium for a perfect gas; Specific examples of the chemical potential; Exercise Set 5.

Lecture 6 : Chemical reactions

Chemical equilibrium; Concentrations and partial pressures; Approximation to the chemical potential; The law of mass action; Osmotic pressure; Solutions of gases; Exercise Set 6.

Lecture 7 : Phase Transitions

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Lecture 8 : The Thermodynamics of Electric, Magnetic and Other Systems

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Lecture 9 : Classical Statistical Mechanics

Ensembles; Phase space and Liouville's theorem; Specific ensembles; Ensembles for quantum mechanical systems; The partition function; Exercise Set 9

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Lecture 11 : Ideal Bose and Fermi Gases

Classical particles, fermions and bosons; Grand partition functions; The pressure and energy density of a quantum gas; The adiabatic equation of state; Exercise Set 11

Lecture 12 : Degenerate Ideal Fermi Gases

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Lecture 13 : Degenerate Bose gases

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Lecture 14 : Black Body Radiation

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Lecture 15 : The Debye Theory for Solids

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Lecture 16 : Ionization Equilibrium

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Lecture 17 : Order-Disorder Transitions

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Lecture 18 : Superfluidity

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Lecture 19 : Thermodynamics in Astrophysics and Cosmology

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