

MASSACHUSETTS INSTITUTE OF TECHNOLOGY

Physics Department

8.044 Statistical Physics I

Spring Term 2003

**COURSE OUTLINE**

I. Probability

- A. Random variables: discrete, continuous, and mixed
- B. Multiple variables: joint and conditional densities
- C. Functions of a random variable
- D. Sums of random variables

Examples: drawn from kinetic theory, Poisson processes, and quantum mechanical wave functions

II. Thermodynamic Systems

- A. Definitions
- B. The concept of temperature
- C. The first law

III. Micro-canonical Ensemble

- A. The postulate of equal a priori probabilities
- B. Temperature, entropy, and the second law
- C. Probabilities for microscopic variables

Examples: ideal gas, 2 level problem, Shottkey defects, 1 dimensional Ising model, harmonic oscillators

IV. Canonical Ensemble

- A. Earlier examples revisited
- B. Connection with thermodynamic potentials
- C. Fluctuations

Examples: polyatomic gases, paramagnetism, thermal radiation and phonons in solids, noise in electronic circuits

V. Ideal Quantum Gases

- A. Zero temperature behavior
- B. Counting of states, failure of canonical ensemble
- C. Low temperature behavior

Examples: Bose-Einstein Condensation; metals, semiconductors, and insulators; neutron stars and white dwarfs