In the Name of God

Advanced Statistical Mechanics Course

References:

1) Statistical Mechanics, R. K. Pathria, First Edition (1972) and Second Edition (1996).
2) http://sci.ui.ac.ir/~sjalali/MSc.Students/pathria.htm
3) Statistical Mechanics, Kerson Huang, (1987)
4) A Modern Course in Statistical Physics, L. E. Reichl (1998)
5) Statistical Physics, F. Mandel (1974)
6) Statistical Mechanics, R. H. Fowler (1966)
7) Statistical Mechanics, R. P. Feyman, W. A. Benjamin (1972)
8) Statistical Physics, L. D. Landau, E. M. Lifshitz (1980)
9) Heat and Thermodynamics, M. W. Zemansky, R. H. Dittman (1968)
10) Equilibrium Thermodynamics, C. J. Adkins, 3rd Edition (1983)

Our Main Reference

Here we concentrate on first edition of the reference number 1, which is statistical mechanics written by R. K. Pathria in 1972.

http://sci.ui.ac.ir/~sjalali/MSc.Students/pathria.htm

http://sci.ui.ac.ir/~sjalali/MSc.Students/statistical.mechanics/pathria.pdf

Presented Lecture notes in the classroom are accessible in PDF format and all of them can be downloaded from the following web site:

http://sci.ui.ac.ir/~sjalali/MSc.Students/pathria.htm

To download the lecture notes you just click on the numbers in front of "Handouts" provided for each chapter separately.

Evaluation Procedures:

1) Midterm (40% or 45%) + Final (50% or 45%) + Homework (10%)

2) Midterm (25% or 30%) + Final (40% or 35%) + Homework (10%) + Research (25%)

N.B. Choice is yours to select procedure Number 1 or Procedure Number 2

If you select procedure 2 I would suggest going through the following text book written by L. E. Reichl in detail:

http://sci.ui.ac.ir/~sjalali/MSc.Students/statistical.mechanics/reichl.djvu

Chapter 1. The Statistical Basis of Thermodynamics

Chapter 2. Elements of Ensemble Theory

Chapter 3. The Canonical Ensemble

3.1. Equilibrium between a system and a heat reservoir
3.2. A system in the canonical ensemble
3.3. Physical significance of the various statistical quantities in the canonical ensemble
3.4. Alternative expressions for the partition function
3.5. The classical systems
3.6. Energy fluctuations in the canonical ensemble: correspondence with the microcanonical ensemble

3.9. The statistics of paramagnetism
3.10. Thermodynamics of magnetic systems: negative temperatures

Chapter 4. The Grand Canonical Ensemble

4.1. Equilibrium between a system and a particle–energy reservoir
4.2. A system in the grand canonical ensemble
4.3. Physical significance of the various statistical quantities
4.4. Examples
4.5. Density and energy fluctuations in the grand canonical ensemble: correspondence with other ensembles

Chapter 5. Formulation of Quantum Statistics

5.1. Quantum-mechanical ensemble theory: the density matrix
5.2. Statistics of the various ensembles
A. The microcanonical ensemble
B. The canonical ensemble
C. The grand canonical ensemble
5.3. Examples
A. An electron in a magnetic field
B. A free particle in a box
C. A linear harmonic oscillator
5.4. Systems composed of indistinguishable particles
5.5. The density matrix and the partition function of a system of free particles

Chapter 6. The Theory of Simple Gases

6.1. An ideal gas in a quantum-mechanical microcanonical ensemble
6.2. An ideal gas in other quantum-mechanical ensembles
6.3. Statistics of the occupation numbers
6.4. Kinetic considerations
6.5. Gaseous systems composed of molecules with internal motion
A. Monatomic molecules
B. Diatomic molecules
C. Polyatomic molecules

Chapter 7. Ideal Bose Systems

7.1. Thermodynamic behavior of an ideal Bose gas
7.2. Thermodynamics of the black-body radiation
7.3. The field of sound waves
7.4. Inertial density of the sound field
7.5. Elementary excitations in liquid helium II

Chapter 8. Ideal Fermi Systems

8.1. Thermodynamic behavior of an ideal Fermi gas
8.2. Magnctic behavior of an ideal Fermi gas
A. Pauli paramagnetism
B. Landau diamagnetism
8.3. The electron gas in metals
A. Thermionic emission (the Richardson effect)
B. Photoelectric emission (the Hallwachs effect)
8.4. Statistical equilibrium of white dwarf stars
8.5. Statistical model of the atom

http://www.launc.tased.edu.au/online/sciences/physics/photo-elec.html

Chapter 9. Statistical Mechanics of Interacting Systems: The Method of Cluster Expansions

Chapter 10. Statistical Mechanics of Interacting Systems: The Method of Pseudopotential

Chapter 11. Phase Transitions: Critically, Universality and Scaling

Chapter 12. Phase Transitions: Exact (or Almost Exact) Results for the Various Models

Chapter 13. Phase Transitions: The Renormalization Group Approach

Chapter 14. Fluctuations

OLD Version of the book

Chapter 9. Statistical Mechanics of Interacting Systems: The Method of Cluster Expansions

Chapter 10. Statistical Mechanics of Interacting Systems: The Method of Pseudopotential

Chapter 10. Statistical Mechanics of Interacting Systems: The Method of Quantized Fields

Chapter 11. Theory of Phase Transitions

Chapter 13. Phase Transitions: The Renormalization Group Approach

Chapter 14. Fluctuations