University of Massachusetts Lowell

Department of Physics and Applied Physics

95.421/521 Statistical Physics

Fall 2008

Schedule: Tues, Thur 8.30- 9.45

Room: OH 115

Credits: 3

Instructor: Dr. K. Sebastian, **Office OH 134**

Office Hours: Tues, Thu 10-11.30, Other times by appointment

Text Books: Statistical Physics (Second Edition) By Mandl (Wiley)

Thermal Physics by C. Kittel and H. Kroemer (Freeman)

Prerequisites/ Corequisites: Junior Quantum Mechanics and Mechanics

Grading Policy: Exam I, Tuesday, October 14, 2008 (20%)

Exam II, Tuesday, November18, 2008 (20%)

Final Exam: TBA (30%)

Home Work: (30%)

No late home work will be accepted. The student should be in class when submitting the home work.

Syllabus and home work: See the attached sheets.

95.421/521
Statistical Physics

Syllabus and Homework Assignments

First Week: Aims of Statistical Physics- Outline of the approach to be taken- Summary of the Course- Some thermal concepts- Definition of Temperature- First Law of Thermodynamics- Read Chapter 1 of Mandl.
Problem Set I: 1.1 – 1.7 of Mandl

Second Week: Second Law of Thermodynamics, The direction of natural processes, Macrostates and Microstates, The statistical weight of a macrostate, Boltzmann's definition of entropy, Thermal equilibrium of a system in contact with a heat bath, Canonical Partition Function and the Boltzmann factor. Read Chapter 2 of Mandl.
Problem Set II: 2.1 – 2.3, 2.5, 2.6 of Mandl, 2.1,2.3,2.4 of Kittel and Kroemer (KK)

Third Week: Application of the Partition Function Approach, Derivation of the induced magnetic moment of a paramagnetic solid in a magnetic field as a function of temperature and the magnetic field. Application of other approaches to the same problem. Read Chapter 3 of Mandl.
Problem Set III: 2.4, 3.1, 3.3,3.4 of Mandl, 3.1, 3.3, 3.7 of KK

Fourth Week: Second Law applied to a subsystem in contact with a heat bath, Clausius Inequality, Thermodynamic potentials, The third law of thermodynamics, Calculation of entropy changes for simple processes. Read Chapter 4 of Mandl
Problem Set IV: 4.1 – 4.6 of Mandl

Fifth Week: Other forms of Second law, Carnot cycle, Heat Engines and Refrigerators, Heat pumps. Read sections 5.1 and 5.2 of Mandl. Also read Cahpter 8 of KK.
Problem Set V: 8.1, 8.4 – 8.8 of KK

Sixth Week: Phase Equilibria, Equilibrium conditions, The Clausius Clapeyron eauation and its applications. Read Chapter 8 of Mandl.
Problem Set VI: 8.2 – 8.7 of Mandl.

Seventh and Eighth Weeks: The heat capacity of solids, Einstein and Debye Models, Black body radiation and Planck's law for the spectral distribution. Read Chapters 6 and 10 of Mandl. Also read chapter 4 of KK.
Problem Set VII: 6.1 – 6.4 of Mandl, 4.11 and 4.14 of KK
Problem Set VIII: 4.2, 4.3, 4.5, and 4.7 of KK , 10.2, 9.1 of Mandl

Ninth Week: The grand canonical partition function, Gibb's Distribution, Derivation of Bose-Einstein and Fermi Dirac distributions for ideal gases. Read Chapter 5 of KK and Chapter 11 of Mandl.
Problem Set IX: 5.6 – 5.10 of KK.

Tenth Week: The Classical Perfect Gas, Derivation of the perfect gas equation, Entropy, etc. Maxwell distribution of velocities, Equipartition theorem. Read chapter 7 of Mandl and Chapter 6 of KK.
Problem Sets Xand XI: 7.1 – 7.5, 7.9 – 7.11 of Mandl and 6.7, 6.9, 6.12 of KK.

Eleventh and Twelfth Weeks: Ideal Fermi gas, Conduction electrons in metals, White dwarf stars. Ideal Bose gas, Bose Einstein condensation, Superfluidity of He II. Read Chapter 11 of Mandl and Chapter 7 of KK.
Problem Sets XII and XIII: 11.1, 11.4, 11.5 of Mandl and 7.1 – 7.3, 7.5 – 7.10 of KK.