

**INSTRUCTOR:** J. Sirker  
Office: Room 515, Allen Building  
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**LECTURES:** Tuesday and Thursday, 10:00-11:15 am, Allen Building 330  
Attendance at all lectures is expected. It is advisable to take detailed notes, and to review them after each lecture. Please come and see me during consultation times if you have any questions.

**CONSULTATION TIMES:**

- Regular consultation times are from 10:30 - 11:30 am on Mondays and Wednesdays.
- Please send me an email if you want to see me at a different time.

**TEXTBOOKS:**  
There is no required textbook for this course. Course notes will be published online. However, you might want to consult some of the textbooks listed below:

- 1) LD Landau and EM Lifshitz, *Statistical Physics, Part I* (Elsevier Butterworth-Heinemann, 1980). Excellent discussion of many of the core concepts.
- 2) RK Pathria, *Statistical Mechanics* (Butterworth-Heinemann). Another good introduction into the classical topics of Stat. Mech.
- 3) Roger Bowley and Mariana Sánchez, *Introductory Statistical Mechanics* (Oxford Univ. Press, 1999). This is an undergraduate textbook. However, it contains beautiful explanations of the main ideas and is easy to read.

**ASSIGNMENTS:**  
Homework problems will be assigned on a regular basis (usually every two weeks) and collected for marking (usually one week later).

**EVALUATION PROCEDURE:**  
The final course grade will be made up as follows:

Assignments:	50%
Final exam:	50%

**POLICY ON LATE SUBMISSION OF ASSIGNMENTS:**  
Late assignments will be penalized 5% of the total mark per day overdue, unless a satisfactory reason for the delay is given.

**POLICY ON PLAGIARISM AND CHEATING:**  
The Faculty of Science guidelines on plagiarism and cheating are found on the web at:  
<http://umanitoba.ca/science/student/webdisciplinedocuments.html>  
Acts of academic dishonesty include, but are not limited to bringing unauthorized materials into a test or exam, copying from another individual, using answers provided by tutors, plagiarism, and examination personation. Penalties that may apply, as provided for under the University of Manitoba's Student Discipline By-Law, range from a grade of zero for the assignment or examination, failure in the course, to expulsion from the University. The Student Discipline By-Law may be accessed on the web at:  
[http://umanitoba.ca/admin/governance/policies/section\\_1200/1202.shtml](http://umanitoba.ca/admin/governance/policies/section_1200/1202.shtml)

## COURSE OUTLINE:

In the first part of the course (chapters 1-3) the main ideas and basic formalism will be introduced. In the second part (chapters 4-6) modern applications will be discussed.

1. INTRODUCTION: Objectives of Statistical Mechanics
  
2. BASICS OF EQUILIBRIUM STATISTICAL MECHANICS
  - Ensembles
  - Entropy
  - Partition functions, thermodynamic relations, fluctuations
  
3. THE IDEAL GASES
  - The classical ideal gas
  - Identical particles: Fermions and Bosons
  - The ideal Bose gas (Photon gas, vibrations of solids, Bose-Einstein condensation)
  - The ideal Fermi gas
  
4. BOSE-EINSTEIN CONDENSATION IN WEAKLY INTERACTING GASES
  - Cold atomic gases, traps, optical lattices
  - Thermalization in closed quantum systems
  - Nonequilibrium dynamics: Quantum quenches
  
5. MAGNETIC SYSTEMS
  - The Ising model (Solution in one dimension)
  - The Hubbard and the Heisenberg model
  
6. PHASE TRANSITIONS
  - Mean Field Theory
  - Classification of Phase Transitions: Landau theory
  - Basics of Renormalization Group Theory: Critical exponents
  - $\phi^4$  - theory