

**COURSE NO:**      **PHYS 3680**                      **TITLE: Statistical Mechanics**

Web Site: <http://drop.physics.umanitoba.ca/~jsirker>

## LECTURES

Dr. J. Sirker Tel: 474-6192	<b>MWF 9:30 a.m.</b> office: 515 Allen Bldg email: <a href="mailto:sirker@physics.umanitoba.ca">sirker@physics.umanitoba.ca</a>	<b>Allen 330</b> Consultation Times: 10:30 – 11:30 am (MW)
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## REQUIRED TEXTBOOKS & MATERIALS

1) Roger Bowley and Mariana Sánchez, *Introductory Statistical Mechanics*, 2<sup>nd</sup> ed.  
(Oxford University Press, 1999).

This book is the main reference. Supplementary material for specific chapters will be announced in class.

2) LD Landau and EM Lifshitz, *Statistical Physics, Part I* (Elsevier Butterworth-Heinemann, 1980).  
This is a more advanced book which offers a different point of view on many of the subjects covered.

3) For chapter I: J.R. Taylor, *Classical Mechanics*, (University Science Books, 2005).  
Relevant is chapter 13 (Hamiltonian Mechanics), pages 521 - 550.

## ASSIGNMENTS

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

**EVALUATION PROCEDURE:**

Assignments:	25%
Midterm test:	25%
Final exam:	50%

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Total	100%
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The schedule of assignments, midterm and final exam are detailed below. The marks of the assignments, midterm and final exam will be made available within one week after submission. A sufficient percentage of the total mark will be provided to the students before the Voluntary Withdrawal deadline. The final grades will be posted on the course website and submitted to Aurora by the grade submission deadline.

**The preliminary low-numerical-boundaries for the letter grades:**

A+	90%
A	80%
B+	75%
B	66%
C+	60%
C	50%
D	45%
F	Below 45%

Note that the final numerical boundary for each letter grade may be adjusted depending on the total mark distribution of the class. No student's final grade will be reduced due to the boundary adjustment.

**SCHEDULE OF ASSIGNMENTS AND TESTS:**


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Five assignments	(every two weeks)
Midterm test	Tuesday, March 7, 2017, 6:00-8:00 p.m. (preliminary date)
Final exam	end of April, to be scheduled by Student Records

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**POLICY ON MISSED EXAMS**

No rewrites are given for the mid-term test. If you miss the mid-term test for a legitimate, documented reason, then the weight of the final exam will be increased to 75%. Late assignments will be penalized 10% of the total mark per day overdue, unless a satisfactory reason for the delay is given.

**STUDENT ACCESSIBILITY SERVICES**

If you are a student with a disability, please contact SAS for academic accommodation supports and services such as note-taking, interpreting, assistive technology and exam accommodations. Students who have, or think they may have, a disability (e.g. mental illness, learning, medical, hearing, injury-related, visual) are invited to contact SAS to arrange a confidential consultation.

*Student Accessibility Services*

520 University Centre

204 474 7423

<http://umanitoba.ca/student/saa/accessibility/>

[Student\\_accessibility@umanitoba.ca](mailto:Student_accessibility@umanitoba.ca)

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**SCHEDULE A**

A Schedule A document is posted on the course website. This is a Policy and Resource Document with information on various University and Unit policies regarding academic integrity, student discipline, and respectful learning environment, for example, and on academic and student supports that are available, including a statement regarding mental health with referral information to the Student Counselling Centre and University Health Services.

**PHYS 3680 Course Outline**  
**Winter 2017**

This course serves as an introduction to statistical mechanics. An important goal of the course will be to present the basic principles and illustrate these principles using contemporary examples.

1. INTRODUCTION: Objectives of Statistical Mechanics
2. PROBABILITY AND STATISTICS
  - Introduction to the basics of Probability Theory
  - Permutations and Counting the number of events
  - Distributions
3. THE IDEAS OF STATISTICAL MECHANICS
  - Entropy and Probability
  - Simple Examples
  - Quantum states and the Microcanonical Ensemble
  - The Second Law of Thermodynamics
4. THE CANONICAL ENSEMBLE
  - The Partition Function
  - General definition of Entropy
  - Free Energy
  - Thermodynamic Relations
  - Simple Examples
  - Thermal Equilibrium: Minimizing the Free Energy
5. IDENTICAL PARTICLES
  - Symmetric and antisymmetric wavefunctions
  - Bose and Fermi particles
  - Partition function for identical particles
6. MAXWELL VELOCITY DISTRIBUTION
  - Density of states
  - Distribution of particle speeds in a classical gas
7. PLANCK'S DISTRIBUTION
  - Planck's distribution and radiation law
  - Thermodynamics of the photon gas
  - Thermal vibrations in solids (models of Debye and Einstein)
8. SYSTEMS WITH VARIABLE NUMBERS OF PARTICLES
  - The chemical potential
  - The Grand Canonical Ensemble and Potential
9. FERMI AND BOSE QUANTUM STATISTICS
  - Fermi-Dirac and Bose-Einstein distributions
  - The ideal Fermi gas: properties and examples
  - The ideal Bose gas: Bose-Einstein condensation.
10. PHASE TRANSITIONS
  - Ising Model: Mean Field Theory and the One-Dimensional Case
  - Classification of Phase Transitions: Landau theory

**PLAGIARISM AND CHEATING**

(University of Manitoba Undergraduate Calendar, General Academic Regulations, Academic Integrity)

To plagiarize is to take ideas or words of another person and pass them off as one's own. In short, it is stealing something intangible rather than an object. Obviously it is not necessary to state the source of well known or easily verifiable facts, but students are expected to acknowledge the sources of ideas and expressions they use in their written work, whether quoted directly or paraphrased. This applies to diagrams, statistical tables and the like, as well as to written material, and materials or information from Internet sources. To provide adequate documentation is not only an indication of academic honesty but also a courtesy which enables the reader to consult these sources with ease. Failure to do so constitutes plagiarism. It will also be considered plagiarism and/or cheating if a student submits a term paper written in whole or in part by someone other than him/herself, or copies the answer or answers of another student in any test, examination, or take-home assignment.

Plagiarism or any other form of cheating in examinations or term tests (e.g., crib notes) is subject to serious academic penalty (e.g. suspension or expulsion from the faculty or university). A student found guilty of contributing to cheating in examinations or term assignments is also subject to serious academic penalty.

**EXAMINATIONS: PERSONATIONS**

(University of Manitoba Undergraduate Calendar, General Academic Regulations, Final Examinations)

A student who arranges for another individual to undertake or write any nature of examination for and on his/her behalf, as well as the individual who undertakes or writes the examination, will be subject to discipline under the university's Student Discipline Bylaw, which could lead to suspension or expulsion from the university. In addition, the Canadian Criminal Code treats the personation of a candidate at a competitive or qualifying examination held at a university as an offence punishable by summary conviction. Section 362 of the Code provides:

*Personation at Examination*

362. Every one who falsely, with intent to gain advantage for him/herself or some other person, personates a candidate at a competitive or qualifying examination held under the authority of law or in connection with a university, college or school or who knowingly avails him/herself of the results of such personation is guilty of an offence punishable on summary conviction. 1953- 54,c.51,s.347.

Both the personator and the individual who avails him/herself of the personation could be found guilty. Summary conviction could result in a fine being levied or up to two years of imprisonment.

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**FACULTY OF SCIENCE STATEMENT ON ACADEMIC DISHONESTY**

The Faculty of Science and The University of Manitoba regard acts of academic dishonesty in quizzes, tests, examinations, laboratory reports or assignments as serious offences and may assess a variety of penalties depending on the nature of the offence.

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.

***Note: cell phones, pagers, PDAs, MP3 units or electronic translators are explicitly listed as unauthorized materials, and must not be present during tests or examinations.***

Penalties that may apply, as provided for under the University of Manitoba's Student Discipline ByLaw, range from a grade of zero for the assignment or examination, failure in the course, to expulsion from the University. The Student Discipline ByLaw may be accessed at:

*[http://umanitoba.ca/admin/governance/media/Student\\_Discipline\\_Bylaw\\_-\\_2009\\_01\\_01.pdf](http://umanitoba.ca/admin/governance/media/Student_Discipline_Bylaw_-_2009_01_01.pdf)*

The Faculty of Science guidelines on plagiarism and cheating and suggested minimum penalties are available at:

*[http://umanitoba.ca/faculties/science/resources/Acad\\_Dishon\\_TABLE\\_RevCSS\\_AdminC\\_Jul2012\\_WEB.pdf](http://umanitoba.ca/faculties/science/resources/Acad_Dishon_TABLE_RevCSS_AdminC_Jul2012_WEB.pdf)*

All Faculty members (and their teaching assistants) have been instructed to be vigilant and report all incidents of academic dishonesty to the Head of the Department.