PHYS 4400 Statistical Mechanics Fall 2025

Instructor: Stefan Wallin, office C-3018, phone 864-8880, email swallin@mun.ca
Classes: Mondays, Wednesdays, Fridays 9:00-9:50, Room C-3067 (see Course schedule).
Office hours: Wednesdays 10-12 (or drop by anytime for questions related to the course).
Webpage: Brightspace will be used for all course information, assignments, grades, etc.
Course book: The course has a required text: *Introduction to Modern Statistical Physics* by David Chandler (1987). Oxford University Press.
Prerequisites: Physics 3400 and (co-requisite) Physics 3750.
Course outline: We will cover the material of Chapters 1-5 of Chandler:

Chapter 1. Thermodynamics, fundamentals (~2 weeks). *Laws of thermodynamics, Legendre transforms, Maxwell relations, thermodynamic potentials, Gibbs-Duhem equation.*
Chapter 2. Conditions for equilibrium and stability (~1 week). *Multiphase equilibrium, stability, Gibbs phase rule, plane interfaces.*
Chapter 3. Statistical mechanics (~2 weeks). *Statistical ensembles (microcanonical, canonical, grand canonical), Gibbs entropy formula, fluctuations.*
Chapter 4. Non-interacting (ideal) systems (~2 weeks). *Photon gas, phonon gas, occupation numbers, classical limit, dilute gas of diatomic atoms, chemical equilibria.*
Chapter 5. Statistical mechanical theory of phase transitions (~3 weeks). *Ising model, lattice gas, mean field theory, broken symmetry, renormalization group theory.*

Time permitting: Selected parts of Chapters 6 (Monte Carlo method) or Chapter 8 (Non-equilibrium statistical mechanics).

Problem sessions (weekly): Solving problems is an important part of the course. You should prepare for each problem session by solving — or seriously attempting — the assigned exercises. You will be called upon to solve and discuss your solutions in class. The focus will be on understanding the methods and concepts used to solve the problems, rather than getting the right answer.

Seminars (weekly): Before each meeting you must carefully read and engage with the assigned readings. Come prepared with: (1) *minimum 1-2 pages of notes where you summarize the assigned sections in your own words;* and (2) *3 or more questions on the text* (Which statements/equations/arguments/assumptions/approximations do you find difficult to understand? What are you most confused about?). For each seminar, one student will be assigned to informally and briefly present the material and lead the discussion. If you are unable to attend a seminar, you must contact me in advance.

Project: You will be asked to study a specific topic within statistical mechanics and present it in class. Presentations will take place in the second half of the course. A list of a suggested topics will be provided but you are free to suggest your own.

Assignments (~3-4): Problem sets to be handed in for grading.

Evaluation:

Problem sessions	15%
Seminars	15%
Presentation	15%
Assignments	15%
Final exam	40%

Supplemental final exam will not be allowed.

Student accommodation. Memorial University of Newfoundland is committed to fostering equitable and accessible learning environments for all students. Accommodations for students with disabilities are provided in accordance with the Accommodations for Students with Disabilities Policy (www.mun.ca/policy/site/policy.php?id=239) and its related procedures. Students who feel that they may require formal academic accommodations to address barriers or challenges they are experiencing related to their learning are encouraged to contact Accessibility Services (the Blundon Centre) at the earliest opportunity to ensure any required academic accommodations are provided in a timely manner. You can contact Accessibility Services (Blundon Centre) by emailing blundon@mun.ca.

Academic integrity. Students are expected to adhere to those principles which constitute proper academic conduct. A student has the responsibility to know which actions, as described under Academic Offences in the University Regulations, could be construed as dishonest or improper. Students found guilty of an academic offence may be subject to a number of penalties commensurate with the offence including reprimand, reduction of grade, probation, suspension or expulsion from the University. For more information regarding this policy, students should refer to the University Regulations for Academic Misconduct (Section 6.12) in the University Calendar.

Instructional continuity. In the case of a class disruption or cancellation, and in the case of revisions to evaluation methods, the instructor or the Head of the department will notify all students registered in the course *via the course shell in Brightspace*. Any necessary revisions to the evaluation methods will be made in consultation with the students registered in this course. If a student demonstrates that they would be disadvantaged by the change, then, as per 6.7.4 of the University Calendar, accommodations will be made.

Use of assistive tools. Original work, completed wholly by you, is expected to be submitted in this course. The use of an artificial intelligence tool like ChatGPT is not permitted.