

WILFRID LAURIER UNIVERSITY



## Course Syllabus

PC344: Thermodynamics and Statistical Physics

Department of Physics and Computer Science, Faculty of Science, Waterloo

Fall | 2018

### Instructor Information

Alexei Kaltchenko | N2077 (Science Building)

Contact Information: 519-884-0710 x2217, akaltchenko@wlu.ca

Weekly Office Hours: Wednesday, 4pm-5pm or By Appointment

### Course Information

PC344: Thermodynamics & Stat Physics

MW: 9:30am –103:50am, N1058

Pre-requisites | PC131, PC132, MA201

### Course Overview and Approach

The goals of this course are to help you learn the basic ideas of thermodynamics from both the macroscopic and microscopic viewpoints and how they relate to modern applications. We will look at key concepts such as temperature, energy, entropy and their statistical interpretation. The approaches used to achieve these goals involve (1) lectures to interactively discuss and demonstrate the principles and (2) interaction with instructor to provide one-on-one help with concepts and problem solving.

### Topics covered:

- Energy in Thermal Physics. An overview of temperature, ideal gases, equipartition, the first law, heat capacities, and transport processes.
- The Second Law. Two-state systems and the Einstein solid model; analysis of two interacting Einstein solids, multiplicity of an ideal gas; statistical definition of entropy.
- Interactions and Implications. Temperature, pressure, and chemical potential as partial derivatives of the entropy; the relation between entropy and heat; prediction of heat capacities and other thermal properties of a paramagnet, Einstein solid, and ideal gas
- Engines and Refrigerators. Limits on efficiency from the laws of thermodynamics; Carnot cycle.
- Free Energy and Chemical Thermodynamics. Helmholtz and Gibbs free energies; applications to electrochemistry, phase transformations, mixtures, dilute solutions, and chemical equilibrium.
- Boltzmann Statistics. Boltzmann factors and partition functions, including applications to atomic and molecular excitations, paramagnetism, equipartition theorem, Maxwell distribution, ideal gases.

## Course Tools and Learning Materials

- Daniel V. Schroeder, “An Introduction to Thermal Physics”, any edition.
- [Library e-reserve website and access information](#)

**Note:** Audio and/or video recording and/or broadcasting of the lectures in this course is not permitted unless specific permission has been granted by the instructor.

## Attendance

If a student misses a class without a legitimate documented reason, the material and information presented in the class will not be discussed (or otherwise communicated) afterwards. Attendance might be occasionally taken and used towards the final grade as a bonus.

## Student Evaluation

List each course assessment (assignments, tests, projects, exams)<sup>†</sup> with a weighting (percentage of final grade)<sup>†</sup> and the associated due date<sup>†</sup> in the table below.

Assessment	Weighting	Date
Three tests	3 x 30%	TBA
Final test	1 x 10%	December 5
<b>Total</b>	<b>100%</b>	

## University and Course Policies

1. **Special Needs:** Students with disabilities or special needs are advised to contact Laurier’s Accessible Learning Centre for information regarding its services and resources.
2. **Plagiarism:** The University has approved the following wording for inclusion on all course syllabi about the use of the institutionally supported plagiarism software tool. “Wilfrid Laurier University uses software that can check for plagiarism. If requested to do so by the instructor, students are required to submit their written work in electronic form and have it checked for plagiarism.” (Approved by Senate May 14, 2002) .

In addition to the statement above you may wish to add the following text about academic integrity.

3. **Academic Integrity:** Laurier is committed to a culture of integrity within and beyond the classroom. This culture values trustworthiness (i.e., honesty, integrity, reliability), fairness, caring, respect, responsibility and citizenship. Together, we have a shared responsibility to uphold this culture in our academic and nonacademic behaviour. The University has a defined policy with respect to academic misconduct. As a Laurier student you are responsible for familiarizing yourself with this policy and the accompanying penalty guidelines, some of which may appear on your transcript if there is a finding of misconduct. The relevant policy can be found at Laurier's [academic integrity](#) website along with resources to educate and support you in upholding a culture of integrity. Ignorance is not a defense.

4. **Classroom Use of Electronic Devices:** State your classroom practice and any consequences for student failure to comply – see [Policy 9.3](#) (Approved by Senate March 8, 2012).
5. **Late Assignment Policy:** Specify any penalties that will be assessed when deadlines for the completion of course components are not met (Approved by Senate May 23, 2012). Refer to the Handbook on Undergraduate Course Management for more information.
6. **Final Examinations:** Students are strongly urged not to make any commitments (i.e., vacation) during the examination period. Students are required to be available for examinations during the examination periods of all terms in which they register. Refer to the Handbook on Undergraduate Course Management for more information.
7. **Foot Patrol, the Wellness Centre, and the Student Food Bank:** The University approved the inclusion of information about select wellness and safety services and supports on campus in the course information provided to students. (Approved by Senate November 28, 2011.) Specific language (by campus) is provided below.

**Multi-campus Resource:**

- Good2Talk is a postsecondary school helpline that provides free, professional and confidential counselling support for students in Ontario. Call 1-866-925-5454 or through 2-1-1. Available 24-7.

**Kitchener/Waterloo Resources:**

- [Waterloo Student Food Bank](#): All students are eligible to use this service to ensure they're eating healthy when overwhelmed, stressed or financially strained. Anonymously request a package online 24-7. All dietary restrictions accommodated.
- [Waterloo Foot Patrol](#): 519.886.FOOT (3668). A volunteer operated safe-walk program, available Fall and Winter daily from 6:30 pm to 3 am. Teams of two are assigned to escort students to and from campus by foot or by van.
- [Waterloo Student Wellness Centre](#): 519-884-0710, x3146. The Centre supports the physical, emotional, and mental health needs of students. Located on the 2<sup>nd</sup> floor of the Student Services Building, booked and same-day appointments are available Mondays and Wednesdays from 8:30 am to 7:30 pm, and Tuesdays, Thursdays and Fridays from 8:30 am to 4:15 pm. Contact the Centre at x3146, [wellness@wlu.ca](mailto:wellness@wlu.ca) or @LaurierWellness. After hours crisis support available 24/7. Call 1-844-437-3247 (HERE247).

**Brantford Resources:**

- [Brantford Student Food Bank](#): All students are eligible to use this service to ensure they're eating healthy when overwhelmed, stressed or financially strained. Anonymously request a package online 24-7. All dietary restrictions accommodated.
- [Brantford Foot Patrol](#): 519-751-PTRL (7875). A volunteer operated safe-walk program, available Fall and Winter, Monday through Thursday from 6:30 pm to 1 am; Friday through Sunday 6:30 pm to 11 pm. Teams of two are assigned to escort students to and from campus by foot or by van.
- [Brantford Wellness Centre](#): 519-756-8228, x5803. Students have access to support for all their physical, emotional, and mental health needs at the Wellness Centre. Location: Student Centre, 2nd floor. Hours: 8:30 am to 4:15 pm Monday through Friday. After hours crisis support available 24/7. Call 1-884-437-3247 (HERE247).