

Thermal Physics (Phys 330)

Syllabus

Thermal Physics is the study of phenomena in which temperature, thermal energy and heat are important. It is approached through study of general relationships among macroscopic variables such as energy, volume, temperature and pressure, a subject known as thermodynamics. Einstein asserted that, of all physics laws, laws of thermodynamics would never be overthrown.

But real material systems are composed of vast numbers of identical microscopic entities. Consider gas atoms in the room in which you are sitting, that interact with each other by exchanging energy during collisions. The collision rates are enormous but if one waits a while, the whole gas system will eventually reach an equilibrium state characterized by macroscopic physical variables that are extensive, such as the energy and volume of the system, and intensive properties such as temperature and pressure. Thermodynamic variables fluctuate about mean values. For macroscopic systems composed of, say, 10^{23} atoms or entities, the fluctuations are negligibly small., but can become very large close to phase transitions.

To study the behavior of particular systems, one develops microscopic models for how the entities interact. This is statistical mechanics and results that follow from the models are used to predict properties of materials such as the specific heat, or how the magnetization of a ferromagnet changes with temperature. Our aim in this course will be to develop the methods of thermodynamics and statistical mechanics and apply them to a broad range of physical phenomena, including properties of semiconductors, metals and insulators, magnetism, superconductors, superfluids, phase transitions, and critical phenomena. Physics 330 is appropriate for all math and science majors who have completed the course prerequisites.

Course Catalog Listing

330 Thermal Physics 3 Course Prerequisite: MATH 273 or 283; PHYSICS 202 or 206. Thermal behavior of systems; energy and entropy; equations of state; changes of phase; elements of continuum and statistical approaches. Typically offered in Spring.

Expected outcome

You will have learned how to apply methods of thermodynamics and statistical mechanics to understand and predict the behavior of a wide range of material systems. You will also be prepared to address broader issues such as global warming, the pivotal problem of our age.

General information

Instructor: Professor Gary S. Collins, office Webster 554, 335-1354, cell 336-9225.
Class hours: TTh, 13:25- 14:40, Webster Physical Sciences 11.
Office hours: right after class, whenever my office door is open, or by appointment.
About my research: <http://tinyurl.com/defects-physics-wsu-edu> (an archived page)
About my teaching: <http://public.wsu.edu/~collins/>
My email: <mailto:collins@wsu.edu> (always feel free to contact me with questions!)
Required text: *Statistical and Thermal Physics: With Computer Applications*, Harvey Gould and Jan Tobochnik (Princeton, 2010, ISBN 978-0-691-13744-5)
Text and programs are available **free** at <http://www.compadre.org/stp>.
Public home page: <http://www.wsu.edu/~collins/330>
Syllabus: <http://www.wsu.edu/~collins/330/syllabus.pdf> (remember to reload!)
Schedule: <http://www.wsu.edu/~collins/330/schedule.pdf>

Course format and grading

During class we will review readings and simulation programs from the text. PDF's of written notes, solutions, or powerpoints will be posted online. If you plan to meet with me for assistance, prepare ahead of time by writing down what you don't understand. Please don't hesitate to contact me with questions. That's my job!

In-class activities

1. To prepare, read indicated chapter material ahead of class and try out the associated Java simulation programs. We will review the new topic of the day.
2. Tutorial questions will be reviewed together. When I ask opinions, show me your answer using the folded, colored "ABCD" hand-out sheet, which you should bring to class daily.
3. Brief quizzes on readings or topics may be given in any class.
4. If you have questions at the end of a class or while studying, email me or call and I will try to answer your question individually or during the next class.

Homework

Homework will assigned roughly once a week and due one week later. Turn in homework at the beginning of class on the due date. You are encouraged to discuss problems with fellow students, but your solutions must be your own. Doing homework responsibly is key to internalizing and testing what you are learning. Attend to homework deadlines, late homework gets reduced or zero credit.

Exams

Exam problems will be similar to problems discussed in class, homework problems and sample problems from the text. Studying with fellow students is a great way to learn faster. There will be two hour-exams during the semester and a final exam. Make-up exams will be given only under exceptional circumstances. Exams are closed-book. A week ahead of each exam, an equation sheet will be provided that will appear on the exam. Not all equations you might need will be on the sheet; you should learn to derive other results that you feel are important, or memorize them.

Blackboard website

The site will include the syllabus and class schedule, solutions for homework and exams, and various other items..

Grading

Contributions to your final grade		Grading scale (with pluses and minuses)	
Quizzes and in-class	15%	A	85-100 %
Homework	30%	B	70-85 %
Hour-exams (2) 15% x 2	30%	C	55-70 %
Final exam	25%	D	45-55 %

Tips for doing well

Before the first class, read the "Preface": <http://stp.clarku.edu/notes/preface.pdf>
and Table of Contents: <http://stp.clarku.edu/notes/tableofcontents.pdf>

Attend classes, ask questions and participate in tutorial questions.

Keep up with text readings. And try out the excellent computer simulations.

Keep up with homework. Do your homework to do well. Expect to devote several hours of effort for the homework in each chapter.

Study with fellow students, but solutions you submit must be your own.

If you want a hard copy of the text, let me know during the first class or two and I will arrange for the Bookie to order them. Cost will be about \$110. Or get one used from Amazon for about \$55.

Resources

The complete text and computer programs can be accessed from
<http://www.compadre.org/stp>

An extensive list of online material:
<http://mansoori.people.uic.edu/Thermodynamics.Educational.Sites.html>

Great tutorial videos about thermodynamics, but less about statistical mechanics.
<https://www.khanacademy.org/science/physics/thermodynamics>

Hyperphysics on heat and thermodynamics only:
<http://hyperphysics.phy-astr.gsu.edu/hbase/heacon.html#heacon>

Facebook page ``Physics 330`` for this course:
<https://www.facebook.com/Physics330/>

Fine print

Academic Integrity: Academic integrity is the cornerstone of higher education. As such, all members of the university community share responsibility for maintaining and promoting the principles of integrity in all activities, including academic integrity and honest scholarship. Academic integrity will be strongly enforced in this course. Students who violate WSU's Academic Integrity Policy in Washington Administrative Code (WAC) 504-26-010(3) may lose points on an assignment, fail the assignment, or fail the course, depending on the seriousness of the offense. They may be reported to the Office of Student Conduct, in which case they will not have the option to withdraw from the course pending an appeal.

Cheating includes, but is not limited to, plagiarism and unauthorized collaboration as defined in the Standards of Conduct for Students, WAC 504-26-010(3). You need to read and understand all of the definitions of cheating at apps.leg.wa.gov/WAC/default.aspx?cite=504-26. If you have any questions about what is and is not allowed in this course, you should ask course instructors before proceeding.

If you wish to appeal a faculty member's decision relating to academic integrity, please use the form available at conduct.wsu.edu.

Disability Accommodations: Reasonable accommodations are available for students with documented disabilities. If you have a disability and need accommodation to fully participate in the lecture or lab, visit or contact the Access Center (Washington Building 217, Phone: 335-3417, E-mail: access.center@wsu.edu, URL: accesscenter.wsu.edu) to schedule an appointment with an Access Advisor. All accommodations must be approved through the Access Center. You must notify your instructor of approved accommodations during the first week of the course. Accommodations might not be available if requested later.

Campus Safety: Students and staff are expected to be familiar with emergency procedures. General information on campus safety is posted at safetyplan.wsu.edu. Information on how to prepare for specific emergencies can be found at oem.wsu.edu. Weather warnings and safety alerts are posted promptly at alert.wsu.edu. Urgent warnings that apply to the entire University community will also be broadcast using the Campus Outdoor Warning System (speakers mounted on Holland Library and other buildings) and the Crisis Communication System (e-mail, phone, cell phone). It is important to keep your emergency contact information up to date in MyWSU. To enter or update this information, click on the "Update Now!" link in the "Pullman Emergency Information" box on your MyWSU home page, at my.wsu.edu.

An Emergency Guide is posted near each exit of each lecture room. If faced with an emergency, follow the "Alert, Assess, Act," protocol: Remain ALERT (through direct observation or emergency notification), ASSESS your specific situation, and ACT to ensure your own safety and the safety of those around you. In case of fire, leave the building using the stairs, if necessary; do not use the elevators. If the emergency involves an active shooter, your options are to RUN, HIDE, or FIGHT (oem.wsu.edu/emergency-procedures/active-shooter). Every door in the lecture and lab rooms can be locked from the inside in case of a lock down.

The instructor reserves the right to modify the syllabus.

Syllabus subject to change.

Gary S. Collins, January 9, 2018