

PHYS 125: Soft Matter Physics for Non-physicists

Instructor

Igor Lyuksyutov
office location: MPHY 452
Email: lyuksyutov@tamu.edu
Course website:

Office hours
by appointment

Course (catalog) description

Modern physics in action with hands-on physics experience in simple experiments for non-physics majors; introduction to thermodynamics and soft matter physics; heat, temperature, thermodynamic efficiency, phase transitions, mechanical properties of soft matter, heat transfer mechanisms; physical measurements.

Learning Outcomes

- Students will be able to use scientific method to measure/explain properties of soft matter, including elasticity and thermodynamics. Students will be able to perform physical measurements of temperature, weight, volume, and pressure, prepare gels, and other soft matter substances. Students will be able to use basic laws of thermodynamics to explain phase transitions in the soft matter and to calculate/measure stress and strain in soft matter.
- Students will develop critical thinking. Students will learn the fundamental principles of thermodynamics and soft matter physics. To solve problems and perform experiments, they will develop critical thinking to determine which laws of thermodynamics to apply and how these laws explain soft matter properties. Students will be able to inquire, analyze, and evaluate different factors important for particular processes and synthesize available information to get answers.
- Students will develop oral, visual, and written communication skills by presenting their results in the form of reports which include written text and visual presentations (graphs, photos, short video clips).
- Students will develop empirical and quantitative skills in problem solving by manipulation and analysis of the labs numerical data. They will also develop empirical and quantitative skills by analyzing and comparison their data with those obtained by their peers.
- Students in class will develop teamwork skills through work in the labs.

Prerequisites

None.

Texts

Lecture notes.

Grading

20% Midterm exam
40% Final exam
40% Labs

A = 90-100%
B = 80-89%
C = 60-79%
D = 50-59%
F = 0-49%

Attendance is required. Make-up exams and labs are possible with university-excused absence. See <http://student-rules.tamu.edu/rule07> for information on university-excused absences.

Topics

- Week 1. Lecture 1: Introduction. Lecture 2: Heat, Temperature, Heat capacity, Heat transfer. No Lab.
- Week 2. Lectures 3-4: Laws of Thermodynamics, Entropy. Lab: Introduction, safety training.
- Week 3. Lectures 5-6: Phases, phase transitions and phase diagrams. Lab 1: Heat conduction, part 1.
- Week 4. Lectures 7-8: Soft Matter: Polymers, physical properties and phase transitions. Rubber. Lab 1: Heat conduction, part 2.
- Week 5. Lectures 9-10: Soft Matter: Gels, physical properties and phase transitions. Lab 2: Comparison of mechanical properties of gels 1.
- Week 6. Lectures 11-12: Soft Matter: Membranes, physical properties. Soap bubbles. Lab 2: Comparison of mechanical properties of gels 2.
- Week 7. Lecture 13: Physics of Ice and Water: Heat transfer and energy balance. Lecture 14: Exam Review; Lab 3: Physics of Ice and Water: Heat transfer and energy balance.
- Week 8. Lecture 15: Midterm Exam. Lecture 16: Exam discussion. Lab 3: Physics of Ice and Water 2: Heat transfer and energy balance.
- Week 9. Lectures 17-18: Soft Matter: Membranes physical properties. Lab 4: Membranes formation. Soap films 1.
- Week 10. Lectures 19-20: Soft Matter: Foam. Visco-elastic properties. Gel foam memory. Lab 4: Membranes formation. Soap films 2.
- Week 11. Lectures 21-22: Lecture and Lab topic will be proposed by the students in coordination with instructor.
- Week 12. Lectures 23-24: Lecture and Lab topic will be proposed by the students in coordination with instructor.
- Week 13. Lectures 25-26: Final Exam Review. Lab: Make-up Lab.
- Week 14. Lectures 27-28: Final Exam Review. Lab: Make-up Lab.

ADA statement

The Americans with Disabilities Act (ADA) is a federal anti-discrimination statute that provides comprehensive civil rights protection for persons with disabilities. Among other things, this legislation requires that all students with disabilities be guaranteed a learning environment that provides for reasonable accommodation of their disabilities. If you believe you have a disability requiring an accommodation, please contact Disability Services, currently located in the Disability Services building at the Student Services at White Creek complex on west campus or call 979-845-1637. For additional information, visit <http://disability.tamu.edu>.

Academic integrity

The Aggie Honor Code is *"An Aggie does not lie, cheat, or steal or tolerate those who do."* For more information, refer to the Honor Council Rules and Procedures on the web at <http://aggiehonor.tamu.edu/>