

ICE PHYSICS - PHYS 614 (3 credits)

Prerequisites: Graduate standing or permission of instructor

Spring 2019, GI (Elvey), Rm 414, TR 9:45-11:15

Instructor: Martin Truffer, Geophysical Institute 401 D, *5359
mtruffer2@alaska.edu

office hours: by appointment

Text: A manuscript will be provided

Additional reading:

- Ice Physics (Hobbs)
- Physics of Ice (Petrenko and Whitworth)
- Creep and Fracture of Ice (Schulson and Duval)
- The Chemical Physics of Ice (Fletcher)
- Solid State Physics (Kittel)

Good online resources:

- <http://www.lsbu.ac.uk/water>
- <http://www.snowcrystals.com>

Course type: Classroom instruction

Course description:

A survey of the physics of ice. Topics will include the crystal structure and properties of ice, high pressure phases, hydrogen bonding, mechanical, thermal, electrical and acoustic properties, nucleation and growth, and optical and surface properties (adhesion, friction).

Student Learning Outcomes:

The student will become familiar with the basic concepts of the physics of ice. Specifically, we will develop an understanding of mechanical, thermal, electric, optical, and acoustic properties from basic physical principles. The main goal of the course is to learn sufficient basic physics of ice to read modern literature in ice physics and glaciology. Student learning is assessed in a series of homework assignments that apply the principles developed in the course to specific problems. A student project is designed to assess whether the student can successfully interpret the physics of ice in current scientific literature.

Instructional methods: lectures and student presentations

Course outline and tentative schedule:

- Week 1: Introduction, why study ice? The H₂O molecule
- Week 2 and 3: Ice Ih architecture, crystallography
- Week 4: Phase diagram, different kinds of ice
- Week 5: Defects
- Week 6 and 7: Optical properties
- Week 8: Electrical properties
- Week 9: Thermal properties
- Week 10 and 11: Mechanical properties
- Week 12: Surface of ice
- Week 13: Nucleation
- Week 14: Snow transformation and ice cores

Homework will generally be assigned every three lectures (approx. 1.5 weeks) and is due at the beginning of the third lecture after it was assigned. You are encouraged to work with others on the homework and to seek help from the instructor, however, you need to turn in your own work.

Student project: Each student is expected to give one 20 minute presentation on a particular topic in ice physics. The topic should be discussed with the instructor, and a list of suggestions is given below. Finding a different topic is encouraged. The presentations should be accompanied by a written report; suggested length is 3-4 pages. The report should essentially be a literature review on the chosen topic. A project proposal with a suggested list of references is due on Thursday, 29 September. At this point I will assign times for the presentations.

Possible topics for student presentations (finding your own topic is encouraged):

- Ice in the solar system
- Life at sub-freezing temperatures (cryo-biology)
- High pressure forms of ice
- Radar studies of glacier ice
- Frost heave and ice lens formation
- Friction and adhesion of ice
- Atmospheric haloes
- Grain growth in ice sheets

Class attendance is mandatory and participation strongly encouraged.

Grading:	Problem sets:	50%
	Student projects:	25%
	Final Exam:	20%
	Participation:	5%

The final exam will be in the form of an extended homework.

Class documents and assignments will be distributed through Google Classroom. Your .alaska.edu email will enable you to participate in the class, and you will receive an email invitation to participate. Homeworks can be submitted through Google Classroom, or in paper form to me.

Every qualified student is welcome in my classroom. As needed, I am happy to work with you, disability services, veterans' services, rural student services, etc to find reasonable accommodations. Students at this university are protected against sexual harassment and discrimination (Title IX), and minors have additional protections. As required, if I notice or am informed of certain types of misconduct, then I am required to report it to the appropriate authorities. For more information on your rights as a student and the resources available to you to resolve problems, please go to the following site: www.uaf.edu/handbook/

UA is an AA/EO employer and educational institution and prohibits illegal discrimination against any individual: <https://alaska.edu/nondiscrimination/>.

Your instructor follows the University of Alaska Fairbanks Incomplete Grade Policy: "The letter "I" (Incomplete) is a temporary grade used to indicate that the student has satisfactorily completed (C or better) the majority of work in a course but for personal reasons beyond the student's control, such as sickness, has not been able to complete the course during the regular semester. Negligence or indifference are not acceptable reasons for an "I" grade."

Effective communication: Students who have difficulties with oral presentations and/or writing are strongly encouraged to get help from the UAF Department of Communication's Speaking Center (907-474-5470, speak@uaf.edu) and the UAF English Department's Writing Center (907-474-5314, Gruening 8th floor), and/or CTC's Learning Center (604 Barnette Street, 907-455-2860).