

## Cryogenics

Spring 2010

Phy 4550 (section 1329) and Phy 6555C (section 1339 and 8890)

Tuesday/Thursday (5:10 pm to 6:25 pm) Rm 1002 NPB

Gary G. Ihas

[ihas@phys.ufl.edu](mailto:ihas@phys.ufl.edu)

352-392-9244

2253 NPB

**General:** This is a practical course in the generation and use of cryogenic fluids, and the design and construction of low temperature apparatus. The class will be comprised of lectures, problem solving, and hands-on experience. There will be at least 3 weeks when trips to facilities will take the place of one or two classes. This course fulfills the Physics Department distribution requirement for non-low temperature experimentalists.

**Pre-requisites:** Two semesters of chemistry, 2 semesters of physics, and partial differential equations or my permission.

**Grading:** There will short homework assignments from the text during the first half of the semester, but no exams. Your grade will depend on class participation (30% for graduate students, 40% for undergraduate students), homework (10%) and the 10 minute presentation of your library-research paper at the Cryogenic Mini-Symposium held during the final weeks of class (50%--topic to be approved by me). Field trips are mandatory for graduate students, who must write a one-page paper (500 words for a total of 10% of their grade) summarizing the science and technology presented during the trip; undergraduates may go on field trips, but do not write a report.

**Objectives:** This course provides you with a practical prospective on the cryogenic world. An historical and current picture of cryogenics in industry, government, and university laboratories will help you in many careers. The technical aspects of both the classroom and laboratory work will prepare you to actually begin work in many different types of jobs in cryogenics, which has become ubiquitous in industry, government labs, and medical centers. You will be able to see the equipment and processes that are prevalent in the modern cryogenic workplace. You will also be given the background that will enable you to contribute to the advancement of the art of cryogenics in their future work.

**Field Trips:** Helium Liquefaction Facility (NPB); MRI Research Facility and Medical Facility (Brain Institute and Hospital); Microkelvin Research Laboratory. I am also open to other suggestions.

**Text:** *Cryogenic Engineering* 2<sup>nd</sup> edition by Thomas M. Flynn, Dekker NY (2005). \$99.95 in Reitz Union Bookstore-be sure to get this special price (regular price \$269.95).

## **Schedule** (subject to adaptation)

### **January**

Historical survey, Cryogenic safety, Properties of cryogenic fluids;  
Read Ch. 1, 11, and 3-sec. 1 in text/Report on Cryogenics in the last decade.  
Jan. 21 and 26: Movie *Absolute Zero*  
Visit Microkelvin Lab/Write report.

### **February**

Cooling below 4 K; read pages 433-439 in text.  
Theory of refrigeration and Liquefaction of “permanent” gases.  
Visit UF Liquefier Facility.  
Homework problems to be assigned from textbook.  
Outline and references for research paper due Feb. 16; approval/disapproval Feb. 18.

### **March**

Cryostat construction; Insulation techniques; Recycling; Cryogenic instrumentation.  
Talk first drafts due March 10.  
Spring break: No class March 9 and 11.  
Talk Final draft due March 17 for 1st day speakers  
Talk Final draft due March 21 for 2nd day speakers  
Talk Final draft due March 24 for 3rd day speakers  
Talk Final draft due March 28 for 4th day speakers  
Talk Final draft due March 31 for 5th day speakers

Cryogenic symposium: March 18, 23, 25, 30, April 1.

### **April**

Visit Brain Institute.

### **Reading List:**

Randall F. Barron, *Cryogenic Systems* (second edition) Raymond G. Becker, John Gorrie, M.D. (Carlton Press) Norman R. Brek, *Cryogenic Recycling and Processing* (CRC Press) B.A. Hands, *Cryogenic Engineering* (Academic) G.G. Haselden, *Cryogenic Fundamentals* (Academic) Ralph G. Scurlock, *History and Origins of Cryogenics* (Oxford) Steven W. Van Sciver, *Helium Cryogenics* ((Plenum)