Randall D. Kamien

Physics 5528: Liquid Crystals

This course will provide an overview of the physics of liquid crystalline phases, focussing strongly on statics and phase transitions. Additional topics will include liquid crystal optics and devices, defects in liquid crystalline systems and, if time permits, polymer liquid crystals. This is a course that should enable you to sit through any seminar on liquid crystals - happily.

Topics to be covered

- 1. Overview: The Liquid Crystal Zoo
- 2. Review of Statistical Mechanics, Equipartition, Partition Functions
- 3. Continuum mechanics and elasticity
- 4. The nematic phase, Maier-Saupe Theory
- 5. The Frank free energy
- 6. Phase transitions, Landau Theory
- 7. Goldstone's theorem
- 8. The nematic redux
- 9. The twisted nematic display
- 10. Smectic liquid crystals
- 11. Chiral Nematics or Cholesterics
- 12. Fluctuations: the Higgs mechanism in disguise
- 13. Topological Defects
- 14. Polymer liquid crystals and columnar phases

Prerequisites: Rudimentary statistical mechanics, good attitude

Course Times: MW 1:45PM -3:15PM

Text: "Liquid Crystals", by S. Chandrasekhar, "The Physics of Liquid Crystals", by de Gennes and Prost, "Principles of Condensed Matter Physics", by Chaikin and Lubensky. All are recommended, the first is available at the bookstore and is a comprehensive text that you might like to keep. **Homework & Exams**: Final Paper, randomly-timed homework exercises.

Contact Information: email: kamien@physics.upenn.edu, office phone: 215.898.5940, office: 2N26. Office hours by appointment (send me an email to make a time).

Grader: Carl Modes, email: cmodes@sas.upenn.edu. Office hours by appointment.