

Syllabus, Information, & Policies

Soft Condensed Matter: Graduate Course Phys 7430, Fall 2019 (3 credits)

Where: DUAN G1B25

When: Tuesdays & Thursdays, 3:30 PM - 4:45 PM

Web page: <https://spot.colorado.edu/~smalyukh/SoftMatter/>

Instructor: Prof. Ivan Smalyukh

Office: Gamow Tower, F-521;

Office hours: Fridays, 11:00 AM - noon & by appointment, Gamow Tower office F-521

Email: ivan.smalyukh@colorado.edu

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Course Goals:

"Soft Condensed Matter Physics" is a course about the science of liquid crystals, polymers, biological membranes, biopolymers, block copolymers, molecular monolayers, colloids, nanoparticle suspensions, emulsions, foams, gels, elastomers, and other soft materials. The course is intended for graduate students. Soft materials are attractive not only because of the richness of observed physics phenomena but also because of the wealth of potential technological applications and because of their significance for the fields of biology, biotechnology, and medicine. These materials combine properties of crystalline solids and ordinary liquids in unexpected ways, often possessing fluidity along with orientational order and varying degrees of positional order. The constituent molecules (or particles and other building blocks) of soft matter interact via many different types of interactions, ranging from van der Waals interactions, to screened electrostatic and steric interactions, and to specific chemical binding. However, the interactions are usually weak and comparable in strength to thermal fluctuations. Therefore, these relatively fragile forms of matter easily respond to mechanical stresses, electric and magnetic fields, temperature variations, presence of ions, optical fields of focused laser beams, etc. Often exhibiting birefringence, optical activity, and self-organized structures with periodicity in the nanometer and micrometer ranges, these materials can be used to deflect laser beams in telecommunications and to visualize information in displays. At the same time, electric and magnetic fields, tiny temperature changes, and light (in a form of focused laser beams) can be used to control these materials by shaping patterns of molecular orientations, manipulation of colloidal particles and defects, etc.

Our goal in this course is to hit the highlights of the past century's developments, to give students a working knowledge of ideas they will apply daily as they move on to Soft Matter research. For students who do not intend to continue in Soft Matter research, this course is also useful as a course that shows how our world works on a microscopic scale. Course is geared toward graduate students interested in conducting research in soft condensed matter. In the course, hands-on experience will be widely used to promote interest & understanding of the material.

Prerequisites:

The course is geared toward graduate students (although advanced undergraduates can also take this course) with diverse preparation backgrounds, including students from Departments of Physics, Chemistry & Biochemistry, MCDB, Chemical and Biological Engineering, Electrical and Computer Engineering, Mechanical Engineering, Materials Science and Engineering, etc. The instructor will make sure to introduce and overview concepts, techniques, and approaches needed in this course.

Textbooks:

This course has no formal textbook, since there are no textbooks that would cover all topics of this course at an appropriate level. Students will be provided with all lecture notes and handouts needed in this course. In addition, I will place on reserve in the Physics Library a set of quite good books, from which I have learned a lot. I encourage you to look these books over and to find the ones that appeal to you. The lecture notes will also be made available on the web, as well as additional interesting materials. When needed, I will post suggested reading assignments on the course website. These reading assignments are not mandatory, but the lectures will make more sense if you're already thinking about the subject. The following books are useful:

- (1) P.M. Chaikin & T.C. Lubensky, Principles of Condensed Matter Physics (Cambridge Univ. Press, 2000);
- (2) I. W. Hamley, Introduction to Soft Matter (Wiley, 2000);
- (3) R.G. Larson, The Structure and Rheology of Complex Fluids (Oxford Univ. Press, 1999);
- (4) P-G de Gennes and J. Prost, The Physics of Liquid Crystals (Clarendon, Oxford, 1993), 2nd Ed.
- (5) R.A.L. Jones, Soft Condensed Matter (Oxford Univ. Press, 2003);
- (6) M. Kleman and O. Lavrentovich, Soft Matter Physics: an introduction (Springer, 2003);
- (7) M. Daound and C.E. Williams (eds.), Soft Matter Physics (Springer, 1999);
- (8) P. Oswald and P. Pieranski, Nematic and Cholesteric Liquid Crystals (Taylor & Francis, 2005);
- (9) P. Oswald and P. Pieranski, Smectic and Columnar Liquid Crystals (Taylor & Francis, 2006).
- (10) J. Selinger, Introduction to Soft Matter (Springer, 2015).

GRADING

Midterm Exam	30%	Midterm
Final Exam	40%	Final Exam
HW's	30%	Assigned throughout the semester
TOTAL	100%	

Homeworks

There will be ~10 homework assignments, worth 10 points each. The HWs should be submitted electronically (as pdf-type files) to the appropriate University of Colorado Google Drive folder created for this course. Graded HWs will be placed in the same folder in electronic version.

WEB RESOURCES

- <http://www.softmatterworld.org/>
- <http://plc.cwru.edu/tutorial/enhanced/main.htm>
- <http://softmatterworld.org/education/books.html>

- <http://www.ilcsoc.org/ILCS/LClearning.html>
- <http://bly.colorado.edu/lcphysics.html>
- <http://dept.kent.edu/spie/liquidcrystals/>
- <http://www.personal.kent.edu/~mgu/LCD/index.htm>

Disabilities Policy

If you qualify for accommodations because of a disability, please submit to your professor a letter from Disability Services in a timely manner (for exam accommodations provide your letter at least one week prior to the exam) so that your needs can be addressed. Disability Services determines accommodations based on documented disabilities. Contact Disability Services at 303-492-8671 or by e-mail at dsinfo@colorado.edu. If you have a temporary medical condition or injury, see [Temporary Injuries guidelines](#) under the Quick Links at the [Disability Services website](#) and discuss your needs with your professor.

Policy on Religious Observances

See Professor Smalyukh at beginning of semester if you will be absent from class during a valid religious observance so that reasonable accommodation can be considered. Campus policy regarding religious observances requires that faculty make every effort to reasonably and fairly deal with all students who, because of religious obligations, have conflicts with scheduled exams, assignments or required attendance.

See [campus policy regarding religious observances](#) for full details.

Policy on Cheating

All students of the University of Colorado at Boulder are responsible for knowing and adhering to [the academic integrity policy](#) of this institution. Violations of this policy may include: cheating, plagiarism, aid of academic dishonesty, fabrication, lying, bribery, and threatening behavior. All incidents of academic misconduct shall be reported to the Honor Code Council (honor@colorado.edu; 303-735-2273). Students who are found to be in violation of the academic integrity policy will be subject to both academic sanctions from the faculty member and non-academic sanctions (including but not limited to university probation, suspension, or expulsion). Additional information regarding the [Honor Code policy can be found online](#) and at the [Honor Code Office](#).

Behavior Issues

Students and faculty each have responsibility for maintaining an appropriate learning environment. Those who fail to adhere to such behavioral standards may be subject to discipline. Professional courtesy and sensitivity are especially important with respect to individuals and topics dealing with differences of race, color, culture, religion, creed, politics, veteran's status, sexual orientation, gender, gender identity and gender expression, age, disability, and nationalities. Class rosters are provided to the instructor with the student's legal name. I will gladly honor your request to address you by an alternate name or gender pronoun. Please advise me of this preference early in the semester so that I may make appropriate changes to my records. For more information, see the [policies on classroom behavior](#) and [the student code](#).

The University of Colorado Boulder (CU-Boulder) is committed to maintaining a positive learning, working, and living environment. CU-Boulder will not tolerate acts of discrimination or harassment based upon Protected Classes or related retaliation against or by any employee or student. For purposes of this CU-Boulder policy, "Protected Classes" refers to race, color, national origin, sex, pregnancy, age, disability, creed, religion, sexual orientation, gender identity, gender expression, veteran status, political affiliation or political philosophy. Individuals who believe they have been discriminated against should contact the Office of Institutional Equity and Compliance (OIEC) at 303-492-2127 or the Office of Student Conduct and Conflict Resolution (OSC) at 303-492-5550. Information about the OIEC, the above referenced policies, and the campus resources available to assist individuals regarding discrimination or harassment can be found at the [OIEC website](#). The [full policy on discrimination and](#)

[harassment](#) contains additional information.

Technology in class

To ensure a distraction free environment for all students, laptops, MP3 players, cell phones, and similar devices are not allowed to be used during lecture.

Other Information/Policies

Homework/exam answer sheets: Answer sheets will be posted in the CU Google Drive folder created for this course.

Show your work: You will not get credit for simply stating a word or number for your answer. You must show your reasoning, calculations, and write a paragraph for full credit. If you are asked to make a drawing, be NEAT. Label parts of your diagrams.

Calculator: You will need a calculator that uses scientific notations.

Disclaimer

Any information in this syllabus is as accurate as is possible at the time of writing. Announcements about changes of any kind will be made via e-mail as well as in class and on the web page, and will take precedence over this syllabus. You are responsible to be aware of the announcements made in class (whether or not you are in attendance), via e-mail, as well as in class and on the web page.