

# Physics 562 – Soft Condensed Matter – Spring 2017

Meets MWF, 10:00 – 10:50 am, Math & Science Center room N301

Professor: Eric Weeks  
Email: [erweeks@emory.edu](mailto:erweeks@emory.edu) (best way to contact me)  
Office: Math/Science Center N250, phone 7-4479  
Office hours: By appointment  
Texts: R. A. L. Jones, “Soft Condensed Matter” (required)  
Website: <http://www.physics.emory.edu/faculty/weeks/class/>

## Grade policy:

20% – homework

- Should work with others, but solutions must be written independently
- Due at beginning of class on due date
- Two homeworks will be accepted up to one week late, otherwise no late homework will be accepted

40% – reading questions

- Send me at least two questions on the reading by midnight, the night before we discuss the reading in class.
- You can entirely skip the reading questions up to three times with no penalty; otherwise no late questions will be accepted for credit.

20% – exams

- There will be one in-class exam and one final exam, each worth 10% of your course grade.

10% – class participation

- Discussion is an important part of the class; you are expected to be prepared to ask (and answer!) questions and otherwise participate in the discussion.

10% – student presentation

- Near the end of the semester, you will present one topic of your choice to the class.

## Goals of the class:

- Be able to follow colloquia, seminars, and conference talks in various areas of soft condensed matter physics.
- Improve scientific reading and thinking skills. This course emphasizes skills related to your qualifier proposal: reading papers and applying what you've read.
- See applications of traditional statistical mechanics. You should be able to make simple arguments about how entropy and  $k_B T$  relate to the behavior of soft materials.

I encourage you to give me feedback during the semester. If you would prefer to remain anonymous, drop a note in my mailbox in the Math & Science Center. Any suggestions or comments would be appreciated. And in particular, I expect the material we cover to be strongly guided by your interests.

## Course Schedule – Physics 562, Spring 2017

|     | <b>Date</b> | <b>Topic</b>                             |
|-----|-------------|--|
| Jan | 9 M         | first day of class                       |
|     | 11 W        |  |
|     | 13 F        |  |
|     | 16 M        | <i>no class – Martin Luther King Day</i> |
|     | 18 W        |  |
|     | 20 F        |  |
|     | 23 M        |  |
|     | 25 W        |  |
|     | 27 F        |  |
|     | 30 M        |  |
| Feb | 1 W         |  |
|     | 3 F         |  |
|     | 6 M         |  |
|     | 8 W         | <i>No class – Eric out of town</i>       |
|     | 10 F        |  |
|     | 13 M        |  |
|     | 15 W        |  |
|     | 17 F        |  |
|     | 20 M        | <i>No class – Eric out of town</i>       |
|     | 22 W        |  |
|     | 24 F        |  |
|     | 27 M        |  |
| Mar | 1 W         |  |
|     | 3 F         |  |
|     | 6-10        | <i>Spring Break – no class</i>           |
|     | 13 M        | <i>No class – Eric out of town</i>       |
|     | 15 W        | <i>No class – Eric out of town</i>       |
|     | 17 F        | <i>No class – Eric out of town</i>       |
|     | 20 M        |  |
|     | 22 W        |  |
|     | 24 F        |  |
|     | 27 M        |  |
|     | 29 W        |  |
|     | 31 F        |  |
| Apr | 3 M         |  |
|     | 5 W         |  |
|     | 7 F         |  |
|     | 10 M        |  |
|     | 12 W        |  |
|     | 14 F        |  |
|     | 17 M        |  |
|     | 19 W        |  |
|     | 21 F        |  |
|     | 24 M        | Last official day of class               |
| May | 3 W         | <b>Final exam (8 am)</b>                 |

# Tentative reading list – Physics 562, Spring 2017

Not in order

## Big Topics

- RAL Jones, *Soft Condensed Matter* (Oxford University Press, 2002)
  - Chapters 1-4, 7, 9, and 10 as the basic foundation of the course (~9 classes)
- P Tabeling, *Introduction to Microfluidics* (Oxford University Press, 2005)
  - Chapters 0-1 as introduction to fluid mechanics, microfluidics (~3 classes)

## Smaller topics I think are important

- DJ Tritton, *Physical Fluid Dynamics* (Oxford Univ Press, 1988)
  - Chapters 1, 2, 5, 8 (intro, Navier-Stokes Eqn, Reynolds number) (~2 classes)
- HC Berg, *Random Walks in Biology* (Princeton Univ Press, 1993)
  - Chapters 1-2 (random walks & diffusion), 4-5 (sedimentation & kT) (2 classes)
- Two classic papers on hard spheres (1-2 classes):
  - Widom, *Science* **157**, 375 (1967)
  - Pusey & van Megen, *Nature* **320**, 340 (1986)
- RG Larson, *Structure and Rheology of Complex Fluids* (Oxford Univ. Press, 1999)
  - Pages 1-38 as a brief overview of rheology (~3 classes)

## Other topics we might cover

- granular media & effective temperatures (1 class)
  - SF Edwards & RBS Oakeshott, *Physica A* **157**, 1080 (1989)
  - IK Ono et al., *Phys. Rev. Lett.* **89**, 095703 (2002)
- EM Purcell, *Am. J. Phys.* **45**, 3 (1977)
  - “Life at Low Reynolds Numbers” – important fluids article
- D Weaire & S Hutzler, *The Physics of Foams* (Oxford University Press, 1999)
  - Chapters 1 & 2 (1 class)
- I Müller & P Strehlow, *Rubber and Rubber Balloons* (Springer-Verlag, 2004)
  - Chapters 1-2 as introduction, more if interested (1+ classes)
- J Bibette, FL Calderon & P Poulin, *Rep. Prog. Phys.* **62**, 969 (1999)
  - review of emulsions: pp 971-995 intro, 1011-1023 on coalescence (~2 classes)
- J Israelachvili, *Intermolecular & Surface Forces* (Academic Press, 1991)
  - Chapters 1-2, brief historical & thermodynamical discussion of forces (1 class)
  - Chapter 8 stands alone, on water (H-bonding, etc) (1 class)
- *Experimental and Computational Techniques in Soft Condensed Matter Physics*, ed. J Olafsen (Cambridge University Press, 2010)
  - microscopy, Langmuir monolayers (1–2 classes)
- ER Weeks, in *Statistical Physics of Complex Fluids* (Tohoku University Press, 2007)
  - sections 4 & 5 on jamming (definitions, phenomena, open questions; 1 class)
- PG de Gennes, *Rev. Mod. Phys.* **71**, S374 (1999)
  - short review on granular media (1 class)