PY542 INFORMATION **Fall 2008**

Instructor: Sidney Redner (321 SCI, x2618)

Office Hours: Tues. & Fri. 9-10:30am, and by appointment.

General: This course treats non-equilibrium statistical mechanics and transport phenomena. Because of the rapid developments in the field, the breadth of topics, and the lack of an established formalism, most of the classic texts no longer seem appropriate for this course. For these reasons, the "unofficial" course text is a very incomplete book that I am currently writing with 2 co-authors. Individual chapters are posted on the course website and updates will be continuously posted whenever non-negligible revisions have been made.

Other books that should be helpful during the semester include:

(i) N. G. Van Kampen, *Stochastic Processes in Physics and Chemistry* (North-Holland). This gives an excellent treatment of stochastic processes. Buy it used if you can. I would have assigned this as the text if the price was a factor 2 smaller.

(ii) F. Reif, *Statistical and Thermal Physics* (McGraw-Hill). A standard advanced undergraduate text for statistical mechanics. The last few chapters provide a particularly useful introduction to various aspects of non-equilibrium processes.

(iii) K. Huang, *Statistical Mechanics* 2^{nd} edition (Wiley). Relevant chapters are 3 and 5 that deal with kinetic theory and transport phenomena.

(iv) N. Wax (editor), *Selected Papers on Noise and Stochastic Processes* (Dover). This book contains reprints of some of the most important classic research articles on stochastic processes. Although out of print, it may be possible to obtain used somewhere. However, the book contains reprints of articles that are generally available on the web. The most useful is "Stochastic Problems in Physics in Astronomy" by S. Chandrasekhar, Rev. Mod. Phys. **15**, 1–89 (1943). Other useful articles include "On the Theory of the Brownian Motion", by G. E. Uhlenbeck and L. S. Orenstein, Phys. Rev. **26**, 823–41 (1930) & "On the Theory of the Brownian Motion II" by M. C. Wang and G. E. Uhlenbeck, Rev. Mod. Phys. **17**, 323–42 (1945).

(v) S. Redner, *A Guide to First-Passage Processes* (Cambridge University Press). This book gives background on random walks and diffusion processes, as well as a reference for the portion of the course on first-passage phenomena. If you purchase the hardcover version, I will refund you my royalty (approximately $5.50 per book), but the paperback version is much cheaper. I will also post relevant excerpts on the course website.

(vi) R. Kubo, M. Toda and N. Hashitsume, *Statistical Physics II* (Springer-Verlag). Contains a particularly good discussion of linear response theory and the fluctuation-dissipation theorem.

(vii) J. A. McLennan, *Introduction to Non-Equilibrium Statistical Mechanicsi* (Prentice-Hall). This book contains a thorough discussion of the Boltzmann transport equation.

(viii) H. J. Kreuzer, *Non-Equilibrium Thermodynamics and its Statistical Foundations* (Oxford University Press). Comprehensively treats transport theory from the macroscopic viewpoint and has an excellent discussion of the Rayleigh-Bénard instability.

Course organization:

Lectures: Lectures will be held on Tuesdays and Thursdays from 2:00—3:30 in SCI B58. The outline that is posted on the course website represents a reasonable approximation to the material that I expect to cover this semester.

Discussion: Sections will be held weekly starting Wed. Sept. 3 at 2:00pm in PRB 365. Please note that this first section is on the second day of classes.

Homework: Approximately 10 assignments will be handed out. While some collaboration on homework is acceptable, what is turned in should represent your personal effort.

Exams and Grading: The average of the homeworks will count approximately $30 \pm 5\%$ of the total class grade. I will give one midterm exam (exact format to be determined) that will also count approximately $30 \pm 5\%$ of the total class grade. For the final, I am currently planning a take-home but time-limited final exam that will count for the approximately remaining 40% of the total course grade.