

**Chemistry 540:**

**STATISTICAL MECHANICS IN CHEMISTRY**

**Spring 2023**

**Instructor:** Prof. Oleg Prezhdo

Office: SSC 414

E-mail: prezhdo@usc.edu

**Required Textbooks**

“Statistical Mechanics” by Donald McQuarrie (chapters 1-11)

“Statistical Mechanics” by David Chandler (chapters 5, 8)

**Lecture**

Tuesday, Thursday 11:00am to 12:20pm; SSC 604

**Goal**

The goal of this course is to introduce the basic concepts of Statistical Mechanics and to consider its applications to atomic and molecular systems, as they are encountered in chemistry. The course starts with a brief review of quantum and classical mechanics, thermodynamics, and statistics, considers in detail the canonical ensemble, and moves onto other ensembles and a variety of simple applications. Several deeper and more complex topics and applications of statistical mechanics in chemistry will be covered towards the end of the class.

**Other Recommended Textbooks**

Norman Davidson “Statistical Mechanics”

Linda Reichl “A Modern Course in Statistical Physics”

Abraham Nitzan “Chemical Dynamics in Condensed Phases”  
(chapter 11)

**Your Favorite Undergrad Text**

McQuarrie&Simon “Physical Chemistry: A Molecular Approach”

Peter Atkins “Physical Chemistry”

Thomas Engel, Phil Reid “Physical Chemistry”

**Topics:**

- I. Statistical Mechanics Basics:  
Chapters 1-5 of McQuarrie, including Introduction & Review; Canonical, Grand-canonical, Micro-canonical Ensembles and Fluctuations; Ideal Monoatomic Gas.
- II. Selected Applications:  
Chapters 6-9, 10.5, 11 of McQuarrie, including Diatomic and Many-atomic Ideal Gases, Crystals, Chemical Equilibrium, Black-body Radiation and Classical Statistical Mechanics.  
Chapters 5 and 8 of Chandler (Phase Transitions, Ising Model, Mean-Field Model, Correlation Functions)

**Assessment**

Homework (one problem set per week, due Tuesday before class)

100%

Every week a comprehensive problem set will be assigned based on the topics covered in class in the prior week. If you complete all homework problems you will get an A. If you miss some problems or problem sets, the grade will be lower.

You are welcome to use any resource available and discuss with your peers, but you cannot submit solutions that are fully identical with other students.