Syllabus:

Chemistry 2020 - Statistical Mechanics

I. Introduction

Macroscopic vs. microscopic phenomena
Basic overview of statistical mechanics
Brief reviews of probability, classical and quantum mechanics, and thermodynamics

II. The Concept of Ensembles and the Microcanonical Ensemble

Ensemble averaging vs. time averaging
State counting and entropy
Application to the ideal gas
Application to unimolecular chemical reaction rates

III. The Canonical Ensemble - Finite Temperature

Derivation of probability distribution and thermodynamics
The relationship between ensembles
General features of the canonical ensemble
Application to the ideal gas
Application to unimolecular chemical reaction rates

IV. The Grand Canonical Ensemble - Open Systems

Derivation of probability distribution and thermodynamics
The relationship between ensembles
Application to the ideal gas
Multicomponent systems and chemical equilibrium

V. Quantum Statistics and Exchange

Boson and Fermion probability distributions and thermodynamics
The free-electron gas and metals
Bose condensation and superfluid He
The classical limit

VI. Interacting Systems - Introduction to Condensed Phases

Nature of the problem - simple models
Structure vs. thermodynamics
Many-body techniques in statistical mechanics