אוניברסיטת
בן-גוריון בנגב

The Department of Mathematics

2021–22–B term

Course Name Thermodynamics and Stat. Mech. 2

Course Number 203.1.2261

Course web page
`https://www.math.bgu.ac.il//en/teaching/spring2022/courses/thermodynamics-and-stat-mech-2`

Office Hours `https://www.math.bgu.ac.il/en/teaching/hours`

Abstract

Requirements and grading[1]

Course topics

Thermodynamic potentials: Gibbs free energy; per molecule and per unit volume thermodynamic potentials. First order phase transitions: experimental observations; thermodynamic phases; free energy per unit volume; conditions for phase separation; local and global stability of a thermodynamic phase; graphical representation. Molecular interactions: hard-core repulsion; Van der Waals attraction; induced dipole; electronic and dipole polarizability; estimations of Van der Waals attraction for simple molecules; Lennard-Jones potential. Incorporation of molecular interactions into free energy: phase coexistence; common tangent construction; phase diagrams; spinodal and binodal lines; critical temperature; Clausius-Clapeyron equation. Van der Waals gas: free energy; pressure; spinodal; critical point; estimations of critical temperature; approximation of binodal far from the critical point. Van der Waals gas near the critical point: free energy; binodal line; first and second-order phase transition; critical opalescence; nucleation and growth; surface energy; critical nucleous. Ferromagnet-paramagnet second-order phase transition; Landau theory of phase transitions. Kinetic theory of gases: characteristic velocities; kinetic derivation of pressure of ideal gas; Maxwell distribution of velocities. Diffusion and random walks on a lattice model: mean-square displacement; diffusion coefficient; the diffusion equation for random walks; diffusion as transport phenomenon; derivation of Fick's laws from

[1] Information may change during the first two weeks of the term. Please consult the webpage for updates

microscopic considerations; self- diffusion and collective diffusion coefficients. Diffusion in gas: random walks; distribution of free paths; mean free path; mean square displacement of a molecule; self-diffusion coefficient; diffusion in concentration gradient; derivation of Fick's laws; equivalence of self-diffusion and collective diffusion coefficients for gases. Other linear transport phenomena in gases: heat conductivity; Fourier law; thermalization;