



Taras Shevchenko National
University of Kyiv

Physics Department

Course description

Molecular Physics

Level: Bachelor	Language: Ukrainian	Duration: 1 semester	Occurrence: 2 nd semester
Credits: 6	Total Hours: 180	Contact Hours: 90	Self-study Hours: 90

Description of Course Work and Examinations

Module-rating system, results are estimated on a 100-point scale. The course contains 2 midterms 30 pts/90 min each, an exam on high-difficulty problems for 10 pts/180 min, and a final exam for 30 pts/120 min.

Prerequisites

Mathematical Analysis (1st semester), Mechanics (1st semester)

Syllabus

Thermodynamics: macroscopic quantities and measurements (temperature, volume, pressure), work, heat and heat capacity (including calculating C for different processes), First Law of Thermodynamics, isoprocesses (isobaric, isochoric, isothermal, isentropic) in thermodynamic systems and in ideal gases, polytrope, cyclic processes and mechanisms that utilize them, Second Law of Thermodynamics and its alternatives, Carnot cycle, its features, realization, Carnot theorem (highest efficiency), reverse Carnot cycle, absolute temperature and its measurement, conditions for the equilibrium state of systems, entropy, Third Law of Thermodynamics and its corollaries, negative absolute temperatures, degrees of freedom of multiatomic molecules.

Real Gases: virial expansion, isothermic processes in real gases, van der Waals equation, its properties, thermodynamic potentials, chemical potential, Maxwell relations and their applications.

Advanced Thermodynamics: energy dissipation and generation of entropy, kinetic theory of transition process, Brownian motion, molecular dynamics of a polymer chain.

Phase Transitions: crystalline bodies, liquids, classification of phase transitions, Clausius–Clapeyron relation, phase diagrams, critical point, metastable phases.

Surface Processes: surface tension, Young-Laplace formula, excessive pressure under a curved surface, conditions of equilibrium of systems with boundaries, thermodynamics of surface processes.

Kinetic Theory of Gases: intermolecular potentials and interactions, ideal gas law, mean, root mean square and most probable speeds, Maxwell formula, de Broglie wavelength of gas molecules, criterion of applicability of the classical model, Boltzmann distribution, Gibbs distribution, kinetic theory viewpoint on entropy.

Literature

1. I.E. Irodov. *Collection of tasks on general physics*. 2001 Saint-Petersburg, ISBN 5-8114-0319-4.
2. L.A. Bulavin. *Molecular Physics*, 2006 Kyiv, 567 p, ISBN 9-6634-6223-X.

Instructors

Associate Professor Dmytro A. Gavrushenko/Associate Professor Artyom V. Chumachenko.