

Nonequilibrium Statistical Mechanics (0321-4111)

Formerly called “**Thermodynamics & Statistical Mechanics 2**”

Graduate Level Course, Semester B, 2020

School of Physics & Astronomy, Tel Aviv University

Lecturer: Prof. **Yacov Kantor**

Detailed syllabus

1. Stochastic processes, Markovian and Gaussian processes, harmonic analysis, correlation functions, Wiener-Khintchine theorem.
2. Brownian motion, random walk, diffusion equation.
3. Langevin equation, Einstein relations.
4. Fluctuation dissipation theorem.
5. Master equation, computational Monte Carlo method.
6. Fokker-Planck equation.
7. Boltzmann equation, collision integral, τ -approximation.
8. Boltzmann entropy and H-theorem.
9. Elementary transport theory and macroscopic continuum theory. Calculation of transport coefficients from Boltzmann equation.
10. Quasi-thermodynamics theory of fluctuations, Onsager reciprocal relations.
11. Far-from-equilibrium systems: Jarzynski equality and its extensions.
12. Linear response theory, Kramers-Kronig relations, dielectric relaxation.
13. Collision-less plasma: Vlasov equation, waves, Landau damping.

Supplementary information

Textbooks (any edition of the books can be used)

Main texts that will be used throughout the course:

1. Ryogo Kubo, Morikazu Toda, and Natsuki Hashitsume. *Statistical Physics II, Nonequilibrium Statistical Mechanics*. Springer, Berlin.
2. Federick Reif. *Fundamentals of Statistical and Thermal Physics*. McGraw-Hill, London.
3. Linda E. Reichl. *A Modern Course in Statistical Physics*. Wiley, New York.
4. Evgeny M. Lifshitz and Lev P. Pitaevskii. *Physical Kinetics*. Vol. 10 in Series "Course of Theoretical Physics" by L. D. Landau and E. M. Lifshitz. Pergamon, New York [and Nauka, Moscow (in Russian)].

Texts that will be used only in some parts of the course:

1. Hannes Risken, *The Fokker-Planck equation*, Springer, Berlin.
2. Pavel L. Krapivsky, Sideney Redner, and Eli Ben-Naim. *A Kinetic View of Statistical Physics*. Cambridge University Press.
3. Ryogo Kubo. *Statistical Mechanics*. North-Holland, Amsterdam [and Mir, Moscow (in Russian)].
4. Dmitry N. Zubarev. *Nonequilibrium Statistical Thermodynamics*. Consultants Bureau, New York [and Nauka, Moscow (in Russian)].
5. Kerson Huang. *Statistical Mechanics*. Wiley, New York.

Texts on specific subjects:

1. Radu Balescu. *Equilibrium and Nonequilibrium Statistical Mechanics*. Wiley, New York [and Mir, Moscow (in Russian)].
2. Mehran Kardar. *Statistical Physics of Particles*, Cambridge U. Press.
3. Lev D. Landau and Evgeny M. Lifshitz. *Statistical Physics: Part 1*. Vol. 5 in Series "Course of Theoretical Physics." Elsevier, Amsterdam [and Nauka, Moscow (in Russian)].