Stochastic processes 001.2.4038

3 Credits

Prof. Golan Bel

Many complex systems cannot be described as deterministic systems. Therefore, a common method of modeling these systems is to introduce stochastic processes. This course will provide the basic knowledge of stochastic processes and quantitative description of fluctuations in complex systems. Random walks of different types will be analyzed and their relevance to physical systems will be demonstrated.

Prerequisite: Familiarity with discrete and integral transforms.

Lectures/Exercises/Credit: 3 weekly lecture hours, 3 credit points.

Syllabus:

- Gauss and Lev'y Central Limit Theorems and the Law of Large Numbers
- Discrete and Continuous Time Random Walks
- Correlated random walks
- Master Equations
- Generating Function Techniques
- Renewal Processes
- The Fokker-Planck Equation
- Ito and Stratonovich Integrals
- First Passage Time in Discrete and Continuous Models
- One step processes
- Langevin approach
- Linear response theory

Bibliography:

- N. G. Van Kampen (1992) Stochastic Processes in Physics and Chemistry, North-Holland
- S. Redner (2001) A Guide to First-Passage Processes, Cambridge University Press
- J. P. Bouchaud and A. Georges, Anomalous Diffusion in Disordered Media, Phys. Rep. 195, 127-293 (1990).
- R. Metzler and J. Klafter, The Random Walk's Guide to Anomalous Diffusion, Phys. Rep. 339, 1-77 (2000).
- R. Zwanzig (2001) Non-equilibrium statistical mechanics, Oxford University Press

Grade: 25% Home Assignments, 75% Final Project