Course title: Computer simulations in physics
Institute/Division: Institute of Physics, Faculty of Materials Engineering and Physics
Number of contact hours: 60 hours
Course duration: 1 semester
ECTS credits: 4
Course description: This course will provide an overview of computer methods used to simulate physical phenomena. After completion of this course student will be able to numerically solve ordinary and partial differential equations in classical and quantum physics, write programs simulating physical phenomena using Monte Carlo and Molecular Dynamics methods, and write programs using multimedia libraries.
Topics covered include:
- numerical solution of ordinary and partial differential equations in classical physics,
- numerical solution of differential equations in quantum physics,
- Monte Carlo methods,
- lattice models of magnetic materials,
- models of liquid crystals,
- models of aggregation and adsorption,
- Molecular Dynamics methods,
- intermolecular interactions and potentials,
- real gas models,
- determination of macroscopic properties from simulations,
- Brownian dynamics and Levy flights,
- simulation of active matter.

Literature:
- A. D. Polyanin, V. F. Zaitsev, Handbook of Exact Solutions for Ordinary Differential Equations, 2003, CRC Press,
- A. D. Polyanin, Handbook of linear partial differential equations for engineers and scientists, 2001, Chapman and Hall/CRC,
- D. P. Landau, K. Binder, A Guide to Monte Carlo Simulations in Statistical Physics, 2009, Cambridge University Press,
- D. Frenkel, B.Smit, Understanding Molecular Simulation 2nd Edition, 2001, Academic Press.

Course type: Lectures (15 hours) + computer laboratories (45 hours)
Assessment method: Activity reports, colloquia, and final exam. No more than 3 absences from computer laboratories.
Prerequisites: Basic knowledge of classical and statistical physics. Basic knowledge of C/C++ programming languages.
Primary target group: Majors in Applied Physics
Lecturer: Paweł Karbowniczek, PhD
Contact person: Paweł Karbowniczek, e-mail: pkarbowniczek@pk.edu.pl