Symbolic programming in physical processes simulations - course description

General information

Course name	Symbolic programming in physical processes simulations
Course ID	13.2-WF-FizP-SPPPS-S16
Faculty	Faculty of Physics and Astronomy
Field of study	Physics
Education profile	academic
Level of studies	Second-cycle studies leading to MS degree
Beginning semester	winter term 2018/2019

Course information

Semester	2
ECTS credits to win	3
Course type	obligatory
Teaching language	english
Author of syllabus	

Classes forms

The class form	Hours per semester (full-time)	Hours per week (full-time)	Hours per semester (part-time)	Hours per week (part-time)	Form of assignment
Laboratory	30	2	-	-	Credit with grade

Aim of the course

Students can use a Computer Algebra Systems (Mathematica, Sage, Maxima as examples) in symbolic problem solving in physics and verification of analytical calculations.

Prerequisites

Knowledge of calculus and linear algebra and the basis of classical mechanics, classical electrodynamics and quantum mechanics. Programming in C or Fortran.

Scope

1. Introduction to computer algebra (wxMaxima, Mathematica):
   - Sessions, evaluation of expressions, environment variables,
   - Differentiation and integration,
   - Systems of linear equations,
   - 2D and 3D plots and data visualization,
   - Differential equations.

2. Classical Mechanics:
   - Harmonic oscillator,
   - Coupled harmonic oscillators,
   - Two-body problem.

3. Electrodynamics:
   - Discrete distribution of charges,
   - Poisson equation,
   - Charged particle in an electromagnetic field.

4. Quantum Mechanics:
   - Potential barrier,
   - Potential well,
   - Harmonic oscillator,
   - Hydrogen atom.

Teaching methods

Laboratory classes in the computer lab. Working in groups. Joint solving of more complex or laborious examples.

Learning outcomes and methods of theirs verification

Outcome description	Outcome symbols	Methods of verification	The class form
Student can use the CAS system to analyze the experimental data and for graphical representations of data; is able to analyze the results, present and discuss conclusions.		• an ongoing monitoring during classes	• Laboratory

Outcome description	Outcome symbols	Methods of verification	The class form
Student can present a problem in terms of the physical laws and principles to propose its mathematical model.		• an ongoing monitoring during classes	• Laboratory
Student can use symbolic and numerical calculations in the CAS to solve physical problems; is able to analyze the obtained solution and perform its verification by comparison with known analytical solution (if it exists).		• an ongoing monitoring during classes	• Laboratory

Assignment conditions

The condition of positive assessment is the accomplishment of all programming exercises.

Final assessment: the weighted average of the final test (50%) and programming exercises (50%).

Recommended reading

[1] L. D. Landau, E. M. Lifszyc, *Mechanics*, Vol. 1, (3rd ed.), Butterworth–Heinemann 1976.

[2] D. J. Griffiths, *Introduction to Electrodynamics*, (3rd ed.), Addison Wesley 1999.

[3] L. Piela, *Ideas of Quantum Chemistry*, (1st ed.), Elsevier 2006.

[4] S. Wolfram, *The mathematica book*, 5-th ed., Wolfram Media 2003.

[5] ~~http://maxima.sourceforge.net/docs/tutorial/en/gaertner-tutorial-revision/Contents.htm~~

Further reading

Notes

Modified by dr hab. Piotr Lubiński, prof. UZ (last modification: 28-06-2018 17:48)