ЦЕНТЪР ЗА ОБУЧЕНИЕ – БАН

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Basic Information:
Course Title: Programming and Computational Physics
Lecturer: Assoc. Prof. Martin Makariev
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Total Teaching Hours: 30 hours lectures + 30 hours exercises

Annotation (up to 150 words)
Computational physics is a study, that uses algorithms for finding numerical results of the physical problems, which solution cannot be derived analytically, or it is very hard to obtain. Numerical methods, that are commonly used in physics, are described in the course. This includes solving of system of linear equations, numerical differentiation and integration, interpolation, solving of nonlinear and ordinary differential equations, generation of random numbers, sorting, modeling of data. For programming, the examples are given in C++ language, where also additional libraries, like Armadillo, Boost and CERN package ROOT are used.

Course content (brief description by topics or modules)
Topic 1: Presentation of number. Errors
Topic 2: Systems of linear equations
Topic 3: Numerical differentiation
Topic 4: Interpolation
Topic 5: Numerical Integration
Topic 6: Root finding
Topic 7: Ordinary differential equations
Topic 8: Pseudo-random numbers. Random distributions
Topic 9: Sorting
Topic 10: Data modeling

Teaching and assessment methods
Consultative or Lecture-Based (in the case of multiple doctoral students)
The assessment is carried out on the basis of exercises completed during the course and a course project or an examination based on an approved syllabus at the end of the course. The two components carry equal weight.

Competencies acquired as a result of training (3–5 points)
1. Formulation of a real physics problem into a mathematical model.

2. Software implementation of an algorithm for solving the physics problem.
3. Application of appropriate methods from available libraries to solve a specific physics problem.
4. Evaluation of the reliability and precision of the applied method.

Literature:

1. William H. Press, Saul A. Teukolsky, William T. Vetterling, Brian P. Flannery, "Numerical Recipes in C", CAMBRIDGE UNIVERSITY PRESS
2. M. Hjorth-Jensen, Computational Physics, University of Oslo (2015)
3. "Introduction to Numerical Analysis for Engineers”. Youtube videos link Alberta University

Additional information (optional) (e.g., special requirements, laboratory equipment, prior knowledge)

Basic skills in C++ programming. Part of the exercises can be done in other programming language, like Python.