## 1. Module title:
**Computational Physics**

## 2. Field / responsibility of:
Physics / the faculty, the Dean of Studies

## 3. Module contents:
This module covers methods used in particle and condensed matter physics. Potential topics include:
- Monte Carlo methods
- Numerical solutions to partial differential equations
- Cluster algorithms
- Lattice field theory: Introduction, numerical methods, implementation on the computer, analysis and interpretation of numerical data
- Quantum transport
- Electron structure of condensed matter
- Molecular dynamics
- Complex systems: Random walk, percolation, cellular automata
- Numerical methods for phase transitions

## 4. Qualification objectives of the module / competencies to be acquired:
Acquiring knowledge of key concepts and techniques of numerical simulations in physics

## 5. Prerequisites for participation:

a) **Recommended knowledge:**
Quantum mechanics I, basic knowledge of a programming language

b) **Prerequisite courses:**
None

## 6. Module can be used for:
MSc. in Physics, MSc. in Nanoscience, M.Sc. in Comp. Science; BSc. in Comp. Science

## 7. Module is offered:
On a yearly basis

## 8. Module can be completed in:
1 semester

## 9. Recommended semester of study:
1

## 10. Overall module workload / number of credit points:
**Workload:**
Total number of hours: 240

**Allocation:**
1. Attendance: 6 credit hours
2. Independent study (including exam preparation/exam): 150 hours

**Credit points:** 8

The successful completion of all assignments listed in items 11 and 12 is a prerequisite for receiving the credit points mentioned in item 10.

## 11. Module components:

<table>
<thead>
<tr>
<th>Nr.</th>
<th>Req./req. elective</th>
<th>Form of teaching</th>
<th>Subject area / topic</th>
<th>Credit hours</th>
<th>Coursework</th>
</tr>
</thead>
<tbody>
<tr>
<td>PHY-M-VF 8.1</td>
<td>Required elective</td>
<td>Lecture/Practical course</td>
<td>Computational physics</td>
<td>6</td>
<td>Programming exercises</td>
</tr>
</tbody>
</table>
### Module Exam:

<table>
<thead>
<tr>
<th>Nr.</th>
<th>Competence / topic</th>
<th>Type of Exam</th>
<th>Duration</th>
<th>Time / Notes</th>
<th>Weighting for Module Grade</th>
</tr>
</thead>
<tbody>
<tr>
<td>PHY-M-VF 8.1</td>
<td>Computational physics</td>
<td>Type of exam: Oral or exam or programming project; duration: oral 20 min, or written 105 min, 135 min or 210 min (if it consists of two parts); time: Lecture period to end of semester</td>
<td>1</td>
<td>1</td>
<td></td>
</tr>
</tbody>
</table>

### Notes:

Modules "NS-M-4: Computational Nanoscience" and "NS-M-5: Molecular Electronics" of the master's degree program in nanoscience as well as module CS-B-P8 ("Numerical Methods") of the bachelor's degree program in computational science also count as module "Computational Physics". It is important to ensure that a module is used only once. Further information will be provided by the instructors at the beginning of the course.