<table>
<thead>
<tr>
<th>Module Name</th>
<th>Modul Code</th>
</tr>
</thead>
<tbody>
<tr>
<td>Physical Chemistry 4: Molecular Spectroscopy</td>
<td>chem1003</td>
</tr>
</tbody>
</table>

**Module Coordinator**

Prof. Dr. Friedrich Temps

**Organizer**

Section Chemistry

**Faculty**

Faculty of Mathematics and Natural Science

**Examination Office**

Examination Office Chemistry

**ECTS Credits**

5

**Evaluation**

Graded

**Duration**

One Semester

**Frequency**

Annually Winter Term

**Workload per ECTS Credit**

30 h

**Total Workload**

150 h

**Contact Time**

42 h

**Independent Study**

108 h

**Teaching Language**

English

**Module Courses**

<table>
<thead>
<tr>
<th>Course Type</th>
<th>Course Name</th>
<th>Compulsory/ Optional</th>
<th>SWS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lecture</td>
<td>Molecular Spectroscopy</td>
<td>Compulsory</td>
<td>2</td>
</tr>
<tr>
<td>Exercise</td>
<td>Molecular Spectroscopy</td>
<td>Compulsory</td>
<td>1</td>
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</table>

**Examination(s)**

<table>
<thead>
<tr>
<th>Examination Name</th>
<th>Type of Examination</th>
<th>Evaluation</th>
<th>Compulsory/ Optional</th>
<th>Weighting</th>
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</thead>
<tbody>
<tr>
<td>Mixed Examination: Molecular Spectroscopy</td>
<td>Other</td>
<td>Graded</td>
<td>Compulsory</td>
<td>100</td>
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</table>
### Further Information on the Examination(s)

Exams:
- Solution of homework assignments (H),
- Short questions (T, 10 min every other week),
- Written exam at end of lecture period (K).

Module grade:
- The module marks are calculated according to the following formula:
  
  \[
  P = 0.2 \times (\%H) + 0.2 \times (\%T) + 0.6 \times (\%K)
  \]
  
or
  \[
  P \geq 0.6 \times (\%K)
  \]
  
  whichever is better.

The minimum number of points to pass is 60 %.

Scheduled time for written exam: End of lecture period,
1st repetition: Before start of lecture period of the following semester,
2nd repetition: After lecture period of the following semester.

Exam language: German (for foreign students: English).

- Module grade weighted with CP number enters into M.Sc. grade.

Relevance for final grade M.Ed. Chemistry 2-Subject:
- Module grade enters not M.Ed. grade.

### Course Content

- Common experimental methods and devices in spectroscopy,
- Interactions of electromagnetic radiation with matter,
- Solution of the time-dependent Schrödinger equation,
- Transition dipole moment and intensities of spectroscopic transitions,
- Selection rules,
- Introduction to molecular symmetry and group theory,
- Coherent processes, Rabi frequency,
- Line widths and line broadening mechanisms,
- Rotational spectra of polyatomic molecules,
- Vibrational spectra of polyatomic molecules,
- Electronic spectra of diatomic and polyatomic molecules.

### Learning Outcome

The students learn to apply their fundamental knowledge of spectroscopy from the B.Sc. study course to real (polyatomic) molecules. They learn to analyze and interpret spectra of molecules in different spectral regimes.

### Reading List

- P. F. Bernath, Spectra of Atoms and Molecules, Oxford University Press,
- P. W. Atkins, R. S. Friedman, Molecular Quantum Mechanics, Oxford University Press,
- J. M. Hollas, Moderne Methoden in der Spektroskopie, Vieweg,
- Lecture Script.

### Use

<table>
<thead>
<tr>
<th>Use</th>
<th>Compulsory/ Optional</th>
<th>Semester</th>
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<tbody>
<tr>
<td>Master, 1-Subject, Chemistry, (Version 2007)</td>
<td>Compulsory</td>
<td>1 or 2</td>
</tr>
<tr>
<td>Course</td>
<td>Requirement</td>
<td>Credits</td>
</tr>
<tr>
<td>-----------------------------------------------------------------------</td>
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<tr>
<td>Master, 1-Subject, Chemistry, (Version 2016)</td>
<td>Compulsory</td>
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<tr>
<td>Master, 1-Subject, Business Chemistry, (Version 2008)</td>
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<tr>
<td>Master, 1-Subject, Business Chemistry, (Version 2014)</td>
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<tr>
<td>Master, 1-Subject, Business Chemistry, (Version 2017)</td>
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<td>1 or 2</td>
</tr>
<tr>
<td>Master, 2-Subject, Studies in Secondary Education, Chemie, (Version 2007)</td>
<td>Optional</td>
<td>1 - 4</td>
</tr>
<tr>
<td>Master, 2-Subject, Studies in Secondary Education, Chemie, (Version 2017)</td>
<td>Optional</td>
<td>1 - 4</td>
</tr>
</tbody>
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