<table>
<thead>
<tr>
<th>Identification number</th>
<th>Workload</th>
<th>Credit points</th>
<th>Term of studying</th>
<th>Frequency of occurrence</th>
<th>Duration</th>
</tr>
</thead>
<tbody>
<tr>
<td>MN-BC-BSM13</td>
<td>360 h</td>
<td>12 CP</td>
<td>1st or 2nd term of studying</td>
<td>Summer term, 1st half</td>
<td>7 weeks</td>
</tr>
<tr>
<td>MN-B-SM- (B 5)</td>
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</tbody>
</table>

1. **Type of lesson**
   - a) Lecture
   - b) Practical/lab
   - c) Seminar

<table>
<thead>
<tr>
<th>Contact times</th>
<th>Self-study times</th>
<th>Intended group size*</th>
</tr>
</thead>
<tbody>
<tr>
<td>24 h</td>
<td>48 h</td>
<td>max. 16</td>
</tr>
<tr>
<td>150 h</td>
<td>106 h</td>
<td>max. 16</td>
</tr>
<tr>
<td>8 h</td>
<td>24 h</td>
<td>max. 16</td>
</tr>
</tbody>
</table>

2. **Aims of the module and acquired skills**
Students who successfully completed this module...

   • have acquired fundamental knowledge about the principles of electron microscopy (EM) as a tool in structural biology, including the physical background of electron optics, and about the computational methods required to reconstruct 3D objects from 2D images.

   • are able to prepare sample grids for negative-stain EM, operate a low-kV transmission electron microscope, assess protein quality by EM, and use computational tools to process EM datasets to determine the 3D structures of proteins.

   • are familiar with the use of high-performance computing resources for advanced computational tasks, and are able to write simple computer scripts to automate repetitive tasks.

   • have learned how to present research results in oral and written form, and to critically discuss scientific publications related to the topic of the module on a professional level.

   • are able to transfer skills acquired in this module to other fields of biochemistry.

3. **Contents of the module**

   • Imaging with electrons: theory and practical aspects
   • Sample preparation for EM: negative-staining and vitrification of biological macromolecules
   • Data collection using electron microscopes, routine operations on electron microscopes, and strategies for automated data collection and quality assessment
   • Basic introduction into using high-performance computing resources in structural biology
   • Reconstruction of 3D structures from 2D EM images using single-particle refinement strategies

4. **Teaching/Learning methods**

   • Lectures; Practical/Lab; Seminar; Computer exercises; Guidance to independent research; Training on presentation techniques in oral and written form

5. **Requirements for participation**

   Enrollment in the Master's degree course “Biological Sciences”, in the Master's degree "Biochemistry" course or in the Master's degree course “Chemistry”

6. **Type of module examination**

   The final examination consists of two parts: Two hours written examination about topics of the lectures and the practical/lab part (70 % of the total module mark) and oral presentation (30 % of the total module mark).
7 **Requirements for the allocation of credits**
Regular and active participation;
Each examination part at least “sufficient” (see appendix of the examination regulations for details)

8 **Compatibility with other Curricula**
Biochemical subject module in the master’s degree course “Biological Sciences” and combined advanced and experimental module in the Master’s degree course “Chemistry”.

9 **Significance of the module mark for the overall grade**
In the Master’s degree course “Biochemistry”: 10 % of the overall grade (see also appendix of the examination regulations)

10 **Module coordinator**
Prof. Dr. Elmar Behrmann, phone 470 76300, e-mail: elmar.behrmann@uni-koeln.de

11 **Additional information**
**Subject module** of the Master’s degree course “Biological Sciences”,
**Focus of research:** (B) Biochemistry, Biotechnology and Biophysics
**Participating faculty:** Prof. Dr. E. Behrmann, Prof. Dr. J. Chai, Dr. M. Gunkel, Dr. J. Jirschitzka

**Literature**
- Jensen, G. Getting Started in Cryo-EM. Online course @Caltech [http://cryo-em-course.caltech.edu/]
- Additional material and subject specific literature will be provided ad hoc

**Note:** the module contains hand-on laboratory work conducted by small groups of students and is taught in course rooms and research laboratories. The module contains also computer-based research/practicals as a main component.

**General time schedule:** Week 1-5 (Mon.-Fri.): Lectures from 9:00 to 10:30 three times a week, Experimental/computational work 10:30 to 16:00 including a short lunch break five times a week. Exact times can vary according to the laboratory needs; Week 6 (Mon.-Fri.): Preparation and presentation of the seminar talk; Week 7 (Mon.-Fri.): Preparation for the written examination

**Introduction to the module:** March 28, 2019 at 10:00 a.m., Institute of Biochemistry, seminar room 465 (fourth floor)

**Written examination:** May 17, 2019, second/supplementary examination July 26, 2019; the latter date may vary if students and module coordinator agree. More details will be given at the beginning of the module.

*4 students from the Master’s degree course “Biological Sciences”, 10 students from the Master’s degree course “Biochemistry” and 2 students from the Master’s degree course “Chemistry”.*