# M4455 - Synthetic Biology and Biotechnology

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<tr>
<th>Coordinator (responsible lecturer)</th>
<th>Stand: 01.10.2018</th>
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<tr>
<td>Prof. Dr. Matias Zurbriggen</td>
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<td>(<a href="mailto:matias.zurbriggen@uni-duesseldorf.de">matias.zurbriggen@uni-duesseldorf.de</a>)</td>
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## Lecturers

Prof. Dr. Ilka Axmann, Prof. Dr. Oliver Ebenehö, Prof. Dr. Markus Kollmann, Prof. Dr. Andreas Weber, Prof. Dr. Matias Zurbriggen

## Semester

1.- 2.

## Contact and organization

Prof. Dr. Matias Zurbriggen (matias.zurbriggen@uni-duesseldorf.de)

## Mode

Optional compulsory course

<table>
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<tr>
<th>Workload</th>
<th>Credit points</th>
<th>Contact time</th>
<th>Self-study</th>
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<tr>
<td>420 h</td>
<td>14 CP</td>
<td>225 h</td>
<td>195 h</td>
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## Course components

- **Practical course:** 18 SWS
- **Lectures:** 3 SWS

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<th>Frequency</th>
<th>Group size</th>
<th>Duration</th>
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<td>Each winter semester (if needed also in the summer semester)</td>
<td>16</td>
<td>1 Semester</td>
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## Learning outcomes/skills

The students are able to describe and apply the theoretical and practical principles and strategies of synthetic biology and systems biotechnology in prokaryotic and eukaryotic systems (fungi, yeasts, plants and animals). The students can implement the new synthetic biology technologies and approaches, including new cloning methods and synthetic molecular switches, and can construct signalling, optogenetic and metabolic networks for fundamental research and biotechnological applications. The students are able to develop and formulate scientific questions, to plan experiments and to document, independently interpret and present the results. The students can describe the principles of the signal relay and integration and metabolite processing in prokaryotes and eukaryotes, as well as to understand and apply the concepts and methods of the quantitative biology that describe these systems. This includes the ability to computationally simulate biochemical kinetic parameters and to perform a statistical analysis of experimental data. The students are able to explain how to create and solve differential equations. They can independently perform, analyse and evaluate experimental determinations in the lab. They are able to independently prepare and adequately present in English a seminar on a topic of their own choice with the aid of subject-related literature in English.

## Forms of teaching

Lectures with exercises or wet-lab work, and seminar/presentation

## Content

**Experimentally oriented lecture and practical part:**

The students obtain a review on the central principles of signal transduction, gene regulation, and of the metabolism of prokaryotic and eukaryotic cells of relevance in synthetic biology and biotechnological applications. They will learn new synthetic biology methods for the construction of signalling and metabolic networks, biosensors and chemically- and light-regulated switches. The students receive insights into the novel contributions of synthetic biology in the fundamental and applied fields of agriculture, biomedicine, pharmaceutical development and production, as well as for the production of bioenergy and biomass. The lectures are complemented with practical sessions. Thereby, the students will learn new cloning methods and as an exercise/project will independently design, construct and implement synthetic networks in prokaryotic and eukaryotic systems. The students will obtain
quantitative data from determinations of cellular responses to environmental cues, e.g. determinations of inducible gene expression (light (optogenetics) and chemically-regulated switches), circadian clock regulated genes, and measurements and calculation of metabolite concentrations in cells during different growth phases.

**Theoretically oriented lectures:**
The students learn with simple programming languages (Python how to computationally simulate biochemical reaction rates and to perform statistical analysis thereof. The mathematical principles (differential equations, statistics) will be introduced in accompanying lectures at a level that is easily understandable.

**Eligibility**
Formal: Admission to Master program

**Content-related:** noe

**Examination types**
Learning portfolio consisting of:
1. Skill area knowledge (60% of the grade): written or oral examination on the content of the lecture and the practical course, exercises
2. Skill area documentation (20% of the grade): protocol (presentation of subject, execution, evaluation and discussions of scientific experiments)
3. Skill area scientific presentation (20% of the grade): preparation, presentation and discussion of a subject related publication/seminar.

**Requirements for the award of credit points for this course**
1. Regular attendance and active participation in the classes and the practical course.
   Submission of a protocol complying with the requirements of scientific documentation
2. Pass of exam
3. Oral presentation in a seminar with an accompanying handout.
4. The final grade is calculated from the mark of the written exam (60% of final grade) and the description of the analyses, performance of experiments and the scientific presentation (40% of the grade).

**Relevant for following study programs/major**
M.Sc. Biology
Major:
- Synthetic Biology and Biotechnology
- Molecular Ecology and Evolution
- Physiology and Development
- Structural Biology

**Compatibility with other curricula**
M.Sc. Biochemistry, Molecular Biomedicine

**Significance of the mark for the overall grade**
The mark given will contribute to the final grade in proper relation to its credits.
M.Sc. Biologie 14/72 CP (2-years program)

**Course language**
- German
- English
- German and English
- German, English on demand
- Examination in English; German on demand

**Additional information**
Enrolling into the module is granted by the central study office of the Department of Biology. [http://www.biologie.hhu.de/en/studies-in-biology/students-info/central-allocation-of-modules.html](http://www.biologie.hhu.de/en/studies-in-biology/students-info/central-allocation-of-modules.html) or per e-mail to matias.zurbriggen@uni-duesseldorf.de