ADVANCED COURSE

Multi-Omics approaches for Improvement of Industrial Microbes

2 - 6 June 2025

Aljoscha Wahl
Djordje Bajić
Martin Pabst

AIM OF THE COURSE

This course offers a coherent overview of current state of the art omics technologies, bridging the different cellular levels, i.e. metabolomics, fluxomics, transcriptomics and proteomics. It will be shown how integrated application of these technologies provides holistic, quantitative insights in cellular physiology. Finally, it will be demonstrated how targets for (further) improvement of industrial microbes can be identified through integration of omics data with modelling approaches.

The courses of the Department of Biotechnology at the Delft University of Technology has been known for more that 35 years. Teachers from universities and experts from industries will share their new insights in the field and give you insights they aquired during their career. Throughout the course you will practise with the newly gained knowledge by yourself, to optimize your learning.

The first two days of the course are mainly dedicated to experimental techniques and data aquiring. From experimental design to mass spectrometry to transcript assembly.

The next two days focus on theoretical and modeling aspects of Systems Biology. Approaches from network reconstruction, stoichiometric and thermodynamic network analysis and in-vivo kinetic modeling will be covered. ^{13}C tracer methods will be discussed to increase the information content of stationary state as well as dynamic experiments.

Day five will be dedicated to future perspectives for systems biology and industrial application of multi-omics approaches.

BioTechDelft
POSTGRADUATE EDUCATION

TUDelft

COURSE DESCRIPTION

This one-week course is taught in English and has intensive and long days. To ensure active participation by those attending, a combination of theoretical (lectures) and practical work (exercises and computer simulations) is offered. Some online preparatory materials will be offered to facilitate all participants having the same start knowledge.

LECTURES

In the lectures, attention will be paid to the following themes:

- Genome sequencing and analysis
- Transcriptomics (incl. RNA sequencing)
- Microbial proteomics
- Bioinformatics
- Novel molecular tools and automated strain construction
- Rapid sampling and quenching
- Metabolite quantification and validation using Isotope Dilution Mass Spectrometry (IDMS)
- Estimation of extra- and intracellular rates from experimental data
- Kinetic modeling and approaches to handle parameter identification problems
- Genomics in strain improvement (incl. metabolic and evolutionary engineering)

EXERCISES AND COMPUTER SIMULATIONS

The participants will apply the theory from lectures in case study exercises, especially for concepts from bioinformatics, quantitative metabolomics and metabolic modeling. The participants will focus on analysis of next-generation sequence data, massive data handling, statistics, interpretation and visualisation of multi-omics data.

WHO SHOULD ATTEND?

This Advanced Course is aimed at participants from industry, universities and research institutions who want to update and extend their theoretical knowledge and practical insight in multi-omics and modeling. The course is intended for postgraduates (MSc, EngD, PhD), with a sound background in microbiology, microbial physiology, biotechnology, biochemistry or biochemical engineering, with a basic knowledge in some of the other disciplines and an affinity to applied mathematics.

COURSE BOARD

Aljoscha Wahl
Friedrich Alexander Universitat Erlangen
Nurnberg, Germany

Djordje Bajić
Industrial Microbiology
Delft University of Technology
Delft, the Netherlands

Martin Pabst
Environmental Biotechnology, High-resolution Mass Spectrometry
Delft University of Technology, the Netherlands

COURSE COORDINATION

Yvonne van Gameren
Jenifer Baptiste
BioTech Delft
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LECTURERS

Marcel van den Broek
Industrial Biotechnology
Delft University of Technology
Delft, the Netherlands

Frank Bruggeman
Systems Biology Lab
Vrije Universiteit Amsterdam
Amsterdam, the Netherland

Jeroen Demmers
Erasmus MC
Rotterdam, the Netherlands

Eduard Kerkhoven
Systems and Synthetic Biology
Chalmers University of Technology
Gothenburg, Sweden

Douwe Molenaar
Biochemistry and Molecular Biology
Vrije Universiteit Amsterdam
the Netherlands

Hector Garcia Martin
Lawrence Berkeley National Laboratory
Berkeley, USA

Joanna Kirkpatrick
Thermo Fisher Scientific
Hemel Hempstead, United Kingdom

Joan Gallego Murillo
Meatable
Leiden, The Netherlands

Barbara Kozak
IFF Health & Biosciences
Oegstgeest, the Netherlands

Bas Teusink
Systems Bioinformatics group (AIMMS)
Vrije Universiteit Amsterdam
Amsterdam, the Netherlands

Alexander Wittenberg
KeyGene
Wageningen, the Netherlands

Koen Verhagen
dsm-firmenich
Delft, The Netherlands

PROGRAM

MONDAY 2 JUNE 2025
Theme: Omics technologies: Overview and state of the art
08:45 Registration
09:00 Introduction, including motivation for multi-omix analysis
Djordje Bajić
09:15 Reveal and understand natural variation using long-read sequencing technologies
Alexander Wittenberg
10:30 Introduction to genome analyses
Djordje Bajić
11:30 Genome analyses I
Marcel van den Broek & Djordje Bajić
12.30 Lunch & picture
13:30 Genome analyses II
Marcel van den Broek & Djordje Bajić
17:00 RNA sequencing and transcriptomics
Eduard Kerkhoven
19:00 Social drink and buffet

TUESDAY 3 JUNE 2025
Theme: Mass spectrometry based proteomics & metabolomics techniques
09:00 Genome analyses III
Marcel van den Broek & Djordje Bajić
11:15 Cellular proteomics, introduction and theory
Martin Pabst
12:30 Lunch
13:30 Proteomics data analysis exercise
Martin Pabst
15:45 Targeted proteomics
Jeroen Demmers
17:00 Optional lab tour genomics proteomics

WEDNESDAY 4 JUNE 2025
Theme: Fluxomics & Modelling approaches
09:00 Metabolomics and metabolic networks (theory and links)
Aljoscha Wahl
10:15 Genome-scale modelling for *in-silico* analysis of metabolism
Bas Teusink
11:30 Introduction to Cobra
Aljoscha Wahl
12.00 Lunch
13:00 Exercise with open source tools (Cobra)
Aljoscha Wahl
14:30 Industrial applications (including 13C MFA)
Aljoscha Wahl
15:15 Resource allocation and microbial life cycle strategies
Douwe Molenaar
16:30 Resource allocation modelling (*S. cerevisiae, E. coli*)
Eduard Kerkhoven

THURSDAY 5 JUNE 2025
Theme: Integration of omics data & Modelling approaches
09:00 Regulatory functions of the metabolomic network
Frank Bruggeman
10:15 Introduction to Copasi and exercises
Aljoscha Wahl
12.15 Lunch
13:30 Continuation: Copasi
15:00 Multi omics in industrial environment (with examples)
Koen Verhagen
16:15 Taming *Trichoderma reesei* for industrial needs
Barbara Kozak
18:15 Course Dinner

FRIDAY 6 JUNE 2025
Theme: Future perspectives
09:30 Machine learning for industrial biotechnology
Hector Garcia Martin
11:40 Ex vivo expansion of erythoblasts: Optimization of culture conditions by untargeted metabolomics
Joan Gallego Murillo
12.30 Lunch
13:30 Theme group discussions & questions
Course board
14:30 Single cell omics
Joanna Kirkpatrick
15:30 Evaluation and Farewell Drink

LOCATION
The course will be held at the
Delft University of Technology
Department of Biotechnology
Van der Maasweg 9
2629 HZ Delft, The Netherlands
http://bt.tudelft.nl

COURSE REGISTRATION

Please register via the website to attend the course. Deadline for application is 12 May 2025. Applicants will be handled in order of the date of receipt.

COURSE FEE

€ 2.500 in case booking is made before 24 March 2025 or € 2.750 in case booking is made after this date. In the event of cancellation before 7 April 2025, a full refund will be granted, after this date, a 25% fee charge can be made.
To facilitate enrolment of young PhD-students from universities, a limited number of fellowships is available. The course fee with fellowship is € 1.250. To apply, please include a copy of your registration as a PhD-student from your university.

The fee includes course materials, lunches, the buffet on Monday and the course dinner on Thursday. The fee does not cover other meals and lodging.

When the number of participants is too low to have a fruitful course, BioTech Delft will cancel the event no later than six weeks before the start of the course. The course fee will be reimbursed within three weeks after cancellation.
In case a speaker will not be able to present his/her lecture due to unforeseen circumstances, BioTech Delft will arrange an equivalent replacement.

Preparatory texts will be send a month before the start of the course. The complete digital course book will be supplied at the start of the course.

BioTech Delft organises courses in biotechnology at postgraduate level. BioTech Delft closely cooperates with the department of Biotechnology of Delft University of Technology. Since its foundation, in 1987, BioTech Delft has very successfully organised various types of postdoctoral education.

Currently BioTech Delft offers various Advanced Courses given each year covering the multidisciplinary spectrum of biotechnology. The courses have a long track-record dating back to 1988.

- *Microbial Physiology and Fermentation Technology (1988)*
- *Downstream Processing (1989)*
- *Environmental Biotechnology (1993)*
- *Biocatalysis and Protein Engineering (1999)*
- *Bioprocess Design* (2014)*
- *Multiscale Computational Methods in Bioprocesses (2018)*
- *Integrated Multi-Omics Aproaches for Improvement of Industrial Microbes (2021)*

* in partnership with Wageningen University & Research

FURTHER INFORMATION

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Advanced Courses in Biotechnology

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