

ADVANCED COURSE

Microbial Physiology and Fermentation Technology

12 - 22 January 2026

Course board:
Pascale Daran-Lapujade
Henk Noorman

AIM OF THE COURSE

The aim of the course is to familiarize participants with the integrated, interdisciplinary approach required in modern biotechnology. The course will cover intensive and in-depth presentations of the state of the art. At the same time, the course provides the necessary link between, on one hand, fundamental subjects (thermodynamics, stoichiometry, kinetics, genetics, system biology, fermentor transport and modeling) and, on the other hand, practical aspects (cultivation, (¹³C-)metabolomics, measurements) and applications in large-scale biotechnological processes.

The course provides lectures in fundamental aspects, followed by extensive exercises, made in groups, to stimulate interdisciplinary teamwork. Subsequently the integration of biological and engineering concepts will be experienced in a design task.

topics of interest (technical aspects of fermentation, sampling, analytics) with scientific/technical staff. At the end of the course you have learned to integrate life science and technology to achieve effective development/optimisation of new and existing fermentation processes.

It will be possible to visit research projects and discuss

COURSE DESCRIPTION

This intensive 9 day course is taught in English days. To ensure active participation by those attending, a combination of theory (lectures) and practical work (exercises, computer simulations, design case study) is offered. To ensure an optimal learning experience, preparatory video materials will be provided beforehand, to facilitate (especially) participants with no or limited knowledge in metabolic engineering, to have sufficient background.

LECTURES

Lecture topics:

- Thermodynamics and balances
- Kinetics and stoichiometry (process reaction), membrane transport
- Regulation of metabolism by environmental parameters
- High-cell-density fed batch fermentation
- Metabolic networks: modelling, regulation and stoichiometry
- Case study, Rate based design
- Metabolic engineering, strategy and applications

EXERCISES, DESIGN CASE STUDY, COMPUTER SIMULATIONS

- The exercises by hand cover thermodynamics, balances, kinetics, stoichiometry analysis of fermentation data, metabolomics, pathway stoichiometry.
- Tutorials in setting-up and simulating computer models of metabolic networks.
- Practicals with a fed-batch digital twin
- The case study is on design of a syngas fermentation

CONTACT WITH FACULTY STAFF

- There will be possibilities to visit the fermentation labs of the Department of Biotechnology of Delft University of Technology.
- There will be possibilities to make appointments with faculty staff. Please contact us beforehand.

WHO SHOULD ATTEND?

This Advanced Course is aimed at professionals (MSc, PhD or equivalent experience) in microbiology, biochemistry or biochemical engineering with a basic working knowledge of the two other disciplines. Also, molecular biologists with a microbial background may apply. The course is primarily aimed at those already employed in industry and academia who wish to update their theoretical knowledge and practical insight in this field.

COURSE BOARD

Pascale Daran-Lapujade
Industrial Biotechnology
Experimental Systems Biology/Synthetic
Biology
Henk Noorman
Bioprocess Engineering
dsm-firmenich

FACULTY STAFF

Industrial Biotechnology
Jack Pronk
Djordje Bajic
Bioprocess Engineering
Marieke Klijn
Cees Haringa
Ludovic Jourdin
Environmental Biotechnology
Robbert Kleerebezem
Martin Pabst
Cell Systems Engineering
Sef Heijnen

COURSE COORDINATION

Yvonne van Garmeren
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LECTURERS

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Amsterdam, the Netherlands

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Wageningen, the Netherlands

Adam Feist
University of California, San Diego, USA
DTU Biosustain, Copenhagen, Denmark

Jens Nielsen
BioInnovation Institute
Copenhagen, Denmark

PROGRAM

MONDAY 12 JANUARY 2026

Theme: Beginning with the end in mind, balances, conversion rates, modes of fermenter operation
Coordinator Pascale Daran-Lapujade
08.45 Registration
09.00 Outline of the course
Pascale Daran-Lapujade
09.15 Microbial Physiology vs. Fermentation Technology
Jack Pronk / Henk Noorman
10.30 Verdezyn: A Case Study in Beginning with the End in Mind
Brett Schreyer
11.45 Balances and rates
Sef Heijnen
12.30 Lunch & Picture
13.45 q: Biomass specific conversion rates
Sef Heijnen
14.30 Exercises on balances and biomass specific conversion rates
Sef Heijnen
18.00 Social drink and buffet

TUESDAY 13 JANUARY 2026

Theme: Thermodynamics, stoichiometry and kinetics of growth, product formation and process design
Coordinator Robbert Kleerebezem
09.00 Basic energetics of microbial metabolism
Robbert Kleerebezem
10.15 Exercises on energetics of microbial metabolism
Robbert Kleerebezem
12.30 Lunch
13.15 Thermodynamics: Limits and opportunities in microbial metabolism
Mark Bisschops
14.15 Black Box model: kinetics/parametrization
Sef Heijnen
15.30 Black Box model: stoichiometry/process reaction for design
Sef Heijnen
17.00 Engineering yeast for 1st and 2nd generation bioethanol production
Jack Pronk
18.00 End

WEDNESDAY 14 JANUARY 2026

Theme: Fermentation: design, transport and data analysis
Coordinator Sef Heijnen
09.00 Introduction to bioprocess design using the process reaction
Sef Heijnen
10.00 Exercises on bioprocess reactions in design
Sef Heijnen
12.30 Lunch
13.30 Fermentor O₂/CO₂ transport and fed-batch design
Sef Heijnen
15.15 Exercises on data analysis of fermentation processes
Sef Heijnen
17.00 Balances and modes for fermentation operation
Marieke Klijn
18.00 End

THURSDAY 15 JANUARY 2026

Theme: Pathway stoichiometry, pathway-based models and glutamate fed-batch demo
Coordinator Wouter van Winden
09.00 Fed-Batch: Introduction fed-batch module
Wouter van Winden
09.10 Fed-Batch: Metabolic pathway stoichiometry: for energy, product, biomass
Djordje Bajic
11.10 Exercise: Stoichiometry pathway model for glutamate fed-batch demo
Djordje Bajic / Wouter van Winden / Sef Heijnen
12.30 Lunch
13.15 Continuation Exercise
14.00 Fed-Batch: Design calculation of glutamate fed-batch demo
Wouter van Winden
16.10 Simulation exercise: Introducing the fed-batch simulator and carrying out the designed fed-batch fermentation *in silico*
Wouter van Winden
17.10 Interactive exercise: Discussion on measurements
Sef Heijnen
18.30 End

FRIDAY 16 JANUARY 2026

Theme: Metabolic networks: model-based fed-batch, modelling of large-scale dynamics
Coordinator Wouter van Winden
09.00 Metabolic network models, ME-models, resource allocation
Jens Nielsen
10.00 Metabolic studies in the industrial contexts
Jens Nielsen
11.15 Simulation exercise: Calculations of rates and amounts from your own simulated data
Wouter van Winden
12.15 Interactive exercise: Batch phase: quantification of knowledge for microorganism and fermentor using balance calculations with only online data
Wouter van Winden
12.45 Lunch
13.30 Continuation Interactive exercise
Wouter van Winden
13.45 Interactive exercise: Feed phase: quantification of knowledge for microorganism and fermentor using balance calculations with only online data
Sef Heijnen
15.00 Simulation exercise: In silico optimization of the glutamate fed-batch
Wouter van Winden
16.00 Evaluation glutamate fed-batch demo
Sef Heijnen
16.30 Challenges of large-scale fermentation
Cees Haringa
17.15 Multi-scale modelling of process dynamics in large-scale bioreactors
Cees Haringa
18.30 Social drink

MONDAY 19 JANUARY 2026

Theme: Case study: Ethanol from syngas
Coordinator Henk Noorman
09.00 Rate-based design of biosystems
Sef Heijnen
09.30 Case study: Ethanol from syngas
Henk Noorman / Sef Heijnen
12.00 Gas Fermentation: a path to low carbon fuel and chemical production with impact
Bjorn Heijstra
13.00 Lunch
13.25 (optional) Visit fermentation lab
14.00 Continuation Case Study
Henk Noorman / Sef Heijnen
17.30 Evaluation Case Study
Henk Noorman / Sef Heijnen
18.00 End

TUESDAY 20 JANUARY 2026

Theme: Metabolic engineering: Strategies and applications
Coordinator Henk Noorman
09.00 Metabolic engineering strategies for reducing costs
Sef Heijnen
10.30 Exercises on metabolic engineering strategies for reducing costs
Sef Heijnen
12.30 Lunch
12.55 (optional) Visit fermentation lab
13.30 Metabolic Engineering: from bench to business
Irina Borodina
14.45 Fermentation intensification
Henk Noorman
15.30 Industry Perspective
Mickel Jansen
16.30 Evolutionary Engineering highlighting Adaptive Laboratory Evolution
Adam Feist
17.30 End

WEDNESDAY 21 JANUARY 2026

Theme: Scale down: Single cell studies and heterogeneity, physiology in the screening stage
Coordinator Pascale Daran-Lapujade
09.00 Spatio-temporal single-cell analysis in picoliter reactors
Dietrich Kohlheyer
10.00 Population heterogeneity in large-scale bioprocesses
Anna-Lena Heins
11.15 Scale-down for understanding large-scale performance and robust bioprocessing
Cees Haringa / Anna-Lena Heins
12.15 Lunch
12.40 (optional) Visit fermentation lab
13.15 Transcription factor-based biosensors for strain development
Jan Marienhagen
14.15 Single cell studies of micro-organisms / Microfluidics
Frank Bruggeman
15.30 How to manage biological complexity in an industrial setting
Cees Sagt
16.30 Advances and developments in microbial proteomics
Martin Pabst
17.45 Genome-scale metabolic networks, proteome constrained models and resource allocation
Bas Teusink
19.15 Course dinner

THURSDAY 22 JANUARY 2026

Theme: Microbial protein production: excretion and intracellular accumulation
Coordinator Henk Noorman
09.00 Komagataella phaffii (Pichia pastoris) production of therapeutic proteins
Nico Callewaert
10.15 Microbial proteins for food applications
Katelijne Bekers
11.30 Microbial community engineering for production of chemicals and bioenergy
Robbert Kleerebezem
12.30 Lunch
13.30 Synthetic consortia: new options for industrial biotechnology
Djordje Bajic
14.15 Electrobiotechnology: production of chemicals using renewable electricity as energy source
Ludovic Jourdin
15.15 Developing scalable bioprocesses: Lessons and examples from industry
Chris Mehrer
16.15 What have we learned? Certification
16.45 End

LOCATION

The course will be held at the
Delft University of Technology
Department of Biotechnology
Van der Maasweg 9
2629 HZ Delft, The Netherlands



COURSE REGISTRATION

Please register via the website to attend the course. Applications will be handled in order of the date of receipt.

COURSE FEE

The course fee can be found on the [website](#). 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 sent after receipt of the course fee, 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 biotechnology education 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 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)*
- *Biocatalysis and Protein Engineering (1999)*
- *Bioprocess Design* (2014)*
- *Modelling and Computation for Microorganisms in Bioprocesses (2018)*
- *Multi-Omics approaches for Improvement of Industrial Microbes (2020)*
- *Cellular Agriculture: Precision fermentation and cultured meat (2024)*
- *EPS for resource recovery (2025)*
- *Biopharmaceutical Bioprocessing (2025)*

* in partnership with Wageningen University & Research

FURTHER INFORMATION

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Course coordination

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