

ADVANCED COURSE

Microbial Physiology and Fermentation Technology

11 - 21 January 2027

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, (^{13}C -)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. 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 provide 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, 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, skills 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
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Djordje Bajić
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Bioprocess Engineering
Marieke Klijn
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Ludovic Jourdin
Environmental Biotechnology
Robbert Kleerebezem
Cell Systems Engineering
Sef Heijnen

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DTU Biosustain, Copenhagen, Denmark

Jens Nielsen
BioInnovation Institute
Copenhagen, Denmark

Alexander Grünberger
KIT
Karlsruhe, Germany

PROGRAM

MONDAY 11 JANUARY 2027

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
Microbial Physiology vs. Fermentation Technology
Jack Pronk / Henk Noorman

10.30 Verdezyne: A Case Study in Beginning with the End in Mind
Brett Schreyer

11.45 Balances and rates
Sef Heijnen

12.45 Lunch & Picture
13.45 q: Biomass specific conversion rates
Sef Heijnen

14.30 Excercises on balances and biomass specific conversion rates
Sef Heijnen

18.00 Social drink and buffet

TUESDAY 12 JANUARY 2027

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
Ruud Weusthuis

14.15 Black Box model: kinetics/parametrization
Sef Heijnen

15.30 Black Box model: stoichiometry/process reaction for design
Sef Heijnen

WEDNESDAY 13 JANUARY 2027

Theme: Fermentation: design, transport and data analysis
Coordinator Sef Heijnen

09.00 Introduction to bioprocess design using the process reaction
Sef Heijnen

10.00 Excercises 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

THURSDAY 14 JANUARY 2027

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 Bajić

11.10 Exercise: Stoichiometry pathway model for glutamate fed-batch demo
Djordje Bajić /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

FRIDAY 15 JANUARY 2027

Theme: Metabolic networks: model-based fed-batch, modelling of large-scale dynamics
Coordinator Wouter van Winden

09.00 Interactive exercise Fed-batch: Measurements
Sef Heijnen

10.15 Interactive exercise Fed-batch: Calculations
Sef Heijnen

11.15 Simulation exercise: Calculations of rates and amounts from your own simulated data
Wouter van Winden

12.15 Lunch
13.15 Interactive exercise: Batch phase
Wouter van Winden

14.30 Interactive exercise: Feed phase
Sef Heijnen

15.15 Simulation exercise: In silico optimization of the glutamate fed-batch
Wouter van Winden

16.45 Challenges of large-scale fermentation
Cees Haringa

MONDAY 18 JANUARY 2027

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 Presentation results by each team
Henk Noorman / Sef Heijnen

14.30 Continuation Case Study
17.30 Evaluation Case Study
Henk Noorman / Sef Heijnen

TUESDAY 19 JANUARY 2027

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 Engineering yeast for 1st and 2nd generation bioethanol production
Jack Pronk

14.45 Fermentation intensification
Henk Noorman

15.30 Industry Perspective
Mickel Jansen

16.30 Evolutionary Engineering highlighting Adaptive Laboratory Evolution
Adam Feist

WEDNESDAY 20 JANUARY 2027

Theme: Scale down: Single cell studies and heterogeneity, physiology in the screening stage
Coordinator Pascale Daran-Lapujade

09.00 Bioprocess micro fluidics - from concepts to application
Alexander Grünberger

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
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 Genome-scale metabolic networks, proteome constrained models and resource allocation
Bas Teusink

18.15 Course dinner

THURSDAY 21 JANUARY 2027

Theme: Microbial protein production: excretion and intracellular accumulation
Coordinator Henk Noorman

09.00 Komagataella phaffii (Pichia pastoris) production of therapeutic proteins
Nico Callewaert

10.00 Electrobiotechnology: production of chemicals using renewable electricity as energy source
Ludovic Jourdin

10.45 Microbial proteins for food applications
Katelijne Bekers

11.45 Microbial community engineering for production of chemicals and bioenergy
Robbert Kleerebezem

12.30 Lunch
13.30 Synthetic consortia: new options for industrial biotechnology
Rinke van Tatenhoven-Pel

14.15 Metabolic network models, ME-models, resource allocation
Jens Nielsen

15.30 Metabolic studies in the industrial contexts
Jens Nielsen

16.15 What have we learned? Certificaton

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 Micro-organisms 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)*
- *AI Fundamentals for Biotechnology (2026)*

* in partnership with Wageningen University & Research

FURTHER INFORMATION

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Course coordination

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