

ADVANCED COURSE

Bioprocess Design

11 - 15 October 2027

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AIM OF THE COURSE

With recent advances in molecular biology and a growing biomass availability for use as industrial feedstock, the bio-based economy is getting a wider range of inputs. Scaling up the bio(techno)logy innovations and implementation in large-scale factories or biorefineries clearly is a present bottleneck: industries are struggling to get the bio-opportunities to the market.

Teachers from universities and companies have joined forces and will present a program that in depth addresses industrial fermentation processes, and is flanked by overviews on upstream and downstream processing. The focus of the course is on design of innovative microbial fermentations, for bio-products such as amino acids and monomers for bio-plastics, complemented with examples of marine and mammalian processes, for micro-algae products and bio-pharmaceuticals. A substantial part (ca. 40% of the time) will be dedicated to a case study, executed in teams of 4-6 participants, on the design of a bioprocess for the production of a chemical (1,4-butanediol). In this case, basic theory on thermodynamics, microbial stoichiometry and kinetics, transport phenomena and scale up/down will be extensively applied and integrated. The team with the best design performance wins the Design Award. There are several guest lecturers from leading universities and industries in the bioprocess field, providing latest insights in technology innovations, non-conventional feedstocks and new bio-product categories, complemented with views from the industrial practice. The Advanced Course Bioprocess Design is cooperatively organised by BioTech Delft and VLAG Graduate School.

BioTechDelft POSTGRADUATE EDUCATION
VLAG GRADUATE SCHOOL
WAGENINGEN UNIVERSITY & RESEARCH
TUDelft

COURSE DESCRIPTION

This one-week course is intensive and has long days. To ensure active participation by those attending, a combination of theoretical (lectures) and practical (exercises, case study) work is offered. Some online preparatory materials will be given to ensure all have the same basic knowledge.

LECTURES

The core lectures are mainly scheduled in the mornings and will focus on the following themes:

- Rates, thermodynamics and metabolism of micro organisms
- Transport processes in bioreactors
- Fermentation processes and their scale up features

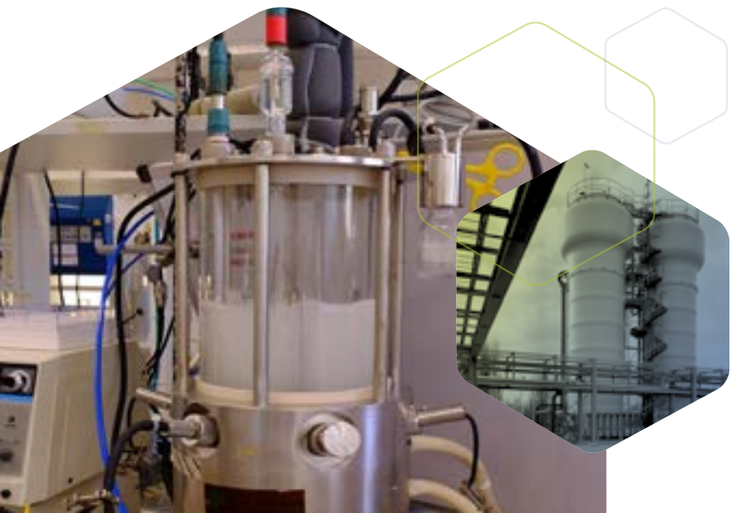
In the early evenings, invited lectures are scheduled on e.g. examples of successful bioprocesses, downstream processing, upstream processing, novel feedstocks and economic aspects of bioprocessing.

EXERCISES AND CASE STUDY

For a better understanding of the lectures, the theory is applied in exercises on the Monday and Tuesday afternoons. From Wednesday on, the practical work continues in a 2.5 day case study on a real-life bioprocess design question where all theory will be needed. The course will be given in English.

WHO SHOULD ATTEND?

The course is primarily aimed at academic and industrial specialists (MSc, PhD or equivalent experience) who seek for refreshing and broadening their knowhow and practical insight in Bioprocess Design, to enable progress towards the biobased economy. A background in e.g. (bio)chemical engineering, microbiology or biochemistry and a basic working knowledge of the other disciplines is expected.



COURSE LEADER

Henk Noorman
DSM-Firmenich
Delft University of Technology
Delft, the Netherlands

COURSE BOARD

Sef Heijnen
Cell Systems Engineering,
Delft University of Technology
Department of Biotechnology
Delft, the Netherlands

Ruud Weusthuis
Bioprocess Engineering
Wageningen University & Research
Wageningen, the Netherlands

COURSE COORDINATION

Yvonne van Gameren
Jenifer Baptiste
BioTech Delft, Delft University of Technology
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GUEST LECTURERS

Michel Eppink
Byondis BV
Nijmegen, the Netherlands and
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Genomatica Inc.
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Mark Bisschops
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Wageningen, the Netherlands

Michael Kopf
DAB
Delft, the Netherlands

CASE STUDY

Amit Deshmukh
DSM-Firmenich
Delft, the Netherlands

PROGRAM

MONDAY 11 OCTOBER 2027

Theme: Processes: DSP, pretreatment
Micro-organisms: rates and process reaction

08:45 Registration
09:00 Course introduction
Henk Noorman
09:30 Downstream Processing
Michel Eppink
10:45 The process reaction for bioprocess design: a thermodynamic approach
Sef Heijnen
12:15 Lunch
13:15 Exercise: obtaining the process reaction
17:15 Precision fermentation
Mark Bisschops
19:00 Social drink and buffet

TUESDAY 12 OCTOBER 2027

Theme: Fermentors: design of transport

09:00 Brief introduction to scale effects and gas-liquid flow
Henk Noorman
09:30 Mixing
Henk Noorman
10:30 Gas transport
Henk Noorman
11:00 Heat transport
Henk Noorman
11:30 Cost-efficient biomanufacturing enabled by in-situ separation technologies
Michael Kopf
12:30 Lunch
13:15 A game of balances: Design calculations using the process reaction
Sef Heijnen
13:45 Exercise: Design of in- and outflows
Sef Heijnen and Henk Noorman
15:15 Exercise: Design of gas transport
Sef Heijnen and Henk Noorman
16:30 Exercise: Mixing and gradients
Sef Heijnen and Henk Noorman
17:45 Interactive discussion on exercises
Henk Noorman
18:20 End of day

WEDNESDAY 13 OCTOBER 2027

Theme: Scale-up of fermentation processes, case study

09:00 Industrial microbial fermentation
Henk Noorman
09:45 Hypes, hopes and the way forward for microalgal biotech
Maria Barbosa
11:00 Animal Cell Cultivation for Production of Biopharmaceuticals
Dirk Martens
12:00 Introduction to the case study
Henk Noorman and Amit Deshmukh
12:30 Lunch
13:15 Metabolic design: example and exercise I
Ruud Weusthuis
14:15 Preparation of the case study
15:00 Interactive discussion case study
15:30 Part 1 of the case study
Calculation of the process reaction stoichiometry
16:45 Part 1: reporting results
17:00 C1 feedstocks fermentation
Liang Wu
18:00 End of the day

THURSDAY 14 OCTOBER 2027

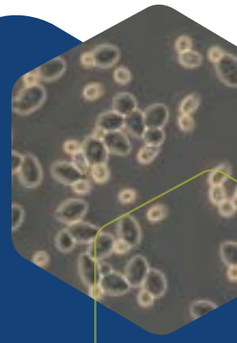
Theme: Case study

09:00 *Monascus ruber* as cell factory for lactic acid production at low pH
Ruud Weusthuis
10:15 The ultimate bioprocess & discussion
Ruud Weusthuis
11:15 Part 2: Quantification of in- and outputs (rates, composition) and fermentor broth mass
12:15 Lunch
13:30 Continuation Part 2
14:00 Part 2: Reporting results
14:45 Part 3 of the case study
Vessel geometry and quantification of transport processes inside the fermentor
17:15 Part 3: Reporting results
19:00 Course dinner

FRIDAY 15 OCTOBER 2027

Theme: Case study

09:00 Scale-up/scale-down approach
Cees Haringa
10:15 Scale-up/scale-down: characteristic times and gradients
Wouter van Winden
11:15 Part 4 of the case study
Full scale conditions and scale-up/scale-down
12:30 Lunch
13:30 Final presentations by the design teams
Strategies for improvement
Amit Deshmukh
15:30 Keynote Lecture
Lessons from the industry: developing scalable bioprocesses
Noelia Gudino
16:15 Design Award
16:30 Closure & certification



LOCATION

The course will be held at
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. Applicants 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 materials will be accessable a month before the start of the course, and after receipt of the course fee.
The complete 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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