

Board of the course

Prof. J.J. Heijnen
Bioprocess Technology

Prof. J.T. Pronk
Physiology of Industrial Microorganisms

Faculty staff

Dr. P.A.S. Daran-Lapujade
Systems Biology

Dr. W.M. van Gulik
Metabolic Engineering

Ir. R. Mans
Metabolic Engineering

Dr. R. Kleerebezem
Environmental Biotechnology

Dr. A.J.A. van Maris
Metabolic Engineering

Dr. L.A. Robertson
Curator of the Beijerinck Museum

Dr. S.A. Wahl
Systems Biology

Coordinators Fed-batch demo

Ing. D.J.M. Geerts
Ing. R. Kerste
Yi Song

Guest lecturers

Dr. R. Douma
Novozymes
Copenhagen, Denmark

Prof. M. Heinemann
Molecular Systems Biology
Rijksuniversiteit Groningen
the Netherlands

Dr. M. Jansen
DSM Biotechnology Center
Delft, the Netherlands

Dr. D. Kohlheyer
Research Centre Jülich
Germany

Dr. S. de Kok
Zymergen
Emeryville, USA

Prof. L.R. Lynd
Dartmouth College, Thayer School of
Engineering, Hannover, NH
USA

Dr. J. Marienhagen
Research Centre Jülich
Germany

Prof. H.J. Noorman
DSM Biotechnology Center and
Delft University of Technology
Delft, the Netherlands

Prof. M. Reuss
Institut für Bioverfahrenstechnik
University Stuttgart
Germany

Prof. R. Takors
Institut für Bioverfahrenstechnik
University of Stuttgart
Germany

Prof. M.J. Teixeira de Mattos
Swammerdam Institute for Life Sciences,
SILS, University of Amsterdam
the Netherlands

Prof. C. Wittmann
Institut für Bioverfahrenstechnik
Braunschweig
Germany

Course coordination

Ms. Jenny Boks-Zondervan
Delft University of Technology
Department of Biotechnology
Delft, the Netherlands

The institute **Biotechnology Sciences Delft Leiden (BSDL-EDU)** constitutes a joint initiative in biotechnological post-graduate education of Delft University of Technology and Leiden University and is coordinated from the department of Biotechnology of Delft University of Technology.

BSDL-EDU was founded in 1987 and has since then very successfully organised various types of postdoctoral education: the Advanced Course Quality Management in Pharma and Biotech, the PDEng programmes and the Advanced Courses in biotechnology. The Advanced Course Quality Management in Pharma and Biotech was developed by BSDL-EDU and is currently organised by PAO Farmacie. The PDEng programmes are special two-year postgraduate programmes that are aimed at those who wish to tailor their own specialisation to the needs of multidisciplinary biotechnological research and design, and lead to the degree of 'Professional Doctorate in Engineering'. Originally developed by BSDL-EDU, these programmes are now hosted by the 3TU School for Technological Design / Stan Ackermans Institute.

Currently BSDL-EDU offers various Advanced Courses covering the multidisciplinary spectrum of biotechnology:

- BIOCATALYSIS AND PROTEIN ENGINEERING
- BIOPROCESS DESIGN
- DOWNSTREAM PROCESSING
- ENVIRONMENTAL BIOTECHNOLOGY
- GENOMICS IN INDUSTRIAL BIOTECHNOLOGY
- METABOLOMICS FOR MICROBIAL SYSTEMS BIOLOGY

Further information

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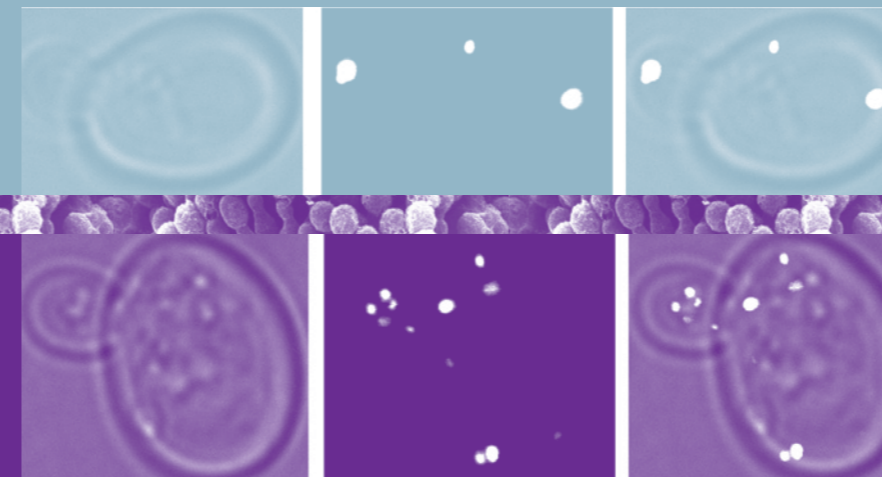
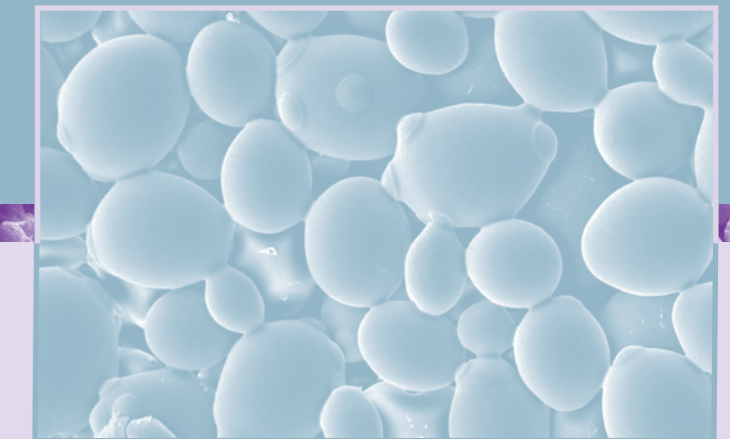
Address

Institute Biotechnology Studies Delft Leiden
Department of Biotechnology, Delft University of Technology
Julianalaan 67, 2628 BC Delft, the Netherlands

Advanced Course

MICROBIAL PHYSIOLOGY AND FERMENTATION TECHNOLOGY

11 - 22 January 2016



Institute Biotechnology Studies Delft Leiden
Department of Biotechnology
Julianalaan 67
2628 BC Delft
The Netherlands

TU Delft
Delft University of Technology



Universiteit Leiden



Aim

The advanced course “Microbial Physiology and Fermentation Technology” aims to

familiarize participants with the integrated, interdisciplinary approach required in modern

biotechnology. Microbial physiologists, enzymologists and (bio)chemical engineers

from the faculty staff, together with invited (inter)national experts from other universities

and industry, will offer a combination of theoretical (lectures, tutorials, mathematical

modelling) and practical work (demonstrations, data collection and interpretation of results).

In this way, the course will present an intensive and in-depth treatment of the state of the

art. At the same time, the course provides the necessary link between, on one hand,

fundamental subjects (e.g. biochemistry / enzymology) and, on the other hand, practical

applications in large-scale biotechnological processes.

Course description

For a better understanding of the lectures and to enhance active participation by those attending, this intensive two-weeks course consists of lectures, practical demo's, computer simulations, exercises and case studies.

Morning and evening

The lectures are mainly scheduled in the mornings and the early evenings. In the lectures, attention will be paid to the following themes:

- Energy transduction and growth thermodynamics
- Kinetics and stoichiometry of growth and product formation
- Regulation of metabolism by environmental parameters
- High-cell-density fermentation
- Metabolic networks: stoichiometry and fluxes
- Rate based design
- Regulation and control of metabolic fluxes
- Metabolic engineering
- Heterogeneity and mixed cultures
- Capita selecta

Afternoon

Demo's in fed-batch fermentation. Discussions and interpretation of results. On- and off-line measurements in the gas and liquid phase of reaction parameters and determination of the kinetics of biological conversions. Statistical data processing using mass balances. Tutorials in setting-up and simulating computer models of metabolic networks. Introduction to rate based design. Possibilities to visit the research projects of the

Department of Biotechnology of Delft University of Technology.

The course will be given in English. A pocket calculator is required.

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 who wish to update their theoretical knowledge and practical insight in this field. In addition, this Advanced Course is an option in the two-year postgraduate programs of Delft University of Technology.

Program, 11 - 22 January 2016

Monday, 11 January 2016

Theme: Energy transduction and growth thermodynamics

08.45 Registration
09.00 Outline of the course
Jack Pronk

09.30 Basic energetics of microbial metabolism
Ton van Maris

10.30 Solute transport: mechanisms and energetics
Jack Pronk

11.15 Balances
Sef Heijnen

13.30 q-rates
Sef Heijnen

14.00 Batch, fed-batch and continuous cultivation
Ton van Maris

15.15 Parallel sessions: Exercises on energetics of microbial metabolism
Exercises on balances and q-rates

18.00 Social drink and buffet

Tuesday, 12 January 2016

Theme: Kinetics and stoichiometry of growth and product formation, process design

09.00 Transport reactions and energy coupling: implications for industrial product formation
Jack Pronk

10.15 Black box model: kinetics
Sef Heijnen

11.30 Black box model: stoichiometry
Sef Heijnen

13.45 Introduction to bioprocess design
Sef Heijnen

14.30 Exercises on bioprocess design

Wednesday, 13 January 2016

Themes: Regulation of metabolism by environmental parameters
High-cell-density fermentation

09.00 Primary metabolism and its regulation
Pascale Daran-Lapujade

10.00 Carbohydrate metabolism in yeasts: respiration versus alcoholic fermentation
Jack Pronk

11.00 Physiological aspects of high cell density fermentation
Jack Pronk

13.00 Fed-batch fermentation and transport phenomena
Sef Heijnen

15.30 Microbial growth with mixtures of carbon substrates
Jack Pronk

16.45 Optional: Visit tour research projects

Thursday, 14 January 2016

Theme: Metabolic networks: stoichiometry and fluxes

09.00 Metabolic network analysis
Sef Heijnen

11.45 Redox balances in microbial sugar metabolism: consequences for industrial product formation
Ton van Maris

13.30 Bioenergetics of microbial growth and the cost of adaptation
Joost Teixeira de Mattos

15.30 Fed-batch demo (1): design of the feed profiles

17:15 Fed-batch demo (2): measurements why and how

Friday, 15 January 2016

Theme: Metabolic networks: stoichiometry and fluxes

09.00 Metabolic flux balancing: theory and applications
Walter van Gulik

10.15 Computer exercises on metabolic network analysis

13.45 Metabolic studies in the industrial contexts
Ralf Takors

14:45 Exercises on high-cell density fed-batch cultivation

17:30 Social drink

Monday, 18 January 2016

Theme: Rate based design

09.00 Rate based design of biosystems
Sef Heijnen

10.00 Case study introduction: feedstock and stoichiometry variants, mass and energy balances
Henk Noorman

10.30 Case study: rate based design

14.00 Reactor types, rate limiting transport steps and reactor sizing
Henk Noorman

14.30 Continuation case study

17:30 Large scale reactors: mixing and scale-up problems
Henk Noorman

Tuesday, 19 January 2016

Theme: Regulation and control of metabolic fluxes

09.00 Multi-scale modelling of process dynamics in large-scale bioreactors
Matthias Reuss

10.15 Multi-level regulation of metabolic fluxes, transcripts versus fluxes
Pascale Daran-Lapujade

11.00 Through Van Leeuwenhoek's Eyes
Lesley Robertson

11.30 Van Leeuwenhoek and Delft: A microbiological pilgrimage (social / cultural event)

14.30 Analysis of in vivo kinetics: rapid sampling and metabolite analysis
Walter van Gulik

15.45 Fed-batch (3): practising fed-batch calculations on the batch phase

Wednesday, 20 January 2016

Theme: Metabolic engineering

09.00 Metabolic engineering strategies for reducing costs
Sef Heijnen

10.30 Design and engineering of industrial microorganisms
Christoph Wittmann

11.45 Engineering, fermentation and scale-up of fungi for protein
Rutger Douma

14.15 Evolutionary and reverse engineering
Jack Pronk

15.30 Exercises on metabolic engineering strategies for reducing costs

17.15 Metabolic engineering of thermophiles
Lee Lynd

Thursday, 21 January 2016

Theme: Heterogeneity and mixed cultures

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

10.15 Spatio-temporal single-cell analysis in picoliter reactors
Dietrich Kohlheyer

11.30 Responsive diversification - an explanation for lag phases?
Matthias Heinemann

13.30 Fed-batch (4): calculations on mass balances of a fed-batch fermentation and evaluation

19.00 Course dinner, downtown Delft

Friday, 22 January 2016

Theme: Capita Selecta

09.30 Low-pH fermentation to succinic acid, the basis for efficient recovery
Mickel Jansen

10.45 High-throughput strain construction and phenotypic screening
Stefan de Kok

13.45 Transcription factor-based biosensors for strain development
Jan Marienhagen

14.45 Keynote lecture
Lee Lynd

15.45 Evaluation of the course

16.00 Farewell drink

Fees and Registration

Please complete and return the form below, or register via the website, if you are interested to attend the course or would like to receive information on other courses. Applicants will be handled in order of the date of receipt.

The course fee is:

Early bird fee: € 3650 in case of payment received on or before **30 November 2015** or Regular fee: € 3900 in case of payment received after this date.

In the event of cancellation before 30 November 2015, a full refund will be granted, after this date, a 25% fee charge will be made. To facilitate enrolment of young PhD-students from universities, a limited number of fellowships is available. The course fee with fellowship is € 1825. To apply, please include a copy of your registration as a PhD-student from your university.

The fee includes course materials, lunches, the buffets on Monday, 11th and Thursday, 14th and the course dinner on Thursday, 21st. The fee does not cover other meals and lodging.

When the number of participants is too low to have a fruitful course, the Institute BSDL 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, BSDL will arrange an equivalent replacement.

Hotel accommodation can be arranged at your request.

Preparatory texts will be sent after receipt of the course fee. The complete set of course books will be supplied at the start of the course.

Advanced Course Microbial Physiology and Fermentation Technology

- I wish to attend the course of 11 - 22 January 2016
- I would like to receive information of the other courses of the Institute BSDL
- Please, send me announcements of the future **Advanced Course Microbial Physiology and Fermentation Technology**

Family name, title, Mr / Ms _____ First name _____

Organisation / Company _____

Address _____

Phone _____

E-mail address _____

Educational background _____

Diet wishes _____

Date / Signature _____

Duration / Location

This Advanced Course will be given on **Monday, 11 January - Friday, 22 January 2016**

The course will be held at the **Department of Biotechnology Delft University of Technology Julianalaan 67 2628 BC Delft The Netherlands**
P +31 15 278 1922
F +31 15 278 2355
E bsd1-edu@tudelft.nl
W www.biotechnologycourses.nl

Accommodation

Hotel accommodation can be arranged at your request addressed to bsd1-edu@tudelft.nl. Lunches, the buffets on Monday, 11th and Thursday, 14th and the course dinner on Thursday, 21st will be provided. For the other meals a variety of restaurants may be found in the centre of the city.

