

MICROBIAL PHYSIOLOGY AND FERMENTATION TECHNOLOGY 2020

Day 1 **Monday, 20 January**
Themes: *Thermodynamics, balances and q-rates*
Coordinator: *Han de Winde*

08.45-09.00	Registration	
09.00-09.15	Outline of the course Han de Winde	
09.15-10.15	Basic energetics of microbial metabolism Robbert Kleerebezem	Chapter 1
10.15-10.30	Break	
10.30-11.30	Balances Sef Heijnen	Chapter 2a
11.30-11.45	Break	
11.45-12.15	q-rates Sef Heijnen	Chapter 2b
12.15-12.20	Photographer	
12.20-13.15	Lunch @Bar 't Lab (TNW-Zuid)	
13.15-15.15	Parallel sessions: Exercises on energetics of microbial metabolism Robbert Kleerebezem	Exercise Ch1
	Exercises on balances and q-rates Sef Heijnen	Exercise Ch2
15.15-15.30	Break	
15.30-17.30	Continuation of the parallel sessions	
17.30-17.40	Evaluations	
17.45-20.00	Welcome drinks and buffet @Bar 't Lab (TNW-Zuid)	

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Day 2 **Tuesday, 21 January**

Themes: *Kinetics and stoichiometry of growth, product formation, process design and membranes transport*

Coordinator: *Sef Heijnen*

09.00-10.00	Batch, fed batch and continuous cultivation Aljoscha Wahl	Chapter 3
10.00-10.15	Break	
10.15-11.15	Black box model: kinetics / parameterization Sef Heijnen	Chapter 4a/b
11.15-11.30	Break	
11.30-12.30	Black box model: stoichiometry Sef Heijnen	Chapter 4c
12.30-13.30	Lunch @Bar 't Lab (TNW-Zuid)	
13.30-14.15	Introduction to bioprocess design (batch, continuous) Sef Heijnen	Chapter 4d
14.15-14.30	Break	
14.30-16.00	Exercises on bioprocess reactions in design Sef Heijnen	Exercise Ch4
16.00-16.15	Break	
16.15-17.30	Continuation of the exercises	
17.30-17.45	Break	
17.45-18.30	Transport over biological membranes: mechanisms and thermodynamics Walter van Gulik	Chapter 5
18.30-18.40	Evaluations	

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Day 3 **Wednesday, 22 January**

Themes: *Regulation of metabolism by environmental parameters, fermentation design and data analysis*

Coordinator: *Han de Winde*

09.00-09.45	Primary metabolism and its regulation Pascale Daran-Lapujade	Chapter 6
09.45-10.00	Break	
10.00-10.45	Microbial growth with mixtures of carbon substrates Han de Winde	Chapter 7
10.45-11.00	Break	
11.00-12.00	Physiological aspects of high cell density fermentation Han de Winde	Chapter 8
12.00-13.00	Lunch @Bar 't Lab (TNW-Zuid)	
13.00-13.45	Fed batch fermentation and transport phenomena - the fermentor - O ₂ / CO ₂ in biological processes - design of fed-batch fermentation processes Sef Heijnen	Chapter 9
13.45-14.00	Break	
14.00-14.30	Continuation	
14.30-15.30	Exercises on data analysis of fermentation processes	Exercise Ch9
15.30-15.45	Break	
15.45-17.00	Continuation exercises	
17.00-18.00	Optional: Lab techniques tour department of Biotechnology followed by drink	

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Day 4 **Thursday, 23 January**

Themes: *Metabolic networks: stoichiometry, Flash energy and Fed batch demo*

Coordinator: *Sef Heijnen*

09.00-10.00	Metabolic network analysis: - energy conversion pathways - from product pathway reaction to network product reaction - the network biomass reaction Sef Heijnen	Chapter 10
10.00-10.15	Break	
10.15-12.30	Exercises: Metabolic pathways stoichiometry	Exercise Ch10
12.30-13.30	Lunch @Bar 't Lab (TNW-Zuid)	
13.30-14.00	Fed batch demo: Stoichiometric network calculation Sef Heijnen	Fed Batch 1
14.00-14.15	Fed batch demo: Fed batch fermentation Sef Heijnen	Fed Batch 2
14.15-14.30	Break	
14.30-15.15	Fed batch demo: Design calculation Rob Kerste	Fed Batch 3
15.15-16.00	Fed batch demo: Measurements why and how Rob Kerste	Fed Batch 4
16.00-16.45	Bioenergetics of microbial growth and the cost of adaptation, Part I Joost Teixeira de Mattos	Chapter 11
16.45-17.00	Break	
17.00-17.45	Bioenergetics of microbial growth and the cost of adaptation, Part II Joost Teixeira de Mattos	
17.45-17.55	Evaluations	
18.00-20.00	Buffet @Bar 't Lab (TNW-Zuid)	

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Day 5 Friday, 24 January

Themes: *Metabolic networks: stoichiometry, fluxes and high-cell density fed batch*

Coordinator: *Aljoscha Wahl*

09.00-10.00	Metabolic flux balancing: theory and applications Aljoscha Wahl	Chapter 12
10.00-10.15	Break	
10.15-12.45	Computer exercises on metabolic network analysis Aljoscha Wahl a.o.	Exercise Ch12
12.45-13.45	Lunch @Bar 't Lab (TNW-Zuid)	
13.45-14.45	Metabolic studies in the industrial contexts Ralf Takors	Chapter 13
14.45-15.30	Exercises on high-cell density fed batch cultivation Walter van Gulik / Aljoscha Wahl	Exercise Ch14
15.30-15.45	Break	
15.45-18.00	Exercises continued	
18.00-18.10	Evaluations	
18.15-20.00	Social drink @Bar 't Lab (TNW-Zuid)	

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Day 6 **Monday, 27 January**
Theme: *Case study: Ethanol from syngas*
Coordinator: *Henk Noorman*

09.00-09.30	Rate based design of biosystems Sef Heijnen	Chapter 15
09.30-10.00	Case study: Ethanol from syngas General introduction and background Task 1 Henk Noorman / Sef Heijnen	Exercise Ch15
10.00-10.15	Break	
10.15-12.15	Calculations Task 1	
12.15-12.45	Presentations by each team: results Task 1 Henk Noorman / Sef Heijnen	
12.45-14.00	Lunch @Bar 't Lab (TNW-Zuid)	
13.25-13.55	(optional) Visit fermentation lab (max. 10 persons) Dirk Geerts / Rob Kerste	
14.00-14.30	Background Task 2 Henk Noorman / Sef Heijnen	Exercise Ch15
14.30-16.15	Calculations Task 2	
16.15-16.30	Break	
16.30-17.00	Presentations by each team: results Task 2	
17.00-17.15	Break	
17.15-18.15	Gas Fermentation: a path to low carbon fuel and chemical production with impact Bjorn Heijstra	Chapter 16
18.15-18.25	Evaluations	

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Day 7 **Tuesday, 28 January**

Themes: *Regulation and control of metabolic fluxes, rapid sampling*

Coordinator: *Walter van Gulik*

09.00-10.00	Multi-scale modelling of process dynamics in large-scale bioreactors Matthias Reuss	Chapter 17
10.00-10.15	Break	
10.15-11.00	Multi-level regulation of metabolic fluxes, transcripts versus fluxes Pascale Daran-Lapujade	Chapter 18
11.00-12.15	Analysis of in vivo kinetics: rapid sampling and metabolite analysis Walter van Gulik	Chapter 19
12.15-13.15	Lunch	
13.15-15.00	Fed batch demo: Balance calculations on batch phase data Sef Heijnen / Dirk Geerts / Rob Kerste / Walter van Gulik	Fed Batch 5
15.00-15.15	Break	
15.15-16.00	Through Van Leeuwenhoek's eyes Lesley Robertson	Chapter 20
16.00-17.30	Van Leeuwenhoek and Delft: A microbiological pilgrimage (social / cultural event) Guide: Lesley Robertson	
18.00-20.30	Drinks + Small dinner @De Gist	

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Day 8 **Wednesday, 29 January**
Theme: *Metabolic and community engineering*
Coordinator: *Han de Winde*

09.00-10.15	Metabolic engineering strategies for reducing costs Sef Heijnen	Chapter 21
10.15-10.30	Break	
10.30-12.30	Exercises on metabolic engineering strategies for reducing costs Sef Heijnen	Exercise Ch21
12.30-13.30	Lunch @Bar 't Lab (TNW-Zuid)	
12.55-13.25	(optional) Visit fermentation lab (max. 10 persons) Dirk Geerts / Rob Kerste	
13.30-14.30	From System Biology to Metabolic Engineering and Industrial Process Development using <i>Clostridium acetobutylicum</i> as a Platform Strain Philippe Soucaille	Chapter 22
14.30-15.30	<i>Monascus ruber</i> as cell factory for lactic acid production at low pH Ruud Weusthuis	Chapter 23
15.30-15.45	Break	
15.45-16.45	Zero growth physiology – from biotechnology to brains Mark Bisschops	Chapter 24
16.45-17.00	Break	
17.00-18.00	Microbial community engineering for production of chemicals and bioenergy Robbert Kleerebezem	Chapter 25
18.00-18.10	Evaluations	

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Day 9 **Thursday, 30 January**
Theme: *Heterogeneity of microbial populations*
Coordinator: *Han de Winde*

09.00-10.00	Single cell studies of micro-organisms / Microfluidics Sander Tans	Chapter 26
10.00-10.15	Break	
10.15-11.15	Spatio-temporal single-cell analysis in picoliter reactors Dietrich Kohlheyer	Chapter 27
11.15-11.30	Break	
11.30-12.30	The limits to growth: the challenge to dissipate energy Matthias Heinemann	Chapter 28
12.30-13.30	Lunch @Bar 't Lab (TNW-Zuid)	
13.30-14.30	Transcription factor-based biosensors for strain development Jan Marienhagen	Chapter 29
14.30-15.30	Fed batch demo: Balance calculations on the fed phase data and evaluation Sef Heijnen / Dirk Geerts / Rob Kerste / Walter van Gulik	Fed Batch 6
15.30-15.45	Break	
15.45-17.00	Continuation and conclusion of fed batch demo	
17.00-18.00	Optional: Practical labtour regarding Chemostat Rob Kerste / Dirk Geerts	
18.00-18.10	Evaluations	
19.00-22.30	Course diner – Restaurant van der Dussen (Bagijnhof 118, Delft)	

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Day 10 **Friday, 31 January**

Theme: *Capita Selecta*

Coordinator: *Sef Heijnen*

09.30-10.30	Microbial protein production in an industrial context Cees Sagt	Chapter 30
10.30-10.45	Break	
10.45-11.45	High-throughput strain construction and phenotype testing Stefan de Kok	Chapter 31
11.45-13.15	Lunch @Sport&Cultuur (Mekelweg 8-10, Delft)	
13.15-14.15	Latest advancements in high-resolution microbial mass spectrometry Martin Pabst	Chapter 32
14.15-15.00	The Origin of Life and Metabolism John Sutherland	Chapter 33
15.00-15.25	Evaluation and certification Sef Heijnen	
15.25-16.25	Optional: Practical labtour regarding Chemostat Rob Kerste / Dirk Geerts	
15.25-18.00	Farewell drink @Bar 't Lab (TNW-Zuid)	