

Module Manual

Degree Programme Schedule

Modules:

Advanced Theory of Cell Biology and Cell Culture Technology	3
Advanced Instrumental Analysis	4
Advanced Theory of Process Engineering	5
Protein Factory – Theory	6
Chemical Process Engineering – Theory	7
Green Engineering – Theory	9
Advanced Separation Technology – Theory	11
Protein Factory – Team Project.....	13
Chemical Process Engineering – Team Project.....	14
Green Engineering – Team Project.....	16
Advanced Separation Technology – Team Project.....	18
Bioinformatics.....	20
Design, Economy and Sustainability in Chemical Engineering.....	21
Disintegration of Particles and Cells.....	22
Particles and Cells Measuring Techniques	23
Quality Management Systems in Biotechnology	24

(Module description arranged in the order of appearance in programme schedule)

Degree Programme Schedule

Consecutive Degree Programme
Master of Science *Biotechnology and Process Engineering*
Flensburg University of Applied Sciences

Term Hours	Semester 1 Summer	Semester 2 Winter	Semester 3 Summer
1	Advanced Theory of Cell Biology and Cell Culture Technology	Project ²⁾ Theory	Master- Thesis
4 5			
8 9	Advanced Theory of Process Engineering	Team Project ²⁾ Practical Experience	
12 13	Elective Courses ¹⁾		
16 17	Non-technical Elective Courses	Elective Courses ¹⁾	
20			

¹⁾ Elective Courses (Examples)	Bioinformatics Design, Economy and Sustainability in Chemical Engineering Disintegration of Particles and Cells Particles and Cells Measuring Techniques Quality Management Systems in Biotechnology
---	---

²⁾ Projects	Protein Factory Chemical Process Engineering / Green Engineering Advanced Separation Technology
------------------------	--

M.Sc. Biotechnology and Process Engineering

Degree Programme:	M.Sc. Biotechnology and Process Engineering
Title of Module:	Advanced Theory of Cell Biology and Cell Culture Technology
Abbreviation:	ATCB
Subtitle:	---
Title of Class:	Cell Biology Cell Culture Technology
Semester:	Semester 2
Responsible for Module:	Prof. Dr. Hans-Udo Peters
Lecturer:	Prof. Dr. Helmut Erdmann Prof. Dr. Hans-Udo Peters
Language:	English
Assignment to Programme:	M.Sc. Biotechnology and Process Engineering Compulsory Class, Semester 2
Class Type / Hours:	Lecture / 4 h/week
Workload:	Study time in class: 60 h Study time at home: 120 h
Credits:	6
Requirements:	---
Study Goals / Skills:	Students familiarize themselves with principles of cell biology and cell culture technology of eukaryotic cells.
Content:	<ol style="list-style-type: none"> 1. Introduction to cell biology of eukaryotic systems 2. Introduction to molecular biology of eukaryotic systems 3. Principles of cell culture technology 4. Quality management systems in cell culture technology
Assessment:	Formal Examination: written exam (120 min.)
Media:	Lecture Notes, Slides, Board, Elearning
Literature:	<ul style="list-style-type: none"> ➤ B. Alberts et al.: Molecular Biology of the Cell GARLAND SCIENCE ➤ B. Alberts et al.: Essential Cell Biology GARLAND PUBLISHING ➤ M. Butler et al.: Animal Cell Culture and Technology BIOS SCIENTIFIC PUBLISHERS

Degree Programme:	M.Sc. Biotechnology and Process Engineering
Title of Module:	Advanced Instrumental Analysis
Abbreviation:	AIAL
Subtitle:	---
Title of Class:	Advanced Instrumental Analysis
Semester:	Semester 1
Responsible for Module:	Prof. Dr. Werner Baumeister
Lecturer:	Prof. Dr. Werner Baumeister
Language:	English
Assignment to Programme:	M.Sc. Biotechnology and Process Engineering Compulsory Class, Semester 1
Class Type / Hours:	Lecture / 4 h/week
Workload:	Study time in class: 60 h Study time at home: 120 h
Credits:	6
Requirements:	---
Study Goals / Skills:	<p>The goal of these lectures is to provide a thorough treatment of the fundamental principles, terminology, methodology, instrumentation, implementation and characteristics of the most widely applied spectroscopic measurement and chromatographic separation methods and to indicate their application to the determination of physical and chemical data commonly employed in biotechnology and process engineering.</p> <p>Students should be enabled to select and supervise analytical procedures and to analyse and evaluate analytical chemical data for process analysis and design.</p>
Content:	<ol style="list-style-type: none"> 1. Spectrochemical Measurement Methods <ul style="list-style-type: none"> Ultraviolet and Visible Absorption Spectrometry Infrared Spectrometry Luminescence Spectrometry Infrared Spectrometry Light Scattering 2. Chromatographic Separation Methods <ul style="list-style-type: none"> Mechanism of Retention Mechanism of Dispersion Chromatography Column Design Optimization of Separation 3. Applications of Analytical Measurements in Biotechnology and Process Engineering <ul style="list-style-type: none"> Determination of Phase Equilibrium Parameters Determination of Binding Constants Determination of Chemical and Physical Rate Constants Physicochemical Measurements by Chromatography
Assessment:	Formal Examination: Written exam (120 min)
Media:	Blackboard, overhead, beamer
Literature:	<ul style="list-style-type: none"> ➤ D. A. Skoog, J. J. Leary: Principles of Instrumental Analysis, 6th ed., SAUNDERS COLLEGE PUBLISHING, Fort Worth ➤ Reading List (to be distributed during lectures)

M.Sc. Biotechnology and Process Engineering

Degree Programme:	M.Sc. Biotechnology and Process Engineering
Title of Module:	Advanced Theory of Process Engineering
Abbreviation:	ATPE
Subtitle:	---
Title of Class:	Advanced Theory of Process Engineering
Semester:	Semester 1
Responsible for Module:	Prof. Dr.-Ing. Jürgen Teifke
Lecturer:	Prof. Dr.-Ing. Jürgen Teifke Prof. Dr.-Ing. Claus Werninger
Language:	English
Assignment to Programme:	M.Sc. Biotechnology and Process Engineering Compulsory Class, Semester 1
Class Type / Hours:	Lecture / 4 h/week
Workload:	Study time in class: 60 h Study time at home: 120 h
Credits:	6
Requirements:	---
Study Goals / Skills:	<p>Students familiarize themselves with appropriate use of standard methods employed in state-of-the-art CPE software to predict thermodynamic equilibrium behaviour of mixtures.</p> <p>Students are rendered capable to set up physical models for heat and mass transfer for CPE operations such as thermal separation or chemical reaction.</p> <p>Students obtain knowledge of how to solve a physical model (with its simplifications) by analytical or numerical methods.</p>
Content:	<ol style="list-style-type: none"> 1. Thermodynamic Equilibrium <ul style="list-style-type: none"> - of pure components - of mixtures (VLE, VLLE) - of chemical reaction 2. Computational methods to predict thermodynamic equilibrium 3. Mass Transfer <ul style="list-style-type: none"> - diffusion, diffusion coefficients - mass transfer models - mass transfer coefficients - integral mass balances 4. Coupled heat and mass transfer
Assessment:	Formal Examination: Written Exam (120 min.)
Media:	Lecture Notes, Slides, Board, Elearning
Literature:	<ul style="list-style-type: none"> ➤ Sandler: Chemical and Engineering Thermodynamics JOHN WILEY & SONS ➤ Bird, Stewart, Lightfoot: Transport Phenomena JOHN WILEY & SONS ➤ Treybal: Mass-Transfer Operations McGRAW-HILL ➤ Baehr, Stephan: Heat and Mass Transfer SPRINGER

Degree Programme:	M.Sc. Biotechnology and Process Engineering
Title of Module:	Protein Factory – Project Theory
Abbreviation:	PF-PT
Subtitle:	---
Title of Class:	Protein Factory – Project Theory
Semester:	Semester 2
Responsible for Module:	Prof. Dr. Helmut Erdmann
Lecturer:	Prof. Dr. Helmut Erdmann Prof. Dr. Hans-Udo Peters
Language:	English
Assignment to Programme:	M.Sc. Biotechnology and Process Engineering Optional Compulsory Class, Semester 2
Class Type / Hours:	Lecture and Workshop / 8 h/week
Workload:	Study time in class: 120 h Study time at home: 240 h
Credits:	12
Requirements:	---
Study Goals / Skills:	Students learn state-of-the-art techniques in an interdisciplinary project of molecular biology, cell culture techniques, bioinformatics, process engineering, quality and safety management as well as business calculations. Students are rendered capable to design and carry out protein production on the basis of eukaryotic cultivation techniques. Students obtain knowledge of how to apply different methods for applications concerning protein production from eukaryotic cell cultures.
Content:	<ol style="list-style-type: none"> 1. Molecular biology of eukaryotic cells 2. Bioinformatics 3. Culture techniques of eukaryotes 4. Bio separations 5. Quality and safety management (gmp/glp) 6. Business calculations
Assessment:	Formal Examination: written exam (120 min.), oral presentation, home work
Media:	Lecture Notes, Slides, Board, Elearning
Literature:	Recent publications from scientific journals

Degree Programme:	M. Sc. Biotechnology and Process Engineering
Title of Module:	Chemical Process Engineering / Green Engineering – Project Theory
Abbreviation:	CPET
Subtitle:	
Title of Class:	Chemical Process Engineering Theory
Semester:	Semester 2
Responsible for Module:	Prof. Dr.-Ing. Claus Werninger
Lecturer:	Prof. Dr.-Ing. Claus Werninger
Language:	English
Assignment to Programme:	M. Sc. Biotechnology and Process Engineering Optional Compulsory Class, Semester 2
Class Type / Hours:	Lecture and Computer Laboratory / 2 & 2 h/week
Workload:	Study time in class: 60 h Study time at home: 120 h
Credits:	6
Requirements:	Participation in Lecture Advanced Theory of Process Engineering
Study Goals / Skills:	Students learn to set up a basic design of a chemical process plant for various problems of process technology by use of heuristic and rigorous solving methods (synthesis). Consecutive to the design step is the process evaluation (analysis). State-of-the-art chemical process engineering software is the appropriate tool to analyse the design. Students will be introduced to CPE software and apply it in computer lab. Methods of effective use of energy and material will be presented.
Content:	<ul style="list-style-type: none"> ➤ Problem solving methods: heuristic and rigorous approach, process synthesis ➤ Introduction to stationary process simulation: conservative variables, thermodynamics, unit operation equipment ➤ Numerics of process simulation ➤ Design strategy for effective and optimized use of energy and material ➤ Process analysis by means of process simulation
Assessment:	Formal Examination: written Exam (120 min.)
Media:	Lecture Notes, Slides, Board, Elearning, CPE software
Literature:	<ul style="list-style-type: none"> ➤ Seider, Seader, Lewin: Process Design Principles JOHN WILEY & SONS ➤ Turton, Baille, Whiting, Shaelwitz: Analysis, Synthesis, and Design of Chemical Processes PRENTICE HALL ➤ Biegler, Grossmann, Westerberg: Systematic Methods of Chemical Process Design PRENTICE HALL ➤ Douglas: Conceptual Design of Chemical Processes McGRAW-HILL ➤ Schuler:

M.Sc. Biotechnology and Process Engineering

	<p>Prozesssimulation WILEY – VCH</p> <ul style="list-style-type: none">➤ Smith: Chemical Process Design and Integration JOHN WILEY & SONS➤ Blass: Entwicklung verfahrenstechnischer Prozesse SPRINGER
--	--

Degree Programme:	M.Sc. Biotechnology and Process Engineering
Title of Module:	Chemical Process Engineering / Green Engineering – Project Theory
Abbreviation:	GET
Subtitle:	---
Title of Class:	Green Engineering Theory
Semester:	Semester 2
Responsible for Module:	Prof. Dr. rer. nat. Jens Born
Lecturer:	Prof. Dr. rer. nat. Jens Born
Language:	English
Assignment to Programme:	M. Sc. Biotechnology and Process Engineering Optional Compulsory Class, Semester 2
Class Type / Hours:	Lecture / 4 h/week
Workload:	Study time in class: 60 h Study time at home: 120 h
Credits:	6
Requirements:	Participation in Lecture Advanced Theory of Process Engineering
Study Goals / Skills:	<ul style="list-style-type: none"> ➤ Knowledge of approaches and methodologies for evaluating and improving the environmental performance of chemical processes and products ➤ Design a process path with (almost) optimal parameters of energy and material consumption ➤ Evaluate design alternatives under the constraint of sustainability ➤ Apply renewable resources
Content:	<ul style="list-style-type: none"> ➤ Introduction to environmental issues and risk concepts ➤ Evaluation and improvement of environmental performance of chemical processes (Evaluating fates, exposures, and performance during process synthesis, green chemistry methods,) ➤ Unit operations and pollution prevention ➤ Process integration and environmental performance of a flow sheet based on life cycle concepts ➤ Renewable resources – sustainable handling and processing strategies
Assessment:	Formal Examination: oral presentation and written report
Media:	Blackboard, Overhead, presentation
Literature:	<ul style="list-style-type: none"> ➤ Allen, Shonnard: Green Engineering PRENTICE HALL ➤ Seider, Seader, Lewin: Process Design Principles JOHN WILEY & SONS ➤ Turton, Baille, Whiting, Shaelwitz: Analysis, Synthesis, and Design of Chemical Processes PRENTICE HALL ➤ Biegler, Grossmann, Westerberg: Systematic Methods of Chemical Process Design PRENTICE HALL ➤ Douglas:

M.Sc. Biotechnology and Process Engineering

	<p>Conceptual Design of Chemical Processes McGRAW-HILL</p> <ul style="list-style-type: none"> ➤ Schuler: Prozesssimulation WILEY – VCH ➤ Smith: Chemical Process Design and Integration JOHN WILEY & SONS ➤ Blass: Entwicklung verfahrenstechnischer Prozesse SPRINGER
--	---

Degree Programme:	M.Sc. Biotechnology and Process Engineering
Title of Module:	Advanced Separation Technology – Project Theory
Abbreviation:	AST-PT
Subtitle:	---
Title of Class:	Filtration / Disintegration, Preparative Chromatographic Separations
Semester:	Semester 2
Responsible for Module:	Prof. Dr.-Ing. Wolfgang F. Hess
Lecturer:	Prof. Dr.-Ing. Wolfgang F. Hess Prof. Dr. Werner Baumeister
Language:	English
Assignment to Programme:	M.Sc. Biotechnology and Process Engineering Optional Compulsory Class, Semester 2
Class Type / Hours:	Lecture, Laboratory and Exercise / 4, 2 & 2 h/week
Workload:	Study time in class: 120 h Study time at home: 240 h
Credits:	12
Requirements:	Knowledge of fundamental aspects of Particle Technology or Down Stream Processing
Study Goals / Skills:	Within Advanced Separation Technology (Project Theory) the students will obtain knowledge of the theoretical basics of filtration / disintegration and practise methods to solve technical tasks together with computer aided modelling. The goal of the chromatographic separations lectures is to provide a thorough treatment of the fundamental principles and techniques of preparative chromatographic separations. Students should be enabled to analyse, design, scale-up, and operate chromatographic separation processes.
Content:	<ol style="list-style-type: none"> 1. Separation techniques for biological dispersions, filtration by differential pressure, filtration resistances, incompressible/compressible cakes 2. Disintegration of cells: <ul style="list-style-type: none"> - chemical, biological, mechanical methods, - energetic comparison of different methods 3. Physicochemical Basics of Chromatography and Mathematical Description of Chromatography: <ul style="list-style-type: none"> - Single/Multi Component, - Linear/Nonlinear, - Ideal/Non ideal, - Reaction Chromatography 4. Numerical Methods for Chromatographic Simulations 5. Optimization of Chromatographic Processes
Assessment:	Formal Examination: written exam (120 min)
Media:	Blackboard, computer, overhead projector, beamer
Literature:	<ul style="list-style-type: none"> ➤ Rushton et al.: Solid-Liquid Filtration and Separation Technology WILEY-VCH ➤ A.T. Jackson: Process Engineering in Biotechnology OPEN UNIVERSITY PRESS ➤ G. Subramanian (ed.):

	<p>Process Scale Liquid Chromatography VCH</p> <p>➤ T. Gu: Mathematical Modelling and Scale-up of Liquid Chromatography, SPRINGER</p>
--	---

Degree Programme:	M.Sc. Biotechnology and Process Engineering
Title of Module:	Protein Factory – Team Project Practical Experience
Abbreviation:	PF – TP
Subtitle:	---
Title of Class:	Protein Factory – Team Project
Semester:	Semester 2
Responsible for Module:	Prof. Dr. Helmut Erdmann
Lecturer:	Prof. Dr. Helmut Erdmann Prof. Dr. Hans-Udo Peters
Language:	English
Assignment to Programme:	M.Sc. Biotechnology and Process Engineering Optional Compulsory Class, Semester 2
Class Type / Hours:	Project: Laboratory / 8 h/week
Workload:	Study time in class: 120 h Study time at home: 240 h
Credits:	12
Requirements:	---
Study Goals / Skills:	Students apply state-of-the-art techniques in an interdisciplinary project of molecular biology, cell culture techniques, bioinformatics, process engineering, quality and safety management as well as business calculations. Students are rendered capable to design and carry out protein production on the basis of eukaryotic cultivation techniques. Students obtain knowledge of how to apply different methods for applications concerning protein production from eukaryotic cell cultures.
Content:	Application in practical projects of the module “Theory Protein Factory” with the aim to combine interdisciplinary methods of molecular biology of eukaryotic cells, bioinformatics, culture techniques of eukaryotes, bio separations, quality and safety management (gmp/glp) and business calculations
Assessment:	Formal Examination: laboratory certificate, oral presentation and home work
Media:	Lecture Notes, Slides, Board, Elearning
Literature:	Recent publications from scientific journals

Degree Programme:	M. Sc. Biotechnology and Process Engineering
Title of Module:	Chemical Process Engineering / Green Engineering – Team Project Practical Experience
Abbreviation:	CPETP
Subtitle:	
Title of Class:	Chemical Process Engineering Team Project
Semester:	Semester 2
Responsible for Module:	Prof. Dr.-Ing. Claus Werninger
Lecturer:	Prof. Dr.-Ing. Claus Werninger
Language:	English
Assignment to Programme:	M. Sc. Biotechnology and Process Engineering Optional Compulsory Class, Semester 2
Class Type / Hours:	Project / 4 h/week (maximum class size: 2 groups with 4 students)
Workload:	Study time in class: 60 h Study time at home: 120 h
Credits:	6
Requirements:	Participation in Lecture Advanced Theory of Process Engineering and Chemical Process Engineering Theory
Study Goals / Skills:	Students apply scientific methods of process engineering to solve a design problem, preferably by use of process simulation. The solving process with respect to content and methods is carried out independently and is only supervised by the professor. Students obtain design knowledge to go from first ideas to basic engineering. In order to optimize their work team members will exercise project management and team work principles.
Content:	A group of 3 – 4 students will work out a process design of a new process or an alternative to an existing process comprising basic layout of equipment and simulation of the process. An important aspect of the project work is the research on material properties Costs of process erection and operation are to be estimated by simple means. Appropriate hours in class will be spent to discuss problems in team with or without the professor. Results are to be presented orally by contributions from each team member and as a written report of the team.
Assessment:	Formal Examination: oral presentation and written report
Media:	Blackboard, Overhead, presentation, CPE software, Elearning
Literature:	<ul style="list-style-type: none"> ➤ Seider, Seader, Lewin: Process Design Principles JOHN WILEY & SONS ➤ Turton, Baille, Whiting, Shaelwitz: Analysis, Synthesis, and Design of Chemical Processes PRENTICE HALL ➤ Biegler, Grossmann, Westerberg: Systematic Methods of Chemical Process Design PRENTICE HALL ➤ Douglas:

M.Sc. Biotechnology and Process Engineering

	<p>Conceptual Design of Chemical Processes McGRAW-HILL</p> <ul style="list-style-type: none"> ➤ Schuler: Prozesssimulation WILEY – VCH ➤ Smith: Chemical Process Design and Integration JOHN WILEY & SONS ➤ Blass: Entwicklung verfahrenstechnischer Prozesse SPRINGER
--	---

Degree Programme:	M. Sc. Biotechnology and Process Engineering
Title of Module:	Chemical Process Engineering / Green Engineering – Team Project Practical Experience
Abbreviation:	GETP
Subtitle:	---
Title of Class:	Green Engineering Team Project
Semester:	Semester 2
Responsible for Module:	Prof. Dr. rer. nat. Jens Born
Lecturer:	Prof. Dr. rer. nat. Jens Born
Language:	English
Assignment to Programme:	M. Sc. Biotechnology and Process Engineering Optional Compulsory Class, Semester 2
Class Type / Hours:	Project / 4 h/week (maximum class size: 2 groups with 4 students)
Workload:	Study time in class: 60 h Study time at home: 120 h
Credits:	6
Requirements:	Participation in Lecture Advanced Theory of Process Engineering and Green Engineering Theory
Study Goals / Skills:	Students apply scientific methods of green engineering to solve a design problem, preferably by use of process simulation. The solving process with respect to content and methods is carried out independently and is only supervised by the professor. Students obtain design knowledge to go from first ideas to basic engineering based on sustainability issues. In order to optimize their work team members will exercise project management and team work principles.
Content:	A group of 3 – 4 students will work out a process design of a new process or an alternative to an existing process comprising basic layout of equipment and simulation of the process. An important aspect of the project work is the research on material properties. Costs of process erection and operation are to be estimated by simple means. Appropriate hours in class will be spent to discuss problems in team with or without the professor. Results are to be presented orally by contributions from each team member and as a written report of the team.
Assessment:	Formal Examination: oral presentation and written report
Media:	Blackboard, overhead, presentation, CPE Software
Literature:	<ul style="list-style-type: none"> ➤ Allen, Shonnard: Green Engineering PRENTICE HALL ➤ Seider, Seader, Lewin: Process Design Principles JOHN WILEY & SONS ➤ Turton, Baille, Whiting, Shaelwitz: Analysis, Synthesis, and Design of Chemical Processes PRENTICE HALL ➤ Biegler, Grossmann, Westerberg:

M.Sc. Biotechnology and Process Engineering

	<p>Systematic Methods of Chemical Process Design PRENTICE HALL</p> <ul style="list-style-type: none"> ➤ Douglas: Conceptual Design of Chemical Processes McGRAW-HILL ➤ Schuler: Prozesssimulation WILEY – VCH ➤ Smith: Chemical Process Design and Integration JOHN WILEY & SONS ➤ Blass: Entwicklung verfahrenstechnischer Prozesse SPRINGER
--	---

Degree Programme:	M.Sc. Biotechnology and Process Engineering
Title of Module:	Advanced Separation Technology – Team Project Practical Experience
Abbreviation:	AST-TP
Subtitle:	---
Title of Class:	Filtration, Disintegration Preparative Chromatographic Separations
Semester:	Semester 2
Responsible for Module:	Prof. Dr.-Ing. Wolfgang F. Hess
Lecturer:	Prof. Dr.-Ing. Wolfgang F. Hess Prof. Dr. Werner Baumeister
Language:	English
Assignment to Programme:	M.Sc. Biotechnology and Process Engineering Optional Compulsory Class, Semester 2
Class Type / Hours:	Project: Laboratory, Exercise / 4 & 4 h/week (maximum class size: 2 groups with 8 students)
Workload:	Study time in class: 120 h Study time at home: 240 h
Credits:	12
Requirements:	Knowledge of fundamental aspects of Particle Technology or Down Stream Processing
Study Goals / Skills:	Participating in the Team Project “ <i>Advanced Separation Technology</i> ” the students will get practical experience in filtration and disintegration processes and in solving technical tasks. They will be able to determine relevant data by experiment using these data for process design. The goal of this project is to gain experience in computational simulation, optimization, scale-up, and parameter estimation of preparative chromatographic separations. Students should be enabled to master these tasks with the help of present day scientific computing and visualization tools.
Content:	<ol style="list-style-type: none"> 1. Filtration of biological dispersions by differential pressure experimental evaluation of filtration resistances 2. Disintegration of cells by mechanical methods, experimental comparison of different methods 3. Simulation of Single and Multi Component Chromatography Models 4. Optimization, Parameter Estimation, and Scale-up of Simulated Chromatographic Separation Processes
Assessment:	Formal Examination: oral presentation and written report
Media:	Blackboard, overhead projector, beamer, software: MATLAB and mathematical toolboxes
Literature:	<ul style="list-style-type: none"> ➤ Rushton et al.: Solid-Liquid Filtration and Separation Technology WILEY-VCH ➤ A.T. Jackson: Process Engineering in Biotechnology OPEN UNIVERSITY PRESS ➤ G. Subramanian (ed.): Process Scale Liquid Chromatography VCH ➤ T. Gu:

M.Sc. Biotechnology and Process Engineering

	<p>Mathematical Modelling and Scale-up of Liquid Chromatography, SPRINGER</p> <p>➤ C.B. Moler: Numerical Computing with MATLAB, Society for Industrial and Applied Mathematics</p>
--	---

M.Sc. Biotechnology and Process Engineering

Degree Programme:	M.Sc. Biotechnology and Process Engineering
Title of Module:	Elective Course Bioinformatics
Abbreviation:	EC-BI
Subtitle:	---
Title of Class:	Bioinformatics
Semester:	Semester 1 or 2
Responsible for Module:	Prof. Dr. Helmut Erdmann
Lecturer:	Prof. Dr. Helmut Erdmann
Language:	English
Assignment to Programme:	M.Sc. Biotechnology and Process Engineering Elective Class, Semester 1 or 2
Class Type / Hours:	Lecture / 4 h/week
Workload:	Study time in class: 60 h Study time at home: 120 h
Credits:	6
Requirements:	---
Study Goals / Skills:	Students learn how to apply state-of-the-art software in the field of bioinformatics. Students are rendered capable to use external data sources and sequence information for the application in sequence alignment, structure function relations, biochemical networking, e.g. Students obtain knowledge of how to apply bioinformatics for different applications in the field of molecular biology.
Content:	<ol style="list-style-type: none"> 1. Introduction to bioinformatics 2. Sequence analysis of DNA, RNA, proteins, 3D-structure 3. Selection and design of data banks 4. Biological and biochemical cellular networking 5. Use of external data sources 6. Sequence alignment 7. Structure function relationship 8. Functional genomics
Assessment:	Class Certificate: written exam (60 min.), oral presentation and home work
Media:	Lecture Notes, Slides, Board, Elearning
Literature:	<ul style="list-style-type: none"> ➤ T. K. Attwood et al: Introduction to Bioinformatics PRENTICE-HALL ➤ O'Reilly: Bioinformatics, Computer Skills ➤ D. W. Mount: Bioinformatics COLD SPRING HARBOR LABORATORY PRESS ➤ A. D. Baxevanis et al: Bioinformatics JOHN WILEY & SONS

M.Sc. Biotechnology and Process Engineering

Degree Programme:	M.Sc. Biotechnology and Process Engineering
Title of Module:	Elective Courses
Abbreviation:	DES
Subtitle:	---
Title of Class:	Design, Economy and Sustainability in Chemical Engineering
Semester:	Semester 2
Responsible for Module:	Prof. Dr. rer. nat. Jens Born
Lecturer:	Prof. Dr. rer. nat. Jens Born
Language:	English
Assignment to Programme:	M.Sc. Biotechnology and Process Engineering Elective Class, Semester 2
Class Type / Hours:	Workshop / 4 h/week
Workload:	Study time in class: 60 h Study time at home: 120 h
Credits:	6
Requirements:	---
Study Goals / Skills:	Basic knowledge and skills to design chemical processes with a holistic view under economic and ecologic constraints
Content:	<ol style="list-style-type: none"> 1. Design concepts, principles and constraints 2. Product design - needs, ideas, selection methods, skills and tools 3. Plant design <ul style="list-style-type: none"> - Process and flow sheet development - Cost estimation and profitability - Basic principles of green chemistry and green engineering - Optimum design and design strategies - Software instruments
Assessment:	Class Certificate: written report
Media:	Board, Powerpoint Presentation, CPE software
Literature:	<ul style="list-style-type: none"> ➤ M. Peters, K. Timmerhaus: Plant Design and Economics for Chemical Engineers McGRAW-HILL ➤ E. L. Cussler, G. D. Moggridge: Chemical Product Design CAMBRIDGE UNIVERSITY PRESS

Degree Programme:	M.Sc. Biotechnology and Process Engineering
Title of Module:	Elective Courses
Abbreviation:	EC-DisInt
Subtitle:	Using Stirred Media Mills in Down Stream Processing
Title of Class:	Disintegration of Particles and Cells
Semester:	Semester 1
Responsible for Module:	Prof. Dr.-Ing. Wolfgang F. Hess
Lecturer:	Prof. Dr.-Ing. Wolfgang F. Hess
Language:	English
Assignment to Programme:	M.Sc. Biotechnology and Process Engineering Elective Class, Semester 1
Class Type / Hours:	Lecture, Workshop and Laboratory / 4 h/week (maximum class size: 15)
Workload:	Study time in class: 60 h Study time at home: 120 h
Credits:	6
Requirements:	Knowledge of fundamental aspects of Particle technology and Down Stream Processing
Study Goals / Skills:	On the basis of the latest scientific literature the students will get knowledge of the measuring techniques within the field of Particle Technology. Theory will be accomplished by practical experience in the lab. Students will be able to evaluate the results according to their real sense and practical use.
Content:	<ol style="list-style-type: none"> 1. Basics of the physics of disintegration of particles and cells down to nano scale 2. Definition and measuring techniques for evaluation of the destruction effect 3. Scale up of comminution processes in ball mills 4. Incremental and cumulative processes 5. Practising laboratory experiments and evaluation of the processes
Assessment:	Class Certificate: written report and oral presentation
Media:	Scientific papers, computer, overhead projector, beamer
Literature:	<ul style="list-style-type: none"> ➤ A.T. Jackson: Process Engineering in Biotechnology OPEN UNIVERSITY PRESS ➤ Current scientific papers

Degree Programme:	M.Sc. Biotechnology and Process Engineering
Title of Module:	Elective Courses
Abbreviation:	EC-PartM
Subtitle:	Measuring Particle Size Distributions and Evaluation
Title of Class:	Particles and Cells Measuring Techniques
Semester:	Semester 1
Responsible for Module:	Prof. Dr.-Ing. Wolfgang F. Hess
Lecturer:	Prof. Dr.-Ing. Wolfgang F. Hess
Language:	English
Assignment to Programme:	M.Sc. Biotechnology and Process Engineering Elective Class, Semester 1
Class Type / Hours:	Lecture, Workshop and Laboratory / 4 h/week (maximum class size: 15 students)
Workload:	Study time in class: 60 h Study time at home: 120 h
Credits:	6
Requirements:	Knowledge of fundamental aspects of Particle Technology and Down Stream Processing
Study Goals / Skills:	On the basis of the latest scientific literature the students will get knowledge of the measuring techniques within the field of Particle Technology. Theory will be accomplished by practical experience in the lab. Students will be able to evaluate the results according to their real sense and practical use.
Content:	<ol style="list-style-type: none"> 1. Basics of the representation and evaluation of particle size distributions. 2. Basics of the physical measuring techniques measuring particles and cells in dispersions down to nano scale 3. Separation techniques in biotechnology and process engineering 4. Incremental and cumulative processes 5. Modern optical working analyser techniques: Dispersion of laser light, dynamical dispersion 6. Comparability and reliability of the results to be used to control processes and in quality assurance
Assessment:	Class Certificate: written report and oral presentation
Media:	Scientific papers, computer, overhead projector, beamer
Literature:	<ul style="list-style-type: none"> ➤ A. Zhong, Lin Wang: Characterization of Nanophase Materials WILEY-VCH ➤ Brian H. Kaye: Characterization of Powders and Aerosols WILEY-VCH ➤ Webb, Orr: Analytical Methods in Fine Particle Technology MICORMERICS ➤ R. H. Müller: Teilchengrößenmessung in der Laborpraxis apv Vol. 38

M.Sc. Biotechnology and Process Engineering

Degree Programme:	M.Sc. Biotechnology and Process Engineering
Title of Module:	Quality Management Systems in Biotechnology
Abbreviation:	EC-QM
Subtitle:	---
Title of Class:	Quality Management Systems in Biotechnology
Semester:	Semester 2
Responsible for Module:	Prof. Dr. Hans-Udo Peters
Lecturer:	Prof. Dr. Hans-Udo Peters
Language:	English
Assignment to Programme:	M.Sc. Biotechnology and Process Engineering Elective Class, Semester 2
Class Type / Hours:	Lecture / 4 h/week
Workload:	Study time in class: 60 h Study time at home: 120 h
Credits:	6
Requirements:	---
Study Goals / Skills:	Students acquire fundamental knowledge of quality management systems with relevance in biotechnology.
Content:	<ol style="list-style-type: none"> 1. Principles of quality management systems 2. Legal basis 3. Documentation 4. Qualification and validation 5. Phases of qualification 6. Cleaning and process validation
Assessment:	Class Certificate: written exam (60 min.), oral presentation
Media:	Lecture Notes, Slides, Board, Elearning
Literature:	➤ Oliver Schmidt (Ed.): Pharmaceutical Quality Systems CRC PRESS