Konsekutiver Masterstudiengang

Biotechnology and Process Engineering

an der

Fachhochschule Flensburg

Flensburg, im Oktober 2013

Dieses Dokument enthält:

1.1 Ziele des Studiengangs Master Biotechnology and Process Engineering

Dieser Masterstudiengang ist konsekutiv zum Bachelorstudiengang *Biotechnologie und Verfahrenstechnik* an der Fh Flensburg. Er ist damit in erster Linie ein Angebot an die Studierenden unserer Hochschule, sich an der Nahtstelle zwischen Naturwissenschaft und Technik weiter zu qualifizieren. Aufgrund der Durchführung des Studiengangs in englischer Sprache ist er aber auch explizit ein Angebot an ausländische Studierende aus fachverwandten Studiengängen.
Ziel des Masterstudiengangs ist es, diejenigen Kenntnisse und Kompetenzen zu vermitteln, die zu einem selbständigen Erkennen und Analysieren von Fragestellungen in der Biotechnologie und Verfahrenstechnik, zur Entwicklung eigenständiger technisch-wissenschaftlicher Lösungen für diese Fragestellungen und zu einer erfolgreichen Umsetzung der entwickelten Lösungen in marktfähige Produkte und Dienstleistungen erforderlich sind.
Dieses Ziel wird einerseits erreicht durch die Vermittlung vertiefter Kenntnisse in biotechnologischen und verfahrenstechnischen Spezialgebieten. Andererseits spricht das Curriculum im weiteren Verlauf die Anwendung dieser Kenntnisse auf wissenschaftliche Problemstellungen aus der Praxis an. Neben der fachlichen Kompetenz bilden sich dabei überfachliche Qualifikationen weiter aus. Das sind selbständiges Arbeiten beim Strukturieren der Problemstellung, Auswahl und Anwendung geeigneter Methoden sowie zielgerichtetes, kooperatives Arbeiten im Team, um nur ein paar Beispiele zu nennen.
Zum Abschluss des Studiums wird durch die wiederholte Arbeit an wissenschaftlichen Projekten – mit Unterstützung und Betreuung durch die Dozenten – die Fähigkeit ausgebaut, sich methodisch und systematisch in Neues und Unbekanntes einzuarbeiten.
Wie bisher durch die erste Akkreditierung ausgesprochen, soll eine Absolventin bzw. ein Absolvent des Masterstudiengangs *Biotechnology und Process Engineering* bei qualifiziertem Abschluss auch die Zulassung zum Höheren Dienst erwerben.

1.2 Lernergebnisse des Studiengangs

Die durch das Studium zu erwerbenden Qualifikationen als Lernergebnisse lassen sich grob in drei Bereiche einteilen:

- Fachliche Qualifikationen
- Persönliche Qualifikationen
- Übergeordnete Qualifikationen

Grundsätzlich sollen alle Studierenden mit einer ausgeprägten Fähigkeit zur Analyse und Lösung von Problemen im technisch-wissenschaftlichen Bereich der stoffwandelnden Industrie ausgestattet werden. Diese setzt neben einer soliden Wissensbasis und der Fähigkeit verschiedene Wissensbereiche zu verknüpfen, die Einübung zielgerichte-

ten Handelns und die Befähigung zur selbständigen Erarbeitung neuen Wissens im Sinne lebenslangen Lernens voraus.
Die Einsatzgebiete der Absolventinnen und Absolventen des stärker anwendungsorientierten Masterstudiengangs *Biotechnology and Process Engineering* sind einer VDI-GVC Empfehlung entsprechend hoch spezialisierte fachliche Arbeit oder Leitungs- und Führungsfunktionen bei der Entwicklung, Planung und Realisierung sowie bei der Überwachung und Betrieb von Verfahren und Anlagen oder einer Tätigkeit im Bereich des Höheren Dienstes.
Die folgende Liste der verschiedenen relevanten Qualifikationen und Kompetenzen, die erst in ihrer Kombination erfolgreiches Arbeiten im beruflichen Umfeld ermöglichen, erlaubt weiter unten eine Einordnung der verschiedenen Module und ihrer Lehrinhalte in den Kontext der zu erreichenden Qualifikationen.

- Fachliche Qualifikationen
  - Technische-naturwissenschaftliche Kompetenz
  - Methodische Kompetenz
  - Interkulturelle Kompetenz
- Persönliche Qualifikationen
  - Selbst- und Projektorganisation
  - Kommunikationsfähigkeit
  - Verantwortungsbewusstsein
  - Kritikfähigkeit
  - Sprachliche Kompetenz (Englisch)
- Übergeordnete Qualifikationen
  - Problemlösungskompetenz
  - Kompetenz zum selbständigen, lebenslangen Lernen
  - Erfolgreiches und zielgerichtetes Handeln
    (Die richtigen Dinge richtig machen!)

Die folgende tabellarische Übersicht zeigt die Zuordnung der einzelnen Qualifikationsmerkmale zu den verschiedenen Modulen des Studiengangs in Form eine Lernziel-Matrix.

	Module des Studiengangs													
Systematik der Lernziele und -ergebnisse im Masterstudiengang, 1. Semester	Advanced Theory of Cell Biology	Cell Culture Technology	Advanced Instrumental Analysis	Advanced Theory of Process Engineering	Bioanalysis	Design, Economy, and Sustainability …	Fluid Flow in Process Equipment	Quality Systems in Food Industry	Presentation Skills	Professional Leadership and Rhetoric	Identification and Evaluation of …	Particles and Cells Measuring Techniques	Disintegration of Particles and Cells	First-Time Manager
Fachliche Qualifikation														
technisch-naturwissenschaftlich	x	x	x	x	x		x					x	x	
methodisch	x	x	x	x	x	x	x	x	x	x	x	x	x	x
interkulturell	gegeben durch internationale Studierende													
Persönliche Qualifikation														
Selbst- und Projektorganisation					x						x			
Kommunikationsfähigkeit									x	x				x
Verantwortungsbewusstsein						x		x		x				x
Kritikfähigkeit									x	x				x
Sprachliche Kompetenz	aktiver und passiver Gebrauch des Englischen													
Übergeordnete Qualifikation														
Problemlösungskompetenz								x						x
Selbständiges, lebenslanges Lernen											x			
Erfolgreiches, zielgerichtetes Handeln											x			

Matrix Teil 1: Module des 1. Semesters und Electives

	Module des Studiengangs								
Systematik der Lernziele und -ergebnisse im Masterstudiengang, 2. u. 3. Semester	Protein Factory - Theory	Protein Factory - Team Project	Chem. and Green Eng. - Theory	Chem. and Green Eng. - Team Project	Separation Techn. - Theory	Separation Techn. - Team Project	Food Biotechn. and Processing - Theory	Food Biotechn. and Processing - Team Project	Master-Thesis
Fachliche Qualifikation									
technisch-naturwissenschaftlich	x		x		x		x		
methodisch	x		x		x		x		x
interkulturell	gegeben durch internationale Studierende								
Persönliche Qualifikation									
Selbst- und Projektorganisation		x		x		x		x	x
Kommunikationsfähigkeit		x		x		x		x	x
Verantwortungsbewusstsein	x	x	x	x	x	x	x	x	x
Kritikfähigkeit		x		x		x		x	
Sprachliche Kompetenz	aktiver und passiver Gebrauch des Englischen								
Übergeordnete Qualifikation									
Problemlösungskompetenz		x		x		x		x	x
Selbständiges, lebenslanges Lernen		x		x		x		x	x
Erfolgreiches, zielgerichtetes Handeln		x		x		x		x	x

Matrix Teil 2: Module des 2. und 3. Semesters und Master-Thesis

1.3 Lernergebnisse der Module / Modulziele

Vgl. auch das Modulhandbuch im Anschluss an diesen Teil!
In den Modulbeschreibungen werden von jedem Modulverantwortlichen die Modulziele beschrieben. Neben dem Erwerb von Fachwissen werden weitere Aspekte des Kompetenzerwerbs angesprochen oder sie ergeben sich durch die Lehrform. Dies sind – ohne eine Zuordnung zu einzelnen Modulen vorzunehmen:

- Lösungskompetenz mit Hilfe moderner experimenteller oder numerischer Methoden
- Zusammenarbeit mit anderen zur Erreichung eines Ziels (Teamarbeit, Projektmanagement)
- Aufbereitung und Präsentation von Ergebnissen (schriftliche und mündliche Kommunikation)

Das Kapitel 1.2 ordnet die Ziele und Lernergebnisse der Module, wie sie im Modulhandbuch beschrieben sind, den Lernergebnissen des Studiengangs zu.

Modul Advanced Theory of Cell Biology and Cell Culture Technology:
Das Modul ist zweigeteilt und vermittelt den Studierenden den notwendigen Wissenshintergrund für das Arbeiten mit Zellkulturen. Im ersten Teil werden aktuelle Forschungsergebnisse der Molekularbiologie und aktuelle Methoden der Zellbiologie behandelt. Die Verfahren und Methoden werden rekapituliert, erweitert und auf die Erfordernisse der Zellkulturtechnik übertragen.
Im zweiten Teil werden vertiefte Kenntnisse der Bioprozesstechnik vermittelt, die für die Anwendung auf tierische Zellkulturen benötigt werden. Sie versetzen die Studierenden in die Lage, Fermentationen mit Zellkulturen zu entwerfen und zu bemessen. Die Studenten können Betriebs- und Ergebnisdaten aus Zellkulturprozessen analysieren, bewerten und kommunizieren.

Modul Advanced Instrumental Analysis:
Das Ziel dieses Moduls ist es, die Studierenden mit den grundlegenden Prinzipien, der Terminologie, der Methodik, der Instrumentierung, der Implementierung und den Charakteristiken der meist angewandten spektroskopischen Messtechniken und der chromatografischen Trennmethoden vertraut zu machen.
Die Studierenden erwerben die Fähigkeit, die Methoden sachgerecht zur Bestimmung von physikalischen und chemischen Daten anzuwenden, die in biotechnologischen und verfahrenstechnischen Prozessen zu Forschungs- oder Überwachungszwecken ermittelt werden müssen.
Abschließend haben die Studierenden die Kompetenz erworben, analytische Prozeduren zu gestalten und zu überwachen sowie die generierten Daten für die Zwecke der Prozessüberwachung oder der Prozesskontrolle zu bewerten.

Modul Advanced Theory of Process Engineering:
Dieses Modul knüpft an Lehrveranstaltungen zur Thermodynamik und zur Wärme- und Stoffübertragung aus dem Bachelorstudium an. Für die Thermodynamik werden Kenntnisse des Verhaltens realer Fluide und insbesondere realer Mischungen vermittelt, der Teil Stoffübertragung des Moduls spricht die Besonderheiten der Stoffübertragung in Analogie zur Wärme- und Impulsübertragung, aber auch deren Unterschiede an. Es werden typische Prozesse, in denen die Stoffübertragung eine zentrale Rolle spielt, angesprochen. Der Unterschied zwischen den gleichgewichtsbasierten Prozessen, die vorrangig im Bachelorstudium angesprochen werden, und den übertragungsbasierten Prozessen wird deutlich gemacht.
In begleitenden Übungen werden die erworbenen Kenntnisse vertieft: Für Grundoperationen der Prozesstechnik werden die thermodynamischen Zustandsgrößen ermittelt und bilanziert, für die Stoffübertragung lernen die Studierenden Übertragungsmodelle aufzusetzen und die Übertragungsgrößen zu ermitteln.
Die Studierenden sind in der Lage, thermodynamische und stoffübertragungsbestimme Modelle in die Gestaltung typischer Grundoperation zu integrieren. Sie können Ergebnisse aus Forschung und realem Anlagenbetrieb bewerten.

Modul Bioanalysis:
Den Studierenden werden für eine Vielzahl biologischer und physiko-chemischer Parameter geeignete Messsensoren vorgestellt und deren Wirkungsweise erläutert.
Mit diesen Kenntnissen werden für diverse Aufgabenstellungen, die im Labor umzusetzen sind, Messsensoren ausgewählt und eingesetzt, um biologische und physiko-chemische Parameter an z.B. Mikroorganismen zu ermitteln.
Die Studierenden sind in der Lage, bioanalytische Aufgaben auf der mikroskopischen oder makroskopischen Größenordnung zu bearbeiten.

Modul Design, Economy and Sustainability in Chemical Engineering:
Den Studierenden wird grundlegendes Wissen und Methodik vermittelt, um biotechnologische und verfahrenstechnische Prozesse im Hinblick auf die Anlagenplanung und den Anlagenbau zu gestalten. Dabei wird im Besonderen Wert auf einen ganzheitlichen Ansatz gelegt, um nach den Prinzipien der Nachhaltigkeit ökonomische, ökologische und soziale Aspekte in gleicher Weise zu berücksichtigen.

Modul Fluid Flow in Process Equipment:
Die Strömung von Fluiden im mehrphasigen Gemisch ist in Prozessapparaten eher die Regel als die Ausnahme. Grundlagen dieser Strömung werden vermittelt. In Übungen wird auf die Gestaltung von Apparaten und Bauteilen eingegangen, um disperse Phasen zu erzeugen, sie in gewünschter Weise im Apparat zu bewegen und später wieder zu separieren.
Die Studierenden sind in der Lage, geeignete Apparate und Anlagen für mehrphasige Reaktions- und Trennprozesse im Basisentwurf hydraulisch zu gestalten.

Modul Quality Systems in Food Industry:
Den Studierenden werden die Merkmale eines Qualitätsmanagementsystems vermittelt. Das Lösen von Qualitätsproblemen sowie die besonderen Anforderungen der Lebensmittelindustrie werden angesprochen. An Beispielen aus der Lebensmittelindustrie werden Qualitätsprobleme analysiert und deren Lösung erarbeitet. Die Studierenden sind in der Lage, die Prinzipien des Qualitätsmanagements anzuwenden.

Modul Professional Leadership and Rhetoric:
Den Studierenden werden grundlegende Kenntnisse in Personalführung und –management, in der Rhetorik und der verbalen und non-verbalen Kommunikation vermittelt.
Durch Übungen und Testläufe erarbeiten sich die Studierenden eine Reihe von Basistechniken wie „Aktives Zuhören“ im Personalmanagement, wie „Coaching“ als eine Maßnahme der Personalführung und Überzeugungstechniken im Umgang mit Mitarbeitern und Kollegen. Sie verbessern damit ihre Sprach- und Kommunikationskompetenz, die sie im Personalmanagement und –führung benötigen.

Modul Identification and Evaluation of Relevant Literature for Scientific Projects:
Die Studierenden werden anhand von Beispielen mit den Methoden der wissenschaftlichen Literaturrecherche vertraut gemacht. Sie entwickeln die Fähigkeit, den wissenschaftlichen Status für ein Projekt anhand der Literatur zu klären und zu bewerten und die Literatur für die Lösung von Fragestellungen zu nutzen. Sie sind in der Lage, in Kenntnis des wissenschaftlichen Hintergrunds die Projektbearbeitung effizienter zu gestalten.

Modul Particles and Cells Measuring Techniques:
Unter Berücksichtigung der aktuellen wissenschaftlichen Literatur werden den Studierenden Kenntnisse zu Messtechniken auf dem Gebiet der Partikeltechnologie und der Aufarbeitungstechnik vermittelt. Einige Messmethoden werden durch Arbeiten im Labor praktisch angewandt. Die Studierenden bewerten die Resultate dieser Arbeiten hinsichtlich ihrer Aussagekraft für die praktische Anwendung.
Die Studierenden sind in der Lage, geeignete Messmethoden auszuwählen, deren Ergebnisse zu bewerten und daraus auf die Produkteigenschaften und –merkmale rückschließen zu können.

Modul Disintegration of Particles and Cells:
Unter Berücksichtigung der aktuellen wissenschaftlichen Literatur werden den Studierenden Kenntnisse zu Zerkleinerungstechniken auf dem Gebiet der Partikeltechnologie und der Aufarbeitungstechnik vermittelt. Die Prozesskontrolle durch geeignete Messmethoden wird erörtert, die Auslegung von Zerkleinerungsprozessen vom Labor- zum Technikumsmaßstab und die Prozessgestaltung werden angesprochen. Am Beispiel eines Prozesses in einer Labormühle wird die Thematik im Labor praktisch vertieft.
Die Studierenden sind in der Lage, geeignete Zerkleinerungsprozesse zu gestalten, deren Leistungsfähigkeit zu bewerten und auf diese Weise gewünschte Produkteigenschaften und –merkmale zu generieren.

Modul First-Time Manager:
Den Studierenden werden die Rollenmerkmale einer Führungskraft vor dem Hintergrund aktueller Managementprinzipien vermittelt. An Beispielen lernen die Studierenden Elemente der Führung, der guten Teamarbeit und der effizienten Kommunikation. Sie werden in die Lage versetzt, Führungsprinzipien und Kommunikationsprinzipien in ihrem Arbeitsleben anzuwenden.

Modul Project Theory und Team Project:
Das Angebot dieser Wahlpflichtmodule im Umfang von 20 CP ist eine thematische Einheit bestehend aus Theorie und Praxisteil (Projekt). Im Theorieteil wird je nach Dozent unterschiedlich gearbeitet, d.h. zum Teil seminaristisch, zum Teil im Stil einer Vorlesung. Die Studierenden erarbeiten sich den notwendigen Hintergrund oder bekommen die Kenntnisse vermittelt, die sie für die Bearbeitung des umfangreichen Projekts in einer Arbeitsgruppe benötigen. Durch die Teilnahme an diesen Modulen werden neben der fachlichen Spezialqualifikation insbesondere die persönlichen und übergeordneten Qualifikationen herausgebildet, wie sie in Kap. 1.2 dieses Berichts angesprochen und erläutert worden sind.
Die Studierenden sind in der Lage, für eine umfangreiche Aufgabenstellung Ziele zu definieren, Maßnahmen im Sinne von praktischen und theoretischen Arbeiten zu ergreifen, um Ziele oder Teilziele zu erreichen, generierte Ergebnisse darzustellen und zu bewerten sowie schließlich das Erarbeitete schriftlich und mündlich zu kommunizieren.

2. Module Manual / Modulhandbuch

Modules / Module:

Abbreviations:
NTE: Non-Technical Elective
TE: Technical Elective

Curriculum / Studienplan

Consecutive Study Programme — Stand: 17.04.2013

Master of Science *Biotechnology and Process Engineering*

Flensburg University of Applied Sciences

Term	Semester 1	Semester 2	Semester 3
hours	Summer	Winter	Summer
1	VMNIG Advanced Theory of Cell Biology and Cell Culture Technology	VIA Project Theory [2)]	TH Master-Thesis
4			
5	VMNIG Advanced Instrumental Analysis		
8			
9	VBVF Advanced Theory of Process Engineering	VIA Team Project / Practical Experience [2)]	
12			
13	VBVF Technical Elective Courses [1)]		
16			
17	NT Non-Technical Elective Courses	VIA Technical Elective Courses [1)]	
20			
	20 h, 30 ECTS	20 h, 30 ECTS	30 ECTS

[1)] Elective Courses (Examples)	Bioanalysis Design, Economy and Sustainability in Chem. Eng. Disintegration of Particles and Cells Particles and Cells Measuring Techniques Quality Systems in Food Industry Professional Leadership and Rhetoric
[2)] Projects	Protein Factory Chemical Process Engineering / Green Engineering Separation Technology Food Biotechnology and Processing

Recommendations made by VDI-Gesellschaft Verfahrenstechnik und Chemieingenieurwesen (VDI-GVC): „Qualification Framework and Curricula of Degree Programmes in Process Engineering, Biochemical and Chemical Engineering at Universities and Universities of Applied Science , 2. ed., 2008

- VMNIG: Vertiefung der mathematisch-naturwissenschaftlichen und Ingenieurwissenschaftlichen Grundlagen
- VBVF: Vertiefung und Erweiterung biotechnologischer und verfahrenstechnischer Fächer
- VIA: Vertiefung der Ingenieuranwendungen
- NT: Nichttechnische Fächer
- TH: Thesis

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:	**Advanced Theory of Cell Biology**
Semester:	1
Responsible for Module:	Prof. Dr. Helmut Erdmann
Lecturer:	Prof. Dr. Helmut Erdmann Prof. Dr. Udo Peters
Language:	English
Assignment to Programme:	M.Sc. Biotechnology and Process Engineering Compulsory Class, Semester 1
Class Type / Hours:	Lecture / 2 h per week
Workload:	Study time in class: 30 h Study time at home: 60 h
Credits:	3 in combination with CCT
Requirements:	Registered Student to M.Sc. BPE or on request
Study Goals / Skills:	Students will be introduced to newest results of research in molecular biology and state of the art methods in cell biology; they learn to use basic skills of molecular biology and transfer them to applications in cell culture techniques.
Content:	Isolation of cells, purification and characterization of proteins, intracellular compartimentation and protein sorting, intravesicular traffic, cell communication, cell birth, apoptosis, cancer
Assessment:	Written or oral exam
Media:	Lecture Notes, Slides, Board, E-Learning
Literature:	➢ Alberts et al.: Molecular Biology of the Cell ➢ Alberts et al.: Essential Cell Biology ➢ Lodish et al.: Molecular Cell Biology

Degree Program:	M.Sc. Biotechnology and Process Engineering
Title of Module:	Advanced Theory of Cell Biology and Cell Culture Technology
Title of Class:	**Cell Culture Technology**
Abbreviation:	CCT
Semester:	1
Responsible for Module:	Prof. Dr. Helmut Erdmann
Lecturer:	Prof. Dr. Hans-Udo Peters
Language:	English
Assignment to Program:	M.Sc. Biotechnology and Process Engineering Compulsory Class, Semester 1
Class Type / Hours:	Seminar 2 h per week
Workload:	Study time in class: 30 h Study time at home: 60 h
Credits:	3 in combination with ATCB
Requirements:	Registered students to M.Sc. BPE or on request
Study Goals / Skills:	**Knowledge:** • The lecture will address extended bioprocess engineering principles to apply to the advanced technology of mammalian cell culture **Skills:** • Design of cell culture fermentation processes **Expertise:** • Analysis and interpretation of cell culture fermentation data • Communicate scientific contents by oral presentations in English language
Content:	1 Lecture topics, presentations, textbooks/literature 2 Historic outline, products and future trends 3 Cell cultures 4 Complete media 5 Serum free media (pres.) 6 Insect cell-based rec. protein production (pres.) 7 Bioreactors for cell cultures 8 Contamination (pres.) 9 Quality control of biotechnological products (pres.) 10 Safety and regulatory aspects (pres.)
Assessment:	Written or oral exam
Media:	Lecture notes, slides, videos, illustrative material
Literature:	• Freshney, R.I., 6th Edition, 2010: Culture of Animal Cells. Wiley& Sons. • Eibl, R., Eibl, D., Pörtner, R., Catapano, G. and Czermak, P. 2009: Cell and Tissue Reaction Engineering. Springer-Verlag Berlin Heidelberg. • Castilho, L.R., Moraes, A.M., Augusto, E.F.P. and Butler, M. (Eds.) 2008: Animal Cell Technology: From Biopharmaceuticals to Gene Therapy. Taylor & Francis.

Degree Programme:	M.Sc. Biotechnology and Process Engineering
Title of Module:	Advanced Instrumental Analysis
Abbreviation:	AIAL
Title of Class:	**Advanced Instrumental Analysis**
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 per week
Workload:	Study time in class: 60 h Study time at home: 120 h
Credits:	6
Requirements:	Registered Student to M.Sc. BPE or on request
Study Goals / Skills:	The goal of this lecture is to provide students with ***knowledge*** of the fundamental principles, terminology, methodology, instrumentation, implementation and characteristics of the most widely applied spectroscopic measurement and chromatographic separation methods. Students should gain the ***ability to apply*** these methods for the determination of physical and chemical data commonly employed in biotechnology and process engineering. Students should gain the ***competence*** to select and supervise analytical procedures and to analyse and evaluate analytical chemical data for process analysis and design.
Content:	1. Spectrochemical Measurement Methods Ultraviolet and Visible Absorption Spectrometry Infrared Spectrometry Luminescence Spectrometry Infrared Spectrometry Light Scattering 2. Chromatographic Separation Methods Mechanism of Retention Mechanism of Dispersion Chromatography Column Design Optimization of Separation 3. Applications of Analytical Measurements in Biotechnology and Process Engineering Determination of Phase Equilibrium Parameters Determination of Binding Constants Determination of Chemical and Physical Rate Constants
Assessment:	Written or oral exam
Media:	Blackboard, overhead projector, beamer
Literature:	D.A. Skoog, J.J. Leary: Principles of Instrumental Analysis, Thomson Brooks/Cole, Belmont, Calif., 6th ed., 2007, Reading List (to be distributed during lectures)

Degree Programme:	M.Sc. Biotechnology and Process Engineering
Title of Module:	Advanced Theory of Process Engineering
Abbreviation:	ATPE
Title of Class:	**Advanced Theory of Process Engineering**
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:	Fundamentals in Fluid Flow and Heat Transfer
Study Goals:	**Knowledge:** • Thermodynamic behaviour of real fluids and mixtures • Extended knowledge on diffusion and convection mass transfer • Analogy between heat and mass transfer **Skills:** • Extend fundamental principles of thermodynamics to process fluids • Calculate state and operational variables in typical processes • Evaluate process operation according to the type and intensity of mass transfer • Estimate material property data for process operation • Set-up mass transfer models • Solve mass transfer models (numerically with the help of software) **Expertise:** • Integrate thermodynamic and mass transfer calculations into a design process for various process operations • Validate results from calculation with operational data
Content:	1. Thermodynamic Equilibrium - of pure components - of mixtures (VLE, VLLE) 2. Calculational methods to predict thermodynamic equilibrium 3. Mass Transfer - diffusion, diffusion coefficients - mass transfer models - mass transfer coefficients - mass transfer applications
Assessment:	Written or oral exam
Media:	Lecture Notes, Slides, Board, E-Learning
Literature:	➢ 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 ➢ Benitez: Mass Transfer Operations, JOHN WILEY & SONS

Degree Program:	M.Sc. Biotechnology and Process Engineering
Title of Module:	Project Theory 1: Protein Factory I
Title of Class:	**Project Theory 1: Protein Factory**
Abbreviation:	PROFA TH1
Semester:	2
Responsible for Module:	Prof. Dr. Helmut Erdmann
Lecturer:	Prof. Dr. Helmut Erdmann Prof. Dr. Hans-Udo Peters
Language:	English
Assignment to Program:	M.Sc. Biotechnology and Process Engineering Compulsory Class, Semester 2
Class Type / Hours:	Seminar / 4 h per week
Workload:	Study time in class: 60 h Study time at home: 120 h
Credits:	6 in combination with PROFA TH2
Requirements:	Advanced Theory of Cell Biology and Cell Culture Technology
Study Goals / Skills:	**Knowledge:** Specific knowledge according to the project topic: • Pathogens, infection, and innate immunity • The adaptive immune system • Therapeutic monoclonal antibody expression in mammalian cells • The DHFR/MTX-amplification system **Skills:** • Increased understanding of the application of therapeutic mAbs • Molecular design of antibody production cell lines **Expertise:** • Target oriented reading of literature to prepare for scientific projects
Content:	Accompanying Lecture for Team Project Protein Factory
Assessment:	Written or oral exam
Media:	Slides, Paper
Literature:	Primary Literature as announced in class

Degree Program:	M.Sc. Biotechnology and Process Engineering
Title of Module:	Project Theory 2: Protein Factory II
Title of Class:	**Project Theory 2: Protein Factory**
Abbreviation:	PROFA TH2
Semester:	2
Responsible for Module:	Prof. Dr. Hans-Udo Peters
Lecturer:	Prof. Dr. Hans-Udo Peters Prof. Dr. Helmut Erdmann
Language:	English
Assignment to Program:	M.Sc. Biotechnology and Process Engineering Compulsory Class, Semester 2
Class Type / Hours:	Seminar / 4 h per week
Workload:	Study time in class: 60 h Study time at home: 120 h
Credits:	6 in combination with PROFA TH1
Requirements:	Advanced Theory of Cell Biology and Cell Culture Technology
Study Goals / Skills:	**Knowledge:** • Theoretical background of Anti-IL-8 production with CHO-DP12, ATCC CRL124451 comprising up-stream and down-stream-processing **Skills:** • Explanation and discussion of general theoretical project backgrounds • Explanation and discussion of experimental results taken from project work **Expertise:** • Find, read, understand and integrate literature in the field of monoclonal antibody production, comprising the aspects mentioned under the previous points • Communicate scientific contents by oral presentations in English language
Content:	Accompanying Seminar for Team Project Protein Factory
Assessment:	Oral presentation or oral exam
Media:	Slides, Papers
Literature:	Primary Literature as announced in class

Degree Program:	M.Sc. Biotechnology and Process Engineering
Title of Module:	Team Project: Protein Factory
Title of Class:	**Protein Factory**
Abbreviation:	PROFA PRJ
Semester:	2
Responsible for Module:	Prof. Dr. Hans-Udo Peters
Lecturer:	Prof. Dr. Hans-Udo Peters Prof. Dr. Helmut Erdmann
Language:	English
Assignment to Program:	M.Sc. Biotechnology and Process Engineering Optional Compulsory Class, Semester 2
Class Type / Hours:	Project / 8 h per week
Workload:	Study time in class: 120 h Study time at home: 240 h
Credits:	12
Requirements:	Advanced Theory of Cell Biology and Cell Culture Technology
Study Goals / Skills:	**Knowledge:** • Introduction to basic tissue culture techniques • Production and Purification of Anti-IL-8 with CHO-DP12, ATCC CRL124451 **Skills:** • Handling of mammalian tissue cultures • Assembling and operation of animal cell culture bioreactors for therapeutic protein production • Separation and purification of monoclonal antibodies **Expertise:** • Design and realization of recombinant protein production using an eukaryotic expression system • Presentation and discussion of experimental results comprising the relevant scientific literature • Preparation of a written assignment
Content:	• One Week Introductory Lab-Course: "Basic Tissue Culture Techniques" • Team Project: "Protein Factory" Project Objectives: Production and purification of monoclonal antibodies (Anti IL-8) with CHO-DP12, ATCC CRL12445
Assessment:	Project report
Media:	Slides, papers
Literature:	Primary literature as announced in class

Degree Programme:	M. Sc. Biotechnology and Process Engineering
Title of Module:	Project Theory: Chemical Process Engineering / Green Engineering
Abbreviation:	CPET
Title of Class:	**Computer Aided Process Engineering (CAPE)**
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 per 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:	**Knowledge:** • Learn about heuristic and rigorous design rules to design single equipment and processes • Obtain basic knowledge on the importance of thermodynamic modelling for material property and thermodynamic state modelling **Skills:** • Learn to select appropriate path of reaction and separation for a process • Apply state-of-the-art software for computer aided process engineering (CAPE) **Expertise:** • Integrate CAPE calculations into a design process • Validate results from calculation with operational data • Use CAPE in redesign existing processes
Content:	➢ Fundamentals of Process Design – Structure and Synthesis ➢ Chemical Reaction Schemes, Equilibrium and Reactor Design ➢ Design of Separation Sequence and Technology ➢ Process Analysis
Assessment:	Written or oral exam
Media:	Lecture Notes, Slides, Board, E-Learning, CAPE software
Literature:	➢ 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: 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:	Project Theory: Chemical Process Engineering / Green Engineering
Abbreviation:	GET
Title of Class:	**Green Engineering**
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:	Seminar / 4 h per 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:	➢ 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:	➢ 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:	Written report and oral presentation
Media:	Blackboard, overhead, presentation
Literature:	➢ 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: 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:	Team Project: Chemical Process Engineering / Green Engineering
Abbreviation:	CPETP
Title of Class:	**Chemical Process Engineering / Green Engineering**
Semester:	2
Responsible for Module:	Prof. Dr.-Ing. Claus Werninger
Lecturer:	Prof. Dr. rer. nat. Jens Born 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 / 8 h per week
Workload:	Study time in class: 120 h Study time at home: 240 h
Credits:	12
Requirements:	Participation in Lecture Advanced Theory of Process Engineering
Study Goals:	**Knowledge:** • Acquire specific knowledge according to the project topic **Skills:** • Apply scientific methods based on sustainability issues to match the principles of Green Engineering • Increase proficiency with CAPE software • Set-up operational plans for group members • Arrange group work into working packages • Communicate on milestones with group members and supervisor **Expertise:** • Project Management Principles • Estimate the benefits of CAPE for research and design
Content:	A group of 2 – 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 operational, kinetic and material data from literature or from experiment. 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:	Written report and oral presentation
Media:	Board, Overhead, presentation, CAPE software, E-Learning
Literature:	➢ 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: 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:	Project Theory: Separation Technology 1
Abbreviation:	AST-PT
Title of Class:	**Separation Technology 1**
Semester:	2
Responsible for Module:	Prof. Dr. Werner Baumeister
Lecturer:	Prof. Dr. Werner Baumeister
Language:	English
Assignment to Programme:	M.Sc. Biotechnology and Process Engineering Optional Compulsory Class, Semester 2
Class Type / Hours:	Lecture and Exercise / 4 h per week
Workload:	Study time in class: 60 h Study time at home: 120 h
Credits:	6 in combination is AST II
Requirements:	Knowledge of fundamental aspects of Down Stream Processing
Study Goals / Skills:	The goal of this lecture is to provide students with ***knowledge*** of the fundamental principles and techniques of preparative chromatographic separations. Students should gain the ***ability to calculate*** spatial and temporal distributions of components in discrete space and discrete/continuous time models of chromatographic separation processes and to analyse single component and overlapping multicomponent chromatographic bands. Students should gain ***competence*** to analyse and evaluate chromatographic separation processes by using simple mathematical models of chromatography.
Content:	1. Physicochemical Basis of Chromatography 2. Mathematical Description of Chromatography 3. Discrete Space Discrete Time Model 4. Discrete Space Continuous Time Model 5. Spatial Distribution of Components 6. Temporal Distribution of Components 7. Properties of Distribution Functions 8. Evaluation of Experimental Distribution Data 9. Overlapping Components: Mixture Distributions 10. Deconvolution of Overlapping Components
Assessment:	Written or oral exam
Media:	Blackboard, computer, overhead projector, beamer
Literature:	• G. Guiochon, B. Lin: Modeling for preparative chromatography, Academic Press, Amsterdam, 1st ed., 2003 • G. Guiochon et al.: Fundamentals of preparative and nonlinear chromatography, Elsevier Academic Press, Amsterdam, 2nd ed., 2006 • Henner Schmidt-Traub (ed.): Preparative Chromatography, Wiley-VCH, Weinheim, 2nd ed., 2012

Degree Programme:	M.Sc. Biotechnology and Process Engineering
Title of Module:	Project Theory: Separation Technology 2
Abbreviation:	AST-PT
Title of Class:	**Separation Technology 2**
Semester:	2
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 Optional Compulsory Class, Semester 2
Class Type / Hours:	Lecture, Laboratory and Exercise / 4 h per week
Workload:	Study time in class: 60 h Study time at home: 120 h
Credits:	6 in combination AST I
Requirements:	Knowledge of fundamental aspects of Particle Technology or Down Stream Processing
Study Goals / Skills:	Within *Separation Technology 2 (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.
Content:	1. Separation techniques for biological dispersions, filtration by differential pressure, filtration resistances, incompressible/compressible cakes 2. Disintegration of cells: - chemical, biological, mechanical methods, - energetic comparison of different methods 3. Scale-up Methods - Dimensional analysis - Specific Process Parameters
Assessment:	Written or oral exam
Media:	Blackboard, computer, overhead projector, beamer
Literature:	➢ Rushton et al.: Solid-Liquid Filtration and Separation Technology WILEY-VCH, Weinheim 2000 ➢ A.T. Jackson: Process Engineering in Biotechnology OPEN UNIVERSITY PRESS, Milton Keynes 1990

Degree Programme:	M.Sc. Biotechnology and Process Engineering
Title of Module:	Team Project: Separation Technology
Abbreviation:	AST-TPPE
Title of Class:	**Separation Technology**
Semester:	2
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 Optional Compulsory Class, Semester 2
Class Type / Hours:	Project: Laboratory, Exercise / 4 and 4 h per 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 *Team Project in Separation Technology* the students will obtain practical experience in filtration and disintegration processes and in solving technical tasks regarding process engineering problems in general. They will be able to determine relevant data by experiment using this data needed for effective process design.
Content:	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. Scale-up Methods
Assessment:	Project report and oral presentation
Media:	Blackboard, overhead projector, beamer, personal computers equipped with MATLAB and several toolboxes (e.g. PDE, Optimization, Curve Fitting)
Literature:	➢ Rushton et al.: Solid-Liquid Filtration and Separation Technology WILEY-VCH, Weinheim 2000 ➢ A.T. Jackson: Process Engineering in Biotechnology OPEN UNIVERSITY PRESS, Milton Keynes 1990

Degree Programme:	M.Sc. Biotechnology and Process Engineering
Title of Module:	Project Theory: Food Biotechnology and Processing 1
Abbreviation:	FBP I
Title of Class:	**Food Biotechnology and Processing 1**
Semester:	2
Responsible for Module:	Prof. Dr. Birte Nicolai
Lecturer:	Prof. Dr. Birte Nicolai
Language:	English
Assignment to Programme:	M. Sc. Biotechnology and Process Engineering Optional Compulsory Class, Semester 2
Class Type / Hours:	Seminar / 4 h per week
Workload:	Study time in class: 60 h Study time at home: 120 h
Credits:	6 in combination is FBP II
Requirements:	Knowledge of fundamental aspects of fermentation, processing and analytical methods
Study Goals	**Knowledge:** • Learn about food biotechnological production methods • Understand processes during food fermentation • Learn about process parameters and analytical methods **Skills:** • Increase proficiency about food fermentations • Set-up process conditions for food production • Assess foods according to their analytical parameters **Expertise:** • Independent study of content • Self-organization
Content:	During this seminar students learn the theoretical background of food biotechnology and processing. This is either done by presentation and by self-studies of the given literature.
Assessment:	Written or oral exam
Media:	Slides, blackboard, literature
Literature:	• Doyle, M.P.; Beuchat, L.R.: Food Microbiology – Fundamentals and Frontiers, ASM Press Washington • Lee, B.H. (1996): Fundamentals of Food Biotechnology, VCH Publishers New York • Primary literature as announced in class

Degree Programme:	M.Sc. Biotechnology and Process Engineering
Title of Module:	Project Theory: Food Biotechnology and Processing 2
Abbreviation:	FBP II
Title of Class:	**Food Biotechnology and Processing 2**
Semester:	2
Responsible for Module:	Prof. Dr. Birte Nicolai
Lecturer:	Prof. Dr. Birte Nicolai
Language:	English
Assignment to Programme:	M. Sc. Biotechnology and Process Engineering Optional Compulsory Class, Semester 2
Class Type / Hours:	Seminar / 4 h per week
Workload:	Study time in class: 60 h Study time at home: 120 h
Credits:	6 in combination with FBP I
Requirements:	Knowledge of fundamental aspects of fermentation, processing and analytical methods
Study Goals	**Knowledge:** • Extend knowledge on preparation, presentation and interpretation of scientific results • Extend knowledge on work with scientific literature **Skills:** • Improve presentation skills • Communication and project follow-up with the group and the supervisor **Expertise:** • Analytical thinking
Content:	Accompanying seminar for team project “Food Biotechnology and Processing”. Students will prepare the team project and present the results to the group. Finally the group will discuss the results against the background of current literature to further develop the project.
Assessment:	Oral presentation or oral exam
Media:	Slides, blackboard
Literature:	Primary literature as announced in class

Title of Module:	Team Project: Food Biotechnology and Processing
Abbreviation:	FBP P
Title of Class:	**Food Biotechnology and Processing (Team Project)**
Semester:	2
Responsible for Module:	Prof. Dr. Birte Nicolai
Lecturer:	Prof. Dr. Birte Nicolai
Language:	English
Assignment to Programme:	M. Sc. Biotechnology and Process Engineering Optional Compulsory Class, Semester 2
Class Type / Hours:	Project / 8 h per week
Workload:	Study time in class: 120 h Study time at home: 240 h
Credits:	12
Requirements:	Knowledge of fundamental aspects of fermentation, processing and analytical methods
Study Goals	**Knowledge:** • Acquire specific knowledge according to the project topic **Skills:** • Increase proficiency with analytical methods and production equipment • Set-up plans for the experimental test design • Arrange group work **Expertise:** • Project Management principles • Analytical thinking
Content:	Students will be introduced to industrial food production by visiting food producing plants and doing food productions in a pilot plant. They will familiarize with the relevant process parameters and analytical methods. Based on the learning, they will work on a current scientific problem in food biotechnology.
Assessment:	Project report
Media:	Slides, blackboard, pilot plant equipment
Literature:	Primary literature as announced in class

Degree Programme:	M.Sc. Biotechnology and Process Engineering
Title of Module:	Elective Course – Professional Leadership and Rhetoric
Abbreviation:	EC-PLR
Title of Class:	**Professional Leadership and Rhetoric**
Semester:	1
Responsible for Module:	Ralf Gorath
Lecturer:	Ralf Gorath
Language:	English
Assignment to Programme:	M.Sc. Biotechnology and Process Engineering Compulsory Class, Semester 1
Class Type / Hours:	Lecture / 4 h per week – class size: minimum 7, maximum 20
Workload:	Study time in class: 60 h Study time at home: 120 h
Credits:	6
Requirements:	Registered Student to M.Sc. BPE or on request
Study Goals:	**Knowledge:** • Acquire basic knowledge of HRM in academic views • Acquire basic knowledge of rhetorics • Acquire basic knowledge of verbal and non-verbal communication **Skills:** • Achieve and increase competence in speech • Use "Active Listening" in personal management • Perform "Coaching" as an active element of leadership • Convincing interaction with employees and peers **Expertise:** • Competence in rhetoric – basics, metaphors and style • Competence in human resources management • Competence in structured communication
Content:	Personnel Management in academic views Motivation and responsibility in HRM Rhetorical craftsmanship – basics, metaphors, analogies, style Active listening in practical management Structured communication as a tool for effective interaction Corporate communication culture Formal authority and informal power Praise and criticism in critical evaluation Personnel recruiting and -development - and costs Team development and coaching
Assessment:	Written exam or homework assignment or presentation
Media:	Board and presentation
Literature:	• Paul Watzlawick: Human communication / Menschliche Kommunikation – Formen, Störungen, Paradoxien. Huber, Bern 1969 [12. unveränderte Aufl. 2011], ISBN 3456834578 • Friedemann Schulz-von-Thun: Miteinander reden: Kommunikation für Führungskräfte. Rowohlt, Reinbek 2000/2003, ISBN 3-499-61531-2 • Ronald H. Carpenter – Choosing powerful words – Allyn and Bacon 1999, ISBN 0-205-27124-3 • Peter Ditko – In Bildern reden – Econ 1998, ISBN 3430121140

Degree Programme:	M.Sc. Biotechnology and Process Engineering
Title of Module:	Elective Course – Identification and evaluation of relevant literature for scientific projects
Abbreviation:	EC-IEL
Title of Class:	**Identification and evaluation of relevant literature for scientific projects**
Semester:	1
Responsible for Module:	Prof. Dr. Detlef Goelling
Lecturer:	Prof. Dr. Detlef Goelling
Language:	English
Assignment to Programme:	M.Sc. Biotechnology and Process Engineering Compulsory Class, Semester 1
Class Type / Hours:	Lecture / 2 h per week
Workload:	Study time in class: 30 h Study time at home: 60 h
Credits:	3
Requirements:	Registered Student to M.Sc. BPE or on request
Study Goals:	**Knowledge:** • Acquire knowledge for scientific literature research **Skills:** • Increase scientific background for project work and for writing project report or thesis • Increase project management skills • Evaluation of scientific background for projects **Expertise:** • Definition of scientific status on project relevant topics • Efficient and reliable literature research
Content:	Each student will be assigned a scientific topic. Then, students carry out a literature search according to their assignment. Finally, they document their findings in a written report.
Assessment:	Project report
Media:	Blackboard, overhead projector, beamer, World Wide Web
Literature:	Medline

Degree Programme:	M.Sc. Biotechnology and Process Engineering
Title of Module:	Elective Course – Quality systems in food industry
Abbreviation:	EC-QSFI
Title of Class:	**Quality systems in food industry**
Semester:	1
Responsible for Module:	Prof. Dr. Birte Nicolai
Lecturer:	Prof. Dr. Birte Nicolai
Language:	English
Assignment to Programme:	M.Sc. Biotechnology and Process Engineering Elective course, Semester 1
Class Type / Hours:	Seminar / 4 h per week
Workload:	Study time in class: 60 h Study time at home: 120 h
Credits:	6
Requirements:	Registered Student to M.Sc. BPE or on request
Study Goals:	**Knowledge:** • Learn about quality management systems, quality solving techniques and the specific requirements of the food industry **Skills:** • Apply quality solving techniques • Understand framework in food industry • Arrange group work • Improve presentation skills **Expertise:** • Quality management principles
Content:	1.) General terms and definitions 2.) Historical development of quality management 3.) Framework in food industry 4.) Quality management and assurance standards 5.) Crisis management
Assessment:	Oral presentation
Media:	Slides, videos, blackboard, case study, management training game
Literature:	▸ Doeg, C.: Crisis Management in the Food and Drinks Industry: A Practical Approach, Springer New York ▸ Quality Management standards ▸ Primary literature as announced in class

Degree Programme:	M.Sc. Biotechnology and Process Engineering
Title of Module:	Elective Course – First-Time Manager
Abbreviation:	EC-FTM
Title of Class:	**First-Time Manager**
Semester:	1
Responsible for Module:	Prof. Dr. Birte Nicolai
Lecturer:	Prof. Dr. Birte Nicolai
Language:	English
Assignment to Programme:	M.Sc. Biotechnology and Process Engineering Elective course, Semester 1
Class Type / Hours:	Seminar / 4 h per week
Workload:	Study time in class: 60 h Study time at home: 120 h
Credits:	6
Requirements:	Registered Student to M.Sc. BPE or on request
Study Goals:	**Knowledge:** • Understand the role of a manager / leader • Learn about the theoretical background and the practical application of management/ leadership elements **Skills:** • Apply management / leadership skills • Arrange group work • Improve presentation skills **Expertise:** • Management / leadership principles • Interpersonal and communication skills
Content:	1.) Management /Leadership 2.) Winning hearts and minds 3.) Leading change 4.) Appraisals 5.) Coaching 6.) Problem solving and diagnostic techniques 7.) Presentation skills
Assessment:	Oral presentation or project report
Media:	Slides, videos, blackboard, management training game, role-playing
Literature:	• Kotter, J.P.: Leading Change, Harvard Business Review Press Boston • Kotter, J.P.: Our Iceberg is Melting, Palgrave Macmillan London • Nahavandi, A.: The Art and Science of Leadership, Prentice Hall, New Jersey • Bass, B.M. and Bass, R.: The Bass Handbook of leadership: Theory, Research and Managerial Applications, Free Press New York • Primary literature as announced in class

Degree Programme:	M.Sc. Biotechnology and Process Engineering
Title of Module:	Elective Course – Bioanalysis
Abbreviation:	EC-BA
Title of Class:	**Bioanalysis**
Semester:	1
Responsible for Module:	Dipl.-Biol. Uwe Krüger
Lecturer:	Dipl.-Biol. Uwe Krüger
Language:	English
Assignment to Programme:	M.Sc. Biotechnology and Process Engineering Compulsory Class, Semester 1 or 2
Class Type / Hours:	Lecture / 4 h per week (blocked as 8 h every other week)
Workload:	Study time in class: 60 h Study time at home: 120 h
Credits:	6
Requirements:	Registered Student to M.Sc. BPE or on request
Study Goals:	**Knowledge:** • Learn about the variety of biological (physicochemical) parameters and appropriate detectors **Skills:** • Apply knowledge in selecting, evaluating and using various physicochemical detectors and devices to provide relevant information on living matter **Expertise:** • Gain expertise in addressing bioanalytical tasks from molecular to macroscopic scale
Content:	The course focusses on problems how to define analytic tasks by matching physicochemical footprints of life with the appropriate detector equipment at various scales and how to derive the desired information from a dataset. In this context students will discuss on taking appropriate samples and also on some data conditioning and statistics. Furthermore, a glimpse on chemometrics has to be included.
Assessment:	Oral presentation
Media:	Laboratory equipment, board, slides, handouts
Literature:	Will be provided according to specific experiments

Degree Programme:	M.Sc. Biotechnology and Process Engineering
Title of Module:	Elective Course – Fluid Flow in Process Equipment
Abbreviation:	EC-FFPE
Title of Class:	**Fluid Flow in Process Equipment**
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 Compulsory Class, Semester 2
Class Type / Hours:	Lecture / 2 h per week
Workload:	Study time in class: 30 h Study time at home: 60 h
Credits:	3
Requirements:	Registered Student to M.Sc. BPE or on request
Study Goals:	**Knowledge:** • Fundamentals of (fluid) multiphase flow • Get familiar with equipment to generate disperse phase **Skills:** • Design process equipment in terms of phase motion and phase contact time **Expertise:** • Propose appropriate equipment design for given multiphase reaction or separation problem
Content:	1. (Fluid) Particles: Generation and Motion 2. Interaction of phases in multiphase flow 3. Equipment design: Nozzles, Trays, Packings
Assessment:	Homework assignment or project report
Media:	Board, slides
Literature:	As anounced in class

Degree Programme:	M.Sc. Biotechnology and Process Engineering
Title of Module:	Elective Courses - Design, Economy and Sustainability in Chemical Engineering
Abbreviation:	DES
Title of Class:	**Design, Economy and Sustainability in Chemical Engineering**
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 Course, Semester 2
Class Type / Hours:	Workshop / 4 h per week
Workload:	Study time in class: 60 h Study time at home: 120 h
Credits:	6
Requirements:	Registered Student to M.Sc. BPE or on request
Study Goals / Skills:	Basic knowledge and skills to design chemical processes with a holistic view under economic and ecologic constraints
Content:	1. Design concepts, principles and constraints 2. Product design - needs, ideas, selection methods, skills and tools 3. Plant design 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:	Project report or oral presentation
Media:	Board, Slides, CAPE software
Literature:	➢ 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 – Disintegration of Particles and Cells
Abbreviation:	EC-DisInt
Title of Class:	**Disintegration of Particles and Cells**
Subtitle:	Using Stirred Media Mills in Down Stream Processing
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 per 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 students will obtain knowledge of 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:	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:	Homework assignment or written project report and oral presentation
Media:	Scientific papers, computer, overhead projector, beamer
Literature:	➢ A.T. Jackson: Process Engineering in Biotechnology OPEN UNIVERSITY PRESS, Milton Keynes ➢ Current scientific papers as supplied by the lecturer

Degree Programme:	M.Sc. Biotechnology and Process Engineering
Title of Module:	Elective Courses – Particles and Cells Measuring Techniques
Abbreviation:	EC-PartM
Title of Class:	**Particles and Cells Measuring Techniques**
Subtitle:	Measuring Particle Size Distributions and Evaluation
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 per 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 obtain knowledge of measuring techniques within the field of Particle Technology and Down Stream Processing. 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. The students will reach the competence to measure, evaluate and explain product properties regarding to Particle Technology, e.g. the particle size distribution, and to Down Stream Processing, e.g. disintegration of cells.
Content:	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. State-of-the-art optical analyser techniques: Dispersion of laser light, dynamical dispersion 6. Comparability and reliability of the results to be used in process control and quality management
Assessment:	Homework assignment or project report and oral presentation
Media:	Scientific papers, computer, overhead projector, beamer
Literature:	➢ A. Zhong, Lin Wang: Characterization of Nanophase Materials WILEY-VCH, Weinheim ➢ Brian H. Kaye: Characterization of Powders and Aerosols WILEY-VCH, Weinheim

Degree Programme:	M.Sc. Biotechnology and Process Engineering
Title of Module:	**Master-Thesis**
Abbreviation:	MA
Semester:	3
Responsible for Module:	Prof. Dr.-Ing. Claus Werninger
Lecturer:	Students will be supervised by one professor of their choice.
Language:	English
Assignment to Programme:	M.Sc. Biotechnology and Process Engineering, Compulsory, Semester 3
Class Type / Hours:	n. a.
Workload:	900 h
Credits:	30
Requirements:	See Study Regulations (Prüfungs- and Studienordnung)
Study Goals:	The student works independently on a problem preferably related to the field of biotechnology and process engineering. He or she uses scientific methods acquired during his participation in this programme. The student is capable to manipulate, discuss and display the data he or she collected for his/her work.
Content:	according to individual problem description
Assessment:	Written report, oral presentation and defence (60 min.) Assessment of all contributions will be accomplished by the supervising professor and one of his/her colleagues.
Media:	n. a.
Literature:	n. a.