Modules for Pharmazie

Date 17/04/25

Pflichtmodule

PHA.08386.01 - M-Both 2023: Abschlussmodul

PHA.08386.01	30 CP
Module label	M-Both 2023: Abschlussmodul
Module code	PHA.08386.01
Semester of first implementation	
Module used in courses of study / semesters	• Pharmaceutical and Industrial Biotechnology (MA120 LP) (Master) > Pharmazie PharmacIndusBiotech.MA120, Version of accreditation valid from WS 2019/20 > Pflichtmodule
Responsible person for this module	
Further responsible persons	Lecturers involved in the course program
Prerequisites	80 credit points
Skills to be acquired in this module	• carrying out of independent research - literature studies and experimental work - writing of the thesis - defense of the thesis
Module contents	• thesis in a research field of biotechnology - carrying out literature research - measurement of experimental data and interpretation of results - oral presentation of the final thesis including defense
Forms of instruction	Independent supervised work Independent supervised work
Languages of instruction	German, English
Duration (semesters)	1 Semester Semester
Module frequency	jedes Sommersemester
Module capacity	unlimited
Time of examination	
Credit points	30 CP
Share on module final degree	Course 1: %; Course 2: %.
Share of module grade on the course of study's final grade	1

Examination	Exam prerequisites	Type of examination
Course 1		
Course 2		
Final exam of module		Masterarbeit, Verteidigung
Exam repetition information		

Module course label	Course type	Course title	SWS	Workload of compulsory attendance	Workload of preparation / homework etc	Workload of independent learning	Workload (examination and preparation)	Sum workload
Course 1	Independent supervised work	Experimental work, writing of the thesis						0
Course 2	Independent supervised work	Preparation for and execution of the defense						0
Workload by module						900		900
Total module workload								900

PHA.08217.01 - P-Both 2023: Project Work

PHA.08217.01	10 CP
Module label	P-Both 2023: Project Work
Module code	PHA.08217.01
Semester of first implementation	
Module used in courses of study / semesters	• Pharmaceutical and Industrial Biotechnology (MA120 LP) (Master) > Pharmazie PharmacIndusBiotech.MA120, Version of accreditation valid from WS 2019/20 > Pflichtmodule • Pharmaceutical and Industrial Biotechnology (MA120 LP) (Master) > Pharmazie PharmacIndusBiotech.MA120, Version of accreditation (WS 2015/16 - SoSe 2023) > Pflichtmodule
Responsible person for this module	
Further responsible persons	M. Pietzsch
Prerequisites	
Skills to be acquired in this module	first independent research experience for the students literature studies and experimental work writing of reports defending results
Module contents	participation in a research group introduction to independent research of the students combining literature and experimental research independent preparation of the research report oral presentation of the results using Power Point
Forms of instruction	Course (8 SWS) Course
Languages of instruction	German, English
Duration (semesters)	1 Semester Semester
Module frequency	jedes Wintersemester
Module capacity	unlimited
Time of examination	
Credit points	10 CP
Share on module final degree	Course 1: %; Course 2: %.
Share of module grade on the course of study's final grade	1

Examination	Exam prerequisites	Type of examination
Course 1		
Course 2		
Final exam of module		Lehrforschungsbericht, Mündliche Präsentation und wissenschaftliche Diskussion
Exam repetition information		

Module course label	Course type	Course title	SWS	Workload of compulsory attendance	Workload of preparation / homework etc	Workload of independent learning	Workload (examination and preparation)	Sum workload
Course 1	Course	Project seminar	8					0
Course 2	Course	Private study						0
Workload by module						300		300
Total module workload								300

PHA.06110.02 - C-Both: Construction of production organisms - Hosts and vectors

PHA.06110.02	10 CP
Module label	C-Both: Construction of production organisms - Hosts and vectors
Module code	PHA.06110.02
Semester of first implementation	
Module used in courses of study / semesters	• Pharmaceutical and Industrial Biotechnology (MA120 LP) (Master) > Pharmazie PharmacIndusBiotech.MA120, Version of accreditation valid from WS 2019/20 > Pflichtmodule • Pharmaceutical and Industrial Biotechnology (MA120 LP) (Master) > Pharmazie PharmacIndusBiotech.MA120, Version of accreditation (WS 2015/16 - SoSe 2023) > Pflichtmodule
Responsible person for this module	
Further responsible persons	S. Schilling
Prerequisites	
Skills to be acquired in this module	• Knowledge on synthesis and structure/function relationship of DNA, RNA and protein • Basic principles of gene structure, regulatory elements, function and regulation of activity in biotechnologically important prokaryotic and eukaryotic organisms • Theoretical ability to cultivate bacteria, yeasts and phototrophic organisms • Knowledge about basic principles of gene cloning • Theoretical ability to construct a genetically modified organism by gene cloning und expression in a final production host • Insight into molecular techniques of plant and microalgae transformation • Survey of basic techniques of plant regeneration and concepts of in vitro plant cell, tissue and organ cultures • Overview of biotechnological application of phototrophic organisms and transgenic plants • Advantages of bacteria, yeast and insect cells as gene expression systems • Overview over products of molecular and classic biotechnology of microorganisms • Practical know-how for transfection and cultivation of microbial cells • Practical know-how on heterologous gene expression in microorganisms and plants • Practical knowhow in analyzing genetically modified plants
Module contents	Course C-Both.1: Methods and strategies for the generation of production strains • Overview biotechnologically relevant organisms: product related selection, advantages/disadvantages • Toolbox biotechnology: Gene analysis, DNA/protein sequencing, detection methods for products • Strategies for improvement of strains and products: random/site directed mutagenesis, protein tags • Examples for successful application in pharmaceutical and industrial biotechnology using different production organisms (bacteria, yeast, plants) Course C-Both.2: Biotechnology of phototrophic organisms • Principal organization and expression of nuclear and organellar plant genomes • Plant and cell architecture, compartments and protein sorting • Strategies and procedures for plant regeneration and propagation • Plant cell, tissue and organ cultures: initiation and maintenance • Mechanism of Agrobacterium-mediated T-DNA transfer and applications • Plant transformation techniques and gene expression systems in plants • Vector design and optimization, stability and analysis of transgenes • Examples of molecular plant biotechnology: natural and novel products • Overview of (biotechnological relevant) micro- and macroalgae and

application
- The unicellular green algae Chlamydomonas reinhardtii as a model organism
- Molecular biology of and gene technology with Cyanobacteria

Course C-Both.3: Molecular Biotechnology

- Principal mechanisms of DNA synthesis in vitro and in vivo and use of enzymes for gene cloning
- Mechanism of RNA and protein synthesis in bacteria
- Structure and function of RNA and DNA
- Regulation of gene expression in prokaryotes and eukaryotes (yeast) and use for heterologous expression of proteins
- Methods of gene cloning and target gene isolation, library construction and screening
- Theoretical ability to construct a genetically modified organism for heterologous protein production
- Theoretical ability to cultivate bacteria and yeasts

Course C-Both.4: Project seminar on construction of hosts and vectors

- Amplification of target DNA using PCR, restriction digest and vector ligation.
- Transformation of E. coli with plasmid, selection, monitoring of the expression success.
- Testing transgenic plants for the presence of transferred DNA
- Monitoring heterologous protein production in plants

Forms of instruction	Lecture (2 SWS) Seminar (3 SWS) Practical training (4 SWS) Course
Languages of instruction	German, English
Duration (semesters)	1 Semester Semester
Module frequency	jedes Wintersemester
Module capacity	unlimited
Time of examination	
Credit points	10 CP
Share on module final degree	Course 1: %; Course 2: %; Course 3: %; Course 4: %.
Share of module grade on the course of study's final grade	1

Examination	Exam prerequisites	Type of examination
Course 1		
Course 2		
Course 3		
Course 4		
Final exam of module	Examination on course contents part microorganisms, Protocol on course part microorganisms, Examination on course contents part plant cell technology, Protocol on course part plant cell technology	Klausur
Exam repetition information		

Module course label	Course type	Course title	SWS	Workload of compulsory attendance	Workload of preparation / homework etc	Workload of independent learning	Workload (examination and preparation)	Sum workload
Course 1	Lecture	Lecture	2					0
Course 2	Seminar	Project seminar	3					0
Course 3	Practical training	Lab course	4					0
Course 4	Course	Selbststudium						0
Workload by module						300		300

Module course label	Course type	Course title	SWS	Workload of compulsory attendance	Workload of preparation / homework etc	Workload of independent learning	Workload (examination and preparation)	Sum workload
Total module workload								300

PHA.06108.01 - A-Both: Introduction to Pharmaceutical and Industrial Biotechnology

PHA.06108.01	5 CP
Module label	A-Both: Introduction to Pharmaceutical and Industrial Biotechnology
Module code	PHA.06108.01
Semester of first implementation	
Module used in courses of study / semesters	• Pharmaceutical and Industrial Biotechnology (MA120 LP) (Master) > Pharmazie PharmacIndusBiotech.MA120, Version of accreditation valid from WS 2019/20 > Pflichtmodule • Pharmaceutical and Industrial Biotechnology (MA120 LP) (Master) > Pharmazie PharmacIndusBiotech.MA120, Version of accreditation (WS 2015/16 - SoSe 2023) > Pflichtmodule
Responsible person for this module	
Further responsible persons	M. Pietzsch
Prerequisites	
Skills to be acquired in this module	• Knowledge of the basic concepts and technologies of Pharmaceutical and Industrial Biotechnology and Bioeconomy: Terminology & Definitions - Overview on industrial development and production processes - Knowledge of product classes - Insight to interdisciplinary cooperation in biopharmaceutical drug development and production - Organizational structures and industries - Interrelation of biotechnology & medicine - Practical skills in biochemical methods - Practical skills in chemical calculations
Module contents	Course A.1: Introduction to Pharmaceutical and Industrial Biotechnology • General introduction and history of Industrial and Pharmaceutical Biotechnology (InPhBT) • Products of Biotechnology • Selection and construction of production strains • Production aspects: Up- and Downstream Processing • Introduction to formulation • Analytical aspects • Clinical aspects • Regulatory aspects Course A.2: Basic Methods in Biotechnology • Chemical calculations (stoichiometry) • Weighing, Pipetting • Spectrophotometry • Centrifugation • Dialysis • Measurement of pH, preparation of buffer solutions, ionic strength. • Protein assay using BRADFORD and BCA-methods • Determination of enzyme activity, continuous and end point methods
Forms of instruction	Lecture (2 SWS) Practical training (3 SWS) Course
Languages of instruction	German, English
Duration (semesters)	1 Semester Semester
Module frequency	jedes Wintersemester
Module capacity	unlimited
Time of examination	
Credit points	5 CP
Share on module final degree	Course 1: %; Course 2: %; Course 3: %.

PHA.06108.01 5 CP

Share of module grade on the course of study's final grade			1					
Examination			Exam prerequisites			Type of examination		
Course 1								
Course 2								
Course 3								
Final exam of module			Attestation on project seminar contents, Protocol			Klausur		
Exam repetition information								
Module course label	Course type	Course title	SWS	Workload of compulsory attendance	Workload of preparation / homework etc	Workload of independent learning	Workload (examination and preparation)	Sum workload
Course 1	Lecture	Lecture	2					0
Course 2	Practical training	Lab course	3					0
Course 3	Course	Private study						0
Workload by module						150		150
Total module workload								150

PHA.06116.01 - G-Both: Purification of Products from Biotechnological Processes (Downstream Processing)

PHA.06116.01	10 CP
Module label	G-Both: Purification of Products from Biotechnological Processes (Downstream Processing)
Module code	PHA.06116.01
Semester of first implementation	
Module used in courses of study / semesters	• Pharmaceutical and Industrial Biotechnology (MA120 LP) (Master) > Pharmazie PharmacIndusBiotech.MA120, Version of accreditation valid from WS 2019/20 > Pflichtmodule • Pharmaceutical and Industrial Biotechnology (MA120 LP) (Master) > Pharmazie PharmacIndusBiotech.MA120, Version of accreditation (WS 2015/16 - SoSe 2023) > Pflichtmodule
Responsible person for this module	
Further responsible persons	M. Pietzsch
Prerequisites	C-Both: Construction of production organisms; D-Both: Introduction to Bioprocess Technology (Upstream Processing)
Skills to be acquired in this module	• Knowledge of the basic concepts of downstream processing • Foundations of protein purification • Knowledge on equipment and design parameters • Knowledge of scale-up parameters • Challenges in prevention or elimination of contaminants • Knowledge on process integration: Strain development, up- and downstream processing • Basics of technical/industrial purification of proteins • Know how to plan and perform the purification of a target protein from biomass
Module contents	Course G.1: Introduction to Downstream Processing • Overview on potential contaminations of target products and strategies for their removal • Equipment: Design and operation • Cell disintegration • Solid-Fluid separations • Liquid-Liquid extraction • Precipitation and crystallization • Chromatographic separations • Special applications: Purification of membrane proteins, inclusion bodies, antibodies, viruses, DNA, etc. Course G-Both.2: Project seminar on Downstream Processing • Purity control by SDS-PAGE and determination of specific enzymatic activity • Cell disintegration • Solid / Liquid Separation • Protein precipitation • Preparative chromatography for the purification of proteins • Packing of chromatography columns • Generation of purification tables
Forms of instruction	Seminar (3 SWS) Seminar (2 SWS) Practical training (3 SWS) Course
Languages of instruction	German, English
Duration (semesters)	1 Semester Semester
Module frequency	jedes Sommersemester
Module capacity	unlimited

PHA.06116.01 10 CP

Time of examination								
Credit points			10 CP					
Share on module final degree			Course 1: %; Course 2: %; Course 3: %; Course 4: %.					
Share of module grade on the course of study's final grade			1					
Examination			Exam prerequisites			Type of examination		
Course 1								
Course 2								
Course 3								
Course 4								
Final exam of module			Attestation on project seminar contents, Project seminar protocol, Oral presentation on a current research topic in downstream processing			Klausur		
Exam repetition information								
Module course label	Course type	Course title	SWS	Workload of compulsory attendance	Workload of preparation / homework etc	Workload of independent learning	Workload (examination and preparation)	Sum workload
Course 1	Seminar	Project seminar	3					0
Course 2	Seminar	Project seminar	2					0
Course 3	Practical training	Lab course	3					0
Course 4	Course	Private studies						0
Workload by module						300		300
Total module workload								300

PHA.06111.01 - D-Both: Introduction to Bioprocess Technology (Upstream Processing)

PHA.06111.01	5 CP
Module label	D-Both: Introduction to Bioprocess Technology (Upstream Processing)
Module code	PHA.06111.01
Semester of first implementation	
Module used in courses of study / semesters	• Pharmaceutical and Industrial Biotechnology (MA120 LP) (Master) > Pharmazie PharmacIndusBiotech.MA120, Version of accreditation valid from WS 2019/20 > Pflichtmodule • Pharmaceutical and Industrial Biotechnology (MA120 LP) (Master) > Pharmazie PharmacIndusBiotech.MA120, Version of accreditation (WS 2015/16 - SoSe 2023) > Pflichtmodule
Responsible person for this module	
Further responsible persons	N. Volk
Prerequisites	
Skills to be acquired in this module	• Knowledge of the basic concept of bioprocess technology • Foundations of microbial growth and cultivation principles • Application of bioprocess engineering principles • Knowledge of bioreactor operations and their industrial applications • Basics of technical/industrial fermentation processes
Module contents	• Basics of bioprocess technology • Microbial growth and cultivation principles • Reactor design and instrumentation • Process control of bioreactors • Balancing and design of bioreactors • Bioprocess scale-up • Sterile technology • Application of fermentation processes • Bioprocess case studies
Forms of instruction	Seminar (4 SWS) Course
Languages of instruction	German, English
Duration (semesters)	1 Semester Semester
Module frequency	jedes Wintersemester
Module capacity	unlimited
Time of examination	
Credit points	5 CP
Share on module final degree	Course 1: %; Course 2: %.
Share of module grade on the course of study's final grade	1

Examination	Exam prerequisites	Type of examination
Course 1		
Course 2		
Final exam of module		Klausur
Exam repetition information		

Module course label	Course type	Course title	SWS	Workload of compulsory attendance	Workload of preparation / homework etc	Workload of independent learning	Workload (examination and preparation)	Sum workload
Course 1	Seminar	Project seminar	4					0
Course 2	Course	Private study						0
Workload by module						150		150

Module course label	Course type	Course title	SWS	Workload of compulsory attendance	Workload of preparation / homework etc	Workload of independent learning	Workload (examination and preparation)	Sum workload
Total module workload								150

PHA.06113.01 - E-Both: Optimization of Bioprocesses

PHA.06113.01	5 CP
Module label	E-Both: Optimization of Bioprocesses
Module code	PHA.06113.01
Semester of first implementation	
Module used in courses of study / semesters	• Pharmaceutical and Industrial Biotechnology (MA120 LP) (Master) > Pharmazie PharmacIndusBiotech.MA120, Version of accreditation valid from WS 2019/20 > Pflichtmodule • Pharmaceutical and Industrial Biotechnology (MA120 LP) (Master) > Pharmazie PharmacIndusBiotech.MA120, Version of accreditation (WS 2015/16 - SoSe 2023) > Pflichtmodule
Responsible person for this module	
Further responsible persons	N. Volk
Prerequisites	Modul D: Introduction to Bioprocess Technology (Upstream Processing)
Skills to be acquired in this module	• Knowledge of mathematical modeling to optimization of bioprocesses • Foundations in the use of simulations languages • Using tools to identification, simulation and optimization • Application of models to optimization of bioprocesses • Knowledge of planning and preparation of bioreactor cultivations • Laboratory scale development of strategies for optimal bioprocessing technologies • Experience in the use of bioprocess cultivation techniques • Practical experience in the preparation and implementation of fermentations • Analyze and validate of results of fermentations
Module contents	Course E-Both.1: Process modeling and simulation • Principles of bioprocess modeling and optimization • Modeling concepts for biological systems and bioreactors • Dynamic modeling of bioreactors • Introduction in simulation language (MATLAB, Copasi, Celldesigner, Berkeley Madonna) • Case studies to simulation • Optimization of bioprocesses • Case studies to optimization Course E-Both.2: Control of bioreactor cultivations • Planning of a bioreactor cultivation process • Mathematical simulation of the process • Preparation of the bioprocess techniques and analytics • Experimental realization of the cultivation process • Analyze and validate the results • Identification of a model from the results • Describe and analyze the process
Forms of instruction	Seminar (2 SWS) Practical training (3 SWS) Course
Languages of instruction	German, English
Duration (semesters)	1 Semester Semester
Module frequency	jedes Sommersemester
Module capacity	unlimited
Time of examination	
Credit points	5 CP
Share on module final degree	Course 1: %; Course 2: %; Course 3: %.
Share of module grade on the course of study's final grade	1

Examination			Exam prerequisites			Type of examination		
Course 1								
Course 2								
Course 3								
Final exam of module			Attestation on project seminar contents, Protocol			Klausur		
Exam repetition information								
Module course label	Course type	Course title	SWS	Workload of compulsory attendance	Workload of preparation / homework etc	Workload of independent learning	Workload (examination and preparation)	Sum workload
Course 1	Seminar	Project seminar	2					0
Course 2	Practical training	Lab Course	3					0
Course 3	Course	Private studies						0
Workload by module						150		150
Total module workload								150

PHA.06117.01 - H-Both: Analytical Methods

PHA.06117.01	10 CP
Module label	H-Both: Analytical Methods
Module code	PHA.06117.01
Semester of first implementation	
Module used in courses of study / semesters	• Pharmaceutical and Industrial Biotechnology (MA120 LP) (Master) > Pharmazie PharmacIndusBiotech.MA120, Version of accreditation valid from WS 2019/20 > Pflichtmodule • Pharmaceutical and Industrial Biotechnology (MA120 LP) (Master) > Pharmazie PharmacIndusBiotech.MA120, Version of accreditation (WS 2015/16 - SoSe 2023) > Pflichtmodule
Responsible person for this module	
Further responsible persons	Dr. M. Niepel
Prerequisites	A-Both: Introduction to Industrial and Pharmaceutical Biotechnology
Skills to be acquired in this module	• Basics of different analytical methods including vibrational spectroscopy, separation techniques (gas and liquid chromatography, electrophoresis), NMR and mass spectrometry • Scope and limitations of these analytical techniques for identification and quantification • Applying the right tools to the right questions • Ability to set up a proteomics workflow in industry • Ability to judge the quality of results, i.e. protein identifications • Understanding the role of computing in knowledge discovery and apply bioinformatics tools in data processing, workflow automation, and structure determination
Module contents	Course H-Both.1: Separation Techniques, Vibrational Spectroscopy and NMR • Liquid Chromatography: Normal and reversed Phase (U)HPLC, Ion exchange chrom. • Electrophoresis: IEF, 2-DE • Detection Methods • Vibrational spectroscopy: FT-IR, NIR, Raman, and Terahertz spectroscopies • Multivariate analysis for qualitative (principal component analysis) and quantitative (partial least squares regression) analysis • NMR spectroscopy for structure elucidation and quantification Course H-Both.2: Mass Spectrometry and Proteomics • Fundamentals of mass spectrometry: ionization techniques in gas, liquid and solid state, different analyzers and their performances, MS2 and MSn, elemental composition determination • Hyphenated techniques, quantitation via LC-MS(/MS), TripleQuad scan modes • Molecular profiling and imaging techniques, ion mobility spectroscopy • Small molecule analysis, sample preparation, qualitative and quantitative investigations via GC-FID and GC-MS, data evaluation and use of databases • Preprocessing of mass spectra and database searching • Qualitative and quantitative proteomics • Protein databases, annotations, and search engines • Characterization of PTMs Course H-Both.3: Analytical methods • Methods for separating complex mixtures • Data-dependent acquisitions for protein mass spectrometry • GC-MS for the quantification of drugs
Forms of instruction	Lecture (3 SWS) Seminar (2 SWS)

	Seminar (1 SWS) Practical training (2 SWS) Course
Languages of instruction	German, English
Duration (semesters)	1 Semester Semester
Module frequency	jedes Sommersemester
Module capacity	unlimited
Time of examination	
Credit points	10 CP
Share on module final degree	Course 1: %; Course 2: %; Course 3: %; Course 4: %; Course 5: %.
Share of module grade on the course of study's final grade	1

Examination	Exam prerequisites	Type of examination
Course 1		
Course 2		
Course 3		
Course 4		
Course 5		
Final exam of module	Attestation, Protocol on project seminar H-Both.3	Klausur
Exam repetition information		

Module course label	Course type	Course title	SWS	Workload of compulsory attendance	Workload of preparation / homework etc	Workload of independent learning	Workload (examination and preparation)	Sum workload
Course 1	Lecture	Lecture	3					0
Course 2	Seminar	Project seminar	2					0
Course 3	Seminar	Project seminar	1					0
Course 4	Practical training	Lab course	2					0
Course 5	Course	Private studies						0
Workload by module						300		300
Total module workload								300

Spezialisierung Pharmaceutical Biotechnology

PHA.06118.02 - I-PhBT: Technological and Clinical Aspects of Biopharmaceutics

PHA.06118.02	10 CP
Module label	I-PhBT: Technological and Clinical Aspects of Biopharmaceutics
Module code	PHA.06118.02
Semester of first implementation	
Module used in courses of study / semesters	• Pharmaceutical and Industrial Biotechnology (MA120 LP) (Master) > Pharmazie PharmacIndusBiotech.MA120, Version of accreditation valid from WS 2019/20 > Spezialisierung Pharmaceutical Biotechnology • Pharmaceutical and Industrial Biotechnology (MA120 LP) (Master) > Pharmazie PharmacIndusBiotech.MA120, Version of accreditation (WS 2015/16 - SoSe 2023) > Spezialisierung Pharmaceutical Biotechnology
Responsible person for this module	
Further responsible persons	M. Pietzsch
Prerequisites	Modules of the first semester (A-Both, B-PhBT, C-Both, D-Both)
Skills to be acquired in this module	Knowledge of drug delivery routes with focus on biotech products Challenges of protein formulations Knowledge of formulation processes and additives Knowledge of drug delivery mechanisms and basic concepts of pharmacokinetics Knowledge of parenteral controlled release formulations Knowledge on posttranslational modifications of proteins in vivo Rationale behind posttranslational modification of proteins Know-how to synthetically modify proteins in vitro Knowledge on the application of biocatalysts for the synthesis of drugs Biosynthetic pathways of plant secondary metabolites Regulatory mechanisms of metabolite production Plant-derived pharmaceuticals Strategies to produce metabolites in transgenic plants Successful examples of pharmaceutical production in plants Knowledge on the application of medical devices in `Regenerative Medicine`, Clarification of terms and definitions Distinction of biomaterial classes and characteristic uses Preparation of scaffolds, hydrogels and tailored surfaces Understanding of benefits and limitations of tissue engineering
Module contents	1. Course I-PhBT.1: Drug delivery • Characteristics of application routes • Basics of pharmacokinetics • Principles of protein formulation techniques • Rational based formulation development / Formulation Screening • Stabilization principles for proteins • Controlled Release: Principles, Materials and Kinetics 2. Course I-Ph.2: Covalent modifications of proteins • Posttranslational modifications found in nature, e. g. glycosylation, farnesylation, phosphorylation, protein-protein cross-linking, protein splicing, oxidation, etc. • Enzymes involved in posttranslational modification • Bio- and chemo-catalysis for the in vitro modification of proteins, e. g. PEGylation, transglutaminase, lysyl oxidase. • Application of biocatalysts in drug synthesis and enzyme technology, e. g. synthesis of semi-synthetic penicillins, synthesis of optically pure D-amino acids, regiospecific hydroxylation of steroids, etc. 3. Course I-PhBT.3: Advanced course on plant cell technology • Induction and subcultivation of plant cell cultures • Induction and cultivation of organ cultures • Selection of cell strains by cell aggregat and protoplast cloning • Introduction of foreign genetic material into plant cells • Expression of foreign genetic material using plant cell and hairy root cultures

- In vitro storage of plant cell culture and meristems by cryopreservation

4. Course I-PhBT.4: Biomaterials and devices

- Biomaterial classes and their general features
- Characteristics of natural and synthetic polymers
- Biomaterial device design and preparation techniques
- Biointerfaces, surface modification
- Bioreactors
- Ex vivo and in vivo tissue engineering
- Examples of devices in Regenerative Medicine

Forms of instruction	Seminar (8 SWS) Course
Languages of instruction	German, English
Duration (semesters)	1 Semester Semester
Module frequency	jedes Wintersemester
Module capacity	unlimited
Time of examination	
Credit points	10 CP
Share on module final degree	Course 1: %; Course 2: %.
Share of module grade on the course of study's final grade	1

Examination	Exam prerequisites	Type of examination
Course 1		
Course 2		
Final exam of module		Klausur
Exam repetition information		

Module course label	Course type	Course title	SWS	Workload of compulsory attendance	Workload of preparation / homework etc	Workload of independent learning	Workload (examination and preparation)	Sum workload
Course 1	Seminar	Project seminar	8					0
Course 2	Course	Private study						0
Workload by module						300		300
Total module workload								300

PHA.06114.01 - F-PhBT: Legal and economical aspects of pharmaceutical biotechnology

PHA.06114.01	5 CP
Module label	F-PhBT: Legal and economical aspects of pharmaceutical biotechnology
Module code	PHA.06114.01
Semester of first implementation	
Module used in courses of study / semesters	• Pharmaceutical and Industrial Biotechnology (MA120 LP) (Master) > Pharmazie PharmacIndusBiotech.MA120, Version of accreditation valid from WS 2019/20 > Spezialisierung Pharmaceutical Biotechnology • Pharmaceutical and Industrial Biotechnology (MA120 LP) (Master) > Pharmazie PharmacIndusBiotech.MA120, Version of accreditation (WS 2015/16 - SoSe 2023) > Spezialisierung Pharmaceutical Biotechnology
Responsible person for this module	
Further responsible persons	R. Szczesny
Prerequisites	
Skills to be acquired in this module	• Understanding of drug quality requirements, pre-requisites and activities • Basic knowledge of the European drug quality system • Connection of the European system with international regulations, differences and overlaps • Knowledge of basic concepts for GMP and on differences between European and US regulations • Knowledge of the basic concepts of a) Strategic & business planning (corporate, marketing, financial, R&D) b) value assessment of developmental projects and intellectual properties with simple standard methods (NPV, double-sided NPV, benchmarking etc) c) portfolio strategy d) structuring cooperation agreements e) patent assessment and trading intellectual properties (licensing) f) alliances and joint ventures • Drafting and evaluation of different forms of cooperation agreements • Calculating value of a particular product in development • Understanding and drafting a commercial term sheet for licensing of a particular product from a development to a distributor company • Drafting a business plan
Module contents	Course F-PhBT.1: Drug quality control - European and international standards and regulations • Requirements for drugs: efficacy, safety, quality • Drug quality: definitions, legal requirements, standards, methods • Good Manufacturing Practices, emphasis on quality; CPMP and ICH guidelines on quality • European, US, and other pharmacopoeiae of international importance Course F-PhBT.2: Good Manufacturing Practice %u2013 European and international regulations • European GMP regulations • Application of GMP guidelines for biotechnology • Aseptic processing • Qualification of materials and devices for pharmaceutical manufacturing • Process validation • GMP compliant documentation • Qualified persons in GMP manufacturing • Modern concepts for "Quality by Design" and Process Analytical Technology Course F-PhBT.3: Economical and marketing aspects, patents and licensing • Strategic planning

- Business Plan
- Value assessment
- Important legal issues for structuring different cooperation agreements
- Evaluation of Intellectual Properties
- Trading with Intellectual Properties
- Exercise Course based on a case study

Forms of instruction	Seminar (1 SWS) Course Seminar (1 SWS) Seminar (2 SWS)
Languages of instruction	German, English
Duration (semesters)	1 Semester Semester
Module frequency	jedes Sommersemester
Module capacity	unlimited
Time of examination	
Credit points	5 CP
Share on module final degree	Course 1: %; Course 2: %; Course 3: %; Course 4: %.
Share of module grade on the course of study's final grade	1

Examination	Exam prerequisites	Type of examination
Course 1		
Course 2		
Course 3		
Course 4		
Final exam of module		Klausur
Exam repetition information		

Module course label	Course type	Course title	SWS	Workload of compulsory attendance	Workload of preparation / homework etc	Workload of independent learning	Workload (examination and preparation)	Sum workload
Course 1	Seminar	Project seminar	1					0
Course 2	Course	Private study						0
Course 3	Seminar	Project seminar	1					0
Course 4	Seminar	Project seminar	2					0
Workload by module						150		150
Total module workload								150

PHA.06120.01 - K-PhBT: Biopharmaceuticals

PHA.06120.01	5 CP
Module label	K-PhBT: Biopharmaceuticals
Module code	PHA.06120.01
Semester of first implementation	
Module used in courses of study / semesters	• Pharmaceutical and Industrial Biotechnology (MA120 LP) (Master) > Pharmazie PharmacIndusBiotech.MA120, Version of accreditation valid from WS 2019/20 > Spezialisierung Pharmaceutical Biotechnology • Pharmaceutical and Industrial Biotechnology (MA120 LP) (Master) > Pharmazie PharmacIndusBiotech.MA120, Version of accreditation (WS 2015/16 - SoSe 2023) > Spezialisierung Pharmaceutical Biotechnology
Responsible person for this module	
Further responsible persons	H. Lilie
Prerequisites	Modules of the first semester (A-Both, B-PhBT, C-Both, D-Both)
Skills to be acquired in this module	• Knowledge of the concepts of the immune response • Basic knowledge about organs, cells and molecules of the immune system • Knowledge, how specific cellular and humoral immune responses are developed • Basic knowledge about autoimmune diseases • Basic knowledge about allergies • Knowledge about principles of tumor immunology including knowledge about selected examples of therapeutic anti-tumor antibodies • Knowledge about principles of vaccine development: selected examples from human and veterinary medicine • Basic knowledge about production/ selection and characterization of therapeutic mono-clonal antibodies and recombinant antibodies • Overview of the different types of monoclonal antibodies (mAbs) • Knowledge of the targets for mAbs • Knowledge of the PK and PD characteristics of mAbs • Insight into mAbs under clinical development • Insight into the currently approved mAbs • Understanding of antibody production: polyclonal antibodies from mice, monoclonal antibodies from hybridoma cells, recombinant antibodies from bacteria • Understanding of antibody action: specificity, affinity, avidity • Understanding the background and basics of different immunological tests: ELISA, Western blot and hemagglutination test • Understanding the production (phages, bacteria) and physical (Western blot) and functional (ELISA) characterization of different formats of recombinant antibodies: nanobod-ies, scFv. • Diseases relevant for DNA therapy • Functional aspects of therapeutic DNA • Delivery systems for DNA • Current therapy strategies
Module contents	Course K-PhBT.1 Vaccines, Immunology • Basic immunology about innate and specific immune response: Organs, cells and molecules of the immune system • Immune cell differentiation, B- and T-lymphocytes, development of the antibody and TCR repertoire • Interaction between cells and molecules in the immune system to develop specific humoral and cellular immune responses • Failures of the immune system: Basics of allergy and autoimmune disease • Basics of tumor immunology • Vaccines in application and in development • Antibodies for therapy and diagnosis Course K-PhBT.2: Clinical development of monoclonal antibodies • Basics of immunology • Technical and methodical basics of production/selection of monoclonal antibodies by classical methods and advanced modern technologies

- The selection of monoclonal recombinant antibodies of different formats by Phage Display, Screening
- Production of monoclonal antibodies in CHO cells including optimization of cell lines, cultivation, media, scale up as well as purification strategies and methods.
- Plant-based antibody production is generally explained with a specific focus to expression enhancement, purification tags and glycan-engineering.
- Mechanisms of action of therapeutic antibodies
- Antibody optimization wrt pharmacokinetical half-life extension, ADCC and CDC
- Development of therapeutic anti-tumour antibodies
- Approval and necessary tests to perform phase I, II and II trials.
- Bleeding of immunized mice, production of sera, characterization by ELISA and Western blot
- Observation of hybridoma cultures, harvest of supernantants, functional characterization by ELISA and Western blot
- Production of specific display phages, nanobodies and scFv in E. coli, physical
- Characterization by Western blot and functional characterization by competitive ELISA
- Characterization of potentially neutralizing anti H5N1 antibodies in an hemagglutination test with plant-derived Virus-Like-Particles (VLPs)

Course K-PhBT.3: DNA for gene therapy

- DNA therapy: monogenic diseases, cancer
- Therapeutic DNA: structure, preparation, quality control, biological requirements
- Delivery systems: viral, liposomes, others; advantages/disadvantages
- Experimental test systems, cell culture, animal model
- Current therapy protocols

Forms of instruction	Seminar (2 SWS) Seminar (3 SWS) Seminar (1 SWS) Course
Languages of instruction	German, English
Duration (semesters)	1 Semester Semester
Module frequency	jedes Wintersemester
Module capacity	unlimited
Time of examination	
Credit points	5 CP
Share on module final degree	Course 1: %; Course 2: %; Course 3: %; Course 4: %.
Share of module grade on the course of study's final grade	1

Examination	Exam prerequisites	Type of examination
Course 1		
Course 2		
Course 3		
Course 4		
Final exam of module	Attestation on project seminar contents, Protocol	Klausur
Exam repetition information		

Module course label	Course type	Course title	SWS	Workload of compulsory attendance	Workload of preparation / homework etc	Workload of independent learning	Workload (examination and preparation)	Sum workload
Course 1	Seminar	Project seminar	2					0
Course 2	Seminar	Project seminar	3					0
Course 3	Seminar	Project seminar	1					0
Course 4	Course	Private study						0
Workload by module						150		150
Total module workload								150

PHA.06109.02 - B-PhBT: Drug target identification and validation

PHA.06109.02	10 CP
Module label	B-PhBT: Drug target identification and validation
Module code	PHA.06109.02
Semester of first implementation	
Module used in courses of study / semesters	• Pharmaceutical and Industrial Biotechnology (MA120 LP) (Master) > Pharmazie PharmacIndusBiotech.MA120, Version of accreditation valid from WS 2019/20 > Spezialisierung Pharmaceutical Biotechnology • Pharmaceutical and Industrial Biotechnology (MA120 LP) (Master) > Pharmazie PharmacIndusBiotech.MA120, Version of accreditation (WS 2015/16 - SoSe 2023) > Spezialisierung Pharmaceutical Biotechnology
Responsible person for this module	
Further responsible persons	W. Sippl
Prerequisites	
Skills to be acquired in this module	• Basic understanding of drug substances and drug targets • Knowledge of methods and illustrative examples of drug target identification and validation - Basic understanding of the connection between molecular and clinical effects of drug substances • Knowledge on enzyme classes and mechanisms relevant for the selective synthesis of active compounds and chemicals • Basic knowledge on enzyme screening, characterization, and selectivity • Basic knowledge on enzyme and reaction engineering • Application of proteomics methods to diseases • Basic understanding of protein based diseases • Basic understanding of approaches to diagnose protein based diseases with focus on neurological disorders • Knowledge of the basic concepts of Computational Biology and Bioinformatics • A first and transparent introduction in comparative modeling and molecular dynamics simulations • Concepts of analyzing proteins/drug targets in 3D • Principles of modeling biological data
Module contents	Course B-PhBT.1: General aspects of drug target identification and validation • Definition and characteristics of drug substances • Definition and characteristics of molecular drug targets • Interaction of drug substances and drug targets • Propagation of molecular drug effects • Methods and techniques for the identification and validation of drug targets • Correlation and causality of molecular and clinical drug effects Course B-PhBT.2: Biocatalysis for drug and chemical syntheses • What are the benefits of biocatalysis? • Enzyme classes and their relevance for the biocatalytic production of active compounds and chemicals • Basic molecular mechanisms of enzyme catalysis • Screening for suitable enzyme activities • Enzyme purification and characterization • Chirality and how it is achieved by enzymes %u2013 kinetic resolution %u2013 asymmetric synthesis • Application modes of biocatalysis %u2013 in vitro and in vivo applications • Improvement of enzyme properties o Directed mutagenesis o Directed evolution • Basics of reaction engineering and cofactor regeneration • Examples of industrial applications

Course B-PhBT.3: Protein based diseases

- General overview on diseases caused by proteins
- Protein misfolding and aggregation in neurological diseases
- Cerebrospinal fluid and blood biomarkers in neurodegenerative disorders
- Metabolic myopathies

4. Course B-PhBT.4: Protein modeling and simulation

- Introduction to Bioinformatics and comparative/homology modeling
- Introduction in sequence alignment techniques
- Analyzing protein structures
- Commonly used force fields for protein simulations
- Introduction to Molecular Dynamics
- Introduction to docking simulations

Forms of instruction	Seminar (9 SWS) Course
Languages of instruction	German, English
Duration (semesters)	1 Semester Semester
Module frequency	jedes Wintersemester
Module capacity	unlimited
Time of examination	
Credit points	10 CP
Share on module final degree	Course 1: %; Course 2: %.
Share of module grade on the course of study's final grade	1

Examination	Exam prerequisites	Type of examination
Course 1		
Course 2		
Final exam of module		Klausur
Exam repetition information		

Module course label	Course type	Course title	SWS	Workload of compulsory attendance	Workload of preparation / homework etc	Workload of independent learning	Workload (examination and preparation)	Sum workload
Course 1	Seminar	Project seminar	9					0
Course 2	Course	Private study						0
Workload by module						300		300
Total module workload								300

Spezialisierung Industrial Biotechnology

PHA.06112.02 - B-InBT: Introduction to Chemical Biotechnology

PHA.06112.02	10 CP
Module label	B-InBT: Introduction to Chemical Biotechnology
Module code	PHA.06112.02
Semester of first implementation	
Module used in courses of study / semesters	• Pharmaceutical and Industrial Biotechnology (MA120 LP) (Master) > Pharmazie PharmacIndusBiotech.MA120, Version of accreditation valid from WS 2019/20 > Spezialisierung Industrial Biotechnology • Pharmaceutical and Industrial Biotechnology (MA120 LP) (Master) > Pharmazie PharmacIndusBiotech.MA120, Version of accreditation (WS 2015/16 - SoSe 2023) > Spezialisierung Industrial Biotechnology
Responsible person for this module	
Further responsible persons	B. Junker
Prerequisites	
Skills to be acquired in this module	• Basic knowledge of natural products (terpenes, fatty acids, proteins, carbohydrates and selected alkaloids) - Basic knowledge of daily occurring products (fibers, dyes, tensides, selected drugs, renewable resources) - Knowledge on enzyme classes and mechanisms relevant for the selective synthesis of active compounds and chemicals - Basic knowledge on enzyme screening, characterization, and selectivity - Basic knowledge on enzyme and reaction engineering - Basic knowledge of methods in top-down systems biology (-omics methods, statistics) - Basic knowledge of methods in bottom-up systems biology (modeling and simulation of biological networks) - Basic knowledge of the principles and objectives of metabolic engineering - Basic knowledge of methods in metabolic engineering (gene identification, gene isolation, gene expression and its optimization)
Module contents	Course B-InBT.1 Basics of organic chemistry of natural products • Biosynthetic basic organic reactions • Terpenes, Steroids: basic structural principles, biological action • Fats, oils, waxes: basic structural principles, biological action • Carbohydrates: Mono-, di- and polysaccharides, basic structural principles, biological action • Amino acids, peptides, proteins: basic structural principles, biological action • Alkaloids, heteroccycles: basic structural principles, biological action • Selected classes of other natural products (changing, e. g. polyketides). • Fibres: cotton, wool, silk, artificial fibres • Dyes: basic principles, natural congeners, industrial and biological importance • Tensides: mode of action, sustainability Course B.InBT.2: Biocatalysis for drug and chemical syntheses • What are the benefits of biocatalysis? • Enzyme classes and their relevance for the biocatalytic production of active compounds and chemicals • Basic molecular mechanisms of enzyme catalysis • Screening for suitable enzyme activities • Enzyme purification and characterization • Chirality and how it is achieved by enzymes %u2013 kinetic resolution %u2013 asymmetric synthesis • Application modes of biocatalysis %u2013 in vitro and in vivo applications • Improvement of enzyme properties o Directed mutagenesis o Directed evolution

- Basics of reaction engineering and cofactor regeneration
- Examples of industrial applications

Course B-InBT.3 Basics of systems biology

- What is systems biology?
- Definitions: Top-down and bottom-up systems biology
- High-throughput technologies (genome sequencing, transcriptomics, proteomics, metabolomics)
- Data analysis and visualization (clustering, graphs, over-representation analysis)
- Principles of mathematical modeling of biological networks

Course B-InBT.4 Basics of metabolic engineering

- Why metabolic engineering? (Process optimization, production of chemicals using renewable resources, new chemicals, chemical sourcing)
- Objects of metabolic engineering (biofuels, commodity chemicals/high value products) and associated constraints (regulatory, environmental, process, financial)
- Methods in metabolic engineering: Gene identification and sourcing (literature and genome data mining, pathway discovery), different host types (microorganisms, algae, plants)
- Engineering optimization based on metabolic modelling
- Optimization based on improvement of gene expression (codon optimization, expression levels, protein stabilization, enzymatic properties)
- Plant metabolic engineering: Potential, challenges and current progress

Forms of instruction	Seminar (8 SWS) Course
Languages of instruction	German, English
Duration (semesters)	1 Semester Semester
Module frequency	jedes Wintersemester
Module capacity	unlimited
Time of examination	
Credit points	10 CP
Share on module final degree	Course 1: %; Course 2: %.
Share of module grade on the course of study's final grade	1

Examination	Exam prerequisites	Type of examination
Course 1		
Course 2		
Final exam of module		Klausur
Exam repetition information		

Module course label	Course type	Course title	SWS	Workload of compulsory attendance	Workload of preparation / homework etc	Workload of independent learning	Workload (examination and preparation)	Sum workload
Course 1	Seminar	Project Seminar	8					0
Course 2	Course	Private study						0
Workload by module						300		300
Total module workload								300

PHA.06121.01 - K-InBT: Systems- and Synthetic Biology

PHA.06121.01	5 CP
Module label	K-InBT: Systems- and Synthetic Biology
Module code	PHA.06121.01
Semester of first implementation	
Module used in courses of study / semesters	• Pharmaceutical and Industrial Biotechnology (MA120 LP) (Master) > Pharmazie PharmacIndusBiotech.MA120, Version of accreditation valid from WS 2019/20 > Spezialisierung Industrial Biotechnology • Pharmaceutical and Industrial Biotechnology (MA120 LP) (Master) > Pharmazie PharmacIndusBiotech.MA120, Version of accreditation (WS 2015/16 - SoSe 2023) > Spezialisierung Industrial Biotechnology
Responsible person for this module	
Further responsible persons	A. Tissier
Prerequisites	Modules of the first semester (A-Both, B-PhBT, C-Both, D-Both)
Skills to be acquired in this module	• Knowledge of latest methods and approaches in molecular/modular cloning • Overview of the various domains of synthetic biology • Introduction to modeling of biological systems and networks • Practical experience in modular cloning methods • Practical experience in metabolic modeling
Module contents	Course K-InBT.1: Synthetic Biology • Synthetic biology introduction: one word, many aspects %u2013 from modular cloning to genome assembly • Molecular biology techniques: Gibson assembly and recombination based systems, re-striction enzyme based cloning systems (Golden Gate). • Concept of standard parts and modular cloning systems • Regulatory circuits and switches Course K-InBT.2: Systems Biology • Modeling of biological networks (linear systems, dynamic systems; metabolic networks, regulatory networks) • Simulation of models of biological networks and analysis of results (steady states and their stability, non-linear dynamics) Course K-InBT.3: Project seminar • Introduction to Golden Gate cloning and modular assembly • Application for metabolic engineering in yeast and/or Nicotiana benthamiana • Stoichiometric modeling with CellNetAnalyzer • Kinetic modeling with Copasi
Forms of instruction	Seminar (5 SWS) Course
Languages of instruction	German, English
Duration (semesters)	1 Semester Semester
Module frequency	jedes Wintersemester
Module capacity	unlimited
Time of examination	
Credit points	5 CP
Share on module final degree	Course 1: %; Course 2: %.
Share of module grade on the course of study's final grade	1

Examination			Exam prerequisites			Type of examination		
Course 1								
Course 2								
Final exam of module			Attestation on project seminar contents, Protocol, Oral presentation on a current research topic			Klausur		
Exam repetition information								
Module course label	Course type	Course title	SWS	Workload of compulsory attendance	Workload of preparation / homework etc	Workload of independent learning	Workload (examination and preparation)	Sum workload
Course 1	Seminar	Project seminar	5					0
Course 2	Course	Selbststudium						0
Workload by module						150		150
Total module workload								150

PHA.06115.01 - F-InBT: Agro- and Economical Aspects of biotechnology

PHA.06115.01	5 CP
Module label	F-InBT: Agro- and Economical Aspects of biotechnology
Module code	PHA.06115.01
Semester of first implementation	
Module used in courses of study / semesters	• Pharmaceutical and Industrial Biotechnology (MA120 LP) (Master) > Pharmazie PharmacIndusBiotech.MA120, Version of accreditation valid from WS 2019/20 > Spezialisierung Industrial Biotechnology • Pharmaceutical and Industrial Biotechnology (MA120 LP) (Master) > Pharmazie PharmacIndusBiotech.MA120, Version of accreditation (WS 2015/16 - SoSe 2023) > Spezialisierung Industrial Biotechnology
Responsible person for this module	
Further responsible persons	R. Szczesny
Prerequisites	
Skills to be acquired in this module	• Knowledge on the importance of different crops as renewable resources • Specific agronomic and husbandry for major crops in relation to the use as a renewable resource • Practical examples of full value chains in renewable resource production based on crops • Knowledge of the basic concepts of a) Strategic & business planning (corporate, marketing, financial, R&D) b) value assessment of developmental projects and intellectual properties with simple standard methods (NPV, double-sided NPV, benchmarking etc) c) portfolio strategy d) structuring cooperation agreements e) patent assessment and trading intellectual properties (licensing) f) alliances and joint ventures • Drafting and evaluation of different forms of cooperation agreements • Calculating value of a particular product in development • Understanding and drafting a commercial term sheet for licensing of a particular product from a development to a distributor company • Drafting a business plan
Module contents	Course F-InBT.1: Agronomic aspects of renewable resources • Breeding for industrial crops • Crop rotations with industrial crops • Tillage for industrial crops • Fertilization for industrial uses • Environmental effects of industrial crops Course F-InBT.2: Economical and marketing aspects, patents and licensing • Strategic planning • Business Plan • Value assessment • Important legal issues for structuring different cooperation agreements • Evaluation of Intellectual Properties • Trading with Intellectual Properties • Exercise Course based on a case study
Forms of instruction	Seminar (2 SWS) Seminar (2 SWS) Course
Languages of instruction	German, English
Duration (semesters)	1 Semester Semester

PHA.06115.01 5 CP

Module frequency	jedes Sommersemester
Module capacity	unlimited
Time of examination	
Credit points	5 CP
Share on module final degree	Course 1: %; Course 2: %; Course 3: %.
Share of module grade on the course of study's final grade	1

Examination	Exam prerequisites	Type of examination
Course 1		
Course 2		
Course 3		
Final exam of module		Klausur
Exam repetition information		

Module course label	Course type	Course title	SWS	Workload of compulsory attendance	Workload of preparation / homework etc	Workload of independent learning	Workload (examination and preparation)	Sum workload
Course 1	Seminar	Project seminar	2					0
Course 2	Seminar	Project seminar	2					0
Course 3	Course	Private study						0
Workload by module						150		150
Total module workload								150