Julius-Maximilians-
UNIVERSITÄT
WÜRZBURG

Module Catalogue

for the Subject

Biofabrication

as a Master's with 1 major

with the degree "Master of Science"

(120 ECTS credits)

Examination regulations version: 2027
Responsible: Faculty of Chemistry and Pharmacy

Contents

The subject is divided into 3
Learning Outcomes 4
Abbreviations used, Conventions, Notes, In accordance with 6
Compulsory Courses 7
Theoretical Basics of Biofabrication 8
Polymers II 9
Biofabrication 10
Materials Science 3 11
Tissue cells meet materials 12
Practical Biofabrication 13
BioFab Research-Thesis 1 14
BioFab Research-Thesis 2 15
Compulsory Electives 16
Theoretical Biofabrication 17
Carrier materials and devices for therapeutic compounds 18
Principles of Cell Biology and Tissue Regeneration 19
Supramolecular Chemistry (Basics) 20
Polymer Materials 1: Technology of Polymer Modification 21
Thesis 22
Master-Thesis Biofabrication 23
Final Colloquium 24
Compulsory Courses Practical Biofabrication Double Degree 25
Practical Biofabrication 26
BioFab Research-Thesis 1 27
BioFab Research-Thesis 2 28
Compulsory Electives Theoretical Biofabrication Double Degree 29
Theoretical Biofabrication 30
Polymers II 31
Biofabrication 32
Physical Chemistry of Supramolecular Assemblies 33
Tissue cells meet materials 34
Carrier materials and devices for therapeutic compounds 35
Supramolecular Chemistry (Basics) 36
Principles of Cell Biology and Tissue Regeneration 37
Polymer Materials 1: Technology of Polymer Modification 38
Courses at the partner university (BioFab Master) 39
Thesis 40
Master-Thesis Biofabrication 41
Final Colloquium 42

The subject is divided into

section / sub-section	ECTS credits	starting page
Compulsory Courses	80	7
Theoretical Basics of Biofabrication	20	8
Practical Biofabrication	60	13
Compulsory Electives	10	16
Theoretical Biofabrication	10	17
Thesis	30	22
Compulsory Courses Practical Biofabrication Double Degree	60	25
Practical Biofabrication	60	26
Compulsory Electives Theoretical Biofabrication Double Degree	30	29
Theoretical Biofabrication	30	30
Thesis	30	40

Learning Outcomes

German contents and learning outcome available but not translated yet.

Wissenschaftliche Befähigung

- Die Absolventinnen und Absolventen können ein breites und vertieftes interdisziplinäres Wissen aus den wichtigsten Disziplinen der Biofabrikation abrufen. Sie verstehen die mathematischen, chemischen und physikalischen Grundlagen der Biofabrikation sowohl theoretisch als auch praktisch und können diese selbständig anwenden. Sie besitzen Abstraktionsvermögen, analytisches Denken, Problemlösungskompetenz und die Fähigkeit, komplexe Zusammenhänge zu strukturieren.
- Die Absolventinnen und Absolventen kennen das Leitbild der nachhaltigen Entwicklung mit seinen ökologischen, sozialen und wirtschaftlichen Dimensionen und die damit verbundenen globalen Herausforderungen sowie die globalen UN-Ziele für nachhaltige Entwicklung (SDGs) und die Konzepte planetarer Belastungsgrenzen. Die Grundlagen hierfür werden im ersten Semester in Vorlesungen und Übungen der Chemie und Medizin vermittelt und mittels Klausuren überprüft.
- Die Absolventinnen und Absolventen können selbständig Experimente durchführen, analysieren und die erhaltenen Ergebnisse darstellen und bewerten. Vermittelt werden diese Fähigkeiten im Rahmen der Projektarbeiten. Die Überprüfung der Zielerreichung findet durch die Erstellung einer Projektarbeit und deren Präsentation in englischer Sprache mit anschließender englischsprachiger Diskussion statt.
- Weiterhin sind die Absolventinnen und Absolventen in der Lage, sich mit Hilfe von Fachliteratur in neue komplexe interdisziplinäre Aufgabengebiete selbständig einzuarbeiten, naturwissenschaftliche Methoden selbständig auf konkrete experimentelle oder theoretische Aufgabenstellungen anzuwenden, Lösungswege zu entwickeln und die Ergebnisse zu interpretieren und zu bewerten. Sie sind in der Lage, aus der Perspektive der Biofabrikation komplexe wissenschaftlich begründete Lösungsansätze für Nachhaltigkeitsherausforderungen zu erarbeiten, weiterzuentwickeln und kritisch zu reflektieren. Auch diese Fähigkeiten werden im Rahmen Projektarbeiten sowie der Masterarbeit entwickelt und durch die anschließende Bewertung der Arbeit überprüft.
- Die Absolventinnen und Absolventen können darüber hinaus ihr Wissen und ihre Erkenntnisse einem Fachpublikum gegenüber darstellen und vertreten, was durch das Abschlusskolloquium zur Masterarbeit überprüft wird.

Befähigung zur Aufnahme einer Erwerbstätigkeit

- Die Absolventinnen und Absolventen können mit wissenschaftlichen Methoden auch unbekannte Probleme aus unterschiedlichen fachlichen Perspektiven analysieren und bearbeiten.
- Die Absolventinnen und Absolventen können z. B. Nachhaltigkeitsfragen aus der Perspektive der Biofabrikation vertieft interdisziplinär bearbeiten. Sie sind befähigt, verschiedene Sichtweisen zu analysieren, zielorientiert zu integrieren und in berufliche Entscheidungs- und Handlungsprozesse einzubeziehen. Der interdisziplinäre Aufbau des Studiengangs, der Elemente aus medizinisch- und naturwissenschaftlichen Fachbereichen vereint und auch grundlegende mechatronische Fähigkeiten vermittelt, fördert von Beginn an interdisziplinäres Lernen, Denken und Verstehen. Dies wird durch den Besuch von Lehrveranstaltungen der Chemie und Medizin vermittelt und durch die erfolgreiche Absolvierung der Module bestätigt. Diese Problemlösungskompetenz können die Absolventinnen und Absolventen gewinnbringend in ihrer Berufspraxis einsetzen, so dass sie erfolgreich an der zukünftigen Weiterentwicklung von Biofabrikations- und 3D- Druck-Technologien teilhaben können.
- Die Absolventinnen und Absolventen sind darüber hinaus in der Lage, theoretisches Wissen in der Praxis anzuwenden. Der Praxisbezug ist durch die praxisnahe Forschung der Kooperations-

partner gegeben, in deren Einrichtungen die Studierenden die Projektarbeiten anfertigen. Überprüft wird diese Fähigkeit durch Projektarbeiten und nicht zuletzt die Abschlussarbeit.

- Absolventinnen und Absolventen sind in der Lage, konstruktiv und zielorientiert in einem heterogenen Team zusammenzuarbeiten, unterschiedliche und abweichende Ansichten produktiv zur Zielerreichung zu nutzen und auftretende Konflikte zu lösen. Diese Teamfähigkeit und Konfliktkompetenz erlernen die Studierenden in der Zusammenarbeit in Arbeitskreisen während der Anfertigung der Projekt- und Abschlussarbeit in verschiedenen Ländern und Kulturen.

Persönlichkeitsentwicklung

- Die Absolventinnen und Absolventen können ihre erworbenen Kompetenzen in unterschiedlichen interkulturellen Kontexten anwenden. Dies üben sie im Rahmen der zwei halbjährigen Projektarbeiten, die im Ausland stattfinden. Im Rahmen des Auslandsaufenthaltes erlernen die Studierenden ebenfalls sich in einem heterogenen Umfeld zu bewegen und abweichende Meinungen und Herangehensweise konstruktiv auf ein gemeinsames Ziel hin einzubinden.
- Die Absolventinnen und Absolventen verfügen demnach über eine ausgeprägte Toleranz und Kooperationsbereitschaft über kulturelle Grenzen hinweg. Ebenso verfügen sie über die Bereitschaft und Befähigung zum selbstständigen und selbstverantwortlichen Lernen und Arbeiten und damit über die Bereitschaft zum lebenslangen Lernen.
- Die Absolventinnen und Absolventen reflektieren ihre eigene Rolle und Verantwortung auch im Kontext der globalen Herausforderungen und der Nachhaltigkeit. Sie entwickeln ein wertebewusstes professionelles Selbstverständnis. Die Zielerreichung wird durch das erfolgreiche Bestehen der Projektarbeiten überprüft, die in einer fremden kulturellen Umgebung erstellt und in einer Fremdsprache verfasst wird.

Gesellschaftliches Engagement

- Die Absolventinnen und Absolventen können gesellschaftliche, naturwissenschaftliche, kulturelle wie auch wirtschaftliche Entwicklungen kritisch reflektieren und deren Auswirkungen auf die Wirtschaft, Gesellschaft und die Umwelt erfassen.
- Die Absolventinnen und Absolventen können z. B. wissenschaftliche und gesellschaftliche Entwicklungen im Nachhaltigkeitskontext mit Bezug zur Biofabrikation kritisch reflektieren und ihre vertieften fachlichen Kompetenzen in Gestaltungs- und Entscheidungsprozesse einbringen. Sowohl in Vorlesungen als auch im Rahmen der Projekt- und Abschlussarbeiten setzen sich die Studierenden mit aktuellen Forschungsthemen selbständig und kritisch auseinander und es werden Grundlagen der guten wissenschaftlichen Praxis, ethische Belange und wirtschaftliche Entwicklungen in dem Fachgebiet vermittelt. Hierzu gehört auch die Reflexion ethischer Folgen der eigenen Arbeit für Wirtschaft und Gesellschaft. Die Zielerreichung wird durch das erfolgreiche Bestehen der Projekt- und Abschlussarbeiten überprüft, in letzterer werden die genannten Themen diskutiert.

Abbreviations used

Course types: **E** = field trip, **K** = colloquium, **O** = conversatorium, **P** = placement/lab course, **R** = project, **S** = seminar, **T** = tutorial, **Ü** = exercise, **V** = lecture

Term: **SS** = summer semester, **WS** = winter semester

Methods of grading: **NUM** = numerical grade, **B/NB** = (not) successfully completed

Regulations: **(L)ASPO** = general academic and examination regulations (for teaching-degree programmes), **FSB** = subject-specific provisions, **SFB** = list of modules

Other: **A** = thesis, **LV** = course(s), **PL** = assessment(s), **TN** = participants, **VL** = prerequisite(s)

Conventions

Unless otherwise stated, courses and assessments will be held in German, assessments will be offered every semester and modules are not creditable for bonus.

Notes

Should there be the option to choose between several methods of assessment, the lecturer will agree with the module coordinator on the method of assessment to be used in the current semester by two weeks after the start of the course at the latest and will communicate this in the customary manner.

Should the module comprise more than one graded assessment, all assessments will be equally weighted, unless otherwise stated below.

Should the assessment comprise several individual assessments, successful completion of the module will require successful completion of all individual assessments.

In accordance with

the general regulations governing the degree subject described in this module catalogue:

ASPO2015

associated official publications (FSB (subject-specific provisions)/SFB (list of modules)):

??-???-2026 (2026-??)

This module handbook seeks to render, as accurately as possible, the data that is of statutory relevance according to the examination regulations of the degree subject. However, only the FSB (subject-specific provisions) and SFB (list of modules) in their officially published versions shall be legally binding. In the case of doubt, the provisions on, in particular, module assessments specified in the FSB/SFB shall prevail.

Compulsory Courses

(80 ECTS credits)

Theoretical Basics of Biofabrication

(20 ECTS credits)

Module title			Abbreviation
Polymers II			03-FU-PM2-272-m01
Module coordinator			**Module offered by**
holder of the Chair of Functional Materials in Medicine and Dentistry			Chair of Chemical Technology of Material Synthesis, Faculty of Medicine
ECTS	**Method of grading**	**Only after succ. compl. of module(s)**	
5	numerical grade	--	
Duration	**Module level**	**Other prerequisites**	
1 semester	graduate	--	

Contents

Basics as well as advanced knowledge about contemporary issues of polymer synthesis, -modification and characterization.

Intended learning outcomes

The student has advanced knowledge of the synthesis, modification and characterization of polymers.

Courses (type, number of weekly contact hours, language — if other than German)

V (2) + P (2)
Module taught in: English

Method of assessment (type, scope, language — if other than German, examination offered — if not every semester, information on whether module is creditable for bonus)

a) written examination (approx. 90 minutes) or
b) oral examination of one candidate each (20 to 30 minutes) or
c) talk (approx. 30 minutes)
Language of assessment: English
Assessment offered: Once a year, summer semester
Internship: creditable for bonus

Allocation of places

--

Additional information

--

Workload

150 h

Teaching cycle

--

Referred to in LPO I (examination regulations for teaching-degree programmes)

--

Module title			Abbreviation
Biofabrication			03-BIOFAB-272-m01
Module coordinator			**Module offered by**
holder of the Chair of Functional Materials in Medicine and Dentistry			Faculty of Medicine
ECTS	**Method of grading**	**Only after succ. compl. of module(s)**	
5	numerical grade	--	
Duration	**Module level**	**Other prerequisites**	
1 semester	graduate	--	

Contents

Definitions within biomaterials, tissue engineering and biofabrication, overview of medical device regulations and practices, description of extracellular matrix, bioprinting, continuous liquid interface polymerisation, two-photon polymerisation, fused deposition modelling, inorganic powder printing, stereolithography, selective laser sintering, melt electrospinning writing, self-healing hydrogels, polymers in 3D printing, introduction to rheology, scientific method and reproducibility, digital signal generation and quality control.

Intended learning outcomes

Students gain a thorough appreciation of the different additive manufacturing (3D printing) technologies available in the context of biofabrication. This includes how the polymers are processed and how each class of 3D printer works, with its strengths and weaknesses. A holistic view of biofabrication is taught, with an understanding of scientific methodology for each stage and the different regulations governing medical devices. Students will acquire the necessary skills to critique and develop opinions on the 3D printing industry and the resulting biomedical applications.

Courses (type, number of weekly contact hours, language — if other than German)

V (2) + Ü (1) + P (1)
Module taught in: English

Method of assessment (type, scope, language — if other than German, examination offered — if not every semester, information on whether module is creditable for bonus)

a) written examination (approx. 90 minutes) or
b) oral examination of one candidate each (20 to 30 minutes) or
c) talk (approx. 30 minutes)
Language of assessment: English

Allocation of places

--

Additional information

--

Workload

150 h

Teaching cycle

--

Referred to in LPO I (examination regulations for teaching-degree programmes)

--

Module title			Abbreviation
Materials Science 3			08-FU-MaWi3-272-m01
Module coordinator			**Module offered by**
holder of the Chair of Functional Materials in Medicine and Dentistry			Chair of Chemical Technology of Material Synthesis
ECTS	**Method of grading**	**Only after succ. compl. of module(s)**	
5	numerical grade	--	
Duration	**Module level**	**Other prerequisites**	
1 semester	undergraduate	--	

Contents

The module covers advanced topics in current areas of materials science, such as polymeric materials, nanoparticles, and solids.

Intended learning outcomes

Students acquire a comprehensive understanding of modern materials. This includes the production, characterization, properties and application of materials.

Courses (type, number of weekly contact hours, language — if other than German)

V (2) + Ü (2)
Module taught in: English

Method of assessment (type, scope, language — if other than German, examination offered — if not every semester, information on whether module is creditable for bonus)

a) written examination (approx. 90 to 180 minutes) or
b) oral examination of one candidate each (20 to 30 minutes) or
c) oral examination in groups of up to 3 candidates (approx. 15 minutes per candidate) or
d) log (approx. 20 pages) or
e) presentation (approx. 30 minutes)
Language of assessment: English

Allocation of places

--

Additional information

--

Workload

150 h

Teaching cycle

--

Referred to in LPO I (examination regulations for teaching-degree programmes)

--

Module title			Abbreviation
Tissue cells meet materials			03-GEWMAT-272-m01
Module coordinator			**Module offered by**
holder of the Chair of Tissue Engineering and Regenerative Medicine			Chair of Chemical Technology of Material Synthesis
ECTS	**Method of grading**	**Only after succ. compl. of module(s)**	
5	numerical grade	--	
Duration	**Module level**	**Other prerequisites**	
1 semester	--	--	

Contents

The module teaches the following contents: The cell culture techniques required for the construction of artificial tissues (tissue or also bioengineering), the basics of constructing such models using suitable (bio)materials, the use of such models as alternative test systems to animal experimentation. Another topic is the development of cell-based transplants, medical devices and drugs, as well as the regulatory basis for their approval (REACH, GLP, GMP, etc.).

Intended learning outcomes

Students will gain content-related and methodological insights into current key topics in tissue engineering as well as the use of these tissues as substitutes for animal models or as transplants in regenerative medicine.

Courses (type, number of weekly contact hours, language — if other than German)

V (2) + P (2)
Module taught in: English

Method of assessment (type, scope, language — if other than German, examination offered — if not every semester, information on whether module is creditable for bonus)

a) report on practical training (approx. 10 pages) and
b) presentation (approx. 30 minutes) or written examination (approx. 90 minutes)
Language of assessment: English

Allocation of places

--

Additional information

--

Workload

150 h

Teaching cycle

--

Referred to in LPO I (examination regulations for teaching-degree programmes)

--

Practical Biofabrication

(60 ECTS credits)

Module title			Abbreviation
BioFab Research-Thesis 1			08-BFFP1-272-m01
Module coordinator		**Module offered by**	
chairperson of examination committee Biofabrikation (Biofabrication)		Chair of Biochemistry	
ECTS	**Method of grading**	**Only after succ. compl. of module(s)**	
30	numerical grade	--	
Duration	**Module level**	**Other prerequisites**	
1 semester	graduate	--	

Contents

This module gives students the opportunity to enhance their skills in advanced synthesis and analytical methods in biofabrication. Students will be expected to conduct their work in the lab independently, write a lab report documenting their findings and deliver a presentation.

Intended learning outcomes

Students are able to use advanced synthesis and analytical methods in biofabrication in the lab and to interpret their findings. They are able to write a lab report documenting their findings and deliver a presentation.

Courses (type, number of weekly contact hours, language — if other than German)

P (0)
Module taught in: English

Method of assessment (type, scope, language — if other than German, examination offered — if not every semester, information on whether module is creditable for bonus)

report on practical course (40 to 60 pages) and talk (approx. 20 to 30 minutes)
Language of assessment: English

Allocation of places

--

Additional information

--

Workload

900 h

Teaching cycle

--

Referred to in LPO I (examination regulations for teaching-degree programmes)

--

Module title			Abbreviation
BioFab Research-Thesis 2			08-BFFP2-272-m01
Module coordinator		**Module offered by**	
chairperson of examination committee Biofabrikation (Biofabrication)		Chair of Biochemistry	
ECTS	**Method of grading**	**Only after succ. compl. of module(s)**	
30	numerical grade	--	
Duration	**Module level**	**Other prerequisites**	
1 semester	graduate	--	

Contents

This module gives students the opportunity to enhance their skills in advanced synthesis and analytical methods in biofabrication. Students will be expected to conduct their work in the lab independently, write a lab report documenting their findings and deliver a presentation.

Intended learning outcomes

Students are able to use advanced synthesis and analytical methods in biofabrication in the lab and to interpret their findings. They are able to write a lab report documenting their findings and deliver a presentation.

Courses (type, number of weekly contact hours, language — if other than German)

P (0)
Module taught in: English

Method of assessment (type, scope, language — if other than German, examination offered — if not every semester, information on whether module is creditable for bonus)

report on practical course (40 to 60 pages) and talk (approx. 20 to 30 minutes)
Language of assessment: English

Allocation of places

--

Additional information

--

Workload

900 h

Teaching cycle

--

Referred to in LPO I (examination regulations for teaching-degree programmes)

--

Compulsory Electives

(10 ECTS credits)

Theoretical Biofabrication

(10 ECTS credits)

Module title			Abbreviation
Carrier materials and devices for therapeutic compounds			03-SP3A1-272-m01
Module coordinator			**Module offered by**
holder of the Chair of Functional Materials in Medicine and Dentistry			Faculty of Medicine
ECTS	**Method of grading**	**Only after succ. compl. of module(s)**	
5	numerical grade	--	
Duration	**Module level**	**Other prerequisites**	
1 semester	graduate	--	

Contents

Integration and binding of active agents in particles, functionalisation of particles for (intracellular) transport processes, targeting and release of the active agents.

Intended learning outcomes

Students have developed a knowledge of the integration and binding of active agents in particles and of the functionalisation of particles for (intracellular) transport processes, targeting and release of active agents.

Courses (type, number of weekly contact hours, language — if other than German)

V (2) + P (1)
Module taught in: German and/or English

Method of assessment (type, scope, language — if other than German, examination offered — if not every semester, information on whether module is creditable for bonus)

a) report on practical course (approx. 10 pages) and
b) written examination (approx. 90 minutes) or presentation (approx. 30 minutes)
Language of assessment: German and/or English

Allocation of places

--

Additional information

--

Workload

150 h

Teaching cycle

--

Referred to in LPO I (examination regulations for teaching-degree programmes)

--

Module title			Abbreviation
Principles of Cell Biology and Tissue Regeneration			03-FU-Zell-272-m01
Module coordinator		**Module offered by**	
holder of the Chair of Orthopaedics (Jakob/Ebert)		Faculty of Medicine	
ECTS	**Method of grading**	**Only after succ. compl. of module(s)**	
5	numerical grade	--	
Duration	**Module level**	**Other prerequisites**	
1 semester	undergraduate	--	

Contents

Foundations of cell biology (cell structure, organelles, DNA, replication, protein biosynthesis, signal transduction, cell metabolism, stem cells, viruses and prokaryotes, immune system).

Intended learning outcomes

Students acquire fundamental knowledge in cell and molecular biology.

Courses (type, number of weekly contact hours, language — if other than German)

V (4)
Module taught in: German and/or English

Method of assessment (type, scope, language — if other than German, examination offered — if not every semester, information on whether module is creditable for bonus)

a) written examination (approx. 90 to 180 minutes) or
b) oral examination of one candidate each (20 to 30 minutes) or
c) oral examination in groups of up to 3 candidates (approx. 15 minutes per candidate) or
d) log (approx. 20 pages) or
e) presentation (approx. 30 minutes)
Language of assessment: German and/or English

Allocation of places

--

Additional information

--

Workload

150 h

Teaching cycle

--

Referred to in LPO I (examination regulations for teaching-degree programmes)

--

Module title			Abbreviation
Supramolecular Chemistry (Basics)			08-SCM1-161-m01
Module coordinator		**Module offered by**	
lecturer of the seminar "Supramolecular Chemistry (Basics)"		Institute of Organic Chemistry	
ECTS	**Method of grading**	**Only after succ. compl. of module(s)**	
5	numerical grade	--	
Duration	**Module level**	**Other prerequisites**	
1 semester	graduate	--	

Contents

This module introduces students to the fundamental principles of supramolecular chemistry. It focuses on interactions between molecules, molecular recognition by receptors, complexes, supramolecular polymers, coordination polymers and networks, liquid crystals, self-assembly in aqueous media, synthetic ion channels and modern applications of supramolecular chemistry.

Intended learning outcomes

Students are able to explain interactions between molecules demonstrating a high degree of expertise in the field as well as to describe the formation, structure and polymers of coordination compounds. They are able to describe the self-assembly of polymers in aqueous media as well as to identify the characteristics of synthetic ion channels. They can name modern applications of supramolecular chemistry.

Courses (type, number of weekly contact hours, language — if other than German)

S (3)
Module taught in: German or English

Method of assessment (type, scope, language — if other than German, examination offered — if not every semester, information on whether module is creditable for bonus)

a) written examination (approx. 90 minutes) or
b) oral examination of one candidate each (approx. 20 minutes)
Language of assessment: German and/or English

Allocation of places

--

Additional information

--

Workload

150 h

Teaching cycle

--

Referred to in LPO I (examination regulations for teaching-degree programmes)

--

Module title			Abbreviation
Polymer Materials 1: Technology of Polymer Modification			08-FU-PW1-272-m01
Module coordinator		**Module offered by**	
degree programme coordinator Funktionswerkstoffe (Functional Matrierials)		Chair of Chemical Technology of Material Synthesis	
ECTS	**Method of grading**	**Only after succ. compl. of module(s)**	
5	numerical grade	--	
Duration	**Module level**	**Other prerequisites**	
1 semester	graduate	--	

Contents

Polymer synthesis methods; the structure of polymers and polymer compounds; properties of polymers; technologies for the manufacturing of polymer compounds and components, procedures for the characterisation of polymer compounds and components.

Intended learning outcomes

Students have developed a knowledge of the special properties of polymers and polymer compounds (e.g. time and temperature-dependent viscoelastic behaviour). They have become familiar with the characteristics of important production technologies (polymer synthesis methods, compounding technologies, processing methods such as injection moulding) and understand the different ways of influencing the properties of materials and manufactured products. They have become familiar with ways to calculate complex flow conditions in polymer processing machines and tools.

Courses (type, number of weekly contact hours, language — if other than German)

V (2) + P (2)
Module taught in: German and/or English

Method of assessment (type, scope, language — if other than German, examination offered — if not every semester, information on whether module is creditable for bonus)

a) written examination (approx. 90 minutes) or
b) oral examination of one candidate each (20 minutes) or
c) oral examination in groups (groups of 2, approx. 30 minutes per candidate)
Language of assessment: German and/or English
Assessment offered: Once a year, winter semester
Internship: creditable for bonus

Allocation of places

--

Additional information

--

Workload

150 h

Teaching cycle

--

Referred to in LPO I (examination regulations for teaching-degree programmes)

--

Thesis

(30 ECTS credits)

Module title			Abbreviation
Master-Thesis Biofabrication			08-MBF-MT-272-m01
Module coordinator		**Module offered by**	
degree programme coordinator Chemie (Chemistry)		Chair of Biochemistry	
ECTS	**Method of grading**	**Only after succ. compl. of module(s)**	
25	numerical grade	--	
Duration	**Module level**	**Other prerequisites**	
1 semester	graduate	--	

Contents

This module gives students the opportunity to research and write on a defined problem within a given time frame and using the scientific methods they have learned during the programme.

Intended learning outcomes

Students are able to conduct research on a defined problem/topic, adhering to the principles of good scientific practice, and to present the results of their work in written form.

Courses (type, number of weekly contact hours, language — if other than German)

No courses assigned to module
Module taught in: English

Method of assessment (type, scope, language — if other than German, examination offered — if not every semester, information on whether module is creditable for bonus)

written thesis (approx. 60 pages)
Language of assessment: English

Allocation of places

--

Additional information

--

Workload

750 h

Teaching cycle

--

Referred to in LPO I (examination regulations for teaching-degree programmes)

--

Module title			Abbreviation
Final Colloquium			08-MBF-KOLL-272-m01
Module coordinator			**Module offered by**
Dean of Studies Funktionswerkstoffe (Functional Materials)			Chair of Biochemistry
ECTS	**Method of grading**	**Only after succ. compl. of module(s)**	
5	numerical grade	--	
Duration	**Module level**	**Other prerequisites**	
1 semester	graduate	--	

Contents

Students deliver a presentation on the findings of their Master's thesis and critically discuss them with their audience.

Intended learning outcomes

Students are able to orally defend their Master's thesis.

Courses (type, number of weekly contact hours, language — if other than German)

No courses assigned to module
Module taught in: English

Method of assessment (type, scope, language — if other than German, examination offered — if not every semester, information on whether module is creditable for bonus)

final colloquium (approx. 60 minutes): talk (approx. 30 minutes) with subsequent discussion (approx. 30 minutes)
Language of assessment: English

Allocation of places

--

Additional information

--

Workload

150 h

Teaching cycle

--

Referred to in LPO I (examination regulations for teaching-degree programmes)

--

Compulsory Courses Practical Biofabrication Double Degree

(60 ECTS credits)

Practical Biofabrication

(60 ECTS credits)

Module title			Abbreviation
BioFab Research-Thesis 1			08-BFFP1-272-m01
Module coordinator		**Module offered by**	
chairperson of examination committee Biofabrikation (Biofabrication)		Chair of Biochemistry	
ECTS	**Method of grading**	**Only after succ. compl. of module(s)**	
30	numerical grade	--	
Duration	**Module level**	**Other prerequisites**	
1 semester	graduate	--	

Contents

This module gives students the opportunity to enhance their skills in advanced synthesis and analytical methods in biofabrication. Students will be expected to conduct their work in the lab independently, write a lab report documenting their findings and deliver a presentation.

Intended learning outcomes

Students are able to use advanced synthesis and analytical methods in biofabrication in the lab and to interpret their findings. They are able to write a lab report documenting their findings and deliver a presentation.

Courses (type, number of weekly contact hours, language — if other than German)

P (0)
Module taught in: English

Method of assessment (type, scope, language — if other than German, examination offered — if not every semester, information on whether module is creditable for bonus)

report on practical course (40 to 60 pages) and talk (approx. 20 to 30 minutes)
Language of assessment: English

Allocation of places

--

Additional information

--

Workload

900 h

Teaching cycle

--

Referred to in LPO I (examination regulations for teaching-degree programmes)

--

Module title			Abbreviation
BioFab Research-Thesis 2			08-BFFP2-272-m01
Module coordinator		**Module offered by**	
chairperson of examination committee Biofabrikation (Biofabrication)		Chair of Biochemistry	
ECTS	**Method of grading**	**Only after succ. compl. of module(s)**	
30	numerical grade	--	
Duration	**Module level**	**Other prerequisites**	
1 semester	graduate	--	

Contents

This module gives students the opportunity to enhance their skills in advanced synthesis and analytical methods in biofabrication. Students will be expected to conduct their work in the lab independently, write a lab report documenting their findings and deliver a presentation.

Intended learning outcomes

Students are able to use advanced synthesis and analytical methods in biofabrication in the lab and to interpret their findings. They are able to write a lab report documenting their findings and deliver a presentation.

Courses (type, number of weekly contact hours, language — if other than German)

P (0)
Module taught in: English

Method of assessment (type, scope, language — if other than German, examination offered — if not every semester, information on whether module is creditable for bonus)

report on practical course (40 to 60 pages) and talk (approx. 20 to 30 minutes)
Language of assessment: English

Allocation of places

--

Additional information

--

Workload

900 h

Teaching cycle

--

Referred to in LPO I (examination regulations for teaching-degree programmes)

--

Compulsory Electives Theoretical Biofabrication Double Degree

(30 ECTS credits)

Theoretical Biofabrication

(30 ECTS credits)

Module title			Abbreviation
Polymers II			03-FU-PM2-272-m01
Module coordinator			**Module offered by**
holder of the Chair of Functional Materials in Medicine and Dentistry			Chair of Chemical Technology of Material Synthesis, Faculty of Medicine
ECTS	**Method of grading**	**Only after succ. compl. of module(s)**	
5	numerical grade	--	
Duration	**Module level**	**Other prerequisites**	
1 semester	graduate	--	

Contents

Basics as well as advanced knowledge about contemporary issues of polymer synthesis, -modification and characterization.

Intended learning outcomes

The student has advanced knowledge of the synthesis, modification and characterization of polymers.

Courses (type, number of weekly contact hours, language — if other than German)

V (2) + P (2)
Module taught in: English

Method of assessment (type, scope, language — if other than German, examination offered — if not every semester, information on whether module is creditable for bonus)

a) written examination (approx. 90 minutes) or
b) oral examination of one candidate each (20 to 30 minutes) or
c) talk (approx. 30 minutes)
Language of assessment: English
Assessment offered: Once a year, summer semester
Internship: creditable for bonus

Allocation of places

--

Additional information

--

Workload

150 h

Teaching cycle

--

Referred to in LPO I (examination regulations for teaching-degree programmes)

--

Module title			Abbreviation
Biofabrication			03-BIOFAB-272-m01
Module coordinator			**Module offered by**
holder of the Chair of Functional Materials in Medicine and Dentistry			Faculty of Medicine
ECTS	**Method of grading**	**Only after succ. compl. of module(s)**	
5	numerical grade	--	
Duration	**Module level**	**Other prerequisites**	
1 semester	graduate	--	

Contents

Definitions within biomaterials, tissue engineering and biofabrication, overview of medical device regulations and practices, description of extracellular matrix, bioprinting, continuous liquid interface polymerisation, two-photon polymerisation, fused deposition modelling, inorganic powder printing, stereolithography, selective laser sintering, melt electrospinning writing, self-healing hydrogels, polymers in 3D printing, introduction to rheology, scientific method and reproducibility, digital signal generation and quality control.

Intended learning outcomes

Students gain a thorough appreciation of the different additive manufacturing (3D printing) technologies available in the context of biofabrication. This includes how the polymers are processed and how each class of 3D printer works, with its strengths and weaknesses. A holistic view of biofabrication is taught, with an understanding of scientific methodology for each stage and the different regulations governing medical devices. Students will acquire the necessary skills to critique and develop opinions on the 3D printing industry and the resulting biomedical applications.

Courses (type, number of weekly contact hours, language — if other than German)

V (2) + Ü (1) + P (1)
Module taught in: English

Method of assessment (type, scope, language — if other than German, examination offered — if not every semester, information on whether module is creditable for bonus)

a) written examination (approx. 90 minutes) or
b) oral examination of one candidate each (20 to 30 minutes) or
c) talk (approx. 30 minutes)
Language of assessment: English

Allocation of places

--

Additional information

--

Workload

150 h

Teaching cycle

--

Referred to in LPO I (examination regulations for teaching-degree programmes)

--

Module title	Abbreviation
Physical Chemistry of Supramolecular Assemblies	08-PCM5-161-m01

Module coordinator	Module offered by
lecturer of the seminar "Physikalische Chemie Supramolekularer Strukturen"	Institute of Physical and Theoretical Chemistry

ECTS	Method of grading	Only after succ. compl. of module(s)
5	numerical grade	--

Duration	Module level	Other prerequisites
1 semester	graduate	--

Contents

This module examines the basic interactions between molecules. It discusses the formation and physical-chemical properties of aggregates as well as key applications of supramolecular chemistry.

Intended learning outcomes

Students are able to explain the basic interactions between molecules demonstrating a high degree of expertise in the field. They can describe the formation and physical-chemical properties of aggregates. They can name modern applications of supramolecular chemistry.

Courses (type, number of weekly contact hours, language — if other than German)

S (2) + Ü (1)
Module taught in: German or English

Method of assessment (type, scope, language — if other than German, examination offered — if not every semester, information on whether module is creditable for bonus)

a) written examination (approx. 90 minutes) or
b) oral examination of one candidate each (approx. 20 minutes) or
c) talk (approx. 30 minutes)
Language of assessment: German and/or English

Allocation of places

--

Additional information

--

Workload

150 h

Teaching cycle

--

Referred to in LPO I (examination regulations for teaching-degree programmes)

--

Module title	Abbreviation
Tissue cells meet materials	03-GEWMAT-272-m01

Module coordinator	Module offered by
holder of the Chair of Tissue Engineering and Regenerative Medicine	Chair of Chemical Technology of Material Synthesis

ECTS	Method of grading	Only after succ. compl. of module(s)
5	numerical grade	--

Duration	Module level	Other prerequisites
1 semester	--	--

Contents

The module teaches the following contents: The cell culture techniques required for the construction of artificial tissues (tissue or also bioengineering), the basics of constructing such models using suitable (bio)materials, the use of such models as alternative test systems to animal experimentation. Another topic is the development of cell-based transplants, medical devices and drugs, as well as the regulatory basis for their approval (REACH, GLP, GMP, etc.).

Intended learning outcomes

Students will gain content-related and methodological insights into current key topics in tissue engineering as well as the use of these tissues as substitutes for animal models or as transplants in regenerative medicine.

Courses (type, number of weekly contact hours, language — if other than German)

V (2) + P (2)
Module taught in: English

Method of assessment (type, scope, language — if other than German, examination offered — if not every semester, information on whether module is creditable for bonus)

a) report on practical training (approx. 10 pages) and
b) presentation (approx. 30 minutes) or written examination (approx. 90 minutes)
Language of assessment: English

Allocation of places

--

Additional information

--

Workload

150 h

Teaching cycle

--

Referred to in LPO I (examination regulations for teaching-degree programmes)

--

Module title			Abbreviation
Carrier materials and devices for therapeutic compounds			03-SP3A1-272-m01
Module coordinator			**Module offered by**
holder of the Chair of Functional Materials in Medicine and Dentistry			Faculty of Medicine
ECTS	**Method of grading**	**Only after succ. compl. of module(s)**	
5	numerical grade	--	
Duration	**Module level**	**Other prerequisites**	
1 semester	graduate	--	

Contents

Integration and binding of active agents in particles, functionalisation of particles for (intracellular) transport processes, targeting and release of the active agents.

Intended learning outcomes

Students have developed a knowledge of the integration and binding of active agents in particles and of the functionalisation of particles for (intracellular) transport processes, targeting and release of active agents.

Courses (type, number of weekly contact hours, language — if other than German)

V (2) + P (1)
Module taught in: German and/or English

Method of assessment (type, scope, language — if other than German, examination offered — if not every semester, information on whether module is creditable for bonus)

a) report on practical course (approx. 10 pages) and
b) written examination (approx. 90 minutes) or presentation (approx. 30 minutes)
Language of assessment: German and/or English

Allocation of places

--

Additional information

--

Workload

150 h

Teaching cycle

--

Referred to in LPO I (examination regulations for teaching-degree programmes)

--

Module title	Abbreviation
Supramolecular Chemistry (Basics)	08-SCM1-161-m01

Module coordinator	Module offered by
lecturer of the seminar "Supramolecular Chemistry (Basics)"	Institute of Organic Chemistry

ECTS	Method of grading	Only after succ. compl. of module(s)
5	numerical grade	--

Duration	Module level	Other prerequisites
1 semester	graduate	--

Contents

This module introduces students to the fundamental principles of supramolecular chemistry. It focuses on interactions between molecules, molecular recognition by receptors, complexes, supramolecular polymers, coordination polymers and networks, liquid crystals, self-assembly in aqueous media, synthetic ion channels and modern applications of supramolecular chemistry.

Intended learning outcomes

Students are able to explain interactions between molecules demonstrating a high degree of expertise in the field as well as to describe the formation, structure and polymers of coordination compounds. They are able to describe the self-assembly of polymers in aqueous media as well as to identify the characteristics of synthetic ion channels. They can name modern applications of supramolecular chemistry.

Courses (type, number of weekly contact hours, language — if other than German)

S (3)
Module taught in: German or English

Method of assessment (type, scope, language — if other than German, examination offered — if not every semester, information on whether module is creditable for bonus)

a) written examination (approx. 90 minutes) or
b) oral examination of one candidate each (approx. 20 minutes)
Language of assessment: German and/or English

Allocation of places

--

Additional information

--

Workload

150 h

Teaching cycle

--

Referred to in LPO I (examination regulations for teaching-degree programmes)

--

Module title			Abbreviation
Principles of Cell Biology and Tissue Regeneration			03-FU-Zell-272-m01
Module coordinator		**Module offered by**	
holder of the Chair of Orthopaedics (Jakob/Ebert)		Faculty of Medicine	
ECTS	**Method of grading**	**Only after succ. compl. of module(s)**	
5	numerical grade	--	
Duration	**Module level**	**Other prerequisites**	
1 semester	undergraduate	--	

Contents

Foundations of cell biology (cell structure, organelles, DNA, replication, protein biosynthesis, signal transduction, cell metabolism, stem cells, viruses and prokaryotes, immune system).

Intended learning outcomes

Students acquire fundamental knowledge in cell and molecular biology.

Courses (type, number of weekly contact hours, language — if other than German)

V (4)
Module taught in: German and/or English

Method of assessment (type, scope, language — if other than German, examination offered — if not every semester, information on whether module is creditable for bonus)

a) written examination (approx. 90 to 180 minutes) or
b) oral examination of one candidate each (20 to 30 minutes) or
c) oral examination in groups of up to 3 candidates (approx. 15 minutes per candidate) or
d) log (approx. 20 pages) or
e) presentation (approx. 30 minutes)
Language of assessment: German and/or English

Allocation of places

--

Additional information

--

Workload

150 h

Teaching cycle

--

Referred to in LPO I (examination regulations for teaching-degree programmes)

--

Module title			Abbreviation
Polymer Materials 1: Technology of Polymer Modification			08-FU-PW1-272-m01
Module coordinator		**Module offered by**	
degree programme coordinator Funktionswerkstoffe (Functional Matrierials)		Chair of Chemical Technology of Material Synthesis	
ECTS	**Method of grading**	**Only after succ. compl. of module(s)**	
5	numerical grade	--	
Duration	**Module level**	**Other prerequisites**	
1 semester	graduate	--	

Contents

Polymer synthesis methods; the structure of polymers and polymer compounds; properties of polymers; technologies for the manufacturing of polymer compounds and components, procedures for the characterisation of polymer compounds and components.

Intended learning outcomes

Students have developed a knowledge of the special properties of polymers and polymer compounds (e.g. time and temperature-dependent viscoelastic behaviour). They have become familiar with the characteristics of important production technologies (polymer synthesis methods, compounding technologies, processing methods such as injection moulding) and understand the different ways of influencing the properties of materials and manufactured products. They have become familiar with ways to calculate complex flow conditions in polymer processing machines and tools.

Courses (type, number of weekly contact hours, language — if other than German)

V (2) + P (2)
Module taught in: German and/or English

Method of assessment (type, scope, language — if other than German, examination offered — if not every semester, information on whether module is creditable for bonus)

a) written examination (approx. 90 minutes) or
b) oral examination of one candidate each (20 minutes) or
c) oral examination in groups (groups of 2, approx. 30 minutes per candidate)
Language of assessment: German and/or English
Assessment offered: Once a year, winter semester
Internship: creditable for bonus

Allocation of places

--

Additional information

--

Workload

150 h

Teaching cycle

--

Referred to in LPO I (examination regulations for teaching-degree programmes)

--

Module title			Abbreviation
Courses at the partner university (BioFab Master)			08-VPU-BF-272-m01
Module coordinator		**Module offered by**	
programme coordinator of the exchange programme		Faculty of Chemistry and Pharmacy	
ECTS	**Method of grading**	**Only after succ. compl. of module(s)**	
30	numerical grade	--	
Duration	**Module level**	**Other prerequisites**	
1 semester	undergraduate	Please consult with course advisory service in advance.	

Contents

This module discusses topics from the curriculum of the partner university abroad.

Intended learning outcomes

Students have developed the knowledge and skills taught in the courses attended by them at the partner university.

Courses (type, number of weekly contact hours, language — if other than German)

No courses assigned to module
Module taught in: German and/or English

Method of assessment (type, scope, language — if other than German, examination offered — if not every semester, information on whether module is creditable for bonus)

Assessments as specified by partner university abroad
Language of assessment: German and/or English and/or language spoken at partner university abroad

Allocation of places

--

Additional information

--

Workload

900 h

Teaching cycle

--

Referred to in LPO I (examination regulations for teaching-degree programmes)

--

Thesis

(30 ECTS credits)

Module title			Abbreviation
Master-Thesis Biofabrication			08-MBF-MT-272-m01
Module coordinator		**Module offered by**	
degree programme coordinator Chemie (Chemistry)		Chair of Biochemistry	
ECTS	**Method of grading**	**Only after succ. compl. of module(s)**	
25	numerical grade	--	
Duration	**Module level**	**Other prerequisites**	
1 semester	graduate	--	

Contents

This module gives students the opportunity to research and write on a defined problem within a given time frame and using the scientific methods they have learned during the programme.

Intended learning outcomes

Students are able to conduct research on a defined problem/topic, adhering to the principles of good scientific practice, and to present the results of their work in written form.

Courses (type, number of weekly contact hours, language — if other than German)

No courses assigned to module
Module taught in: English

Method of assessment (type, scope, language — if other than German, examination offered — if not every semester, information on whether module is creditable for bonus)

written thesis (approx. 60 pages)
Language of assessment: English

Allocation of places

--

Additional information

--

Workload

750 h

Teaching cycle

--

Referred to in LPO I (examination regulations for teaching-degree programmes)

--

Module title			Abbreviation
Final Colloquium			08-MBF-KOLL-272-m01
Module coordinator			**Module offered by**
Dean of Studies Funktionswerkstoffe (Functional Materials)			Chair of Biochemistry
ECTS	**Method of grading**	**Only after succ. compl. of module(s)**	
5	numerical grade	--	
Duration	**Module level**	**Other prerequisites**	
1 semester	graduate	--	

Contents

Students deliver a presentation on the findings of their Master's thesis and critically discuss them with their audience.

Intended learning outcomes

Students are able to orally defend their Master's thesis.

Courses (type, number of weekly contact hours, language — if other than German)

No courses assigned to module
Module taught in: English

Method of assessment (type, scope, language — if other than German, examination offered — if not every semester, information on whether module is creditable for bonus)

final colloquium (approx. 60 minutes): talk (approx. 30 minutes) with subsequent discussion (approx. 30 minutes)
Language of assessment: English

Allocation of places

--

Additional information

--

Workload

150 h

Teaching cycle

--

Referred to in LPO I (examination regulations for teaching-degree programmes)

--