MARTIN-LUTHER-UNIVERSITÄT
HALLE-WITTENBERG

Modulhandbuch

für den
Studiengang:

Polymer Materials Science

im Master - Studiengang 120 Leistungspunkte

(Modulversionstand vom 02.09.2019)

Inhalt:

Präambel:

(1) Examination periods
There are two examination periods with four weeks duration directly after the semester (examination period A) or at the end of the semester break (examination period B). Final examinations finishing each module usually take place in the examination periods A or B. The assignment to examination period A or B is given in the general description of the respective modules. Modules covering more than one semester should finish in examination period B. Modules finals that require less preparation time can be arranged in the examination period A.
(2) Modules of the Master course (M.Sc. Polymer Materials Science)
All modules are compulsory or optional as indicated in the curriculum. Modules of the third semester should be selected according to the planned research topic of the Master Thesis. The Master Thesis work is carried out in the fourth semester after finishing all examinations of the previous semesters.
(3) Director and Examination Board
In order to improve and develop the courses, an examination board is selected. The director of the the board collects information and feedback of the students and the teaching staff. He is responsible for changes of the curriculum and further developments.

Modul: Advanced Polymer Chemistry

Identifikationsnummer:

CHE.05564.03

Lernziele:

- Advanced theoretical and practical knowledge of polymerization techniques
- Special living/controlled and catalytic polymerizations
- Enzymatic and biological polymer synthesis, preparation of polymer/drug conjugates
- Advanced characterization techniques, in vivo and in vitro testing of polymers

Inhalte:

Lectures:

1. Advanced Polymer Synthesis
   - Standard polymerization techniques for special monomers
   - Living polymerization methods (CRP, LCCP, living anionic polymerization)
   - Polycondensation, ROP, ROMP
   - Polymer analogous reactions for tailoring polymer properties
   - Synthesis of block copolymers
   - Design of polymeric architectures
   - Emulsion polymerization
   - Design and preparation of advanced polymeric materials
   - Supramolecular polymers
   - Shape memory polymers
   - Synthesis of biopolymers and their application
2. Polymer Analytics
   - Basics of analytical techniques in polymer science
   - NMR-spectroscopy (solution NMR, basic techniques, sensivity, heteronuclear-NMR, basic 2D-techniques, relaxation in marcomolecules)
   - Discussion of practical application of techniques to polymer molecules (training and discussion of chemical shift analysis, spin/spin-coupling patterns, coupling constants in relation to chemical structure, isotopic patterns and molecular weight, determination of exact chemical structures, discussion of 2D-COSY-spectroscopy and practical analysis)
   - Advanced GPC/HLPC chromatography (2D-methods in relation to polarity and coupling techniques)

   Lab course:

   Polymer Synthesis Lab e.g.
   - Safe handling of polymerization techniques
   - Multiple step polymerizations
   - Polymers with special magnetic and electric properties
   - Ionic polymerization
   - Living polymerization (ATRP, NMP, LCCP)
   - Block copolymer Synthesis

Verantwortlichkeiten (Stand 19.05.2016):

Fakultät	Institut	Verantwortliche/r
Naturwissenschaftliche Fakultät II - Chemie, Physik und Mathematik	Chemie	Prof. Dr. Wolfgang Binder

Studienprogrammverwendbarkeiten (Stand 14.04.2014):

Abschluss	Studienprogramm	empf. Studien-semester	Modulart	Benotung	Anteil der Modulnote an Abschlussnote
Master	Polymer Materials Science - 120 LP 1. Version 2014	2.	Wahlpflichtmodul	Benotet	10/113

Teilnahmevoraussetzungen:

Obligatorisch:

keine

Wünschenswert:

keine

Dauer:

1 Semester

Angebotsturnus:

jedes Sommersemester

Studentischer Arbeitsaufwand:

300 Stunden

Leistungspunkte:

10 LP

Sprache:

Englisch

Modulbestandteile:

Lehr- und Lernformen	SWS	Studentische Arbeitszeit in Stunden	Semester
Lecture Advanced Polymer Synthesis	2	30	Sommersemester
Lab course Polymer Synthesis	5	75	Sommersemester
Lecture Polymer Analytics	1	15	Sommersemester
Private study	0	180	Sommersemester

Studienleistungen:

- lab course protocols and lab-safety examinations
- seminar problem set solutions

Modulvorleistungen:

- keine

Modulleistung:

Modulleistung	1. Wiederholung	2. Wiederholung	Anteil an Modulnote
oral or written examination (Advanced Polymer Synthesis, Polymer Analytics)	oral or written examination	oral or written examination	100 %

Termine für die Modulleistung:

1.Termin: examination period A or B

1.Wiederholungstermin: up to 6 months after the end of the semester

2.Wiederholungstermin: up to the examination of the same module in the next year

Modul: Advanced Polymer Engineering

Identifikationsnummer:

INW.05571.01

Lernziele:

- Acquiring perspectives for the work as a polymer engineer
- Advanced knowledge on processing polymer blends and composites
- Practical skills for processing polymer blends and composites
- Basic principles of advanced structure characterization techniques

Inhalte:

Lectures:

1. Lecture Processing of polymer blends and composites

   Techniques of modifying of polymers, creation of blends, compounds and master batches, compatibility and incompatibility of blends, special aspects of blend technology, influence of process parameters, technology of polymer composites: nano, micro and macro composites, manufacturing by different forms of composite components (particles, lamellas, short, long and endless fibers), special aspects of composites technology
2. Lecture Polymer Structure and Morphology

   Scattering techniques: basic principles & general aspects, primary scattering and interference, comparison X-rays and neutrons, radiation sources and detectors; X-ray diffraction (WAXS): typical setups, diffraction by crystals, Braggs law and Laue condition, Miller indices, Structure factor and lattice factor, scattering of amorphous materials and liquids; small-angle X-ray scattering (SAXS): typical setups, application to semi-crystalline and self-assembled polymers, Guinier law and application to disordered systems; Imaging techniques: light microscopy, atomic force microscopy, electron microscopy techniques

   Lab courses
1. Lab Course: Processing of polymer blends and composites

   Practical exercises to special aspects by processing polymer blends and composites
2. Lab Course: Polymer Structure and Morphology

   Practical exercises in imaging techniques

Verantwortlichkeiten (Stand 29.08.2019):

Fakultät	Institut	Verantwortliche/r
Hochschule Merseburg	Fachbereich Ingenieur- und Naturwissenschaften	Prof. Dr. Mario Beiner

Studienprogrammverwendbarkeiten (Stand 02.04.2014):

Abschluss	Studienprogramm	empf. Studien-semester	Modulart	Benotung	Anteil der Modulnote an Abschlussnote
Master	Polymer Materials Science - 120 LP 1. Version 2014	2.	Wahlpflichtmodul	Benotet	10/113

Teilnahmevoraussetzungen:

Obligatorisch:

keine

Wünschenswert:

keine

Dauer:

1 Semester

Angebotsturnus:

jedes Sommersemester

Studentischer Arbeitsaufwand:

300 Stunden

Leistungspunkte:

10 LP

Sprache:

Englisch

Modulbestandteile:

Lehr- und Lernformen	SWS	Studentische Arbeitszeit in Stunden	Semester
Lecture Processing of polymer blends and composites	2	30	Sommersemester
Lecture Polymer Structure and Morphology	2	30	Sommersemester
Lab Processing of polymer blends and composites	3	45	Sommersemester
Lab Polymer Structure and Morphology	1	15	Sommersemester
Private Study	0	180	Sommersemester

Studienleistungen:

- Completion of lab course protocols

Modulvorleistungen:

- keine

Modulleistung:

Modulleistung	1. Wiederholung	2. Wiederholung	Anteil an Modulnote
oral or written examination (Processing of polymers, Polymer structure)	oral or written examination	oral or written examination	100 %

Termine für die Modulleistung:

1.Termin: examination period A or B

1.Wiederholungstermin: up to 6 months after the end of the semester

2.Wiederholungstermin: up to the examination of the same module in the next year

Modul: Advanced Polymer Physics

Identifikationsnummer:

PHY.05566.03

Lernziele:

- Deepening background knowledge in polymer physics
- Fundamental principles of soft-matter physics
- Gaining experience in advanced concepts of experimental or theoretical polymer physics

Inhalte:

Lectures:

1. Lecture Soft Condensed Matter Physics
   - Structure and dynamics of liquids (existence, pair correlation function, glass transition)
   - Liquid crystals (classification, structure and defects in nematics, nematic-to-isotropic phase transition, elastic properties and Fredericks-transition)
   - Surfactants: supramolecular structures and self-organization (micelles and membranes)
   - Colloidal dispersions: heterogeneous systems (Brownian motion, forces between colloids, colloidal phase transitions)
   - Polymers (conformations: ideal chains, rubber elasticity, introduction into semicrystalline polymers)

2a. (either) Polymer Structure and Morphology
   - Scattering techniques: basic principles & general aspects, primary scattering and interference, comparison x-rays and neutrons, radiation sources and detectors
   - X-ray diffraction (WAXS): typical setups, diffraction by crystals, Braggs law and Laue condition, Miller indices, Structure factor and lattice factor, scattering of amorphous materials and liquids
   - Small-angle X-ray scattering (SAXS): typical setups, application to semi-crystalline and self-assembled polymers, Guinier law and application to disordered systems
   - Imaging techniques: light microscopy, atomic force microscopy, electron microscopy techniques

2b. (or) Polymer Theory
   - Conformational statistics of polymers
   - Flory-Huggins theory for solutions and blends
   - Self-consistent field theory
   - Random phase approximation
   - Polymer networks
   - Scaling theory of polymers
   - Theories of polymer dynamics

Lab courses:

1. Lab course Advanced Polymer Physics Lab e.g.
   - Dielectric spectroscopy
   - low-field NMR
   - AFM/SAXS
2. (optional) Lab Course Polymer Structure and Morphology
   - Practical exercises in imaging techniques

Verantwortlichkeiten (Stand 08.03.2017):

Fakultät	Institut	Verantwortliche/r
Naturwissenschaftliche Fakultät II - Chemie, Physik und Mathematik	Physik	Prof. Dr. Kay Saalwächter

Studienprogrammverwendbarkeiten (Stand 02.06.2016):

Abschluss	Studienprogramm	empf. Studien-semester	Modulart	Benotung	Anteil der Modulnote an Abschlussnote
Master	Polymer Materials Science - 120 LP 1. Version 2014	2.	Wahlpflichtmodul	Benotet	10/113

Teilnahmevoraussetzungen:

Obligatorisch:

keine

Wünschenswert:

keine

Dauer:

1 Semester

Angebotsturnus:

jedes Sommersemester

Studentischer Arbeitsaufwand:

300 Stunden

Leistungspunkte:

10 LP

Sprache:

Englisch

Modulbestandteile Variante 1:

Lehr- und Lernformen	SWS	Studentische Arbeitszeit in Stunden	Semester
Lecture Soft Condensed Matter Physics	3	45	Sommersemester
Seminar Soft Condensed Matter Physics	1	15	Sommersemester
Lab course Advanced Polymer Physics	1	15	Sommersemester
Lecture Polymer Structure and Morphology	2	30	Sommersemester
LabCourse Polymer Structure and Morphology	1	15	Sommersemester
Private study	0	180	Sommersemester

Modulbestandteile Variante 2:

Lehr- und Lernformen	SWS	Studentische Arbeitszeit in Stunden	Semester
Lecture Soft Condensed Matter Physics	3	45	Sommersemester
Seminar Soft Condensed Matter Physics	1	15	Sommersemester
Lab Course Advanced Poly.Phys. Lab	1	15	Sommersemester
Lecture Polymer Theory	2	30	Sommersemester
Seminar Polymer Theory	1	15	Sommersemester
Private study	0	180	Sommersemester

Studienleistungen:

- lab course attestations/protocols
- oral or written examination (Polymer Theory or Polymer Structure)

Modulvorleistungen:

- keine

Modulleistung:

Modulleistung	1. Wiederholung	2. Wiederholung	Anteil an Modulnote
oral or written examination (Condensed Matter)	oral or written examination	oral or written examination	100 %

Termine für die Modulleistung:

1.Termin: examination period A

1.Wiederholungstermin: up to 6 months after the end of the semester

2.Wiederholungstermin: up to the examination of the same module in the next year

Modul: Basics of Materials and Polymer Physics

Identifikationsnummer:

PHY.05548.02

Lernziele:

- Learning the central physical concepts in materials science
- Learning and training the necessary mathematical skills
- Planning, performing and evaluating scientific experiments using modern instrumentation
- Error estimation and analysis
- Recording, evaluating and presenting measurement data, writing a report

Inhalte:

Lectures:

1. Lecture Introduction to Materials Physics
   - Atoms and bonds, crystal structures
   - Structure analysis: microscopy techniques
   - Basics of scattering (Bragg and crystal structures, wave equation, interference, structure factor)
   - Phase transitions and phase diagrams
   - Mechanical properties of solids
   - Thermal, optical, magnetic, electric and dielectric properties
2. Lecture Mathematical and Theoretical Concepts for Polymer Science
   - Mathematical tools (linear algebra, trigonometry, complex numbers, Fourier transformation, delta function)
   - Calculus: integration, differentiation, solving differential simple equations, applications to reaction kinetics and simple mechanical polymer models
   - Statistics: distribution functions (mol. weight distributions, averages and moments), data treatment, error handling, linear regression
   - Diffusion, Brownian motion and random walks; single-chain structure (Gaussian coil, radius of gyration)
   - Basics of computer simulation techniques (interaction potentials, MD vs. MC)
   - Introduction to quantum mechanics: Schroedinger equation, wave functions, particle in a box, harmonic oscillator, hydrogen atom, bonding

Lab course - Basic Physics and Physical Chemistry Lab:

9 experiments are performed. Each experiment consists of 4 hours lab time and private study of basics, writing the protocol and evaluating the experiment. The lab includes a tutorial experiment (radioactivity) that includes an introduction into the Origin software. The list of experiments is subject to changes. Current experiments are:

- Viscosity (falling ball viscometer)
- Humidity (dew point hygrometer)
- RLC oscillator (oscilloscope handling)
- Diffraction spectrometer (optical spectroscopy)
- Polarimeter and refractometer
- X-ray methods (spectrum of Mo tube, dosimetry)
- Vapor pressure and heat of vaporization (Clausius-Clapeyron)
- Freezing point depression
- Surface tension of liquids
- Solubility diagram of liquids (miscibility gap)

Verantwortlichkeiten (Stand 26.03.2015):

Fakultät	Institut	Verantwortliche/r
Naturwissenschaftliche Fakultät II - Chemie, Physik und Mathematik	Physik	Dr. Karsten Busse

Studienprogrammverwendbarkeiten (Stand 15.04.2014):

Abschluss	Studienprogramm	empf. Studien-semester	Modulart	Benotung	Anteil der Modulnote an Abschlussnote
Master	Polymer Materials Science - 120 LP 1. Version 2014	1.	Pflichtmodul	Benotet	10/113

Teilnahmevoraussetzungen:

Obligatorisch:

keine

Wünschenswert:

keine

Dauer:

1 Semester

Angebotsturnus:

jedes Wintersemester

Studentischer Arbeitsaufwand:

300 Stunden

Leistungspunkte:

10 LP

Sprache:

Englisch

Modulbestandteile:

Lehr- und Lernformen	SWS	Studentische Arbeitszeit in Stunden	Semester
Lecture Introduction to Materials Physics	1	15	Wintersemester
Lecture Mathematical and Theoretical Concepts for Polymer Science	2	30	Wintersemester
Lab course Basic Physics and Physical Chemistry Lab	3	45	Wintersemester
Seminar Introduction to Materials Physics	1	15	Wintersemester
Seminar Mathematical and Theoretical Concepts for Polymer Science	2	30	Wintersemester
Private Study	0	165	Wintersemester

Studienleistungen:

- lab course attestations

Modulvorleistungen:

- keine

Modulleistung:

Modulleistung	1. Wiederholung	2. Wiederholung	Anteil an Modulnote
oral or written examination (Materials Physics, mathmatical and theoretical concepts)	oral or written examination	oral or written examination	100 %

Termine für die Modulleistung:

1.Termin: examination period A or B

1.Wiederholungstermin: up to 6 months after the end of the semester

2.Wiederholungstermin: up to the examination of the same module in the next year

Modul: Introduction to Polymer Research

Identifikationsnummer:

CHE.05558.01

Lernziele:

- Preparation for independent research
- Project work as the first independent research experience for the students
- Learning to give a scientific presentation
- Introduction to modern research topics in the field of polymers

Inhalte:

Lectures:
Lecture Polymer Colloquium / Ring Lecture

- Introduction to database and literature research (block lecture)
- Modern methods and developments in polymer chemistry, physics and engineering
- New material developments
- Latest research activities by leading guest lecturers
- Activities in the local research groups (ring lecture)
- Interdisciplinary topics from adjacent fields

Lab course:
Lab course Project Work

- Participation in a research group at university or in industry
- Introduction to independent research
- Combining literature and experimental research
- Independent preparation of the research report
- Oral presentation of the results using PowerPoint

Verantwortlichkeiten (Stand 25.07.2016):

Fakultät	Institut	Verantwortliche/r
Naturwissenschaftliche Fakultät II - Chemie, Physik und Mathematik	Chemie	Prof. Dr. Jörg Kreßler, Prof. Dr. Beate Langer

Studienprogrammverwendbarkeiten (Stand 10.12.2013):

Abschluss	Studienprogramm	empf. Studien-semester	Modulart	Benotung	Anteil der Modulnote an Abschlussnote
Master	Polymer Materials Science - 120 LP 1. Version 2014	3.	Pflichtmodul	Benotet	15/113

Teilnahmevoraussetzungen:

Obligatorisch:

keine

Wünschenswert:

keine

Dauer:

1 Semester

Angebotsturnus:

jedes Wintersemester

Studentischer Arbeitsaufwand:

450 Stunden

Leistungspunkte:

15 LP

Sprache:

Englisch

Modulbestandteile:

Lehr- und Lernformen	SWS	Studentische Arbeitszeit in Stunden	Semester
Lecture Polymer Colloquium / Ring Lecture	1	15	Wintersemester
Lab Course Project Work	10	150	Wintersemester
Private Study	0	285	Wintersemester

Studienleistungen:

- oral presentation in the group seminar

Modulvorleistungen:

- keine

Modulleistung:

Modulleistung	1. Wiederholung	2. Wiederholung	Anteil an Modulnote
written examination (report)	written examination	written examination	100 %

Termine für die Modulleistung:

1.Termin: examination period A

1.Wiederholungstermin: up to 6 months after the end of the semester

2.Wiederholungstermin: up to the examination of the same module in the next year

Modul: Master Thesis (M.Sc.)

Identifikationsnummer:

CHE.05565.01

Lernziele:

- Carrying out independent research
- Literature studies and experimental work
- Writing and defence of the thesis

Inhalte:

- Thesis related to polymer chemistry, physics or engineering
- Carrying out literature research
- Planning research strategies
- Collecting and evaluating experimental data
- Oral presentation of the final results including defence

Verantwortlichkeiten (Stand 27.05.2014):

Fakultät	Institut	Verantwortliche/r
Naturwissenschaftliche Fakultät II - Chemie, Physik und Mathematik	Chemie	Hochschullehrer der Institute Physik oder Chemie bzw. des Fachbereiches der Hochschule Merseburg

Studienprogrammverwendbarkeiten (Stand 14.04.2014):

Abschluss	Studienprogramm	empf. Studien-semester	Modulart	Benotung	Anteil der Modulnote an Abschlussnote
Master	Polymer Materials Science - 120 LP 1. Version 2014	4.	Pflichtmodul	Benotet	30/113

Teilnahmevoraussetzungen:

Obligatorisch:

at least 75 Credit Points (75 LP)

Wünschenswert:

keine

Dauer:

1 Semester

Angebotsturnus:

jedes Semester

Studentischer Arbeitsaufwand:

900 Stunden

Leistungspunkte:

30 LP

Sprache:

Englisch

Modulbestandteile:

Lehr- und Lernformen	SWS	Studentische Arbeitszeit in Stunden	Semester
Master Thesis	30	900	Winter- und Sommersemester

Studienleistungen:

- keine

Modulvorleistungen:

- keine

Modulteilleistungen block 1:

Modulteilleistungen block 1	1. Wiederholung	2. Wiederholung	Anteil an Modulnote
written Master-Thesis	written Master-Thesis	nicht möglich laut RStPOBM §20 Abs.13	75 %
oral defence	oral defence	nicht möglich laut RStPOBM §20 Abs.13	25 %

Termine für Modulteilleistung Nr. 1:

1.Termin: within the running semester

1.Wiederholungstermin: within 6 months after the end of the semester

Termine für Modulteilleistung Nr. 2:

1.Termin: within the running semester

1.Wiederholungstermin: within 6 months after the end of the semester

Modul: Polymer Chemistry

Identifikationsnummer:

CHE.05562.03

Lernziele:

- Knowledge of the basic concepts of polymer synthesis: terminology, synthesis, and characterization of composition, molar mass and distributions
- Knowledge of basic concepts of organic chemistry and polymer synthesis
- Learning to safely handle chemicals, basic organic/polymer synthesis, preparation and purification techniques
- Writing of scientific reports

Inhalte:

Lectures:

1. Introduction to Macromolecules
   - General introduction and history of polymer science
   - General principles of polymer synthesis (step growth, chain growth, thermodynamics, kinetics, copolymerization, technical polymerizations, living polymerization)
   - Reactions with polymers: isomerization, grafting, crosslinking
   - Basics of polymer characterization: end-group titration/NMR, osmometry, viscosity, chromatography, mass spectrometry, Flory-Huggins theory, polymer additives
   - Microphase-separated polymers: block copolymers, thin films, amphiphilic polymers in solvents, micelles, polymer crystallization, amorphous state
2. Organic Chemistry and Polymer Synthesis
   - Basic principles of organic chemistry
   - Reaction mechanisms in organic chemistry
   - Principles of homogeneous and heterogeneous catalysis
   - Basics of solution-state NMR
   - Free-radical and controlled free-radical polymerizations
   - Living polymerizations, block copolymer synthesis
   - Catalytic polymerizations (Ziegler/Natta, metallocene, ROMP)
   - Polycondensation
   - Network synthesis/thermosets

Lab course:

Basic Chemistry and Polymerization Lab

- Basic operations (distillation, recrystallization, precipitation)
- Esterification, amidation
- Free-radical polymerization
- Suspension/emulsion polymerization
- Resin preparation (amino-, epoxy-resins)

Verantwortlichkeiten (Stand 02.09.2019):

Fakultät	Institut	Verantwortliche/r
Naturwissenschaftliche Fakultät II - Chemie, Physik und Mathematik	Chemie	Prof. Dr. Wolfgang Binder

Studienprogrammverwendbarkeiten (Stand 10.12.2013):

Abschluss	Studienprogramm	empf. Studien-semester	Modulart	Benotung	Anteil der Modulnote an Abschlussnote
Master	Polymer Materials Science - 120 LP 1. Version 2014	1.	Pflichtmodul	Benotet	10/113

Teilnahmevoraussetzungen:

Obligatorisch:

keine

Wünschenswert:

keine

Dauer:

1 Semester

Angebotsturnus:

jedes Wintersemester

Studentischer Arbeitsaufwand:

300 Stunden

Leistungspunkte:

10 LP

Sprache:

Englisch

Modulbestandteile:

Lehr- und Lernformen	SWS	Studentische Arbeitszeit in Stunden	Semester
Lecture Introduction to Macromolecules	2	30	Wintersemester
Lecture Organic Chemistry and Polymer Synthesis	2	30	Wintersemester
Lab course Basic Chemistry and Polymerization Lab	5	75	Wintersemester
Seminar Organic Chemistry and Polymer Synthesis	1	15	Wintersemester
Private study	0	150	Wintersemester

Studienleistungen:

- laboratory protocols and lab-safety examinations
- written examination Macromolecules, Organic Chemistry and Polymer Synthesis I
- written examination Macromolecules, Organic Chemistry and Polymer Synthesis II

Modulvorleistungen:

- keine

Modulleistung:

Modulleistung	1. Wiederholung	2. Wiederholung	Anteil an Modulnote
oral or written examination	oral or written examination	oral or written examination	100 %

Termine für die Modulleistung:

1.Termin: examination period A or B

1.Wiederholungstermin: up to 6 months after the end of the semester

2.Wiederholungstermin: up to the examination of the same module in the next year

Modul: Polymer Engineering

Identifikationsnummer:

INW.05559.02

Lernziele:

- Acquiring perspectives for the work as a polymer scientist or polymer engineer
- Basic knowledge on processing of polymer materials
- Basic knowledge on polymer testing
- Practical skills in processing of polymer materials
- Practical skills in mechanical and physical testing of polymer materials

Inhalte:

Lectures:

1. Lecture Polymer Processing

   Basics of melt flow, extrusion, injection molding, spinning, foaming, elastomer processing, processing tires, blown film extrusion, recycling of polymer materials
2. Lecture Polymer Testing

   Elastic, visco-elastic and plastic deformation behaviour of polymer materials and phenomenological models, quasi-static test methods of polymer materials (tensile, compression, bending), hardness measurement and test methods, charpy impact test, instrumented impact tests as methods for toughness characterizations of polymer materials, fracture mechanics concepts for polymer materials

Lab Courses:

1. Polymer Processing Lab

   Extrusion, injection molding, elastomer processing, blown film extrusion
2. Polymer Testing Lab

   Characterization of elastic properties, tensile test, dynamic-mechanical analysis, bend test, ball indentation test, Charpy impact test, drop weight test, tensile impact test

Verantwortlichkeiten (Stand 10.06.2015):

Fakultät	Institut	Verantwortliche/r
Hochschule Merseburg	Fachbereich Ingenieur- und Naturwissenschaften	Prof. Dr. Beate Langer

Studienprogrammverwendbarkeiten (Stand 11.12.2013):

Abschluss	Studienprogramm	empf. Studien-semester	Modulart	Benotung	Anteil der Modulnote an Abschlussnote
Master	Polymer Materials Science - 120 LP 1. Version 2014	1.	Pflichtmodul	Benotet	10/113

Teilnahmevoraussetzungen:

Obligatorisch:

keine

Wünschenswert:

keine

Dauer:
2 Semester

Angebotsturnus:
jedes Wintersemester

Studentischer Arbeitsaufwand:
300 Stunden

Leistungspunkte:
10 LP

Sprache:
Englisch

Modulbestandteile:

Lehr- und Lernformen	SWS	Studentische Arbeitszeit in Stunden	Semester
Lecture Polymer Processing	2	30	Wintersemester
Polymer Processing Lab	2	30	Wintersemester
Lecture Polymer Testing	2	30	Sommersemester
Polymer Testing Lab	2	30	Sommersemester
Private study	0	180	Winter- und Sommersemester

Studienleistungen:
- written examination Polymer Processing
- written examination Polymer Testing
- completion of lab course protocols

Modulvorleistungen:
- keine

Modulleistung:

Modulleistung	1. Wiederholung	2. Wiederholung	Anteil an Modulnote
oral examination	oral examination	oral examination	100 %

Termine für die Modulleistung:

1.Termin: examination period A

1.Wiederholungstermin: up to 6 months after the end of the semester

2.Wiederholungstermin: up to the examination of the same module in the next year

Modul: Polymer Engineering Focus

Identifikationsnummer:

INW.05570.02

Lernziele:

- Acquiring perspectives for the work as a polymer scientist or polymer engineer
- Knowledge on applying polymers for different part specifications
- Advanced knowledge on elastomeric materials
- Advanced knowledge on preparation and properties of elastomers
- Practical skills in polymer/elastomer preparation and characterization

Inhalte:

Lectures:

1. Lecture Polymers in Industry

   Application range of polymers/thermoplasts and other materials, specification and requirements for material and processing technology, consideration of requirements and the costs, review of typical applications in automotive, medical, pharmaceutical, construction, packaging, electronics.

2. Lecture Elastomeric Materials

   Structure, production and properties of rubber and elastomeric materials, filler, cross linking agent, additives, technology of rubber mixtures, rheological and thermodynamic behaviour, testing of elastomeric materials, technology of elastomeric goods, recycling of elastomeric materials

Lab courses:

1. Elastomeric Materials Lab

Content items: compounding of rubber mixtures, vulcanisation, vulcametry, dispersion index, determination of mechanical properties of elastomeric materials

Seminars:

Research Seminar

Student presentation of research results from the literature from the polymer engineering field

Verantwortlichkeiten (Stand 10.10.2016):

Fakultät	Institut	Verantwortliche/r
Hochschule Merseburg	Fachbereich Ingenieur- und Naturwissenschaften	Prof. Dr.-Ing. Peter Michel

Studienprogrammverwendbarkeiten (Stand 12.12.2013):

Abschluss	Studienprogramm	empf. Studien-semester	Modulart	Benotung	Anteil der Modulnote an Abschlussnote
Master	Polymer Materials Science - 120 LP 1. Version 2014	3.	Wahlpflichtmodul	Benotung ohne Anteil	0/113

Teilnahmevoraussetzungen:

Obligatorisch:

keine

Wünschenswert:

keine

Dauer:

1 Semester

Angebotsturnus:

jedes Wintersemester

Studentischer Arbeitsaufwand:

210 Stunden

Leistungspunkte:

7 LP

Sprache:

Englisch

Modulbestandteile:

Lehr- und Lernformen	SWS	Studentische Arbeitszeit in Stunden	Semester
Lecture Polymer in Industry	2	30	Wintersemester
Lecture Elastomeric Materials	2	30	Wintersemester
Lab course Elastomeric Materials	2	30	Wintersemester
Research Seminar	1	15	Wintersemester
Private study	0	105	Wintersemester

Studienleistungen:

- completion of lab course protocols
- written examinations

Modulvorleistungen:

- keine

Modulleistung:

Modulleistung	1. Wiederholung	2. Wiederholung	Anteil an Modulnote
oral examination (presentation)	oral examination	oral examination	100 %

Termine für die Modulleistung:

1.Termin: examination period A

1.Wiederholungstermin: up to 6 months after the end of the semester

2.Wiederholungstermin: up to the examination of the same module in the next year

Modul: Polymer Engineering Science

Identifikationsnummer:

CHE.05560.02

Lernziele:

- Acquiring perspectives for the work as a polymer engineer
- Basics of technical/industrial polymerization processes, instrumentation
- Basic knowledge of polymerization kinetics, kinetic modeling approaches, design of polymerization reactors and industrial polymerization processes
- Acquiring a basic knowledge about physical properties of polymeric materials, including composites

Inhalte:

Lectures:

1. Lecture Polymer Reaction Engineering
   - Classification of polyreactions and polymerization processes
   - Kinetics and kinetic modeling of polymerizations and molecular weight distributions (free-radical, emulsion, coordinative polymerization)
   - Rheological properties of reaction mixtures
   - Design and dimensioning of polymerization reactors, heat removal, mixing, non-idealities
   - Industrial polymerization processes
2. Lecture Polymeric Materials
   - Chemical and physical structure
   - Basics of melt flow
   - Liquid/melt - solid transition: crystallization / glass transition
   - Mechanical behaviour: elastic deformation / rubbery-elasticity / visco-elastic behavior of polymeric solids / plastic deformation
   - Thermal, optical, electrical, acoustic properties of polymers
   - Polymeric materials: structure, properties, applications:

     a) Thermoplastics (commodity polymers, polyesters/-amides, high-performance polymers)

     b) Elastomers

     c) Thermosets

     d) Blends and composites

     Lab course:

     Lab course Polymer Computer Modelling
   - Computer modelling of liquids and polymers
   - Using advanced simulation codes (NAMD) for structure and dynamics of polymers
   - predicting polymer properties, miscibility calculations, blend behaviour, diffusion in polymers, simulation of molecule vibrations

Verantwortlichkeiten (Stand 05.10.2015):

Fakultät	Institut	Verantwortliche/r
Naturwissenschaftliche Fakultät II - Chemie, Physik und Mathematik	Chemie	Prof. Dr. Michael Bartke

Studienprogrammverwendbarkeiten (Stand 12.12.2013):

Abschluss	Studienprogramm	empf. Studien-semester	Modulart	Benotung	Anteil der Modulnote an Abschlussnote
Master	Polymer Materials Science - 120 LP 1. Version 2014	3.	Pflichtmodul	Benotet	8/113

Teilnahmevoraussetzungen:

Obligatorisch:

keine

Wünschenswert:

keine

Dauer:

1 Semester

Angebotsturnus:

jedes Wintersemester

Studentischer Arbeitsaufwand:

240 Stunden

Leistungspunkte:

8 LP

Sprache:

Englisch

Modulbestandteile:

Lehr- und Lernformen	SWS	Studentische Arbeitszeit in Stunden	Semester
Lecture Polymer Reaction Engineering	2	30	Wintersemester
Lecture Polymeric Materials	2	30	Wintersemester
Lab Course Polymer Computer Modelling	2	30	Wintersemester
Seminar Polymeric Materials	1	15	Wintersemester
Private study	0	135	Wintersemester

Studienleistungen:

- lab course presentation
- seminar problem set solutions

Modulvorleistungen:

- keine

Modulleistung:

Modulleistung	1. Wiederholung	2. Wiederholung	Anteil an Modulnote
oral or written examination	oral or written examination	oral or written examination	100 %

Termine für die Modulleistung:

1.Termin: examination period A or B

1.Wiederholungstermin: up to 6 months after the end of the semester

2.Wiederholungstermin: up to the examination of the same module in the next year

Modul: Polymer Physical Chemistry

Identifikationsnummer:

CHE.05561.02

Lernziele:

- Basics of the physical chemistry of polymers and their characterization methods
- Overview of analytical techniques for polymers
- Learning to perform basic polymer analyses using different techniques
- Writing of scientific reports

Inhalte:

Lectures:

1. Instrumental Analytics of Polymers
   - Basic principles of analytical chemistry
   - Statistical treatment of analytical data
   - Special chromatographic techniques for the investigation of polymers and polymer additives
   - Principles and instrumental parameters in molecule spectroscopy (IR- and Raman spectroscopy)
   - Thermal analytical methods for the characterization of chemical and physical propertiers of polymers
2. Physical Chemistry
   - Phenomenological thermodynamics: Gibbs free energy, enthalphy, chemical potentials
   - Chemical and phase equilibrium, thermodynamics of mixtures
   - Chemical kinetics
   - Basics of statistical thermodynamics
3. Polymer Characterization
   - Determination of molecular masses and distributions
   - Thermodynamics of polymer solutions, colligative properties
   - Viscosity and diffusion
   - DSC, DMA, TMA
   - Principles of chromatography
   - Characterization of non-linear polymers
   - Microstructure analysis by NMR
   - Electrospray GC-MS, MALDI-TOF
   - End-group titration

Lab courses:

1. Instrumental Analytics of Polymers Lab e.g.
   - Extraction of additives and analysis of extracts and residual monomers by GC/MS
   - Elastomer characterization by TGA
   - Qualitative analysis of polymers and copolymers by FTIR spectroscopy (MIR or NIR)
   - Mn of polymers by vapour pressure osmometry or membrane osmometry
2. Polymer Characterization Lab e.g.
   - static light scattering
   - Dynamic light scattering
   - Wide-angle X-ray scattering
   - CMC determination
   - Gel permeation chromatography (GPC/SEC)
   - End-group titration
   - Intrinsic viscosity
   - Solubility of polymers
   - Mass spectrometry of polymers (ESI and MALDI TOF)

Verantwortlichkeiten (Stand 25.07.2016):

Fakultät	Institut	Verantwortliche/r
Naturwissenschaftliche Fakultät II - Chemie, Physik und Mathematik	Chemie	Prof. Dr. Jörg Kreßler

Studienprogrammverwendbarkeiten (Stand 15.04.2014):

Abschluss	Studienprogramm	empf. Studien-semester	Modulart	Benotung	Anteil der Modulnote an Abschlussnote
Master	Polymer Materials Science - 120 LP 1. Version 2014	1.	Pflichtmodul	Benotet	10/113

Teilnahmevoraussetzungen:

Obligatorisch:

keine

Wünschenswert:

keine

Dauer:

2 Semester

Angebotsturnus:

jedes Wintersemester

Studentischer Arbeitsaufwand:

300 Stunden

Leistungspunkte:

10 LP

Sprache:

Englisch

Modulbestandteile:

Lehr- und Lernformen	SWS	Studentische Arbeitszeit in Stunden	Semester
Lecture Instrumental Analytics of Polymers	1	15	Wintersemester
Lab course Instrumental Analytics of Polymers	1	15	Wintersemester
Lecture Physical Chemistry	2	30	Sommersemester
Lecture Polymer Characterization	2	30	Sommersemester
Lab course Polymer Characterization	2	30	Sommersemester
Physical Chemistry	1	15	Sommersemester
Private study	0	165	Winter- und Sommersemester

Studienleistungen:

- laboratory protocols
- problem set solutions

Modulvorleistungen:

- keine

Modulleistung:

Modulleistung	1. Wiederholung	2. Wiederholung	Anteil an Modulnote
oral or written examination (Instrumental Analytics, Physical Chemistry, Polymer Characterization)	oral or written examination	oral or written examination	100 %

Termine für die Modulleistung:

1.Termin: examination period A or B

1.Wiederholungstermin: up to 6 months after the end of the semester

2.Wiederholungstermin: up to the examination of the same module in the next year

Modul: Polymer Physics

Identifikationsnummer:

PHY.05563.02

Lernziele:

- Acquaintance with the fundamental concepts of experimental polymer physics
- Learning and applying the theoretical fundamentals and the experimental physical methods used to characterize and investigate polymer materials
- Gaining practical experience with basic methods in experimental polymer physics
- Understanding the properties of polymer surfaces
- Knowledge of methods and technologies to modify and analyse polymer surfaces

Inhalte:

Lectures:

1. Lecture Introduction to Polymer Physics
   - Structure of single chains (ideal vs. real chains, scattering, semidilute solutions and melts)
   - Mechanical properties of polymers (liquids vs. solids, rubber elasticity, viscoelasticity, relaxation processes in polymer melts, Debye relaxation, flow behavior, time-temperature superposition and glass transition)
   - Molecular structure and weight distributions (chemical structure, architecture, polymerization processes, determination of structures and molecular weights)
   - Microscopic models for polymer dynamics (viscosity and diffusion, Rouse model, entanglements and reptation)
   - Thermodynamics of solutions and melts (dilute and semidilute solutions, Flory-Huggins theory, kinetics of phase separation, block copolymers, semicrystalline polymers)
2. Lecture Polymer Surface Science
   - Surface vs. bulk
   - Surface composition and ordering
   - Dynamic surface processes (adsorption, desorption, diffusion)
   - Surface tension
   - Surface analysis (XPS, SIMS, SEM, AFM)
   - Surface modification by deposition (wet processes, dry processes, CVD, PE-CVD, PVD), polymer film growth
   - Surface modification and functionalization (wet and dry etching, grafting, plasma treatment)
   - Polymer in lithography
   - Technical applications for surface modification

   Lab course:

   Lab course Polymer Physical Lab e.g.
   - Rheology/mechanical spectroscopy
   - DSC
   - Polarization microscopy

Verantwortlichkeiten (Stand 03.03.2016):

Fakultät	Institut	Verantwortliche/r
Naturwissenschaftliche Fakultät II - Chemie, Physik und Mathematik	Physik	Prof. Dr. Kay Saalwächter

Studienprogrammverwendbarkeiten (Stand 30.04.2014):

Abschluss	Studienprogramm	empf. Studien-semester	Modulart	Benotung	Anteil der Modulnote an Abschlussnote
Master	Polymer Materials Science - 120 LP 1. Version 2014	2.	Pflichtmodul	Benotet	10/113

Teilnahmevoraussetzungen:

Obligatorisch:

keine

Wünschenswert:

keine

Dauer:

1 Semester

Angebotsturnus:

jedes Sommersemester

Studentischer Arbeitsaufwand:

300 Stunden

Leistungspunkte:

10 LP

Sprache:

Englisch

Modulbestandteile:

Lehr- und Lernformen	SWS	Studentische Arbeitszeit in Stunden	Semester
Lecture Introduction to Polymer Physics	3	45	Sommersemester
Lecture Polymer Surface Science	2	30	Sommersemester
Lab Course Polymer Physics Lab	1	15	Sommersemester
Seminar Introduction to Polymer Physics	1	15	Sommersemester
Private study	0	195	Sommersemester

Studienleistungen:

- lab course protocols
- seminar problem set solutions and written examination `Polymer Physics`
- written examination `Polymer Surface Science`

Modulvorleistungen:

- keine

Modulleistung:

Modulleistung	1. Wiederholung	2. Wiederholung	Anteil an Modulnote
oral examination	oral examination	oral examination	100 %

Termine für die Modulleistung:

1.Termin: examination period B

1.Wiederholungstermin: up to 6 months after the end of the semester

2.Wiederholungstermin: up to the examination of the same module in the next year

Modul: Polymer Science Focus

Identifikationsnummer:

PHY.05568.03

Lernziele:

- Becoming familiar with recent developments and modern research topics and methods in synthesis, characterization and properties of polymers and composite materials
- Learning to give a presentation based on literature work

Inhalte:

Lectures:

1. Lecture Modern Concepts of Polymer and Biopolymer Synthesis

   Special topics in current synthetic polymer chemistry research:

   - Modern concepts of controlled and living polymerization techniques
   - Star block copolymers, dendrimers, hyper branched polymers, graft copolymers
   - Organic-inorganic hybrid materials
   - Polymerization in alternative reaction media (ionic liquids, supercritical solvents)
   - Click-chemistry, IPN, semi-IPN, graft polymerization
   - New industrially synthesized polymers (e.g. s-PS, s-PP)
   - Biochemical methods: enzymatic polymerizations
   - Modifications and degradation of biopolymers
   - Special analytical tools for the analysis of biopolymers
   - Biopolymer applications

2. Lecture Modern Physical Polymer Science

   Special topics in current physical polymer research:

   - Block copolymers and polymer nanostructures
   - Crystallization of polymers
   - Nanocomposites
   - Polymer dynamics
   - Modern scattering techniques
   - Polymers in electronics and optics
   - Principles and applications of magnetic resonance techniques

   Seminar:

   Research seminar

   - Student presentation of research results from the literature from the fields of polymer chemistry of physics

Verantwortlichkeiten (Stand 20.01.2016):

Fakultät	Institut	Verantwortliche/r
Naturwissenschaftliche Fakultät II - Chemie, Physik und Mathematik	Physik	Prof. Dr. Kay Saalwächter

Studienprogrammverwendbarkeiten (Stand 10.12.2013):

Abschluss	Studienprogramm	empf. Studien-semester	Modulart	Benotung	Anteil der Modulnote an Abschlussnote
Master	Polymer Materials Science - 120 LP 1. Version 2014	3.	Wahlpflichtmodul	Benotung ohne Anteil	0/113

Teilnahmevoraussetzungen:

Obligatorisch:

keine

Wünschenswert:

keine

Dauer:

1 Semester

Angebotsturnus:

jedes Wintersemester

Studentischer Arbeitsaufwand:

210 Stunden

Leistungspunkte:

7 LP

Sprache:

Englisch

Modulbestandteile:

Lehr- und Lernformen	SWS	Studentische Arbeitszeit in Stunden	Semester
Lecture Modern Concepts of Polymer and Biopolymer Synthesis	2	30	Wintersemester
Seminar Modern Concepts of Polymer and Biopolymer Synthesis	1	15	Wintersemester
Lecture Modern Physical Polymer Science	2	30	Wintersemester
Seminar Modern Physical Polymer Science	1	15	Wintersemester
Research seminar	1	15	Wintersemester
Private study	0	105	Wintersemester

Studienleistungen:

- oral or written examination Modern Concepts of Polymer and Biopolymer Synthesis
- oral or written examination Modern Physical Polymer Science

Modulvorleistungen:

- keine

Modulleistung:

Modulleistung	1. Wiederholung	2. Wiederholung	Anteil an Modulnote
oral examination (presentation)	oral examination	oral examination	100 %

Termine für die Modulleistung:

1.Termin:	examination period A
1.Wiederholungstermin:	up to 6 months after the end of the semester
2.Wiederholungstermin:	up to the examination of the same module in the next year