JACOBS UNIVERSITY

Module Handbook

Undergraduate Studies 2015 / 2016

Bachelor of Arts, Bachelor of Science

Introduction

All undergraduate programs at Jacobs University are based on a coherently modularized structure, which provides students with a broad and flexible choice of study plans to meet their major as well as minor study interests.

The first study year is characterized by a broad offer in disciplinary and interdisciplinary education. Students select three CHOICE modules from a variety of study programs. As a unique asset, our curricula allow students to select their study program freely from among the three selected CHOICE modules during their first year of study.

In the second year, students take three in-depth, discipline-specific CORE modules. One CORE module can also be taken from a second, complementary discipline, which allows students to incorporate a minor study track into their undergraduate education. Students will generally qualify for a minor, if they have successfully taken at least one CHOICE module and one CORE module in a second field.

This module handbook provides the module data for all 1st year CHOICE and all 2nd year CORE modules offered by Jacobs University.

For further detailed information concerning the general curricular structure of Jacobs University as well as the program specific information, please consult the respective study program handbook.

Jacobs University's Undergraduate Study Programs according to Focus Area

Focus Area Health

- Medicinal Chemistry and Chemical Biology (MCCB)
- Physics
- Chemistry
- Biochemistry and Cell Biology (BCCB)
- Earth and Environmental Sciences (EES)

Focus Area Mobility

- Intelligent Mobile Systems (IMS)
- Mathematics (Math)
- Electrical and Computer Engineering (ECE)
- Computer Science (CS)
- Industrial Engineering and Management (IEM)

Focus Area Diversity

- Psychology
- Global Economics and Management (GEM)
- Integrated Social Sciences (ISS)
- International Relations: Politics and History (IRPH)
- International Business Administration (IBA)

Remark:
In the focus area Health we additionally offer the Bachelor of Science program *Medical Natural Sciences* which follows a slightly different curricular structure. Therefore, MedNat modules are not listed in this handbook.

Overview Undergraduate CHOICE and CORE Modules 2015/16

Type	Module Number	Module Name	Mandatory for	Mandatory Elective for	Page
CHOICE	CH01-CellBio	Cell Biology	BCCB		4
CHOICE	CH02-BioChem	Biochemistry and Molecular Biology	BCCB, MCCB		5
CHOICE	CH03-OrgChem	Organic Chemistry	Chemistry, MCCB		6/7
CHOICE	CH04-InorgChem	Inorganic Chemistry and Environmental Systems	Chemistry, EES		8
CHOICE	CH05-PhysNatSys	Physics of Natural Systems	EES, Physics		9
CHOICE	CH06-PhysAppMath	Physics and Applied Mathematics	Physics		10
CHOICE	CH07-FundMath	Fundamental Mathematics	Mathematics		11
CHOICE	CH08-GenCS	General Computer Science	CS		12
CHOICE	CH09-IntroIMS	Introduction to Intelligent Mobile Systems	IMS		13
CHOICE	CH10-IntroEE	Introduction to Electrical Engineering	ECE		14
CHOICE	CH11-GenIEM	General Industrial Engineering and Management	IEM		15
CHOICE	CH12-GenMan	General Management	IBA, GEM		16/17
CHOICE	CH13-GenEcon	General Economics	GEM, IBA, ISS		18
CHOICE	CH14-PolSocMedia	Political, Social & Media Diversity	ISS		19
CHOICE	CH15-IntroIR	Introduction to International Relations	IRPH		20
CHOICE	CH16-IntroPsych	Introduction to Psychology	Psychology		21
CORE	CO01-Biomed	Biomedicine		BCCB	22
CORE	CO02-InfImm	Infection and Immunity		BCCB	23
CORE	CO03-MolBio	Molecular Biology		BCCB	24
CORE	CO04-ChemBio	Chemical Biology		MCCB	25
CORE	CO05-DrugProd	Drug Action and Production		MCCB	26
CORE	CO06-DrugDev	Drug Development		MCCB	27
CORE	CO07-ChemBiotec	Chemical Biotechnology		Chemistry	28/29
CORE	CO08-PhysChem	Physical and Analytical Chemistry		Chemistry	30
CORE	CO09-CoChem	Inorganic and Supramolecular Chemistry		Chemistry	31
CORE	CO10-FundEES	Fundamental Earth and Environmental Sciences		EES	32
CORE	CO11-EOEnvChem	Earth, Ocean, and Environmental GeoChemistry		EES	33
CORE	CO12-EOEnvPhys	Earth, Ocean, and Environmental GeoPhysics		EES	34
CORE	CO13-PhysMatter	Physics of Matter		Physics	35
CORE	CO14-PhysTech	Physics and Technology		Physics	36
CORE	CO15-TheoPhys	Theoretical Physics		Physics	37
CORE	CO16-CoreMaths	Core Mathematics		Mathematics	38
CORE	CO17-CorePureMath	Core Pure Mathematics		Mathematics	39
CORE	CO18-CoreAppMath	Core Applied Mathematics		Mathematics	40
CORE	CO19-ApplCS	Applied Computer Science		CS	41
CORE	CO20-TechCS	Technical Computer Science		CS	42
CORE	CO21-TheoCS	Theoretical Computer Science		CS	43
CORE	CO22-IntelSys	Intelligent Systems		IMS	44
CORE	CO23-AutoControl	Automation and Control		IMS	45
CORE	CO24-PlanOpt	Planning and Optimization		IMS	46
CORE	CO25-Communic	Communications		ECE	47
CORE	CO26-ElectroNoise	Electronics and Noise		ECE	48
CORE	CO27-SigProcess	Signal Processing		ECE	49
CORE	CO28-FinProjMan	Finance and Project Management		IEM, IBA	50
CORE	CO29-ProcessEng	Process Engineering		IEM	51
CORE	CO30-ProductEng	Production and Engineering		IEM	52
CORE	CO31-StratMan	Strategy and Management		IBA	53
CORE	CO32-ManDivers	Managing Diversity		IBA, GEM	54
CORE	CO33-EconPolicy	Economic Policy Challenges		GEM	55
CORE	CO34-EconInstOrg	Economic Institutions and Organization		GEM	56
CORE	CO35-IntPolitics	International Politics and Policy		ISS, IRPH	57
CORE	CO36-CommCult	Communication, Culture and Consumers		ISS	58
CORE	CO37-GoodSociety	The Good Society		ISS	59
CORE	CO38-GlobDynHist	Global Dynamics in Historical Perspective		IRPH	60
CORE	CO39-ArenaPolLife	Arenas of Political Life		IRPH	61
CORE	CO40-BioBrainCog	Biology, Brain, and Cognition		Psychology	62
CORE	CO41-HumanSoCo	Humans in Social Context		Psychology	63
CORE	CO42-ApplPsych	Applied Psychology		Psychology	64

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Module Data Sheet

Module Name **Cell Biology**	*Module Code* **CH01-CellBio**	*ECTS* **15**
Pre-requisites ☐Corresponding CHOICE Modules ☒None	*Module Contact Person* Dr. Susanne Illenberger	*Level (type)* ☒Year 1 (CHOICE) ☐Year 2 (CORE) ☐Year 3 (CAREER) ☐Any (Jacobs Track)
Frequency Every year	*Duration* 1 year	

Module Description / Content

Cell Biology is an introductory module giving a comprehensive overview about cellular structure and physiology. It will explain cellular architecture and organization and how cells need to interact and communicate in multicellular organisms. This module will thus provide insight into both, the organismal organization and specialization of cells as well as the underlying molecular processes, e.g., gene expression and intracellular transport. Both 5-ECTS-lectures are complemented by a 2.5-ECTS lab course each, offering practical training in key techniques applied in modern molecular cell biology. This module provides the foundation from which you may progress to the higher level modules "Biomedicine" and "Infection and Immunity".

Module Aims

This module aims at teaching core concepts in cell biology on both, the level of the individual cell as well as cells in a multi-cellular context. It will provide the fundamental understanding of cellular processes and their experimental analyses preparing students for advanced studies in modern molecular cell biology.

Intended Learning Outcomes (ILOs)

Discipline Specific Skills

- Explain the molecular composition of cells and how a cells molecular repertoire defines its properties
- Understand the plasticity of cells in order to fulfill specific functions in tissues and organs
- Teaching core concepts in molecular cell biology
- Explaining the structure-function relationship of biomolecules at the cellular level
- Gain first insight into the experimental analysis of cells on both, theoretical and practical levels

Module Function (in Study Programs)

- mandatory for: Biochemistry and Cell Biology
- elective for: all other study programs

Module Components and Types

Course Nr.	**Course Name**	**Type**	**ECTS**	**Number of Sessions** (per Semester)	**Duration of Session** (min)	**Total** (hours)
CH01-520122	From Cells to Tissues and Body Functions	Lecture	5	28	75	35
CH01-520123	General Cell Biology Lab	Lab	2,5	6	255	25,5
CH01-520102	General Molecular Cell Biology	Lecture	5	28	75	35
CH01-520112	General Molecular Cell Biology Lab	Lab	2,5	5	255	25,5

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Module Data Sheet

Module Name **Biochemistry and Molecular Biology**	*Module Code* **CH02-BioChem**	*ECTS* **15**
Pre-requisites ☐Corresponding CHOICE Modules ☒None	*Module Contact Person* Dr. Susanne Illenberger	*Level (type)* ☒Year 1 (CHOICE) ☐Year 2 (CORE) ☐Year 3 (CAREER) ☐Any (Jacobs Track)
Frequency Every year	*Duration* 1 year	

Module Description / Content

Biochemistry and Molecular Biology is a first year module that explains how the structure of biological molecules (proteins, sugars, lipids, nucleic acids) defines their biochemical properties and cellular functions. Students will be introduced to the basics of thermodynamics and molecular kinetics to understand key biomolecular concepts, e.g., protein folding, metabolism, and gene expression. Each of the two 5-ECTS-lectures is complemented by a 2.5 ECTS lab course offering practical training in key techniques applied in biochemistry and molecular biology. This module provides the foundation for the CORE modules "Molecular Biology" and "Chemical Biology".

Module Aims

This module aims at teaching core concepts in biochemistry and molecular biology. It will provide the fundamental understanding of the versatile functions of biological molecules and their experimental investigation, preparing students for advanced studies in biochemistry and molecular biology.

Intended Learning Outcomes (ILOs)

Discipline Specific Skills

- Explain the structure and biochemical properties of the major classes of biological molecules
- Understand how chemical structure defines cellular function
- Gain first insight into the experimental analysis of biological molecules at both theoretical and practical levels
- Understand the molecular principles underlying gene expression.
- Introduction to thermodynamics and kinetics.

Module Function (in Study Programs)

- mandatory for: Biochemistry and Cell Biology (BCCB) Medicinal Chemistry and Chemical Biology (MCCB)
- elective for: all other study programs

Module Components and Types

Course Nr.	**Course Name**	**Type**	**ECTS**	**Number of Sessions** (per Semester)	**Duration of Session** (min)	**Total** (hours)
CH02-520101	General Biochemistry and Molecular Biology I	Lecture	5	28	75	35
CH02-520111	General Biochemistry and Molecular Biology I Lab	Lab	2,5	6	255	25,5
CH02-520201	General Biochemistry and Molecular Biology II	Lecture	5	28	75	35
CH02-520121	General Biochemistry and Molecular Biology II Lab	Lab	2,5	6	255	25,5

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Module Data Sheet

Module Name **Organic Chemistry**	*Module Code* **CH03-OrgChem**	*ECTS* **15**
Pre-requisites ☐Corresponding CHOICE Modules ☒None	*Module Contact Person* Prof. Dr. T. Nugent	*Level (type)* ☒Year 1 (CHOICE) ☐Year 2 (CORE) ☐Year 3 (CAREER) ☐Any (Jacobs Track)
Frequency Every year	*Duration* 1 year	

Module Description / Content

We begin by reestablishing atomic structure, and the importance of Lewis dot structures, resonance, valence-shell electron-pair repulsion, and valence-bond theory to give meaning to a covalent bond. Hybridization is then introduced to allow an accurate and predictive accounting of molecular shape. This foundation permits the introduction of: functional groups, conformation, chirality, acidity and basicity, and the basics of equilibria, thermodynamic, and kinetic phenomena. With these concepts in hand, we develop organic reactivity by examining the mechanistic pathways (arrow pushing) and chemical principles behind substitution, elimination, and addition reactions. Common reagents and functional group transformations are then learned in the context of the importance of their order and type (retrosynthetic analysis and strategy) for brevity in synthesis.

Module Aims

The student will obtain a strong foundation in the main principles and concepts of organic chemistry and will be conversant in a wide array of subtopics. At each new level of understanding in this "two –course-one-lab"-module a stronger understanding for the biological relevance of organic molecules will be apparent. Natural product and pharmaceutical drug examples are elucidated on in class and firmly establish the connectivity with bioactivity. The lecture material is complemented by hands-on practical experience involving lab safety, basic chemical reactions and techniques, including lab equipment and basic chemical reactions in organic chemistry (esterification, bromination, saponification, substitution, natural product isolation).

Intended Learning Outcomes (ILOs)

Discipline Specific Skills

- Nomenclature is interwoven at all times
- Bonding and hybridization, aromaticity, HOMO/LUMO concepts
- Lewis acids and bases
- The basics of equilibrium, thermodynamic, and kinetic phenomena
- Conformation, stereochemistry, chirality
- Major functional group manipulations: alkyl halides, alkenes, alkynes, alcohols, ethers, aromatic compounds, ketones, esters, carboxylic acids, amines, imines, amides, phenols
- Reactive species (carbocations, carbanions, radicals)
- Synthesis
- Name reactions: aldol, Friedel-Crafts alkylation and acylation, Diels-Alder reaction, Williamson ether synthesis, Swern Oxidation, Wittig olefination, Hofmann rearrangement, Haloform reaction, etc.
- Natural Products

Module Function (in Study Programs)

- mandatory for: Chemistry, MCCB
- elective for: all other study programs

Module Components and Types

Course Nr.	**Course Name**	**Type**	**ECTS**	**Number of Sessions** (per Semester)	**Duration of Session** (min)	**Total** (hours)
CH03-400102	Organic Chemistry I	Lecture	5	28	75	35

CH03-400112	Organic Chemistry I Lab	Lab	2,5	6	255	25,5
CH03-400103	Organic Chemistry II	Lecture	5	28	75	35
CH03-400113	Organic Chemistry II Lab	Lab	2,5	6	255	25,5

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Module Data Sheet

Module Name **Inorganic Chemistry and Environmental Systems**	*Module Code* **CH04-InorgChem**	*ECTS* **15**
Pre-requisites ☐Corresponding CHOICE Modules ☒None	*Module Contact Person* Prof. Dr. D. Gabel (Chemistry) Prof. Dr. J. Vogt / M. Bau (EES)	*Level (type)* ☒Year 1 (CHOICE) ☐Year 2 (CORE) ☐Year 3 (CAREER) ☐Any (Jacobs Track)
Frequency Every year	*Duration* 1 year	

Module Description / Content

The bi-functional module "Inorganic Chemistry and Environmental Systems" provides an introduction to (inorganic) chemistry and to the anthropogenic impact on the natural (near-) surface environment of Earth. Two introductory lecture courses ("Inorganic Chemistry I" (focus on the elements of the PSE, molecular compounds derived from them, redox reactions) and "Introduction to Environmental Systems" (focus on Geodynamics, Petrography, Soil Science, Oceanography, Hydrogeology, Geomorphology, and anthropogenic impact on the (near-)surface environment) are complemented by an on-campus laboratory course (Inorganic Chemistry I Lab) and an off-campus field-lab (excursion) to develop fundamental practical skills.

Module Aims

This module forms the basis for the second-year CORE modules in the "Chemistry" and the "Earth and Environmental Sciences" programs and aims at providing the essential fundamental theoretical knowledge and practical skills.

Intended Learning Outcomes (ILOs)

Discipline Specific Skills

- Knowledge of basic concepts in inorganic chemistry;
- Knowledge about the general properties of the main group elements;
- Knowledge about the trends of properties of the transition metals;
- Ability to perform stoichiometric calculations, qualitative and quantitative analyses;
- Knowledge of basic concepts in Geology, Oceanography, and Environmental Science;
- Knowledge of basic terminology and concepts in Petrography, Soil Science and Hydrogeology;
- Knowledge of major anthropogenic disturbance of the natural (near-)surface system;
- Familiarity with the basic practical skills of geological and geochemical field work.

Module Function (in Study Programs)

- mandatory for: Chemistry and Earth and Environmental Sciences
- elective for: all other study programs

Module Components and Types

Course Nr.	**Course Name**	**Type**	**ECTS**	**Number of Sessions** (per Semester)	**Duration of Session** (min)	**Total** (hours)
CH04-210131	Introduction to Earth and Environmental Systems	Lecture	5	28	75	35
CH04-210111	GeoEnvironmental Systems and their Chemistry – Field Lab	Excursion (Lecture + Lab)	2,5	4 lectures/ 3 lab days	75/ 600	35
CH04-400101	Inorganic Chemistry I	Lecture	5	28	75	35
CH04-400111	Inorganic Chemistry I Lab	Lab	2,5	6	255	25,5

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Module Data Sheet

Module Name **Physics of Natural Systems**	*Module Code* **CH05-PhysNatSys**	*ECTS* **15**
Pre-requisites ☐Corresponding CHOICE Modules ☒None	*Module Contact Person* Prof. Dr. J. Fritz Prof. Dr. P. Schupp Prof. Dr. J. Vogt Prof. Dr. M. Bau	*Level (type)* ☒Year 1 (CHOICE) ☐Year 2 (CORE) ☐Year 3 (CAREER) ☐Any (Jacobs Track)
Frequency Every year	*Duration* 1 year	

Module Description / Content

Physics of Natural Systems provides an introduction to the physical description of natural phenomena and covers fundamental topics in physics and earth and environmental sciences (EES). Important concepts from mechanics, thermodynamics, fluid dynamics, electromagnetism, atoms and nuclei are introduced and applied to essential processes in Earth, marine, and planetary sciences. Structure and dynamics of natural systems are studied with moderate use of mathematics. Practical sessions will cover important experimental techniques and tools. This module provides a foundation for the higher level EES and Physics modules Earth, Ocean, and Environmental Physics, Physics and Technology, Theoretical Physics, and Physics of Matter.

Module Aims

This module introduces selected topics in physics and in EES using synergies between topics whenever possible. The goal is to learn and understand fundamental concepts by applying them in a practical setting. The module provides the basis for advanced studies in EES and Physics, and offers a set of basic problem solving skills with respect to the explanation of natural and everyday phenomena in terrestrial and marine environments.

Intended Learning Outcomes (ILOs)

Discipline Specific Skills

- Explain the basic concepts of motion, force, and energy and apply them to natural systems.
- Explain fundamental phenomena and concepts of earth, its history, oceans and setting in the solar system.
- Do a quantitative basic mathematical analysis and description of physical and natural systems.
- Investigate natural phenomena using basic experimental and observational techniques.
- Communicate in scientific language and know the basic field-specific technical terms.

Module Function (in Study Programs)

- mandatory for: Earth and Environmental Sciences, Physics
- elective for: all other study programs

Module Components and Types

Course Nr.	**Course Name**	**Type**	**ECTS**	**Number of Sessions** (per Semester)	**Duration of Session** (min)	**Total** (hours)
CH05-200104	Classical Physics	Lecture	5	28	75	35
CH05-200114	Classical Physics Lab	Lab	2,5	6	255	25,5
CH05-210132	Introduction to Earth and Marine Systems	Lecture	5	28	75	35
CH05-210133	Introduction to Mineralogy	Lecture	2,5	14	75	17,5

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Module Data Sheet

Module Name **Physics and Applied Mathematics**	*Module Code* **CH06-PhysAppMath**	*ECTS* **15**
Pre-requisites ☐Corresponding CHOICE Modules ☒None	*Module Contact Person* Prof. Dr. J. Fritz Prof. Dr. P. Schupp	*Level (type)* ☒Year 1 (CHOICE) ☐Year 2 (CORE) ☐Year 3 (CAREER) ☐Any (Jacobs Track)
Frequency Every year	*Duration* 1 year	

Module Description / Content

Physics and Applied Mathematics is an introduction to the mathematical description of natural phenomena. Mathematics is the language and physics is the foundation of all other natural sciences and many engineering disciplines. In this module, we will study fundamental laws of physics and the underlying mathematical concepts and applications. Topics include vector calculus, differential equations, complex analysis; mechanics of systems of particles, oscillations, waves, relativity, electrodynamics, and quantum physics. Lectures are complemented by practical sessions that provide training in computational and experimental skills, including a quantitative analysis of measurements.

Module Aims

The module comprises a calculus based overview of classical and modern physics and an introduction to the relevant mathematical methods. The goal is to be able to understand, analyze, and develop mathematical models of physical systems. The module provides the foundation for advanced studies in physics and other quantitative sciences.

Intended Learning Outcomes (ILOs)

Discipline Specific Skills

- Explain natural phenomena, physical systems and technical devices qualitatively as well as quantitatively.
- Construct mathematical models of natural phenomena and physical systems and do a quantitative analysis.
- Understand the fundamental laws of physics and the underlying mathematical concepts.
- Investigate physical systems using computational and experimental methods.
- Communicate in scientific language and know the field-specific technical terms.

Module Function (in Study Programs)

- mandatory for: Physics
- elective for: all other study programs

Module Components and Types

Course Nr.	**Course Name**	**Type**	**ECTS**	**Number of Sessions** (per Semester)	**Duration of Session** (min)	**Total** (hours)
CH06-100101	Applied Mathematics	Lecture	5	28	75	35
CH06-100111	Applied Mathematics Lab	Lab	2,5	6	255	25,5
CH06-200102	Modern Physics	Lecture	5	28	75	35
CH06-200112	Modern Physics Lab	Lab	2,5	6	255	25,5

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Module Data Sheet

Module Name **Fundamental Mathematics**	*Module Code* **CH07-FundMath**	*ECTS* **15**
Pre-requisites ☐Corresponding CHOICE Modules ☒None	*Module Contact Person* Prof. Dr. Marcel Oliver Prof. Dr. Dierk Schleicher	*Level (type)* ☒Year 1 (CHOICE) ☐Year 2 (CORE) ☐Year 3 (CAREER) ☐Any (Jacobs Track)
Frequency Every year	*Duration* 1 year	

Module Description / Content

Fundamental Mathematics is the central first year major-specific module. It complements the first-year Service Mathematics courses in Calculus/Analysis and Linear Algebra with additional in-depth material necessary for any Mathematics student and useful for students of other quantitative majors or those with an independent interest in Mathematics.

Module Aims

This module, complemented by courses in the Jacobs Track, provides students with the fundamental mathematical concepts necessary to continue into the Mathematics Core and useful for further study in any of the quantitative science and engineering majors. The module further develops problem solving skills, presentation skills, and gives a first introduction to the use of mathematical software.

Intended Learning Outcomes (ILOs)

Discipline Specific Skills

- Have a good command of single and multivariable calculus in one and several variables
- Be familiar with the foundations of mathematical analysis
- Know the basics of Linear Algebra and its applications.
- A first introduction to broadly usable mathematical and quantitative programming and writing tools

Module Function (in Study Programs)

- mandatory for: Mathematics
- elective for: all other study programs

Module Components and Types

Course Nr.	**Course Name**	**Type**	**ECTS**	**Number of Sessions** (per Semester)	**Duration of Session** (min)	**Total** (hours)
CH07-100101	General Mathematics I	Lecture	5,0	28	75	35
CH07-100111	Mathematical Software Lab	Lab	2,5	6	255	25,5
CH07-100212	Analysis II	Lecture	5,0	28	75	35
CH07-100122	Undergraduate Seminar	Seminar	2,5	6	255	25,5

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Module Data Sheet

Module Name **General Computer Science**	*Module Code* **CH08-GenCS**	*ECTS* **15**
Pre-requisites ☐Corresponding CHOICE Modules ☒None	*Module Contact Person* Prof. Dr. J. Schönwälder	*Level (type)* ☒Year 1 (CHOICE) ☐Year 2 (CORE) ☐Year 3 (CAREER) ☐Any (Jacobs Track)
Frequency Every year	*Duration* 1 year	

Module Description / Content

The introductory module General Computer Science covers abstract and concrete notions of computing machines, information, and algorithms. You will develop an understanding of the mathematical foundations of computer science. Core concepts such as algorithms, computations, and complexity will be introduced. The module also introduces you to basic data structures and elementary sort and search algorithms. You will learn how to represent graphs and how basic graph algorithms work. By studying elementary algorithms in depth, you will learn how to prove properties of algorithms such as their complexity. The module finally introduces you to different programming paradigms and how to approach and solve programming problems in a systematic way. The object-oriented programming paradigm and object-oriented design patterns will be studied in some depths.

Module Aims

This module aims to teach you core concepts of computer science. It covers the mathematical foundation of computer science and it provides an in depths understanding of elementary data structures and algorithms for sorting, searching, and graph traversal. The module introduces object-oriented programming languages and object-oriented design pattern.

Intended Learning Outcomes (ILOs)

Discipline Specific Skills

- Understand Boolean logic and number systems
- Be familiar with the big O notation and able to apply it to Boolean expressions
- Recall basic proof techniques and how they can be applied to show properties of algorithms
- Explain different sorting and search algorithms and their complexity properties
- Understand basic data structures such as arrays, vectors, lists, stacks, trees, hash tables, and maps
- Can write programs in an object-oriented programming language and can apply object-oriented design pattern

Module Function (in Study Programs)

- mandatory for: Computer Science
- elective for: all other study programs

Module Components and Types

Course Nr.	**Course Name**	**Type**	**ECTS**	**Number of Sessions** (per Semester)	**Duration of Session** (min)	**Total** (hours)
CH08-320101	General Computer Science	Lecture	5	28	75	35
CH08-320142	Object-Oriented Programming I	Lab	2,5	6	255	25,5
CH08-320201	Algorithms and Data Structures	Lecture	5	28	75	35
CH08-320143	Object-Oriented Programming II	Lab	2,5	6	255	25,5

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Module Data Sheet

Module Name **Introduction to Intelligent Mobile Systems**	*Module Code* **CH09-IntroIMS**	*ECTS* **15**
Pre-requisites ☐Corresponding CHOICE Modules ☒None	*Module Contact Person* Prof. Dr. A. Birk Prof. Dr. G. Abreu	*Level (type)* ☒Year 1 (CHOICE) ☐Year 2 (CORE) ☐Year 3 (CAREER) ☐Any (Jacobs Track)
Frequency Every year	*Duration* 1 year	

Module Description / Content

This is an introductory module providing a strong theoretical and practical foundation for the core courses in the second year. The key components required to make man-made mobile systems intelligent are sensors, actuators, and algorithms. Students will be given an overview of basic technologies and concepts underlying each of these components. The module will cover the fundamental engineering tools to model mechanical, electrical, and mechatronic systems. A detailed introduction to linear systems theory will be provided, aided by computer simulation. Finally, you will get an introduction to basic electronics and complement your knowledge with lab exercises.

Module Aims

This module aims to teach you concepts which lie at the heart of technologies and algorithms needed to design intelligent mobile systems. These include introductory physical modeling and simulation, systems theory, control theory, artificial intelligence, and electronics.

Intended Learning Outcomes (ILOs)

Discipline Specific Skills

- Model common mechanical and electrical systems which are part of intelligent mobile systems
- Explore linear systems and tune their behavior in simulation
- Understand basic electronic components and circuits
- Understand basic algorithms used in the field of Artificial Intelligence

Module Function (in Study Programs)

- mandatory for: Intelligent Mobile Systems
- elective for: all other study programs

Module Components and Types

Course Nr.	**Course Name**	**Type**	**ECTS**	**Number of Sessions** (per Semester)	**Duration of Session** (min)	**Total** (hours)
CH09-320103	General Intelligent Mobile Systems I	Lecture	5	28	75	35
CH09-320113	Introduction to Intelligent Mobile Systems Lab I	Lab	2,5	6	255	25,5
CH09-320104	General Intelligent Mobile Systems II	Lecture	5	28	75	35
CH09-320114	Introduction to Intelligent Mobile Systems Lab II	Lab	2,5	6	255	25,5

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Module Data Sheet

Module Name **Introduction to Electrical Engineering**	*Module Code* **CH10-IntroEE**	*ECTS* **15**
Pre-requisites ☐Corresponding CHOICE Modules ☒None	*Module Contact Person* Prof. Dr.-Ing. W. Henkel	*Level (type)* ☒Year 1 (CHOICE) ☐ Year 2 (CORE) ☐Year 3 (CAREER) ☐Any (Jacobs Track)
Frequency Every year	*Duration* 1 year	

Module Description / Content

The module comprises the classical introduction to Electrical Engineering (EE) in general. Starting from the basics of the electric phenomenon, its fundamental elements (charge, current, potential, energy, etc.), its interaction with materials (conductivity, capacitance, inductance etc.) and its manipulation by man-made structures (electronic components and circuits), the course then develops into a wide set of general principles, laws and analytical tools to understand electric circuits and electric systems in general. The module also offers a solid foundation on which specialization areas in EE (*e.g.* Communications, Control, etc.) are built.

Module Aims

Students will be taught the essentials of electrical engineering, including circuit theory applied not only to DC steady state, but also transient analysis and AC circuits. Classic materials include (but are not limited to): Kirchhoff's Laws, Volta's Law, Faraday's Law, Thevenin and Norton's Theorem, Tellegen's Theorem, Source Transformations, Non-linear electronic components, OpAmp circuits, State-space Method, Laplace Transform for Higher-order Circuits, Circuit Transfer Functions, AC power analysis, Fourier Series and Transform, etc.

Intended Learning Outcomes (ILOs)

Discipline Specific Skills

- Understanding of the fundamental principles of electric systems (charge, current, potential, energy and its conservation, etc.)
- Ability to analyze electric circuits including: resistive circuits, operational circuits, higher-order circuits (transient and steady-state) in both DC and AC variations, in both time and frequency domains.
- Understanding of the origins of electric signals and their processing via electric circuits, with application to digital signal processing and communications
- Ability to operate lab equipment (oscilloscopes, electric sources, voltmeters) to investigate simple DC and AC circuits. This lab equipment is also utilized in other areas.
- Analytical and mathematical modeling skills of electric networks, which transcend application to electric circuits and can also be used to study other physical systems (such as mechanical systems and control systems)

Module Function (in Study Programs)

- mandatory for: Electrical and Computer Engineering
- elective for: all other study programs

Module Components and Types

Course Nr.	**Course Name**	**Type**	**ECTS**	**Number of Sessions** (per Semester)	**Duration of Session** (min)	**Total** (hours)
CH10-300101	General Electrical Engineering I	Lecture	5	28	75	35
CH10-300102	General Electrical Engineering II	Lecture	5	28	75	35
CH10-300111	Electrical Engineering I Lab	Lab	2.5	6	255	25,5
CH10-300112	Electrical Engineering II Lab	Lab	2.5	6	255	25,5

Version (Date of Revision)
002 (07/2015)

Module Data Sheet

Module Name **General Industrial Engineering and Management**	*Module Code* **CH11-GenIEM**	*ECTS* **15**
Pre-requisites ☐Corresponding CHOICE Modules ☒None	*Module Contact Person* Prof. Dr. oec. Julia C. Bendul	*Level (type)* ☒Year 1 (CHOICE) ☐Year 2 (CORE) ☐Year 3 (CAREER) ☐Any (Jacobs Track)
Frequency Every year	*Duration* 1 year	

Module Description / Content

General IEM is an introductory module designed to provide an overview of processes in industrial systems, logistics and supply chains. Students will learn the fundamentals of industrial engineering, industrial management, manufacturing technology, and logistics systems. Practical sessions will offer a number of exercises and activities to demonstrate and substantiate the technical concepts taught in lectures. The module provides a solid basis for further development in the Industrial Engineering and Management field, equipping the students with tools and concepts that are highly relevant for the further modules.

Module Aims

This module aims to cover the fundamental skills in industrial engineering and management and to provide students with a broad view of operations within the factory and supply chain related processes. Moreover, the module introduces students to new technologies, future trends and strategies in industrial engineering and management.

Intended Learning Outcomes (ILOs)

Discipline Specific Skills

- Get a broad overview of the scope of industrial systems, manufacturing, transportation, resource and supply chain management.
- Comprehend the entire value added chain from the supplier to the customer (the procurement, the production, the distribution and the reverse (waste management) logistics)
- Gain a basic understanding of the main principles of industrial systems' analysis (e.g. business process modeling, computer simulation of production processes, distribution planning, safety stock calculation, linear programming)
- Get familiar with the main manufacturing technologies (casting, milling, welding, and grinding), the manufacturing process flow, bill of materials, and factory planning principles

Module Function (in Study Programs)

- mandatory for: Industrial Engineering and Management
- elective for: all other study programs

Module Components and Types

Course Nr.	**Course Name**	**Type**	**ECTS**	**Number of Sessions** (per Semester)	**Duration of Session** (min)	**Total** (hours)
CH11-050103	Industrial Engineering	Lecture	5	28	75	35
CH11-050111	Industrial Engineering Lab	Lab	2,5	6	255	25,5
CH11-050262	Basics of Manufacturing Technology (Intersession)	Seminar	2,5	14	75	17,5
CH11-050101	Introduction to Logistics & SCM	Lecture	5	28	75	35

Version (Date of Revision)
002 (07/2015)

Module Data Sheet

Module Name **General Management**	*Module Code* **CH12-GenMan**	*ECTS* **15**
Pre-requisites ☐Corresponding CHOICE Modules ☒None	*Module Contact Person* Prof. Dr. Christoph Lattemann	*Level (type)* ☒Year 1 (CHOICE) ☐Year 2 (CORE) ☐Year 3 (CAREER) ☐Any (Jacobs Track)
Frequency Every year	*Duration* 1 year	

Module Description / Content

The module "General Management" provides the foundation for the basic domains of business practices and management tools in the international context in which modern businesses increasingly interact with their various stakeholders. The module consists of three courses: "Introduction to International Business", "Entrepreneurship and Innovation", and "International Financial Accounting".

"International Business" provides the foundation for the basic domains of business (accounting, economics, finance, management, marketing and production). It builds the base for all other management and business courses. "Entrepreneurship and Innovation" deals with firm-internal processes and methods to start and run a business. "International Financial Accounting" explains the applications of international accounting standards. Special emphasis is placed on managing international entrepreneurship with respect to how accounting applies to global strategies and the key accounting issues that influence multinational decision making.

Module Aims

This module describes and analyzes the business-eco system which defines the environment for firm's activities. It further aims to teach basic practices and tools to run a business and explains firm's international driving forces. The module will also provide the basics in international accounting to understand the fundamental pillars of firm's activities. This module provides the foundation from which you may progress to higher level modules in Managing Diversity, Finance and Project Management, and Strategy and Management.

Intended Learning Outcomes (ILOs)

Discipline Specific Skills

- Describe and discuss global economic development from a firm's perspective
- Identify international strategies and the corporate-level strategies that companies use
- Explain the impact globalization is having on international marketing activities
- Perform entry level accounting operations (Understand the mechanisms of a balance sheet, profit/loss and cash flow statements)
- Develop a well-presented business plan
- Create appropriate a business model
- Demonstrate the understanding of how to launch the individual's entrepreneurial career
- Learn how to apply the Design Thinking Approach
- Apply critical thinking skills
- Demonstrate oral communication skills
- Demonstrate written communication skills
- Analyze international environment
- Analyze ethical issues
- Utilize technology skills

Module Function (in Study Programs)

- mandatory for: International Business Administration, Global Economics and Management
- elective for: all other study programs

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Module Data Sheet

Module Components and Types						
Course Nr.	**Course Name**	**Type**	**ECTS**	**Number of Sessions** (per Semester)	**Duration of Session** (min)	**Total** (hours)
CH12-032201	Introduction to International Business	Seminar	5	28	75	35
CH12-930103	Financial Accounting	Seminar	5	28	75	35
CH12-930113	Entrepreneurship and Innovation I	Seminar	2,5	14*	75	17,5
CH12-930123	Entrepreneurship and Innovation II	Seminar	2,5	14*	75	17,5

** When scheduled during a lab rotation (default option), seminars may have up to 18 sessions.*

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Module Data Sheet

Module Name **General Economics**	*Module Code* **CH13-GenEcon**	*ECTS* **15**
Pre-requisites ☐Corresponding CHOICE Modules ☒None	*Module Contact Person* Prof. Dr. W. Werner	*Level (type)* ☒Year 1 (CHOICE) ☐Year 2 (CORE) ☐Year 3 (CAREER) ☐Any (Jacobs Track)
Frequency Every year	*Duration* 1 year	

Module Description / Content

This module introduces the workings of economies, progressing from national to international markets. The decisions that firms, workers and consumers make are examined in Microeconomics. Macroeconomics addresses the whole economy of a country in terms of the goal of stable and sustainable economic growth. The nature of economic globalization and its many effects on firms, governments and individuals are analyzed in International Economics. A key question in all three courses of this module is when, how and why governments may want to intervene in markets in order to deliver satisfactory outcomes for society as a whole, while balancing the contradicting interests of various societal stakeholders.

Module Aims

The aim of this module is to enable students to employ economic theories, models and methods to understand market dynamics and to address real world problems. By explaining the essentials of economic thought, it enables students to critically evaluate the determinants, motives and effects of decisions taken by various economic actors and governments.

Intended Learning Outcomes (ILOs)

Discipline Specific Skills

- Be able to understand and analyze the consumption patterns of private households and the costs, profitability and production decisions of firms
- Know about different cost structures, market dynamics and government regulations in various industries, including high tech industries
- Learn how to analyze the performance of national economies through key indicators such as GDP growth, unemployment, inflation, government deficit and trade imbalances
- Explain and evaluate the goals and effectiveness of government interventions to combat economic crises in the form of monetary and fiscal policies
- Learn how supply side measures such as improvements in infrastructure, education, and research can improve long-term growth and the international competitiveness of companies
- Analyze the effects of international trade, migration, knowledge transfer, and investments on individuals, firms and governments
- Understand that economic development and economic policy decisions have a strong potential of producing winners and losers among economic actors

Module Function (in Study Programs)

- mandatory for: General Economics Management, International Business Administration, Integrated Social Sciences
- elective for: all other study programs

Module Components and Types

Course Nr.	**Course Name**	**Type**	**ECTS**	**Number of Sessions** (per Semester)	**Duration of Session** (min)	**Total** (hours)
CH13-032101	Microeconomics	Lecture	5	28	75	35
CH13-910301	International Economics I	Seminar	2.5	14*	75	17,5
CH13-032102	Macroeconomics	Lecture	5	28	75	35
CH13-910302	International Economics II	Seminar	2.5	14*	75	17,5

** When scheduled during a lab rotation (default option), seminars may have up to 18 sessions.*

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Module Data Sheet

Module Name **Political, Social & Media Diversity**	*Module Code* **CH14-PolSocMedia**	*ECTS* **15**
Pre-requisites ☐Corresponding CHOICE Modules ☒None	*Module Contact Person* Prof. Dr. Marion G. Müller	*Level (type)* ☒Year 1 (CHOICE) ☐Year 2 (CORE) ☐Year 3 (CAREER) ☐Any (Jacobs Track)
Frequency Every year	*Duration* 1 year	

Module Description / Content

Political and Social Diversity is an introductory module which provides the essentials for understanding contemporary societies. You will study what the main differences between democracies and other political regime types are (the political science perspective); how the set-up of societies change over time and differ across world regions (the sociological perspective); and how mass communication systems work and which role they play in politics and society (the mass communication perspective). This module provides the basis from which you progress to higher-level modules in the Social Sciences.

Module Aims

This module aims to teach you key concepts of political science, sociology, and mass communication, and how they speak to each other. By drawing on examples from many world regions, the module also demonstrates how important cross-national comparisons in order to understand the world.

Intended Learning Outcomes (ILOs)

Discipline Specific Skills

- Understand the variety of political regimes that exist in today's world
- Identify basic types of societies, and how they play out in different parts of the world
- Understand how mass media work and which influence they have
- Understand how politics, mass media, and society influence each other

Module Function (in Study Programs)

- mandatory for: Integrated Social Sciences (ISS)
- elective for: all other study programs

Module Components and Types

Course Nr.	**Course Name**	**Type**	**ECTS**	**Number of Sessions** (per Semester)	**Duration of Session** (min)	**Total** (hours)
CH14-910101	Comparing Political Systems	Lecture	5	28	75	35
CH14-930101	Social Structure and Processes I	Seminar	2,5	14*	75	17,5
CH14-910112	Mass Media in Digital Contexts	Lecture	5	28	75	35
CH14-930111	Social Structure and Processes II	Seminar	2,5	14*	75	17,5

** When scheduled during a lab rotation (default option), seminars may have up to 18 sessions.*

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Module Data Sheet

Module Name **Introduction to International Relations**	*Module Code* **CH15-IntroIR**	*ECTS* **15**
Pre-requisites ☐Corresponding CHOICE Modules ☒None	*Module Contact Person* Prof. Dr. Corinna Unger	*Level (type)* ☒Year 1 (CHOICE) ☐Year 2 (CORE) ☐Year 3 (CAREER) ☐Any (Jacobs Track)
Frequency Every year	*Duration* 1 year	

Module Description / Content

This module presents an introduction to the interdisciplinary field of International Relations. With the help of concepts and theories from political science, students gain insight into the functioning and impact of many of today's international institutions. In addition, students are offered a comprehensive historical overview of the political, economic and social changes of the international system during the past few centuries. Emphasis is put on the particularly disruptive and violent twentieth century (called the 'Age of Extremes' by historian Eric Hobsbawm), out of which today's international institutions and system emerged.

Module Aims

The module aims to provide students with an overview of the topics, contents, and methods that define the field of International Relations, both from a political and a historical perspective. By doing so it allows students to understand the functioning of international relations in the modern era, which improves their ability to analyze current international developments and challenges.

Intended Learning Outcomes (ILOs)

Discipline Specific Skills

- Understand the key developments of international relations in the modern period
- Identify key actors and institutions in international relations
- Be familiar with the most important concepts of modern political life
- Analyze complex, interdependent social and political structures
- Have an overview of the most important social scientific and historical concepts and approaches

Module Function (in Study Programs)

- mandatory for: International Relations: Politics and History
- elective for: all other study programs

Module Components and Types

Course Nr.	**Course Name**	**Type**	**ECTS**	**Number of Sessions** (per Semester)	**Duration of Session** (min)	**Total** (hours)
CH15-830102	Contemporary European History	Lecture	5	28	75	35
CH15-910102	International Institutions	Lecture	5	28	75	35
CH15-850201	International Relations of the Twentieth Century I	Seminar	2.5	14*	75	17,5
CH15-850202	International Relations of the Twentieth Century II	Seminar	2.5	14*	75	17,5

** When scheduled during a lab rotation (default option), seminars may have up to 18 sessions.*

Module Data Sheet

Module Name **Introduction to Psychology**	*Module Code* **CH16-IntroPsych**	*ECTS* **15**
Pre-requisites ☐Corresponding CHOICE Modules ☒None	*Module Contact Person* Prof. Dr. Adele Diederich	*Level (type)* ☒Year 1 (CHOICE) ☐Year 2 (CORE) ☐Year 3 (CAREER) ☐Any (Jacobs Track)
Frequency Every year	*Duration* 1 year	

Module Description / Content

This module is a broad introduction to the field of psychology including: sensation, perception, and attention; learning and memory; intelligence, language, and cognition; emotion and motivation; development, personality, and social behavior. The module also teaches the research methods used by psychologists across these areas to study the origins and variations in human behavior including experimental design, psychophysics, and the rational of neuro-scientific methods. This module provides the foundation for higher-level modules in Biology, Brain, and Cognition; Humans in Social Context; and Applied Psychology.

Module Aims

This module aims to give you a broad overview of the field of psychology, in particular of its core theories and empirical findings. Emphasis is placed on scientific methods and analysis of behavior, understanding theories, and interpreting research findings, with the ultimate goal of understanding human behavior from a scientific perspective.

Intended Learning Outcomes (ILOs)

Discipline Specific Skills

- Explain the basic psychological processes
- Relate different psychological processes to each other
- Understand the link between theories and data
- Understand and apply psychological research methods

Module Function (in Study Programs)

- mandatory for: Psychology
- elective for: all other study programs

Module Components and Types

Course Nr.	**Course Name**	**Type**	**ECTS**	**Number of Sessions** (per Semester)	**Duration of Session** (min)	**Total** (hours)
CH16-710103	Introduction to Psychology I	Lecture	5	28	75	35
CH16-710111	Introduction to Psychology II	Lecture	5	28	75	35
CH16-710113	Methods in Psychology and Neuroscience I	Practical Class/ Seminar	2.5	14*	75	17,5
CH16-710114	Methods in Psychology and Neuroscience II	Practical Class/ Seminar	2.5	14*	75	17,5

** When scheduled during a lab rotation (default option), seminars may have up to 18 sessions.*

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Module Data Sheet

Module Name **Biomedicine**	*Module Code* **CO01-Biomed**	*ECTS* **15**
Pre-requisites ☒Corresponding CHOICE Modules CH01-CellBio_Cell Biology ☐None	*Module Contact Person* Dr. Susanne Illenberger	*Level (type)* ☐Year 1 (CHOICE) ☒Year 2 (CORE) ☐Year 3 (CAREER) ☐Any (Jacobs Track)
Frequency Every year	*Duration* 1 year	

Module Description / Content

Biomedicine is an advanced model that builds on the CHOICE module Cell Biology. Biomedicine first expands knowledge on key cellular processes often affected in diseases, e.g. gene expression, cell proliferation, intracellular trafficking, signal transduction and general turnover of cellular compounds. The module will address how these processes become altered in different diseases, e.g., cancer and neurodegenerative diseases, and how diagnostic tools and therapies (ranging from chemical to cell-based approaches) can be developed according to a disease's molecular origin. Two lectures are complemented by a 5 ECTS lab course that introduces students to modern methodology in cell biological research and biomedicine.

Module Aims

This module aims at teaching how profound understanding of cellular processes helps develop diagnostic tools and therapeutic strategies in modern molecular and translational medicine. Key techniques applied in cell-based, functional analyses and imaging of protein trafficking in mammalian cells will be introduced in the lab course.

Intended Learning Outcomes (ILOs)

Discipline Specific Skills

- Advanced understanding of key regulatory processes in cell biology.
- Overview about possible mechanisms of disease
- Introduction to diagnostics and therapy development
- Poster presentations
- Oral presentations on biomedical approaches

Module Function (in Study Programs)

- mandatory for: Biochemistry and Cell Biology (mandatory elective for BCCB students taking a major
- elective for: all other study programs

Module Components and Types

Course Nr.	**Course Name**	**Type**	**ECTS**	**Number of Sessions** (per Semester)	**Duration of Session** (min)	**Total** (hours)
CO01-520234	Advanced Molecular Cell Biology	Lecture	5	28	75	35
CO01-520235	Molecular Mechanisms of Disease , Diagnostics and Therapy	Lecture	5	28	75	35
CO01-520241	Advanced Molecular Cell Biology Lab (Intersession)	Lab	5	36	75	45

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Module Data Sheet

Module Name **Infection and Immunity**	*Module Code* **CO02-InfImm**	*ECTS* **15**
Pre-requisites ☒Corresponding CHOICE Modules CH02-BioChem - Biochemistry and Molecular Biology or CH01-CellBio – Cell Biology ☐None	*Module Contact Person* Dr. Susanne Illenberger	*Level (type)* ☐Year 1 (CHOICE) ☒Year 2 (CORE) ☐Year 3 (CAREER) ☐Any (Jacobs Track)
Frequency Every year	*Duration* 1 year	

Module Description / Content

Infection and Immunity is an advanced module that builds on both BCCB CHOICE modules ("Cell Biology" and "Biochemistry and Molecular Biology"). It combines the fundamentals of microbiology with an overview about the human immune system. Students will learn how microbes act in the environment and on human health, and how scientists investigate and control microbial pathogens. The immune system will be explained and how identifies and eliminates cancer cells, viruses, bacteria, and parasites. Immune evasion mechanisms of pathogens will be elucidated as well as therapeutic approaches. In the 5 ECTS lab course, students will learn to isolate, handle, characterize, and taxonomically identify microorganisms using classical and state-of-the-art technologies.

Module Aims

This module teaches core concepts in microbiology and immunology and their experimental investigation. Both are needed to understand the "arms race" between pathogens and the host immune system. For several diseases, the underlying molecular mechanisms will be analyzed, e.g. host-pathogen interactions, hypersensitivity, and autoimmune diseases.

Intended Learning Outcomes (ILOs)

Discipline Specific Skills

- Understanding of the principles of the world of microorganisms
- Introduction to the complexity of the immune system
- Knowledge of pathogens, diseases, and therapeutic strategies
- Introduction to methodology in microbiology and immunology

Module Function (in Study Programs)

- mandatory for: Biochemistry and Cell Biology (mandatory elective for BCCB students taking a minor)
- elective for: all other study programs

Module Components and Types

Course Nr.	**Course Name**	**Type**	**ECTS**	**Number of Sessions** (per Semester)	**Duration of Session** (min)	**Total** (hours)
CO02-520233	Microbes and Infection	Lecture	5	28	75	35
CO02-520221	Microbiology Lab	Lab	5	28	75	35
CO02-520322	Immunology	Lecture	5	36	75	45

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Module Data Sheet

Module Name **Molecular Biology**	*Module Code* **CO03-MolBio**	*ECTS* **15**
Pre-requisites ☒Corresponding CHOICE Modules CH02-BioChem - Biochemistry and Molecular Biology ☐None	*Module Contact Person* Dr. Susanne Illenberger	*Level (type)* ☐Year 1 (CHOICE) ☒Year 2 (CORE) ☐Year 3 (CAREER) ☐Any (Jacobs Track)
Frequency Every year	*Duration* 1 year	

Module Description / Content

Molecular Biology is an advanced module that builds on the CHOICE module Biochemistry and Molecular Biology. This module introduces the molecular basis of the flow of genetic information with special emphasis on regulatory mechanisms. Students will also learn about principles governing molecular evolution, i.e. types of mutations, causes and consequences of mutations, and how mutations of genes shape a population's adaptation to environmental changes. The 5 ECTS lab course provides an integrated view on the molecular analysis of biomolecules involved in molecular information pathways.

Module Aims

This module aims at teaching advanced level understanding of how genetic information can be selectively utilized in individual cells to produce proteins according to cellular needs. It will analyze how alterations in the DNA sequence by mutations may affect all levels of gene expression and thus alter a cell's fitness or performance.

Intended Learning Outcomes (ILOs)

Discipline Specific Skills

- Advanced understanding of genetic information flow
- Investigation of key regulatory processes in molecular biology
- Analysis of how mutations influence gene expression and cellular performance
- Discuss how mutations may support evolutionary selection processes

Module Function (in Study Programs)

- mandatory for: Biochemistry and Cell Biology (mandatory elective for BCCB students taking a minor)
- elective for: all other study programs

Module Components and Types

Course Nr.	**Course Name**	**Type**	**ECTS**	**Number of Sessions** (per Semester)	**Duration of Session** (min)	**Total** (hours)
CO03-520224	Molecular Information Pathways	Lecture	5	28	75	35
CO03-530661	Molecular Evolution	Lecture	5	28	75	35
CO03-520225	Molecular Biology Lab	Lab	5	36	75	45

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Module Data Sheet

Module Name **Chemical Biology**	*Module Code* **CO04-ChemBio**	*ECTS* **15**
Pre-requisites ☒Corresponding CHOICE Modules CH02-BioChem_Biochemistry and Molecular Biology or CH03-OrgChem_Organic Chemistry ☐None	*Module Contact Person* Prof. Dr. Sebastian Springer Prof. Dr. Nikolai Kuhnert Prof. Dr. Tom Nugent	*Level (type)* ☐Year 1 (CHOICE) ☒Year 2 (CORE) ☐Year 3 (CAREER) ☐Any (Jacobs Track)
Frequency Every year	*Duration* 1 year	

Module Description / Content

Chemical Biology asks how small molecules, such as pharmaceutical drugs, act on biological targets, such as proteins or genes, and how they can be used to influence processes in cells and in the entire organism, both for advancing fundamental knowledge and for treating diseases. Work in chemical biology requires a thorough understanding of how these drug targets function and what natural role they play in the cell. Chemical Biology is an essential complement of Medicinal Chemistry enabling the exploration, design, testing and safety assessment of drugs, a key expertise for a career in the pharmaceutical industry.

Module Aims

The module 'Chemical Biology' provides well-rounded knowledge: how the targets of drugs, proteins and DNA molecules, function and interact with small molecules; recent examples of cellular process manipulation with small molecules; and important therapeutic approaches based on small molecule intervention. A laboratory course provides practical experience of such systems.

Intended Learning Outcomes (ILOs)

Discipline Specific Skills

- Understand structure and dynamics of proteins, DNA, lipids, and carbohydrates on an advanced level.
- Thoroughly understand thermodynamics and kinetics of biomolecular interaction, ligand binding, and enzymatic catalysis.
- Analyze the bioactivity potential of small molecules and of biologicals.
- Have a representative understanding of important targets for small molecules in the cell, which is important both for basic research and for therapy.
- Practically handle cells and proteins, perform binding and catalysis assays, and analyze the action of small molecules.

Module Function (in Study Programs)

- mandatory for: Medicinal Chemistry and Chemical Biology (mandatory elective for MCCB students taking a minor)
- elective for: all other study programs

Module Components and Types

Course Nr.	**Course Name**	**Type**	**ECTS**	**Number of Sessions** (per Semester)	**Duration of Session** (min)	**Total** (hours)
CO04-520203	Introduction to Chemical Biology	Lecture	5	28	75	35
CO04-520213	Lab Course Advanced Biochemistry	Lab	5	18	75	22,5
CO04-520223	Biological Activity	Lecture	5	28	75*	35

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Module Data Sheet

Module Name **Drug Action and Production**	*Module Code* **CO05-DrugProd**	*ECTS* **15**
Pre-requisites ☒Corresponding CHOICE Modules CH02-BioChem_Biochemistry and Molecular Biology or CH03-OrgChem_Organic Chemistry ☐None	*Module Contact Person* Prof. Dr. Sebastian Springer Prof. Dr. Nikolai Kuhnert Prof. Dr. Tom Nugent	*Level (type)* ☐Year 1 (CHOICE) ☒Year 2 (CORE) ☐Year 3 (CAREER) ☐Any (Jacobs Track)
Frequency Every year	*Duration* 1 year	

Module Description / Content

This module introduces students to pharmaceuticals used in current medical practice. Grouped according to therapeutic areas, drugs in current use are discussed in terms of their chemical structure, structural requirement for action, basic pharmacology, synthesis and analysis. The module summarizes current knowledge on the action and production of drugs in the pharmaceutical industry and the essential set of scientific methods and approaches used in drug production and analysis. This knowledge forms the basis for all future drug development.

Module Aims

The module provides a rounded knowledge on drug molecules in current medical use including their chemical structure, structural requirements for drug activity. Students learn to understand basic drug action including pharmacological aspects, binding selectivity, tissue specific receptor subtypes, pharmacokinetics, pharmacodynamics and bioavailability. In addition the practice of drug production including both chemical synthesis and biotechnological approaches will be introduced. This is complemented by an introduction to analytical methods used in the pharmaceutical industry. These include methods for structure elucidation, drug identification and drug quantification used in drug development, production, quality control and in vivo pharmacological studies. The module includes two integrated laboratory courses providing practical experience in biotechnological drug production and analysis.

Intended Learning Outcomes (ILOs)

Discipline Specific Skills

- Knowledge on structural requirements for drug action
- Knowledge on basic pharmacology of drug action
- Knowledge on drug production by chemical and biotechnological means
- Knowledge about pharmaproteins and their production in genetically engineered cells
- Obtain skill set of scientific methods used in pharmaceutical chemistry and biotechnology
- Obtain knowledge on analytical methods used or drug identification and quantification
- Provide practical lab experience in selected areas of biotechnology and analytical pharmaceutical chemistry using state of the art equipment

Module Function (in Study Programs)

- mandatory for: Medicinal Chemistry and Chemical Biology (mandatory elective for MCCB students taking a minor
- elective for: all other study programs

Module Components and Types

Course Nr.	**Course Name**	**Type**	**ECTS**	**Number of Sessions** (per Semester)	**Duration of Session** (min)	**Total** (hours)
CO05-400233	Biopharmaceuticals	Lecture	2,5	14	75	17,5
CO05-400234	Biopharmaceutical Production Lab	Lab	2,5	18	75	22,5
CO05-400241	Pharmaceutical Analytical Chemistry	Lecture	2,5	14	75	17,5
CO05-400243	Pharmaceutical Analytical Chemistry Lab	Lab	2,5	18	75	22,5
CO05-400244	Pharmaceutical Chemistry	Lecture	5,0	28	75	35

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Module Data Sheet

Module Name **Drug Development**	*Module Code* **CO06-DrugDev**	*ECTS* **15**
Pre-requisites ☒Corresponding CHOICE Modules CH02-BioChem_Biochemistry and Molecular Biology or CH03-OrgChem_Organic Chemistry ☐None	*Module Contact Person* Prof. Dr. Sebastian Springer Prof. Dr. Nikolai Kuhnert Prof. Dr. Tom Nugent	*Level (type)* ☐Year 1 (CHOICE) ☒Year 2 (CORE) ☐Year 3 (CAREER) ☐Any (Jacobs Track)
Frequency Every year	*Duration* 1 year	

Module Description / Content

Pharmaceutical drug development is an interdisciplinary scientific endeavor founded on the discovery of new chemical entities that act at biologically relevant disease targets. The work flow of medicinal chemistry entails target validation, high throughput assay screening of 'chemical libraries', drug discovery, drug optimization (in silico and laboratory) via structure activity relationships, lead candidate identification, toxicology, preclinical and finally clinical trials. A constant underlying theme is how, why, and when to take advantage of chemical principles to achieve the desired outcome of forming a therapeutic agent (active pharmaceutical ingredient).

Module Aims

Students will obtain a clear picture of the science behind the identification of drug candidates (basic research) and the steps needed to reach the final marketed drug. In this regard, you will learn how the three dimensional structure and functional group content of an organic molecule can be advantageously tailored to elicit a biological effect from both the experimental and theoretical view. In doing so, you will also become familiar with the scientific jargon of drug discovery and the overarching principles that bring biological relevance to organic chemistry. The societal impact of extended and/or improved quality of life through the treatment of disease will be self-evident from the classroom discussions. This core content will be elaborated on in the corresponding laboratory components.

Intended Learning Outcomes (ILOs)

Discipline Specific Skills
-Molecular interactions: Salt bridges, covalent bonds, and non-covalent interactions
-Drug target interactions
-Structure-Activity Relationships (SAR)
-Synthesis
-Molecular modeling
-Absorption, Distribution, Metabolism, and Excretion (ADME)
-Bioassay identification and high throughput screening
-Fluency with Binding Data

Module Function (in Study Programs)

- mandatory for: Medicinal Chemistry and Chemical Biology (mandatory elective for MCCB students taking a minor)
- elective for: all other study programs

Module Components and Types

Course Nr.	**Course Name**	**Type**	**ECTS**	**Number of Sessions** (per Semester)	**Duration of Session** (min)	**Total** (hours)
CO06-400272	Medicinal Chemistry	Lecture	5	28	75	35
CO06-400271	Medicinal Chemistry Lab I	Lab	5	36	75	45
CO06-400273	Medicinal Chemistry Lab II	Lab	5	36	75	45

Version (Date of Revision)
002 (07/2015)

Module Data Sheet

Module Name **Chemical Biotechnology**	*Module Code* **CO07-ChemBiotec**	*ECTS* **15**
Pre-requisites ☒Corresponding CHOICE Modules CH03-OrgChem (Organic Chemistry) or CH04-InorgChem (Inorganic Chemistry and Environmental Systems) ☐None	*Module Contact Person* Prof. Elke Nevoigt, Prof. Dr. Hector Marcelo Fernandez-Lahore	*Level (type)* ☐Year 1 (CHOICE) ☒Year 2 (CORE) ☐Year 3 (CAREER) ☐Any (Jacobs Track)
Frequency Every year	*Duration* 1 year	

Module Description / Content

This module provides insight into how biotechnology impacts chemical production. The replacement of both chemical catalysts by enzymes and cells and of fossil resources by renewable raw materials are two aspects which are increasingly pushed by the chemical industry in order to achieve a more sustainable production of bulk and fine chemicals, building blocks for chemical industry as well as food ingredients, bioplastics, and biofuels. Using a number of commercially successful examples as well as current R&D efforts of chemical industry, the students will be introduced into the advantages and practice of implementing cells or enzymes for the production of industrially relevant products.
Moreover, the module describes the utilization of biomass and biomass waste streams as feedstock for production of the above mentioned compounds. The concept of biorefinery is also discussed.

Module Aims

This module covers the application of cells (mainly microorganisms) and enzymes to the synthesis of a plethora of compounds that are relevant in the chemical industry. Examples will highlight how biological systems can be utilized in a cost-effective manner for the mild, environmentally friendly, production of chemicals. The students will learn the different ways of how biocatalysts can be used, i.e. biotransformations using isolated enzymes and whole cells for chemical conversion steps (to replace chemical catalysts) as well as de novo synthesis of complex chemicals from simple nutrients by fermenting cells. The underlying metabolic principles will be discussed. Moreover, the module also describes the utilization of biomass (e.g. agricultural subproducts, single cell protein, food waste, algal biomass) for the production of biofuels (e.g. bioethanol, biobutanol, biodiesel, biogas), commodity and fine chemicals. The concept of biorefinery is discussed and examples will illustrate how a new bioeconomy is raising globally. The module will contain practical laboratory demonstrations and hands-on experimentation that will help students to consolidate the theoretical knowledge they have obtained during the lectures.

Intended Learning Outcomes (ILOs)

Discipline Specific Skills

- Understand the concept of a bioeconomy, as opposed to fossil resource utilization
- Understand the impact of biocatalysts in chemical industry
- Understand how the cellular metabolism can be exploited to produce chemicals
- Principle understanding of transferring enzymes and whole metabolic pathways from a donor organism to the production host
- Evaluate the feasibility of bio-based approaches
- Know the potential of biorefineries for the sustainable chemical production
- Bridge chemistry with biology and technology
- Acquire sufficient engineering knowledge as applied to biotechnological systems
- Understand bioprocessing technology and bioprocess design
- Understand the biological basis of (bio) chemical engineering and technology
- Elements of enzyme technology and enzyme immobilization

Module Function (in Study Programs)

- mandatory for: Chemistry (mandatory elective for chemistry students taking a minor)
- elective for: all other study programs

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Module Data Sheet

Module Components and Types						
Course Nr.	**Course Name**	**Type**	**ECTS**	**Number of Sessions** (per Semester)	**Duration of Session** (min)	**Total** (hours)
CO07-400105	Bioproducts and Biosystems Engineering	Lecture	5	28	75	35
CO07-400115	Bioproducts and Biosystems Engineering Lab	Lab	2,5	6	255	25,5
CO07-400104	Enzymes and Cells in Biochemical Production	Lecture	5	28	75	35
CO07-400114	Biochemical Production Lab	Lab	2,5	6	255	25,5

Version (Date of Revision)
003 (10/2015)

Module Data Sheet

Module Name **Physical and Analytical Chemistry**	*Module Code* **CO08-PhysChem**	*ECTS* **15**
Pre-requisites ☐Corresponding CHOICE Modules ☒None	*Module Contact Person* Prof. Dr. D. Gabel	*Level (type)* ☐Year 1 (CHOICE) ☒Year 2 (CORE) ☐Year 3 (CAREER) ☐Any (Jacobs Track)
Frequency Every year	*Duration* 1 year	

Module Description / Content

Teaching physical principles and measurements to understand the properties of matter. The course Physical Chemistry introduces fundamental thermodynamical principles, intermolecular forces, electrochemistry as well as underlying physical principle of chemical kinetics. The students will apply the course content to experiments on osmotic pressure, electrochemistry and optical instrumentation. The analytical chemistry part will provide an overview over the physical principles of spectroscopic and separation methods and their application in quantitative and qualitative analysis.

Module Aims

Students should learn to understand physical principles of investigating matter in space and time to identify and quantify chemical entities. Students should be able to apply this knowledge to solving chemical problems in experimental research.

Intended Learning Outcomes (ILOs)

Discipline Specific Skills

- Explain the basic concepts of physical chemistry
- Thermodynamic principles, equilibrium, entropy,
- Physical properties of intermolecular forces and their impact on reaction kinetics
- Identification of the rate limiting steps in a reaction
- Communicate key practical skills relating specifically to physical chemistry
- Knowledge on physical principles and applications of spectroscopic methods for quantitative and qualitative analysis
- Relating spectral information to chemical structure
- Provide the analytical toolbox for the practicing experimental chemist

Module Function (in Study Programs)

- mandatory for: Chemistry (mandatory elective for chemistry students taking a minor)
- elective for: all other study programs

Module Components and Types

Course Nr.	**Course Name**	**Type**	**ECTS**	**Number of Sessions** (per Semester)	**Duration of Session** (min)	**Total** (hours)
CO08-400211	Physical Chemistry	Lecture	5	28	75	35
CO08-400262	Physical Chemistry Lab	Lab	2,5	6	255	25,5
CO08-400121	Analytical Chemistry	Lecture	5	28	75	35
CO08-400231	Analytical Chemistry Lab	Lab	2,5	6	255	25,5

Version (Date of Revision)
002 (08/2015)

Module Data Sheet

Module Name **Inorganic and Supramolecular Chemistry**	*Module Code* **CO09-InorgSuMolChem**	*ECTS* **15**
Pre-requisites ☒Corresponding CHOICE Modules CH03-OrgChem (Organic Chemistry) or CH04-InorgChem (Inorganic Chemistry and Environmental Systems) ☐None	*Module Contact Person* Prof. Dr. D. Gabel	*Level (type)* ☐Year 1 (CHOICE) ☒ Year 2 (CORE) ☐Year 3 (CAREER) ☐Any (Jacobs Track)
Frequency Every year	*Duration* 1 year	

Module Description / Content

The module gives information about inorganic materials and polymers, and about organic materials and polymers. Coordination compounds as basis of inorganic materials will be discussed. Methods for structure elucidation of polymeric and solid materials will be presented. Basic reactions to form these materials will be given. Industrially important materials and their preparation will be discussed. Examples of non-covalent interactions as basis for supramolecular chemistry are shown, and sensors based on the different technologies will be discussed. An introduction into surface and colloid chemistry forms part of the module.

Module Aims

The module will enable the student to recognize the nature of materials, to know their use in technological settings, and to identify appropriate methods to characterize materials. The basic principle of sensors and of surface-active substances will be understood.

Intended Learning Outcomes (ILOs)

Discipline Specific Skills

- Recognize the nature of materials and their components
- Know the properties of coordination complexes of transition metals
- Correlate structure and properties
- Know how to characterize polymeric and solid-state materials
- Know the basic reactions of formation of organic polymers
- Describe different uses of polymers
- Know the basic principles of sensors

Module Function (in Study Programs)

- mandatory for: Chemistry (mandatory elective for chemistry students taking a minor)
- elective for: all other study programs

Module Components and Types

Course Nr.	**Course Name**	**Type**	**ECTS**	**Number of Sessions** (per Semester)	**Duration of Session** (min)	**Total** (hours)
CO09-400221	Inorganic Chemistry II	Lecture	5	28	75	35
CO09-400232	Inorganic Chemistry II Lab	Lab	2,5	6	255	25,5
CO09-420432	Supramolecular Chemistry	Lecture	5	28	75	35
CO09-420434	Supramolecular Chemistry Lab	Lab	2,5	6	255	25,5

Version (Date of Revision)
002 (08/2015)

Module Data Sheet

Module Name **Fundamental Earth and Environmental Sciences**	*Module Code* **CO10-FundEES**	*ECTS* **15**
Pre-requisites ☒Corresponding CHOICE modules CH04-InorgChem – Inorganic Chemistry and Environmental Systems or CH05-PhysNatSys – Physics of Natural Systems ☐None	*Module Contact Person* Prof. Dr. J. Vogt Prof. Dr. M. Bau	*Level (type)* ☐Year 1 (CHOICE) ☒Year 2 (CORE) ☐Year 3 (CAREER) ☐Any (Jacobs Track)
Frequency Every year	*Duration* 1 year	

Module Description / Content

The module "Fundamental Earth and Environmental Sciences" is comprised of essential geoscience courses that represent the backbone of a sound university education in the geosciences. Core courses on Sedimentology, Structural Geology, Volcanism and Metamorphism are complemented by applied courses in environmental and resource geoscience. If relevant, both marine and terrestrial systems are discussed. Key elements of these courses are on-campus practicals during which the students are introduced to geological methods and techniques. These essential practical skills are further expanded upon and applied in a real-world scenario during a five day off-campus geological field camp.

Module Aims

This module is the backbone of university education in "Earth and Environmental Sciences" and provides theoretical knowledge and practical skills in key geological disciplines and two important fields ("environment" and "resources") that offer a broad range of internship and job opportunities both in industry and academia. This module lays the foundations for process-based understanding of marine and terrestrial environments in the Earth System and practical, hands-on skills and methodological key competencies for both the geochemistry-focused "Earth, Ocean and Environmental Chemistry" CORE module and the geophysics-focused "Earth, Ocean and Environmental Physics" CORE module.

Intended Learning Outcomes (ILOs)

Discipline Specific Skills

- Knowledge of core disciplines such as Sedimentology and Structural Geology,
- Knowledge of sedimentary, igneous and metamorphic rocks and minerals,
- Knowledge of essential terminology and concepts in applied fields such as "environment" and "resources",
- Familiarity with the basic practical skills of geological and geochemical field work.

Module Function (in Study Programs)

- mandatory for: Earth and Environmental Sciences (mandatory elective for EES students taking a minor)
- elective for: all other study programs

Module Components and Types

Course Nr.	**Course Name**	**Type**	**ECTS**	**Number of Sessions** (per Semester)	**Duration of Session** (min)	**Total** (hours)
CO10-210201	Volcanism and Metamorphism	Lecture	2,5	14	75	17,5
CO10-210203	Sedimentology	Lecture	2,5	14	75	17,5
CO10-210206	Structural Geology	Lecture	2,5	14	75	17,5
CO10-210204	Marine Environments	Lecture	2,5	14	75	17,5
CO10-210205	Climate Change	Lecture	2,5	14	75	17,5
CO10-041202	Fieldtrip Environmental Changes and Challenges in Northwestern Germany	Excursion (Lab)	2,5	4 lectures, 4 lab days	75/600	45

Version (Date of Revision)
004 (10/2015)

Module Data Sheet

Module Name **Earth, Ocean and Environmental GeoChemistry**	*Module Code* **CO11-EOEnvChem**	*ECTS* **15**
Pre-requisites ☒Corresponding CHOICE Modules CH04-InorgChem – Inorganic Chemistry and Environmental Systems or CH05-PhysNatSys – Physics of Natural Systems ☐None	*Module Contact Person* Prof. Dr. J. Vogt Prof. Dr. M. Bau	*Level (type)* ☐Year 1 (CHOICE) ☒Year 2 (CORE) ☐Year 3 (CAREER) ☐Any (Jacobs Track)
Frequency Every year	*Duration* 1 year	

Module Description / Content

The module "Earth, Ocean and Environmental GeoChemistry" is comprised of fundamental geochemistry courses that represent the backbone of a sound university education in geochemistry and geochemistry-focused environmental and resource science. Core courses on igneous and aqueous (trace) element geochemistry and introductory courses on stable and radiogenic isotope geochemistry are complemented by a course on the biogeochemical aspects of environmental and resource science and an off-campus field camp focusing on environmental sciences. All courses address terrestrial as well as marine systems.

Module Aims

This module is the backbone of university education in geochemistry-focused fields and provides theoretical knowledge and practical skills in geochemical key disciplines (igneous and aqueous trace element geochemistry, stable and radiogenic isotope geochemistry) and important fields to which these geochemical disciplines are applied ("environment" and "resources"). Both marine and terrestrial systems are addressed, in order to create a holistic view of the Earth System. This module provides important in-depth knowledge about geochemistry-related Earth, Ocean and Environmental Science opening a broad range of internship and job opportunities both in industry and academia. The module further provides knowledge and skills that are essential to make an educated decision about the field of research for the B.Sc. thesis.

Intended Learning Outcomes (ILOs)

Discipline Specific Skills

- Knowledge of core disciplines such as Igenous and Aqueous Geochemistry,
- Knowledge of Stable and Radiogenic Isotope Geochemistry;
- Knowledge of basic terminology and concepts related to the geochemical aspects of environmental and resource science;
- Familiarity with the basic practical skills of geochemical and environmental field work.

Module Function (in Study Programs)

- mandatory for: Earth and Environmental Sciences (mandatory elective for EES students taking a minor)
- elective for: all other study programs

Module Components and Types

Course Nr.	**Course Name**	**Type**	**ECTS**	**Number of Sessions** (per Semester)	**Duration of Session** (min)	**Total** (hours)
CO11-210241	Geochemistry of Igneous and Aqueous Systems	Lecture	2,5	14	75	17,5
CO11-210302	Environmental Geochemistry	Lecture	2,5	14	75	17,5
CO11-210362	Applied Geochemistry	Lecture	2,5	14	75	17,5
CO11-210301	Isotope Geochemistry	Lecture	2,5	14	75	17,5
CO11-210373	Mineral Resources	Lecture	2,5	14	75	17,5
CO11-210202	Fieldtrip Volcanism and Hydrochemistry in the Eifel, Germany	Excursion (Lab)	2,5	4 lectures / 4 lab days	75/600	45

Version (Date of Revision)
003 (09/2015)

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Module Data Sheet

Module Name **Earth, Ocean, and Environmental Physics**	*Module Code* **CO12-EOEnvPhys**	*ECTS* **15**
Pre-requisites ☒CHOICE Module " CH05-PhysNatSys - Physics of Natural Systems" ☐None	*Module Contact Person* Prof. Dr. M. Bau Prof. Dr. J. Vogt	*Level (type)* ☐Year 1 (CHOICE) ☒Year 2 (CORE) ☐Year 3 (CAREER) ☐Any (Jacobs Track)
Frequency Every year	*Duration* 1 year	

Module Description / Content

The module "Earth, Ocean, and Environmental Physics" covers topics and methods that are essential in geophysics and physical oceanography. Emphasis will be on the quantitative assessment of physical processes and structures in terrestrial and marine systems. Important concepts are introduced and studied in lectures, and then applied and consolidated in practical courses such as field trips and computer labs on remote sensing and data analysis. The module constitutes one of the CORE pillars of the Earth and Environmental Sciences (EES) program and in general may complement the education of students interested in a physics-based presentation of fundamental EES topics.

Module Aims

The module provides the thematic and methodological foundation for physics-based disciplines in Earth, ocean, and environmental sciences. Problem-oriented thinking, data analysis and modeling skills are trained and developed using real-world examples and meaningful case studies. After completion, our students are prepared to evaluate their career options in physics-oriented EES disciplines.

Intended Learning Outcomes (ILOs)

Discipline Specific Skills

- Knowledge of key processes and concepts in Earth, Ocean, and Environmental (EOE) Sciences.
- Application of physical concepts and methods to real-world problems in EOE Sciences.
- Knowledge of fundamental techniques in applied and environmental geophysics.
- Numerical analysis and modeling of EOE processes and dynamics.

Module Function (in Study Programs)

- mandatory for: Earth and Environmental Sciences (mandatory elective for EES students taking a minor)
- elective for: all other study programs

Module Components and Types

Course Nr.	**Course Name**	**Type**	**ECTS**	**Number of Sessions** (per Semester)	**Duration of Session** (min)	**Total** (hours)
CO12-210223	Geophysical Techniques and Application	Lecture	2,5	14	75	17,5
CO12-210233	Geophysical Hydrodynamics	Lecture	2,5	14	75	17,5
CO12-210224	Geophysical Data Analysis and Modeling	Lecture	2,5	14	75	17,5
CO12-210214	Physical Oceanography	Lecture	2,5	14	75	17,5
CO12-210213	Earth System Monitoring and Remote Sensing	Lecture	2,5	14	75	17,5
CO12-210251	Oceanographic Excursion / Research Cruise North Sea	Excursion (Lab)	2,5	5 days	600	50

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Module Data Sheet

Module Name **Physics of Matter**	*Module Code* **CO13-PhysMatter**	*ECTS* **15**
Pre-requisites ☒Corresponding CHOICE Modules CH05-PhysNatSys (Physics of Natural Systems) or CH06-PhysAppMath (Physics and Applied Mathematics) ☐None	*Module Contact Person* Prof. Dr. J. Fritz Prof. Dr. P. Schupp	*Level (type)* ☐Year 1 (CHOICE) ☒Year 2 (CORE) ☐Year 3 (CAREER) ☐Any (Jacobs Track)
Frequency Every year	*Duration* 1 year	

Module Description / Content

The module provides an introduction to the physics of systems of many interacting particles. In the first part, classical thermodynamics is introduced and extended to a microscopic statistical description of many particle systems. The second part focuses on the physics of solid materials, their electronic and magnetic properties, different modes of excitations and applications especially in modern electronics and information technology. Additional lab courses give deeper insights into the systems discussed in the lectures and provide instructive examples of experiments in advanced physics.

Module Aims

The module provides an introduction to complex systems and condensed matter: The concepts of first year physics are extended to systems of particles by a statistical approach, as a basis for a deeper understanding of the electronic and magnetic properties of materials and their excitations. The aim is an advanced understanding of the underlying principles of modern materials and devices as used in electronics and information technology.

Intended Learning Outcomes (ILOs)

Discipline Specific Skills

- Explain the basic properties of gases and condensed matter by a microscopic and statistical model.
- Describe the behavior of electrons and how they influence macroscopic and electronic properties of materials.
- Apply basic experimental techniques and procedures needed to investigate solid state materials.
- Communicate in scientific language using advanced field-specific technical terms.

Module Function (in Study Programs)

- mandatory for: Physics (mandatory elective for Physics students taking a minor)
- elective for: all other study programs

Module Components and Types

Course Nr.	**Course Name**	**Type**	**ECTS**	**Number of Sessions** (per Semester)	**Duration of Session** (min)	**Total** (hours)
CO13-200212	Statistical Physics	Lecture	5	28	75	35
CO13-200311	Condensed Matter and Devices	Lecture	5	28	75	35
CO13-200222	Physics of Matter – Advanced Lab	Lab	5	36	75	45

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002 (07/2015)

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Module Data Sheet

Module Name **Physics and Technology**	*Module Code* **CO14-PhysTech**	*ECTS* **15**
Pre-requisites ☒Corresponding CHOICE Modules CH05-PhysNatSys (Physics of Natural Systems) or CH06-PhysAppMath (Physics and Applied Mathematics) ☐None	*Module Contact Person* Prof. Dr. J. Fritz Prof. Dr. P. Schupp	*Level (type)* ☐Year 1 (CHOICE) ☒Year 2 (CORE) ☐Year 3 (CAREER) ☐Any (Jacobs Track)
Frequency Every year	*Duration* 1 year	

Module Description / Content

The module discusses advanced applications of physics in modern technology using a descriptive and experimental approach. It builds on the general concepts and methods developed in the Physics of Natural Sciences Module. The first part focuses on energy sources and energy storage technology, and includes pertinent concepts of thermodynamics and physical chemistry. The second part introduces computational simulation methods as an important tool, useful for the understanding and investigation of physical systems and for a speed up of the development of new technologies. Additional lab courses give deeper insights into the systems discussed in the lectures and provide instructive examples of experiments in advanced physics.

Module Aims

This module aims for an understanding of modern technology from the perspective of physics. Renewable energy is a topic with high societal impact and the scientific understanding of the promises and problems of different options for the generation, storage and use of energy is another aim. Computational techniques for the description, modeling, and development of physical systems are introduced as an alternative to experiments.

Intended Learning Outcomes (ILOs)

Discipline Specific Skills

- Explain advanced concepts of energy generation and storage.
- Describe and judge advantages and disadvantages of different approaches to address the worlds energy problem.
- Understand the scientific background of energy technologies.
- Explain the basic strategies to simulate physical systems.
- Apply computer simulations to describe and analyze general problems in physics.
- Communicate in scientific language using advanced field-specific technical terms.

Module Function (in Study Programs)

- mandatory for: Physics (mandatory elective for Physics students taking a minor)
- elective for: all other study programs

Module Components and Types

Course Nr.	**Course Name**	**Type**	**ECTS**	**Number of Sessions** (per Semester)	**Duration of Session** (min)	**Total** (hours)
CO14-201231	Renewable Energy	Lecture	5	28	75	35
CO14-200221	Renewable Energy – Advanced Lab	Lab	5	36	75	45
CO14-200331	Introduction to Computer Simulation Methods	Lecture	5	28	75	35

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Module Data Sheet

Module Name **Theoretical Physics**	*Module Code* **CO15-TheoPhys**	*ECTS* **15**
Pre-requisites ☒Corresponding CHOICE Modules CH05-PhysNatSys (Physics of Natural Systems) or CH06-PhysAppMath (Physics and Applied Mathematics) ☐None	*Module Contact Person* Prof. Dr. J. Fritz Prof. Dr. P. Schupp	*Level (type)* ☐Year 1 (CHOICE) ☒Year 2 (CORE) ☐Year 3 (CAREER) ☐Any (Jacobs Track)
Frequency Every year	*Duration* 1 year	

Module Description / Content

The module provides a thorough overview of the theoretical foundations of physics. We will study the physics of particles, fields and quanta, while exploring the mathematical structure of nature. The module covers several core topics of physics, including analytical mechanics, electrodynamics, special relativity, and quantum mechanics. Additional lab courses give deeper insights into the systems discussed in the lectures and provide instructive examples in advanced physics.

Module Aims

The aim of the module is an introduction to core topics of physics at a level that prepares for actual research. At the same time, the mathematical repertoire and problem solving skills are further developed. The module serves as a foundation for all physics specialization subjects.

Intended Learning Outcomes (ILOs)

Discipline Specific Skills

- Understand the theoretical foundations of classical and quantum physics.
- Solve challenging problems of practical relevance using advanced mathematical techniques.
- Apply variational techniques to formulate physical laws and derive the equations of motion of physical systems.
- Explain the equivalence of energy and matter as well as the role of special relativity in electrodynamics.
- Understand particle-wave complementarity in quantum mechanics.
- Communicate in scientific language using advanced field-specific technical terms.

Module Function (in Study Programs)

- mandatory for: Physics (mandatory elective for Physics students taking a minor)
- elective for: all other study programs

Module Components and Types

Course Nr.	**Course Name**	**Type**	**ECTS**	**Number of Sessions** (per Semester)	**Duration of Session** (min)	**Total** (hours)
CO15-200201	Analytical Mechanics & Electrodynamics	Lecture	5	28	75	35
CO15-200223	Theoretical Physics – Advanced Lab	Lab	5	36	75	45
CO15-200202	Quantum Mechanics	Lecture	5	28	75	35

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Module Data Sheet

Module Name **Core Mathematics**	*Module Code* **CO16-CoreMaths**	*ECTS* **15**
Pre-requisites ☒Corresponding CHOICE Modules CH07-FundMath_Fundamental Mathematics	*Module Contact Person* Prof. Dr. Marcel Oliver Prof. Dr. Dierk Schleicher	*Level (type)* ☐Year 1 (CHOICE) ☒Year 2 (CORE) ☐Year 3 (CAREER) ☐Any (Jacobs Track)
Frequency Every year	*Duration* 1 year	

Module Description / Content

The module Core Mathematics contains the courses which are taken by all second year mathematics students. It continues the education in Linear Algebra into the second year of study and develops the theory of integration with elements of Functional Analysis and Fourier Methods. In addition, the module complements the second year education in the Jacobs track by providing additional courses in Numerical Methods and Probability.

Module Aims

This module provides core material which every working mathematician must know, and is a sufficient prerequisite for most, but not all of the third year specialization classes. Together with the complementary Jacobs track courses in Numerical Methods and Probability, students who complete this module will have learned the minimum requirements according to the German KmathF recommendations in those fields.

Intended Learning Outcomes (ILOs)

Discipline Specific Skills

- Have an advanced knowledge in Linear Algebra
- Be familiar with the Lebesgue theory
- Have a basic knowledge in Numerical Methods and Probability

Module Function (in Study Programs)

- mandatory for: Mathematics (mandatory elective for Math students taking a minor)
- elective for: all other study programs

Module Components and Types

Course Nr.	**Course Name**	**Type**	**ECTS**	**Number of Sessions** (per Semester)	**Duration of Session** (min)	**Total** (hours)
CO16-100231	Linear Algebra	Lecture	5	28	75	
CO16-100232	Introductory Real Analysis	Lecture	5	28	75	
CO16-100242	Numerical Methods II	Lecture	2.5	14	75	
CO16-100241	Elements of Stochastic Processes	Lecture	2.5	14	75	

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Module Data Sheet

Module Name **Core Pure Mathematics**	*Module Code* **CO17-CorePureMath**	*ECTS* **15**
Pre-requisites ☒Corresponding CHOICE Modules CH07-FundMath – Fundamental Mathematics ☐None	*Module Contact Person* Prof. Dr. Dierk Schleicher, Prof. Dr. Marcel Oliver	*Level (type)* ☐Year 1 (CHOICE) ☒Year 2 (CORE) ☐Year 3 (CAREER) ☐Any (Jacobs Track)
Frequency Every year	*Duration* 1 year	

Module Description / Content

The module Core Pure Mathematics contains a set of courses that are central to an education in pure mathematics. It contains an introduction to Geometry and Topology including differential forms, manifolds, and tensors, a first course in Complex Analysis, and a first course in Algebra.

Module Aims

This module, together with Core Mathematics, enables students to study any specialization in Mathematics, and provides the necessary skills for independent research work in pure mathematics at the Bachelor level.

Intended Learning Outcomes (ILOs)

Discipline Specific Skills

Develop skills in the area of Geometry, Topology, Algebra, and Complex Analysis which every student in pure mathematics should know, independent of (but a prerequisite for) future specialization.

Module Function (in Study Programs)

- mandatory for: Mathematics (mandatory elective for Math students taking a minor)
- elective for: all other study programs

Module Components and Types

Course Nr.	**Course Name**	**Type**	**ECTS**	**Number of Sessions** (per Semester)	**Duration of Session** (min)	**Total** (hours)
CO17-100251	Introduction to Complex Analysis	Lecture	5	28	75	35
CO17-100261	Calculus on Manifolds	Lecture	5	28	75	35
CO17-100252	Introduction to Algebra	Lecture	5	28	75	35

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002 (07/2015)

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Module Data Sheet

Name **Core Applied Mathematics**	*Module Code* **CO18-CoreAppMath**	*ECTS* **15**
Pre-requisites ☒Corresponding CHOICE Module CH07-FundMath – Fundamental Mathematics ☐None	*Module Contact Person* Prof. Dr. Marcel Oliver, Prof. Dr. Dierk Schleicher	*Level (type)* ☐Year 1 (CHOICE) ☒Year 2 (CORE) ☐Year 3 (CAREER) ☐Any (Jacobs Track)
Frequency Every year	*Duration* 1 year	

Module Description / Content

The module Core Applied Mathematics contains a set of core courses which should be taken by all students interested in applications and mathematical modeling. It comprises a first hands-on introduction to theory and applications of dynamical systems, and an introduction to stochastic modeling and mathematical finance.
A crucial component of this module will be the use of computer experiments to foster intuitive understanding and develop students' skills in using the computer to bridge between mathematical idea and concrete implementation and application.

Module Aims

The module aims at teaching fundamental concepts of mathematical modeling, both deterministic and stochastic, which are widely applicable across the sciences and engineering. This module is particularly designed as a fitting additional CORE choice for students of Physics, Computer Science, Electrical Engineering, IMS, and possibly GEM (if prerequisites are satisfied). Moreover, this module plays a central role in the education of students interested in Quantitative Finance and Mathematical Economics.

Intended Learning Outcomes (ILOs)

Discipline Specific Skills

- use fundamental concepts of deterministic and stochastic modeling
- be able to implement and use standard mathematical software.
- be familiar with the idea of designing, conducting, and interpreting controlled in-silico scientific experiments

Module Function (in Study Programs)

- mandatory for: Mathematics (mandatory elective for Math students taking a minor)
- elective for: all other study programs

Module Components and Types

Course Nr.	**Course Name**	**Type**	**ECTS**	**Number of Sessions** (per Semester)	**Duration of Session** (min)	**Total** (hours)
CO18-110231	Dynamical Systems	Lecture	5	28	75	35
CO18-110221	Stochastic Methods	Lecture	5	28	75	35
CO18-110233	Dynamical Systems Lab	Lab	2.5	18	75	22,5
CO18-110222	Stochastic Methods Lab	Lab	2.5	18	75	22,5

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Module Data Sheet

Module Name **Applied Computer Science**	*Module Code* **CO19-ApplCS**	*ECTS* **15**
Pre-requisites ☒Corresponding CHOICE Modules CH08-GenCS (General Computer Science) ☐None	*Module Contact Person* Prof. Dr. J. Schönwälder	*Level (type)* ☐Year 1 (CHOICE) ☒Year 2 (CORE) ☐Year 3 (CAREER) ☐Any (Jacobs Track)
Frequency Every year	*Duration* 1 year	

Module Description / Content

The Applied Computer Science module familiarizes you with core components used by many modern computer applications such as relational databases and associated query languages. You will learn how to use web application frameworks and you will learn the foundations of computer graphics, such as rendering, shading, lighting, or textures. The module also introduces you to tools and techniques that can be used to develop software in a structured way in order to control development efforts and costs while improving the overall software quality.

Module Aims

The module introduces conceptual data models, relational databases, associated query languages, and data model normalization. It also covers web-based application frameworks. The foundations of computer graphics are discussed and in particular the use of graphics rendering libraries. Software engineering is covered by introducing to software design pattern, development tools, and modeling frameworks that assist in the different phases of a software development process.

Intended Learning Outcomes (ILOs)

Discipline Specific Skills

- Can design and normalize data models for relational databases
- Understand how to use the Structured Query Language (SQL)
- Knows how to use web application frameworks to create dynamic web sites
- Understands foundations of computer graphics (rendering, shading, lighting, textures)
- Can program graphics rendering engines using the Open Graphics Library (OpenGL)
- Understand and apply object-oriented design pattern
- Knows how to read and write Unified Modeling Language (UML) diagrams
- Understands the benefits and drawbacks of different software development models
- Apply tools that assist in the software development process

Module Function (in Study Programs)

- mandatory for: Computer Science (mandatory elective for computer science students taking a minor)
- elective for: all other study programs

Module Components and Types

Course Nr.	**Course Name**	**Type**	**ECTS**	**Number of Sessions** (per Semester)	**Duration of Session** (min)	**Total** (hours)
CO19-320302	Databases and Web Services	Lecture	5	28	75	35
CO19-320322	Computer Graphics	Lecture	5	28	75	35
CO19-320212	Software Engineering	Lecture	5	28	75	35

Literature / Reading List

See module component details

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Module Data Sheet

Module Name **Technical Computer Science**	*Module Code* **CO20-TechCS**	*ECTS* **15**
Pre-requisites ☐Corresponding CHOICE Modules ☒ None	*Module Contact Person* Prof. Dr. Jürgen Schönwälder	*Level (type)* ☐Year 1 (CHOICE) ☒Year 2 (CORE) ☐Year 3 (CAREER) ☐Any (Jacobs Track)
Frequency Every year	*Duration* 1 year	

Module Description / Content

The Technical Computer Science module introduces you to systems-oriented aspects of computer science. You will learn how an operating system kernel organizes a collection of hardware components into useful programming abstractions. Concurrent programming will be introduced and the various techniques to prevent race conditions and to coordinate concurrent activities. You will learn how computer programs can communicate. You will understand the purpose of the different layers of computer networks and how the Internet works. Basic distributed algorithms will be introduced that allow you to build robust and scalable distributed applications.

Module Aims

The module introduces concurrent programming and the different mechanisms to synchronize concurrent threads. It discusses core abstractions used by operating systems and how an operating system kernel manages resources. The module introduces interprocess communication and communication over the Internet. The module finally discusses how to build distributed systems that can scale and improve robustness.

Intended Learning Outcomes (ILOs)

Discipline Specific Skills

- Understand race conditions and techniques to deal with them
- Familiar with core abstractions provided by operating systems and how they are implemented
- Knowing different interprocess communication abstractions
- Understand network concepts such as forwarding, routing, naming, addressing, flow control, or congestion control
- Familiarity with protocols used by local area networks and the Internet
- Insights into security limitations of network protocols
- Knowledge about basic distributed algorithms (logical clocks, election algorithms, decision algorithms, …)
- Familiarity with abstractions used by cloud computing infrastructures

Module Function (in Study Programs)

- mandatory for: Computer Science (mandatory elective for computer science students taking a minor)
- elective for: all other study programs

Module Components and Types

Course Nr.	**Course Name**	**Type**	**ECTS**	**Number of Sessions** (per Semester)	**Duration of Session** (min)	**Total** (hours)
CO20-320202	Operating Systems	Lecture	5	28	75	35
CO20-320241	Computer Architecture and Programming Languages	Lecture	5	28	75	35
CO20-320301	Computer Networks	Lecture	5	28	75	35

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Module Data Sheet

Module Name **Theoretical Computer Science**	*Module Code* **CO21-TheoCS**	*ECTS* **15**
Pre-requisites ☐Corresponding CHOICE Modules ☒None	*Module Contact Person* Prof. Dr. Jürgen Schönwälder	*Level (type)* ☐Year 1 (CHOICE) ☒Year 2 (CORE) ☐Year 3 (CAREER) ☐Any (Jacobs Track)
Frequency Every year	*Duration* 1 year	

Module Description / Content

The Theoretical Computer Science module covers the formal foundations of computer science. You will learn about different classes of formal languages and how they relate to discrete automata. You will learn what it means for a function to be computable and that there are functions that are impossible to compute. You will learn how to classify computable problems according to their inherent difficulty. Finally, you will learn how to use first-order logic to reason about programs and how to write programs using programming languages that are based on first-order logic.

Module Aims

The module covers the theoretical foundations of computer science. It introduces formal languages and their relation to discrete automata. It discusses techniques to show that certain functions are not computable and it introduces complexity classes in order to compare the inherent complexity of certain problems. The module finally introduces first-order logic and how to use it to reason about programs.

Intended Learning Outcomes (ILOs)

Discipline Specific Skills

- Provide examples of different classes of formal languages
- Be able to classify a given formal language
- Recap how language classes relate to discrete automata
- Know examples of functions that are not computable
- Understand the different complexity classes (P, NP, …)
- Be able to apply reduction techniques
- Understand different computational models
- Know first-order logic and machine oriented inference calculi
- Program using a logic programming language

Module Function (in Study Programs)

- mandatory for: Computer Science (mandatory elective for Computer Science students taking a minor)
- elective for: all other study programs

Module Components and Types

Course Nr.	**Course Name**	**Type**	**ECTS**	**Number of Sessions** (per Semester)	**Duration of Session** (min)	**Total** (hours)
CO21-320211	Formal Languages and Logic	Lecture	5	28	75	35
CO21-320203	Secure and Dependable Systems	Lecture	5	28	75	35
CO21-320352	Computability and Complexity	Lecture	5	28	75	35

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Module Data Sheet

Module Name **Intelligent Systems**	*Module Code* **CO22-IntelSys**	*ECTS* **15**
Pre-requisites ☐Corresponding CHOICE Modules ☐None	*Module Contact Person* Prof. Dr. A. Birk	*Level (type)* ☐Year 1 (CHOICE) ☒Year 2 (CORE) ☐Year 3 (CAREER) ☐Any (Jacobs Track)
Frequency Every year	*Duration* 1 year	

Module Description / Content

This module teaches you about core technologies and algorithms which endow a man-made system with intelligence. You will learn how machines can process sensor data, including visual data, to perceive and represent their surroundings. Once an environment representation is available, an intelligent machine, such as a robot, can act on and change its environment after deliberate planning. Utilizing its accumulated experience, the machine can learn and adapt its behavior in the future. This module covers all of these aspects and thus gives you an in-depth understanding of machine perception and learning, as well as robotics.

Module Aims

This module aims to teach you a comprehensive list of techniques and algorithms which make any machine intelligent and even autonomous. The core underlying subject areas covered will be robotics, perception, and machine learning. Not only do these subjects possess a remarkable theoretical beauty, but they also provide very practical and usable solutions for real-world problems.

Intended Learning Outcomes (ILOs)

Discipline Specific Skills

- Process image and RGB-D data for object-recognition
- Calibrate cameras and use them to generate 3D models
- Use popular vision software libraries to program your application
- Use probabilistic techniques and algorithms in machine learning
- Select classification and pattern recognition algorithms for various real-world problems
- Understand mobile robots and robotic manipulators
- Understand autonomous mapping and self-localization of mobile robots
- Use popular robotics software frameworks to program your application

Module Function (in Study Programs)

- mandatory for: Intelligent Mobile Systems (mandatory elective for IMS students taking a minor)
- elective for: all other study programs

Module Components and Types

Course Nr.	**Course Name**	**Type**	**ECTS**	**Number of Sessions** (per Semester)	**Duration of Session** (min)	**Total** (hours)
CO22-320671	Computer Vision	Lecture	5	28	75	35
CO22-320311	Robotics	Lecture	5	28	75	35
CO22-320372	Machine Learning	Lecture	5	28	75	35

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002 (07/2015)

Module Data Sheet

Module Name **Automation and Control**	*Module Code* **CO23-AutoControl**	*ECTS* **15**
Pre-requisites ☒Corresponding CHOICE Modules CH09-IntelSys (Intelligent Systems) ☐None	*Module Contact Person* Prof. Dr. A. Birk Prof. Dr. G. Abreu	*Level (type)* ☐Year 1 (CHOICE) ☒Year 2 (CORE) ☐Year 3 (CAREER) ☐Any (Jacobs Track)
Frequency Every year	*Duration* 1 year	

Module Description / Content

This module builds on top of the material learnt in the "Introduction to IMS" module and covers the general areas of control and automation, including also an introductory course in electronics with an accompanying lab. Topics covered include (but are not limited to): stability analysis, frequency (Laplace) domain modeling of systems, Bode plots, programmable controllers, basic electronics, and sensors and actuators used in industrial automation.

Module Aims

The module aims to prepare students for a full understanding of the mechanical, electrical and mechatronic sub-systems that are an integral part of all intelligent mobile systems. In a way, the module gives the background of the "systems" part of an IMS, leaving the "intelligence" and "mobility" aspects to the other accompanying core modules.

Intended Learning Outcomes (ILOs)

Discipline Specific Skills

- Understanding of the engineering aspect of Control, Automation, and Estimation theories
- Ability to understand how systems can be maintained under stable conditions
- Understand how external conditions (delay, noise, fluctuation) can affect the estimation of system's parameters and their control

Module Function (in Study Programs)

- mandatory for: Intelligent Mobile Systems (mandatory elective for IMS students taking a minor)
- elective for: all other study programs

Module Components and Types

Course Nr.	**Course Name**	**Type**	**ECTS**	**Number of Sessions** (per Semester)	**Duration of Session** (min)	**Total** (hours)
CO23-320301	Control Systems	Lecture	5	28	75	35
CO26-300212	Introduction to Electronics	Lecture	2,5	14	75	17,5
CO26-300222	Electronics Lab	Lab	2,5	14	75	17,5
CO23-320203	Automation	Lecture	5	28	75	35

Version (Date of Revision)
003 (08/2015)

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Module Data Sheet

Module Name **Planning and Optimization**	*Module Code* **CO24-PlanOpt**	*ECTS* **15**
Pre-requisites ☐Corresponding CHOICE Modules ☒None	*Module Contact Person* Prof. Dr. A. Birk Prof. Dr. G. Abreu	*Level (type)* ☐Year 1 (CHOICE) ☒Year 2 (CORE) ☐Year 3 (CAREER) ☐Any (Jacobs Track)
Frequency Every year	*Duration* 1 year	

Module Description / Content

This module is focused on developing the mathematical and engineering skills required to plan for and optimize complex systems such as Intelligent Mobile Systems. It contains two courses on optimization: one focusing on quantitative methods and techniques for effective decision making, and the other dedicated to broader optimization problems, covering topics such as Lagrange multipliers, convex, and nonlinear programming. A third course focuses on planning and decision-making algorithms for autonomous systems.

Module Aims

This module aims to provide a solid theoretical and practical foundation in solving the various planning, optimization, and decision-making problems which are commonly encountered in industrial and logistics-related settings. Optimization techniques for both discrete (combinatorial) and continuous domains will be covered. Special emphasis is given to techniques which enable intelligent mobile systems to operate autonomously.

Intended Learning Outcomes (ILOs)

Discipline Specific Skills

- Formulate and solve optimization problems of both theoretical and practical natures, both in continuous and discrete settings
- Use various software tools available to solve optimization problems
- Implement and use various planning and decision-making algorithms which enable intelligent mobile systems to function autonomously.

Module Function (in Study Programs)

- mandatory for: Intelligent Mobile Systems (mandatory elective for IMS students taking a minor)
- elective for: all other study programs

Module Components and Types

Course Nr.	**Course Name**	**Type**	**ECTS**	**Number of Sessions** (per Semester)	**Duration of Session** (min)	**Total** (hours)
CO24-080202	Operations Research	Lecture	5	28	75	35
CO24-300491	Optimization	Lecture	5	28	75	35
CO24-320521	Autonomous Systems	Lecture	5	28	75	35

Version (Date of Revision)
003 (08/2015)

Module Data Sheet

Module Name **Communications**	*Module Code* **CO25-Communic**	*ECTS* **15**
Pre-requisites ☒Corresponding CHOICE Modules CH10-IntroEE (Introduction to Electrical Engineering) ☐None	*Module Contact Person* Prof. Dr.-Ing. Werner Henkel	*Level (type)* ☐Year 1 (CHOICE) ☒Year 2 (CORE) ☐Year 3 (CAREER) ☐Any (Jacobs Track)
Frequency Every year	*Duration* 1 year	

Module Description / Content

The module comprises the essential contents of digital communications. Starting from first steps to understand modulation and demodulation procedures with and without noise, students will learn the basics for modern wireless communications starting from wireless channel properties to wireless transmission and system aspects. Additionally, the information theoretic foundation is provided that determines the possibilities and methods for error analysis, data compression, communications, and encryption.

Module Aims

Students will be taught the essentials of digital communications, including the theoretical foundation. The module is the basis for all further communications-oriented courses.

Intended Learning Outcomes (ILOs)

Discipline Specific Skills

- Ability to model information and communication mathematically
- Understanding of the interworking of various communications systems
- Understanding of the impact of environmental conditions onto the performance of communications systems
- Ability to design fundamental components (compression, coding, modulation, detection mechanisms, etc.) of communications systems in order to improve their performance
- Analysis and modeling skills which transcends information and networks (digital systems) to other types of networks

Module Function (in Study Programs)

- mandatory for: Electrical and Computer Engineering (mandatory elective for ECE students taking a minor)
- elective for: all other study programs

Module Components and Types

Course Nr.	**Course Name**	**Type**	**ECTS**	**Number of Sessions** (per Semester)	**Duration of Session** (min)	**Total** (hours)
CO25-300202	Communications Basics	Lecture	5	28	75	35
CO25-300311	Wireless Communications I	Lecture	5	28	75	35
CO25-300341	Information Theory	Lecture	5	28	75	35

Version (Date of Revision)
002 (07/2015)

Module Data Sheet

Module Name **Electronics and Noise**	*Module Code* **CO26-ElectroNoise**	*ECTS* **15**
Pre-requisites ☒Corresponding CHOICE Modules CH10-IntroEE (Introduction to Electrical Engineering) ☐None	*Module Contact Person* Prof. Dr.-Ing. Werner Henkel	*Level (type)* ☐Year 1 (CHOICE) ☒Year 2 (CORE) ☐Year 3 (CAREER) ☐Any (Jacobs Track)
Frequency Every year	*Duration* 1 year	

Module Description / Content

The module offers a solid background in electromagnetic theory, circuit analysis & design and the theory of noise. To this end, the concepts of electric and magnetic fields are introduced, followed by Maxwell's equations in vacuum and matter, and a discussion of how these lead to lumped element models on the one hand and field-based descriptions on the other. The design course (lecture+ lab) treats a variety of combinations of linear and non-linear circuit elements (resistors, capacitors, inductors, diodes, transistors, operational amplifiers, logic gates, and flip-flops) from a modular design perspective (supplies, amplifiers, switches, triggers, registers, counters and timers). Noise as a ubiquitous challenge, in particular to mobile technology, is presented based on a focused introduction to probabilities, random variables, their distribution functions leading to a discussion of random voltages and rules for their treatment in electrical circuits.

Module Aims

The aim of the module is to prepare the students for a systematic understanding and module oriented analysis & design of electronic devices. Rooted in fundamental electromagnetic theory, a conceptual framework will be established that allows a coherent and goal-driven approach in practice considering a variety of design goals ranging from input- and output-impedance to trigger thresholds and noise robustness.

Intended Learning Outcomes (ILOs)

Discipline Specific Skills

- Understand and explain the role of electric and magnetic fields in vacuum and electronic devices
- Analyzes and design electronic circuits based on a modular approach in particular, supplies, amplifiers, switches, triggers, registers, counters and timers
- Analyze probabilistic relations, in particular the amount and influence of noise in electronic circuits
- Ability to do some standard circuit design together with use of standard lab equipment (oscilloscopes, electric sources, voltmeters), knowledge that is also utilized in other areas
- Analytical and mathematical modeling skills of electric networks, which transcend application to electric circuits and can also be used to study other physical systems (such as mechanical systems and control systems)

Module Function (in Study Programs)

- mandatory for: Electrical and Computer Engineering (mandatory elective for ECE students taking a minor)
- elective for: all other study programs

Module Components and Types

Course Nr.	**Course Name**	**Type**	**ECTS**	**Number of Sessions** (per Semester)	**Duration of Session** (min)	**Total** (hours)
CO26-300211	Electromagnetics	Lecture	5	28	75	35
CO26-300321	Probability and Random Signal Processing	Lecture	5	28	75	35
CO26-300212	Introduction to Electronics	Lecture	2.5	14	75	17,5
CO26-300222	Electronics Lab	Lab	2.5	6	255	25,5

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Module Data Sheet

Module Name **Signal Processing**	*Module Code* **CO27-SigProcess**	*ECTS* **15**
Pre-requisites ☒Corresponding CHOICE Modules CH10-IntroEE (Introduction to Electrical Engineering) ☐None	*Module Contact Person* Prof. Dr.-Ing. Werner Henkel	*Level (type)* ☐Year 1 (CHOICE) ☒Year 2 (CORE) ☐Year 3 (CAREER) ☐Any (Jacobs Track)
Frequency Every year	*Duration* 1 year	

Module Description / Content

The Signal Processing module covers Signals & Systems and Digital Signal Processing together with their corresponding labs, which summarizes knowledge standard for all EE / ECE programs worldwide plus some additional introduction into digital communications as a possible DSP application. The module comprises in depth treatment of all linear transforms, such as Fourier series, Fourier transform, Laplace and z-transforms (one- and two-sided), Discrete Fourier Transform (DFT) and its fast counterpart FFT. Furthermore, digital filters are discussed in detail and methods that are essential for speech, audio, and video processing, such as subband coding, linear prediction, Discrete Cosine Transform to name just a few.

In the digital communications part, the description and components of baseband, single-carrier, and multicarrier transmission are described, including matched filter, whitening filter, and equalizer structures.

Labs will provide practical aspects starting from simple signal processing tasks, up to programing a signal processor, including computer architectural aspects.

Module Aims

The module can be considered to be central to EE or ECE education and is the basis for all further signal processing and communications.

Intended Learning Outcomes (ILOs)

Discipline Specific Skills

- Ability to model and analyze signals mathematically, enabling their manipulation (filtering, recovery, sampling, etc.) and the design of various engineering applications
- Analytical and mathematical modeling skills regarding electric signals that transcend applications to communications systems and are applicable to speech, audio, and video signal processing, automation, and control systems.

Module Function (in Study Programs)

- mandatory for: Electrical and Computer Engineering (mandatory elective for ECE students taking a minor)
- elective for: all other study programs

Module Components and Types

Course Nr.	**Course Name**	**Type**	**ECTS**	**Number of Sessions** (per Semester)	**Duration of Session** (min)	**Total** (hours)
CO27-300201	Signals and Systems	Lecture	5	28	75	35
CO27-300221	Signals and Systems Lab	Lab	2.5	6	255	25,5
CO27-300302	Digital Signal Processing	Lecture	5	28	75	35
CO27-300231	Digital Signal Processing and Communications Lab	Lab	2.5	6	255	25,5

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Module Data Sheet

Module Name **Finance and Project Management**	*Module Code* **CO28-FinProMan**	*ECTS* **15**
Pre-requisites ☒Corresponding CHOICE Modules CH12-GenMan (General Management) ☐None	*Module Contact Person* Prof. Dr. Christoph Lattemann	*Level (type)* ☐Year 1 (CHOICE) ☒Year 2 (CORE) ☐Year 3 (CAREER) ☐Any (Jacobs Track)
Frequency Every year	*Duration* 1 year	

Module Description / Content

The module "Finance and Project Management" deals with International Finance, Managerial Accounting and Project Management. The finance and accounting courses examine the principles, techniques, and uses of international standards in the steering (planning and control) of business organizations in general, and in projects and in financial and investment activities. The course surveys international financial and managerial accounting topics emphasizing the analysis of financial statements and managerial decision techniques. It exposes students to theory and techniques used for solving many different investment problems in firms and on the financial market. Real-life projects with firms will be conducted in the course "Project Management" to experience how to plan, monitor, control and proceed in projects. The course will base on the techniques if the world most famous PMI Standard.

Module Aims

The aim of this module is to prepare students to be able to apply fundamental management skills in finance, accounting and project management, such as task assignment and resource allocation, budgeting, financing, tracking, and scheduling techniques as well as with project leadership and team processes.

Intended Learning Outcomes (ILOs)

Discipline Specific Skills

- Student will learn to understand and apply international managerial accounting standards
- They know about theories and practice of international finance, financial management and investment
- They know about international capital markets and investment strategies
- Students will learn how to set up, organize, manage, control projects by applying the MPI standard
- Students will learn key skills for managing a firm: task assignment and resource allocation, budgeting, tracking, controlling, and scheduling techniques as well as with project leadership and team processes
- Students learn to work in real projects and to work together with companies.
- They learn to analyze companies and project performances
- They learn about internationally accepted standards and procedure to run and control a company and projects.

Module Function (in Study Programs)

- mandatory for: International Business Administration, Industrial Engineering and Management (mandatory elective for IBA and IEM students taking a minor)
- elective for: all other study programs

Module Components and Types

Course Nr.	**Course Name**	**Type**	**ECTS**	**Number of Sessions** (per Semester)	**Duration of Session** (min)	**Total** (hours)
CO28-990221	Applied Project Management	Seminar	5	28	75	35
CO28-930242	Corporate Finance and Investment	Seminar	5	28	75	35
CO28-930221	Managerial Accounting	Seminar	5	28	75	35

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002 (05/2015)

Module Data Sheet

Module Name **Process Engineering**	*Module Code* **CO29-ProcessEng**	*ECTS* **15**
Pre-requisites ☒Corresponding CHOICE Modules CH11-GenIEM (General Industrial Engineering and Management) ☐None	*Module Contact Person* Prof. Dr. oec. Julia C. Bendul	*Level (type)* ☐Year 1 (CHOICE) ☒Year 2 (CORE) ☐Year 3 (CAREER) ☐Any (Jacobs Track)
Frequency Every year	*Duration* 1 year	

Module Description / Content

The Process Engineering Module is an advanced module building on the knowledge acquired from the General IEM courses. The students will learn to model business processes, to apply various quantitative techniques for optimizing logistics processes in networks and for assessing the involved risks, as well as to employ advanced lean methods for the elimination of waste in the manufacturing processes. The module is heavily focused on the applicability of all the tools learned, enabling the students to apply theory in practice by solving case studies, homework assignments and game-based activities.

Module Aims

This module aims at providing students with an in-depth understanding of processes and techniques to optimize them. The students will be equipped with tools for modeling, simulating, optimizing, and managing business processes.

Intended Learning Outcomes (ILOs)

Discipline Specific Skills

- Model business processes and develop simulation studies for them
- Find optimal or near-optimal solutions to complex decision-making problems using operations research methods
- Employ techniques such as mathematical modeling, statistical analysis, and mathematical optimization
- Solve problems in supply chain design
- Understand the notion of lean and related practices: elimination of waste, one-piece flow, pull principle, value stream mapping, 6 sigma and zero defects
- Conduct business impact analysis and risk assessments

Module Function (in Study Programs)

- mandatory for: Industrial Engineering and Management (mandatory elective for IEM students taking a minor)
- elective for: all other study programs

Module Components and Types

Course Nr.	**Course Name**	**Type**	**ECTS**	**Number of Sessions** (per Semester)	**Duration of Session** (min)	**Total** (hours)
CO29-080202	Operations Research	Lecture	5	28	75	35
CO29-050212	Process Modelling & Simulation	Lab	2,5	14	75	17,5
CO29-050332	Advanced Lean Methods	Seminar	2,5	14	75	17,5
CO29-050272	Risk and Business Continuity Management	Lecture	2,5	14	75	17,5
CO29-050252	Supply Chain Management	Seminar	2,5	14	75	17,5

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003 (10/2015)

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Module Data Sheet

Module Name **Production and Engineering**	*Module Code* **CO30-ProductEng**	*ECTS* **15**
Pre-requisites ☒Corresponding CHOICE Modules CH11-GenIEM (General Industrial Engineering and Management ☐None	*Module Contact Person* Prof. Dr. oec. J. C. Bendul	*Level (type)* ☐Year 1 (CHOICE) ☒Year 2 (CORE) ☐Year 3 (CAREER) ☐Any (Jacobs Track)
Frequency Every year	*Duration* 1 year	

Module Description / Content

The Production and Engineering module is an advanced module building on the knowledge acquired from the General IEM courses. This module takes an in-depth look into production systems, providing the students with understanding product development and design activities, production planning and control methods, as well as the co-ordination of the entire manufacturing processes. Hands-on experience in the practical sessions will ensure an understanding of the complexity and challenges of the various production systems. In addition, the module focuses on the practical application of the taught theoretical concepts in industrial companies.

Module Aims

This module introduces how companies produce goods and services, and how they manage their technological developments to create competitive advantage. It aims to teach students production planning and control methods and their coherences with the essential processes of the order management. The module also develops the students' understanding of the engineering mind-set and the various product design phases.

Intended Learning Outcomes (ILOs)

Discipline Specific Skills

- Understand the problems production companies are confronted with
- Learn the targets of production systems and their trade-offs and to manage them effectively
- Apply the production planning and control (PPC) methods
- Manage innovation and create competitive advantage by means of design, planning and application of technological products, processes and services
- Fully comprehend and apply the "Product Development" framework: from clarification of the requirements, through development of the product, to the actual manufacturing
- Gain experience in working with CAx systems

Module Function (in Study Programs)

- mandatory for: Industrial Engineering and Management (mandatory elective for IEM students taking a minor)
- elective for: all other study programs

Module Components and Types

Course Nr.	**Course Name**	**Type**	**ECTS**	**Number of Sessions** (per Semester)	**Duration of Session** (min)	**Total** (hours)
CO30-050232	Production Planning & Control	Lecture	5	28	75	35
CO30-050131	Fundamentals of Engineering Design	Lab	2,5	14	75	17,5
CO30-052102	Production & Technology Management	Lecture	5	28	75	35
CO30-050222	Advanced Production System Design	Seminar	2,5	14	75	17,5

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002 (07/2015)

Module Data Sheet

Module Name **Strategy and Management**	*Module Code* **CO31-StratMan**	*ECTS* **15**
Pre-requisites ☒Corresponding CHOICE Modules CH12-GenMan (General Management) ☐None	*Module Contact Person* Prof. Dr. C. Lattemann	*Level (type)* ☐Year 1 (CHOICE) ☒Year 2 (CORE) ☐Year 3 (CAREER) ☐Any (Jacobs Track)
Frequency Every year	*Duration* 1 year	

Module Description / Content

The module "Strategy and Management" examines the process, problems, and consequences of creating, implementing, and evaluating business strategy on a global scale and within an internet-driven business-eco-systems. Emphasis is given to detailed case studies of a variety of firms, global e-commerce, marketing, supply chains, networks, innovation, customer relationship management, and future developments in business models.

Module Aims

This module aims to describe, analyze, and explain process, problems, and consequences of creating, implementing, and evaluating business strategy on a global scale.

Intended Learning Outcomes (ILOs)

Discipline Specific Skills

- Be able to examine the development of and future prospects for electronic business
- Understand and develop business models and strategies adopted by firms for the "new economy"
- Know and understand international management theories, concepts, and applications
- Discusses how the political, economic, social, technological, ecological, and legal environments affect the business functions, including finance/accounting, marketing, human resources/organizational behavior, and ethical behaviors of the company in a globalized world.
- The course will use experiential learning, including case studies, simulations and/or "live cases" and engage students in formal presentations, situational analysis, formulation of objectives and strategies, implementation of action plans, and evaluation of results.

Module Function (in Study Programs)

- mandatory for: International Business Administration (mandatory elective for International Business Administration students taking a minor)
- elective for: all other study programs

Module Components and Types

Course Nr.	**Course Name**	**Type**	**ECTS**	**Number of Sessions** (per Semester)	**Duration of Session** (min)	**Total** (hours)
CO31-930224	Global E-Business	Seminar	5	28	75	35
CO31-930214	International Management	Seminar	5	28	75	35
CO31-930204	Strategic Management	Seminar	5	28	75	35

Version (Date of Revision)
002 (07/2015)

Module Data Sheet

Module Name **Managing Diversity**	*Module Code* **CO32-ManDivers**	*ECTS* **15**
Pre-requisites ☐Corresponding CHOICE Modules ☒None	*Module Contact Person* Profs. W. Werner and C. Lattemann	*Level (type)* ☐Year 1 (CHOICE) ☒Year 2 (CORE) ☐Year 3 (CAREER) ☐Any (Jacobs Track)
Frequency Every year	*Duration* 1 year	

Module Description / Content

The Module "Managing Diversity" addresses the opportunities and challenges that the diversity of human needs and resources poses for modern enterprises, especially international and internationalizing companies. Inside the firm, Leadership and Human Resource Management need to build on the latest evidence in Organizational Behavior and Cross-Cultural Management in order to motivate and monitor a diverse workforce successfully and responsibly. Outside the firm, Marketing practices must reflect the differentiated needs of customers and business partners for creating unique offerings tailored to specific segments in dynamic, globalized markets. The module provides a holistic view of how companies manage diversity to create value for firms' stakeholders.

Module Aims

This module equips students with the essential knowledge of Organizational Behavior and Human Resource Management, including Leadership, Cross-Cultural Management and Corporate Social Responsibility issues, as well as the foundations of Marketing with an emphasis on segmentation, customization and customer relationship management. Students will be able to analyze diverse internal and external environments and devise appropriate organizational strategies.

Intended Learning Outcomes (ILOs)

Discipline Specific Skills

- Identify factors that produce conflict or cooperation within firms
- Reflect on leadership styles and their effectiveness in different circumstances
- Define appropriate policies for recruiting and developing a diverse workforce
- Recognize relevant dimensions of diversity inside and outside the firm
- Manage relationships with internal and external partners/customers
- Develop differentiated marketing strategies and programs

Module Function (in Study Programs)

- mandatory for: Global Economics and Management, International Business Administration
- elective for: all other study programs

Module Components and Types

Course Nr.	**Course Name**	**Type**	**ECTS**	**Number of Sessions** (per Semester)	**Duration of Session** (min)	**Total** (hours)
CO32-930352	Marketing	Seminar	5	28	75	35
CO32-930231	Organizational Behavior and Human Resource Management	Seminar	5	28	75	35
CO32-930232	Diversity and Cross-Cultural Management	Seminar	5	28	75	35

Version (Date of Revision)
002 (07/2015)

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Module Data Sheet

Module Name **Economic Policy Challenges**	*Module Code* **CO33-EconPolicy**	*ECTS* **15**
Pre-requisites ☐Corresponding CHOICE Modules ☒None	*Module Contact Person* Prof. Dr. W. Werner	*Level (type)* ☐Year 1 (CHOICE) ☒Year 2 (CORE) ☐Year 3 (CAREER) ☐Any (Jacobs Track)
Frequency Every year	*Duration* 1 year	

Module Description / Content

The world's economic policy challenges are many-facetted. In this module students learn about critical challenges in two different fields. The course Development Economics focusses not only on the economic policy issues faced by large parts of the world population living in developing countries but also seeks to evaluate the consequences of these challenges for industrialized countries. The course Environmental and Resource Economics is devoted to the overarching question of environmental and resource security, which concerns all country groups. The third course, Innovation Economics, helps students to understand the vital role that research and development plays in solving a broad range of challenges in firms, industries, and national economies.

Module Aims

The aim of this module is to enable students to identify and critically evaluate current economic challenges for individual economic actors, country groups and the world. Students will learn how to employ theoretical and empirical methods of analysis to make policy proposals on how to solve these challenges.

Intended Learning Outcomes (ILOs)

Discipline Specific Skills

- Identify and explain critical policy challenges in various country groups and the world and what they mean for various economic actors and governments
- Analyze economic interests of various stakeholders and how they collide
- Identify and explain best practices from other countries and their suitability for the country under consideration
- Identify and apply suitable theoretical and empirical methods of analysis
- Explain regulatory, technological, political and societal aspects of the challenge
- Understand the crucial importance of Research and Development for many economic policy challenges
- Evaluate the costs and benefits of suggested policy measures
- Analyze the distributional effects of suggested policy measures and their implications for the feasibility of suggested measures

Module Function (in Study Programs)

- mandatory for: Global Economics and Management (mandatory elective for Global Economics and Management students taking a minor)
- elective for: all other study programs

Module Components and Types

Course Nr.	**Course Name**	**Type**	**ECTS**	**Number of Sessions** (per Semester)	**Duration of Session** (min)	**Total** (hours)
CO33-930112	Development Economics	Seminar	5	28	75	35
CO33-040122	Environmental and Resource Economics	Seminar	5	28	75	35
CO33-930202	Innovation Economics	Seminar	5	28	75	35

Version (Date of Revision)
002 (07/2015)

Module Data Sheet

Module Name **Economic Institutions and Organization**	*Module Code* **CO34-EconInstOrg**	*ECTS* **15**
Pre-requisites ☐Corresponding CHOICE Modules ☒None	*Module Contact Person* Prof. Dr. W. Werner	*Level (type)* ☐Year 1 (CHOICE) ☒Year 2 (CORE) ☐Year 3 (CAREER) ☐Any (Jacobs Track)
Frequency Every year	*Duration* 1 year	

Module Description / Content

This module gives an overview of the many ways in which value creation can be organized in economic institutions on national and sub-national levels. The course Comparing Economic Systems introduces the many different forms of market capitalism and their different performances. The course Organization Theory and Design focusses on the sub-national level. It offers explanations for why new organizational forms emerge in firms while traditional forms become less important. Since value creation happens not only in profit-oriented firms but to a large extent also in non-profit organizations, international organizations, and governmental organizations, this module also covers in a third course examples from Public Management and Public Policy. In all these fields organization involves the division and coordination of labor and other resources for meaningful purposes and it is fascinating to study how it is achieved in practice.

Module Aims

This module equips students with the essential knowledge of Organizational Theory and Organizational Design with a special emphasis on 21st-century advances in theory and practice. Students will understand the specific organizational opportunities and challenges of private and public, profit-seeking and non-profit organizations. Students will be able to use this knowledge to build their careers in a variety of organizational contexts and contribute to their organizations' purposes more effectively.

Intended Learning Outcomes (ILOs)

Discipline Specific Skills

- Analyze diverse contextual forces and dynamic organization-environment relationships
- Assess the potential and limitations of organizational design efforts
- Apply competing and complementary theories of organizational effectiveness
- Understand the specific character and recent developments of Public Management
- Evaluate the opportunities and requirements of Social Entrepreneurship ventures
- Reflect on one's own roles as member, partner or client of various organizations

Module Function (in Study Programs)

- mandatory for: Global Economics and Management (mandatory elective for Global Economics and Management students taking a minor
- elective for: all other study programs

Module Components and Types

Course Nr.	**Course Name**	**Type**	**ECTS**	**Number of Sessions** (per Semester)	**Duration of Session** (min)	**Total** (hours)
CO34-930203	Comparing Economic Systems	Seminar	5	28	75	35
CO34-930213	Organization and Theory Design	Seminar	5	28	75	35
CO34-970202	Public Management and Public Policy	Seminar	5	28	75	35

Version (Date of Revision)
002 (07/2015)

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Module Data Sheet

Module Name **International Politics and Policy**	*Module Code* **CO35-IntPolitics**	*ECTS* **15**
Pre-requisites ☐Corresponding CHOICE Modules ☒None	*Module Contact Person* Prof. Dr. Corinna Unger	*Level (type)* ☐Year 1 (CHOICE) ☒Year 2 (CORE) ☐Year 3 (CAREER) ☐Any (Jacobs Track)
Frequency Every year	*Duration* 1 year	

Module Description / Content

This module offers an introduction to the politics and policy-making of international relations. It does so through discussing some of the most pressing questions of global politics and policy today. These include: what is democracy, should it be spread around the world, and can it be incorporated at the international level? Moreover, is it possible to reduce warfare, terrorism and other forms of transnational violence? Last, what roles can diplomacy and foreign policy play in bringing about a prosperous, equitable and peaceful international system? The module shows that alternative theories in political science provide different answers to these questions, and it helps students critically reflect on these frameworks.

Module Aims

This module aims to introduce students to theories of democracy, foreign policy-making and international security. Thus, it trains students to constructively analyze pressing international issues and challenges. It also offers students insights into the skills and tools employed by diplomats and international civil servants.

Intended Learning Outcomes (ILOs)

Discipline Specific Skills

- Knowledge of a wide range of theories of democracy, international politics, and foreign policy;
- Insight into what diplomats, international civil servants and foreign policy-makers do (and how they do it);
- Ability to critically and creatively analyze international problems.

Module Function (in Study Programs)

- mandatory for: International Relations: Politics and History (mandatory elective for IRPH students taking a minor)
- mandatory elective for taking a minor

Module Components and Types

Course Nr.	**Course Name**	**Type**	**ECTS**	**Number of Sessions** (per Semester)	**Duration of Session** (min)	**Total** (hours)
CO35-910202	Democratic Governance	Seminar	5	28	75	35
CO35-910201	Diplomacy and Foreign Policy	Lecture	5	28	75	35
CO35-970301	International Security	Seminar	5	28	75	35

Version (Date of Revision)
002 (07/2015)

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Module Data Sheet

Module Name **Communication, Culture and Prosumption**	*Module Code* **CO36-CommCult**	*ECTS* **15**
Pre-requisites ☐Corresponding CHOICE Modules ☒None	*Module Contact Person* Prof. Dr. Marion G. Müller	*Level (type)* ☐Year 1 (CHOICE) ☒Year 2 (CORE) ☐Year 3 (CAREER) ☐Any (Jacobs Track)
Frequency Every year	*Duration* 1 year	

Module Description / Content

Communication, Culture and Prosumption is an advanced module which focuses on the pervasive role mass communication and consumerism play in contemporary societies globally. Starting from sociological conceptions of capitalism and consumer society, you will learn to assess the value and problems of modern consumerism, the choices and constraints of humans in societies that have been increasingly shaped by consumption behavior. Recently, due to digital globalization, social network sites and the spread of technological tools easy to use for lay people, consumers become ever more competent in not only passively consuming goods and services, but actively shaping these products and services through the cultural practice of *"prosumption"*, a fusion of formerly separated social roles of producer and consumer. You will further analyze mass communication systems from a production, consumption, and *prosumption* perspective. Finally, the module provides you with the methodological tools and research skills to analyze communication systems and prosumption, based on a variety of data sources. The module combines rich theoretical insights with many empirical examples and exercises.

Module Aims

This module aims to teach you in-depth how mass media and consumption shape modern (and post-modern) societies. The module also enables you to conduct own empirical research on the mass media and on consumption-related attitudes and behavior.

Intended Learning Outcomes (ILOs)

Discipline Specific Skills

- Understand theories of consumerism and mass communication
- Identify and critically evaluate advantage and disadvantages of mass consumption and consumerism
- Apprehend how mass media systems and communication work, and to what effect
- Know about empirical tools for analyzing mass communication and consumption

Module Function (in Study Programs)

- mandatory for: Integrated Social Sciences (mandatory elective for Integrated Social Science students taking a minor)
- elective for: all other study programs

Module Components and Types

Course Nr.	**Course Name**	**Type**	**ECTS**	**Number of Sessions** (per Semester)	**Duration of Session** (min)	**Total** (hours)
CO36-940212	Consumer Culture &Society	Seminar	5	28	75	35
CO36-940202	Communication, Culture & Prosumption Lab I	Seminar	2,5	14*	75	17,5
CO36-940201	Comparing Mass Communication Systems	Seminar	5	28	75	35
CO36-940203	Communication, Culture & Prosumption Lab II	Seminar	2,5	14*	75	17,5

** When scheduled during a lab rotation (default option), seminars may have up to 18 sessions.*

Version (Date of Revision)
002.1 (09/2015)

Module Data Sheet

Module Name **The Good Society**	*Module Code* **CO37-GoodSociety**	*ECTS* **15**
Pre-requisites ☐Corresponding CHOICE Modules ☒None	*Module Contact Person* Prof. Dr. Marion G. Müller	*Level (type)* ☐Year 1 (CHOICE) ☒Year 2 (CORE) ☐Year 3 (CAREER) ☐Any (Jacobs Track)
Frequency Every year	*Duration* 1 year	

Module Description / Content

The Good Society is an advanced module which is concerned with progress (or the lack thereof) towards better and fairer societies. You will learn about concepts and theories of equality and justice, and how unequal contemporary societies actually are (and what can be done about it). You will further engage with political cultures worldwide, i.e. the attitudes, values and socio-political behavior of mass citizens – often a powerful social force pushing for a better society. Finally, the module provides you with the methodological tools and statistical skills to study inequalities and political cultures worldwide, based on cross-national surveys and other data sources. The module is unique in combining rich theoretical insights with lots of empirical examples and exercises.

Module Aims

This module aims to teach you in-depth the advances towards and challenges of creating more equal, fair and inclusive societies. The module also enables you to conduct own empirical research on inequalities and political culture.

Intended Learning Outcomes (ILOs)

Discipline Specific Skills

- Understand key concepts and theories of inequality and political culture
- Know about key worldwide differences and trends in inequalities and political culture
- Assess indicators and data sources for social research
- Conduct secondary data analysis

Module Function (in Study Programs)

- mandatory for: Integrated Social Sciences (ISS) (mandatory elective for ISS students taking a minor)
- elective for: all other study programs

Module Components and Types

Course Nr.	**Course Name**	**Type**	**ECTS**	**Number of Sessions** (per Semester)	**Duration of Session** (min)	**Total** (hours)
CO37-920203	Political Culture	Seminar	5	28	75	35
CO37-920211	Social Data & Survey Lab I	Seminar	2,5	14*	75	17,5
CO37-920202	Equality & Social Justice	Seminar	5	28	75	35
CO37-920212	Social Data & Survey Lab II	Seminar	2,5	14*	75	17,5

** When scheduled during a lab rotation (default option), seminars may have up to 18 sessions.*

Version (Date of Revision)
002.1 (09/2015)

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Module Data Sheet

Module Name **Global Dynamics in Historical Perspective**	*Module Code* **CO38-GlobDynHist**	*ECTS* **15**
Pre-requisites ☐Corresponding CHOICE Modules ☒None	*Module Contact Person* Prof. Dr. Corinna Unger	*Level (type)* ☐Year 1 (CHOICE) ☒Year 2 (CORE) ☐Year 3 (CAREER) ☐Any (Jacobs Track)
Frequency Every year	*Duration* 1 year	

Module Description / Content

This module discusses the importance of historical forces underlying contemporary politics, economies and societies. It teaches students not only to think about global integration from historical perspectives but also encourages them to reflect upon the past trajectories of empires, nation states and other key forces in world politics. With one course dealing with the history of modern Asia as a key region, this module accentuates the lasting importance of regional differences in a globalizing world. Students will be invited to pose challenging questions when thinking about politics and history from global perspectives. For instance, how can we balance the need for global thought and action with the appreciation of societal diversity?

Module Aims

This module aims to introduce students to thinking about globalization and global politics in historically informed ways. This also means widening one's regional competence and training the ability to think globally without chiefly relying on Eurocentric paradigms. Students will be exposed to the frontiers of thinking in a variety of fields – frontiers that are also of utmost importance to international organizations and global corporations.

Intended Learning Outcomes (ILOs)

Discipline Specific Skills:

- Ability to think about globalization/global politics from regional perspectives; questioning Eurocentric thinking
- Thinking about history from transnational and global perspectives
- Ability to present problems in a concise and comprehensive manner (oral presentations and short essay writing)
- Analyzing primary source materials (texts, images and audiovisual materials)

Module Function (in Study Programs)

- mandatory for: International Relations: Politics and History (mandatory elective for IRPH students taking a minor)
- mandatory elective for taking a minor

Module Components and Types

Course Nr.	**Course Name**	**Type**	**ECTS**	**Number of Sessions** (per Semester)	**Duration of Session** (min)	**Total** (hours)
CO38-820222	Empires and Nation States	Lecture	5	28	75	35
CO38-820201	Modern Asian History	Seminar	5	28	75	35
CO38-820212	Global History	Seminar	5	28	75	35

Version (Date of Revision)
002 (07/2015)

Module Data Sheet

Module Name **Arenas of Political Life**	*Module Code* **CO39-ArenaPolLife**	*ECTS* **15**
Pre-requisites ☐Corresponding CHOICE Modules ☒None	*Module Contact Person* Prof. Dr. Corinna Unger	*Level (type)* ☐Year 1 (CHOICE) ☒Year 2 (CORE) ☐Year 3 (CAREER) ☐Any (Jacobs Track)
Frequency Every year	*Duration* 1 year	

Module Description / Content

This module presents an interdisciplinary combination of courses covering different levels of political processes, ranging from ideas to structures to actors. The course "Public Management and Public Policy" offers an overview of influential theories, ideas and debates that have shaped the ways in which we understand political life. The course "Modern Economic and Social History" provides students with an understanding of the emergence of the capitalist system and the global economy, taking into consideration the role of social and cultural phenomena and their interplay with economic factors. Finally, "Regional Integration" investigates the efforts of different political actors to overcome the boundaries of the nation state, be it for political, cultural, or economic reasons.

Module Aims

The module aims to allow students to understand the ways in which ideas, structures, and actors together shape political life, both individually and collectively and on the regional, national, and international levels. It trains students in thinking across disciplinary boundaries and to understand the complexity of modern political life.

Intended Learning Outcomes (ILOs)

Discipline Specific Skills

- Become familiar with key texts and arguments in modern political thought
- Understand the interdependencies between socioeconomic and political developments
- Identify key issues and challenges in integration process

Module Function (in Study Programs)

- mandatory for: International Relations: Politics and History (mandatory elective for IRPH students taking a minor)
- mandatory elective for taking a minor

Module Components and Types

Course Nr.	**Course Name**	**Type**	**ECTS**	**Number of Sessions** (per Semester)	**Duration of Session** (min)	**Total** (hours)
CO39-830211	Regional Integration	Seminar	5	28	75	35
CO39-830212	Modern Economic and Social History	Lecture	5	28	75	35
CO34-970202	Public Management and Public Policy	Seminar	5	28	75	35

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002 (07/2015)

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Module Data Sheet

Module Name **Biology, Brain, and Cognition**	*Module Code* **CO40-BioBrainCog**	*ECTS* **15**
Pre-requisites ☒Corresponding CHOICE Modules CH16-IntroPsych (Introduction to Psychology) ☐None	*Module Contact Person* Prof. Dr. Adele Diederich	*Level (type)* ☐Year 1 (CHOICE) ☒Year 2 (CORE) ☐Year 3 (CAREER) ☐Any (Jacobs Track)
Frequency Every year	*Duration* 1 year	

Module Description / Content

The module provides an introduction to what is known about the link between the brain, cognitive processes and behavior. Starting from the organization of the neural systems and the neuroanatomy of the brain, the module focuses on the neurobiological bases of cognitive processing in the areas of perception, motor control, attention, emotion, memory, learning, language etc. What is the social brain? How is the brain involved in making decisions? What is neuro-economics? What do drugs do to the brain and how do they alter behavior? These and other questions as well as critical perspectives are addressed in this module. The methods to study the link between brain, mind, and behavior, as well as their pros and cons, will also be discussed.

Module Aims

The module gives you a basic review of the brain as a biological organ, including its basic structure and operations, and will teach you how the brain gives rise to a wide variety of complex behaviors. You will learn to evaluate the challenges and limits of modern, neuro-oriented psychology.

Intended Learning Outcomes (ILOs)

Discipline Specific Skills

- Explain the basic brain structure and processes
- Relate brain structures to psychological processes
- Understand the rationale of neuroscientific methods
- Critically evaluate the neuroscience approach to psychology

Module Function (in Study Programs)

- mandatory for: Psychology (mandatory elective for psychology students taking a minor
- elective for: all other study programs

Module Components and Types

Course Nr.	**Course Name**	**Type**	**ECTS**	**Number of Sessions** (per Semester)	**Duration of Session** (min)	**Total** (hours)
CO40-710201	Neurobiological Foundations of Psychology	Lecture/Seminar	5	28	75	35
CO40-710212	Attention, Sensation & Perception	Lecture	5	28	75	35
CO40-710102	Learning and Memory	Lecture (with lab component)	5	28	75	35

Version (Date of Revision)
002 (07/2015)

Module Data Sheet

Module Name **Humans in Social Context**	*Module Code* **CO41-HumanSoCo**	*ECTS* **15**
Pre-requisites ☒Corresponding CHOICE Modules CH16-IntroPsych (Introduction to Psychology) ☐None	*Module Contact Person* Prof. Dr. Adele Diederich	*Level (type)* ☐Year 1 (CHOICE) ☒Year 2 (CORE) ☐Year 3 (CAREER) ☐Any (Jacobs Track)
Frequency Every year	*Duration* 1 year	

Module Description / Content

Humans are profoundly social beings, and their thinking, feeling, and action is fundamentally shaped by the social context. Both proximal factors in the current social context (such as the presence or absence of others), as well as distal ones (such as evolution or culture) affect how people perceive themselves and others and how they interact with others. Specific questions addressed in this module include: How do we perceive ourselves and others? How can we change others' behavior through social influence? Which factors predict conformity or deviance in groups? What is the role of stereotypes in intergroup conflicts? The answers to these questions contribute to improving the interactions of individuals from diverse backgrounds.

Module Aims

This module seeks to acquaint you with individual-focused as well as group-oriented analyses of the social and cultural embeddedness of human experience and behavior. It aims to generate a thorough understanding of this social and cultural embeddedness through an emphasis on social psychological theories, scientific methods, and empirical research findings.

Intended Learning Outcomes (ILOs)

Discipline Specific Skills

- Understand the social and cultural context of individual behavior
- Understand how group and intergroup processes influence individuals
- Understand how individuals influence groups
- Critically apply and evaluate social psychological research methods

Module Function (in Study Programs)

- mandatory for: Psychology (mandatory elective for psychology students taking a minor)
- elective for: all other study programs

Module Components and Types

Course Nr.	**Course Name**	**Type**	**ECTS**	**Number of Sessions** (per Semester)	**Duration of Session** (min)	**Total** (hours)
CO41-730102	Social Cognition	Lecture	5	28	75	35
CO41-701101	Group Processes and Intergroup Relations	Lecture	5	28	75	35
CO41-730222	Current Debates in Social Cognition	Seminar	2,5	14*	75	17,5
CO41-701102	Current Debates in Group Processes and Intergroup Relations	Seminar	2,5	14*	75	17,5

** When scheduled during a lab rotation (default option), seminars may have up to 18 sessions.*

Version (Date of Revision)
002.1 (09/2015)

Module Data Sheet

Module Name **Applied Psychology**	*Module Code* **CO42-ApplPsych**	*ECTS* **15**
Pre-requisites ☒Corresponding CHOICE Modules CH16-IntroPsych (Introduction to Psychology) ☐None	*Module Contact Person* Prof. Dr. Adele Diederich	*Level (type)* ☐Year 1 (CHOICE) ☒Year 2 (CORE) ☐Year 3 (CAREER) ☐Any (Jacobs Track)
Frequency Every year	*Duration* 1 year	

Module Description / Content

This module focuses on implications of the biological and cognitive processes, as well as social and cultural factors, which underlie human behavior for applications in domains such as business, education, health, politics, and society. Three processes are central across these domains: (a) decision making (of individuals, in groups, in institutions), (b) behavioral change (in terms of marketing approaches; maintenance and restoration of health; in organizations) and (c) conflict analysis & resolution (e.g., mediation, negotiation). In all these domains, diversity plays a major role, therefore the impact of age, gender and cross-cultural variance will be addressed. The module also covers applied methods (intervention, training, evaluation).

Module Aims

The module focuses on the transfer of theories and methods of psychological research to solving practical problems. It provides you with the core knowledge, hands-on methods and skills necessary for successful applications of psychological findings in areas that are relevant for the individual and for society.

Intended Learning Outcomes (ILOs)

Discipline Specific Skills

- Acquire skills to diagnose where and how to intervene
- Perform a needs-assessment
- Use the Intervention Mapping approach to plan and implement an intervention
- Perform decision analysis
- Consider ethical aspects

Module Function (in Study Programs)

- mandatory for: Psychology (mandatory elective for psychology students taking a minor)
- elective for: all other study programs

Module Components and Types

Course Nr.	**Course Name**	**Type**	**ECTS**	**Number of Sessions** (per Semester)	**Duration of Session** (min)	**Total** (hours)
CO42-710302	Judgement and Decision Making	Seminar	5	28	75	35
CO42-710231	Business Psychology (Industrial and Organizational psychology)	Seminar	5	28	75	35
CO42-710232	Current Topics in Applied Psychology	Seminar	5	28	75	35

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002 (07/2015)