FRIEDRICH-ALEXANDER
UNIVERSITÄT
ERLANGEN-NÜRNBERG

Department of
Mechanical Engineering

Module handbook

Modules in English language
for incoming students
of the

Department of Mechanical Engineering

University
Erlangen-Nuremberg

https://www.department.mb.fau.de/incomings/

Date: April 2019

Preface

Whether you are planning to come to Erlangen as an international exchange or guest student (incoming student) or whether you are considering taking your entire degree here (regular student), the University of Erlangen-Nuremberg has plenty to offer you. In this module handbook, you will find practical information about the courses in English language that are especially suitable for incoming students.

The modules in English language of our study program "International Production Engineering and Management" (IP) offered by the department of mechanical engineering are ideal for foreign students to study one semester (winter or summer semester is equally suitable) or 2 semesters abroad in Germany at one of the largest universities in Bavaria. Beside our basic modules in German language like mathematics, we offer various engineering and management courses in English language, which are especially suitable for exchange students and which could be accompanied by our special German language courses for exchange students.

Incoming students may choose compulsory and elective courses in English or German language. This module handbook describes the lectures taught in English language.

For studying as an exchange student at the University Erlangen-Nuremberg, you have to apply at the Central Office for International Affairs of our university. Further information may be found on our English homepage for incoming students: https://www.department.mb.fau.de/incomings/

Dr. Oliver Kreis

List of Abbreviations:

WS: Winter semester (Wintersemester)
SS: Summer semester (Sommersemester)
SWS: semester credit hour (Semesterwochenstunden)

1 Course list

The following Courses will be held in English language:

Course	Head of module / Lecturer	ECTS in winter sem (WS)	ECTS in summer sem. (SS)	Level [2)]
Engineering (Bachelor and Master level)				
Production Technology 1 with Exercises (with training in technical english)	Merklein e.a.	–	5	basic (B)
Production Technology 2 with Exercises (with training in technical english)	M. Schmidt e.a.	5	–	basic (B)
Fundamentals in Metrology	Hausotte	–	5	basic (B)
Quality Management	NN	–	5	basic (B)
Advanced Seminar on International and Sustainable Production	div.	2,5	2,5	basic (B)
German language courses	University language center	5 – 15	5 – 15	basic, intermediate oder advanced (B, M)
Laser Technology	Schmidt	5	–	advanced (B, M)
Engineering of Solid State Lasers	Schmidt, Pflaum	–	2,5	advanced (B, M)
Integrated Production Systems (E-Learning course at vhb)	Franke	5	5	advanced (B, M)
International Supply Chain Management (E-Learning course at vhb)	Franke	2,5	2,5	advanced (B, M)
Introduction to the Finite Element Method	Pfaller	–	5	advanced (B, M)
Nonlinear Finite Elements	Pfaller	5	–	advanced (B, M)
Computational Dynamics	Steinmann	5	–	advanced (B, M)
Linear continuum mechanics	Steinmann	5	-	advanced (B, M)
Nonlinear continuum mechanics	Steinmann	-	5	advanced (B, M)
Management (Bachelor level, may also be taken by Master students)				
Innovation	Voigt	–	5	advanced (B, M)
Sustainability Management: Issues, Concepts and Tools	Beckmann	5	–	advanced (B, M)
Innovation Strategy III	Möslein	–	2,5	advanced (B, M)
Innovation Design	Möslein	2,5	–	advanced (B, M)
Management (only for Master students)				
Global operations strategy (seminar)	Voigt	5	–	advanced (M)
Technology and Innovation management	Voigt	–	5	advanced (M)
Advanced Service Management	Bodendorf	-	5	advanced (M)
Advanced Process Management	Bodendorf	5	–	advanced (M)
Business strategy	Hungenberg	5	–	advanced (M)
Change management	Hungenberg	–	5	advanced (M)

Advanced Sustainability Management and Corporate Functions	Beckmann	5	–	advanced (M)
Global Retail Logistics (E-Learning course at vhb)	Hartmann	5	5	advanced (M)
Designing technology	Möslein	5	-	advanced (M)
Platform Strategies	Möslein	5	-	advanced (M)
Organizing for Digital Transformation	Möslein	-	5	advanced (M)
International Technology Management Research Seminar	Brem	5	5	advanced (M)
Strategic intellectual property management	Brem	5	5	advanced (M)
Internet of Things and Industrial Services Seminar	Matzner/Stierle/Pauli	-	5	advanced (M)
Bachelor thesis with advanced seminar [4)]	div.	12+3	12+3	advanced (B)
Project thesis with advanced seminar [4)]	div.	12+3	12+3	advanced (M)
Master thesis [4)]	div.	30	30	advanced (M)

2) B=suitable for incoming Bachelor students; M=suitable for incoming Master students

4) For theses, a language level of at least C1 in English or German and individual agreements with one of our institutes are necessary.

Term	**Start – End**
Winter semester 2018/19	2018-10-15 – 2019-02-09
Summer semester 2019	2019-04-23 – 2019-07-27
Winter semester 2019/20	2019-10-14 – 2020-02-24
Summer semester 2020	2020-04-20 – 2020-07-14

2 Engineering (bachelor and master level)

2.1 Production Technology 1 + 2

1	**Module description**	**Production Technology 1 + 2**	**10,0 ECTS**
2	Course	SS: – Lecture "Production Technology 1" (2 SWS) – Exercise "Exercises in Production Technology (with training in technical English) 1" (2 SWS) WS: – Lecture "Production Technology 2" (2 SWS) – Exercise "Exercises in Production Technology (with training in technical English) 2" (2 SWS)	 2,5 ECTS 2,5 ECTS 2,5 ECTS 2,5 ECTS
3	Lecturers	Profes. Merklein, Franke, Drummer, Schmidt, Hanenkamp	

4	**Head of module**	**Production Technology 1:** Prof. Dr.-Ing. habil. Marion Merklein **Production Technology 2:** Prof. Dr.-Ing. Jörg Franke
5	**Contents**	Production Technology 1 Based on the DIN 8580, the course Production Technology 1 deals with the current technologies and machinery used in the manufacturing processes primary shaping, forming, cutting und joining. The process chains as well as process-specific characteristics are part of the lecture and get exemplified on the basis of practice-oriented parts. At first, metallurgical essentials, like the microstructure of metals and their plastic behaviour, are explained in order to improve the understanding of the manufacturing processes. Subsequently, the two primary shaping processes casting and powder metallurgy are presented. The lecture continues with a comparison of the bulk forming processes upsetting, forging, extrusion and rolling. The chapter sheet metal forming deals with the production of components by deep drawing, stretch drawing and bending. The introduction of the main group cutting concentrates on dividing and machining. Furthermore, the lecture unit corresponding to the joining technologies presents the production of joints via forming, welding and soldering. An introduction to the production technologies of plastic components with emphasis on extrusion technologies is given conclusively.Additional tutorials serve the improvement and application of the knowledge gained in the lecture. Production Technology 2 The lecture deals with processing of polymers (injection moulding, generation of thermosetting / thermoplastic fiber composites) and metals with focus on beam based techniques (cutting, welding and additive manufacturing by applying water jet, electron beam and laser beam). Furthermore, basics of machine tool and machine tool building (components, functionalities, applications) and assembly and joining technologies (design and construction of connections, process specific realization) are included. Additional topics are electric drives production and electronic production (functionality and manufacturing of electronic drive units, design and production of electronic components).

6	**Learning targets and skills**	• The students acquire basic knowledge in metallurgy and the processing of metals. • The students obtain an overview of the production technologies primary shaping, forming, cutting, and joining as well as their subgroups. • The students acquire a basic understanding of the processes and the acting mechanisms. • The students acquire knowledge about the process management as well as the specific characteristics of the production technologies. • The students obtain a basic understanding of the properties of plastics and their processing. • The students acquire knowledge about material related aspects and material characteristics as well as material behavior before, during and after the processes. • The students get an essential understanding of multi-material composites. • The students gain basic knowledge about the functionality and the production of electric drive units as well as the production of electronic components (MID). • The students acquire basic knowledge in product design and development (production possibilities, process limitations, design restrictions for each process) • The students are able to understand the basic principles of the production process and its development. • The students understand the essentials of tool and plant engineering • The students are able to determine suitable production processes for the manufacturing of technical products (focus: primary shaping, forming, cutting und joining). • The students are capable of identifying the different production processes and differentiate them conforming to standards.
7	**Suggested prerequisites**	none
8	**Integration in curriculum**	Winter and summer semester (Semester 2 and 3)
9	**Module application**	– Bachelor IP, compulsory module – Module for incoming students (basic level)
10	**Method of examination**	– Written examination, 120 min. (exam on the topics of 1 sem. possible after individual agreement) – Successfull participation in the exercises (ungraduated course achievement)
11	**Grading procedure**	Written examination
12	**Course frequency**	Annual (part 1 in SS, part 2 in WS)
13	**Work load**	Attendance Lecture: 60 h (= 4 SWS) Attendance Exercise: 60 h (= 4 SWS) Self-study, Exercises preparation/postprocessing: 180 h
14	**Duration**	2 Semesters
15	**Lecture language**	English
16	**Recommended literature**	Not required

2.2 Fundamentals of Metrology

1	**Module description**	**Fundamentals of Metrology**	**5,0 ECTS**
2	Course	SS: Lecture “Fundamentals in Metrology” (2 SWS) Exercise (2 SWS)	2,5 ECTS 2,5 ECTS
3	Lecturers	Prof. Dr.-Ing. habil. Tino Hausotte, Andreas Gröschl, Martin Heinl	

4	**Head of module**	Prof. Dr.-Ing. habil. Tino Hausotte
5	**Contents**	General basics • **What is metrology:** Metrology and braches, application fields, historical development of the unit system, SI unit system - Definitions of SI units (cd, K, kg, m, s, A, mol) - Quantity, quantity value - Extensive and intensive quantities - Measurement, measurand, measurement unit, measurement result, measured quantity value - Correct use and notation of units and of quantity values - Basic requirements for the measurement – Traceability • **Principles, methods and procedures of measurement:** Principles, methods and procedures of measurement - Classification of measurement methods, deflection, differential, substitution and compensation measurement methods - Principle of a measuring instrument, direct and indirect measurement methods - Characteristic curve, types of characteristic curves, analogue and digital measurement methods, continuous and discontinuous measurement, resolution, sensitivity, measuring interval - Absolute and incremental measurement methods • **Statistics - Evaluation of measurements series:** Calculation of a measurement result based on measurement series - Basic terms of descriptive statistics - Presentation and interpretation of measured value distributions (histograms) - Frequency (absolute, relative, cumulative, relative cumulative) - Calculation and interpretation of basic parameters: location (mean, median, mode), dispersion (range, variance, standard deviation, coefficient of variation), shape (skewness, excess, kurtosis) - Basic terms of stochastics, probabilities, distributions (rectangle, U and normal distribution), central limit theorem, statistical moments - Basic terms of analytical statistics, statistical tests and statistical estimation methods - Correlation and regression • **Measurement errors and measurement uncertainty:** Measured value, true value, key comparison, conventional quantity value - Influences on the measurement (Ishikawa diagram) – Measurement error (absolute, relative, systematic, random) - Handling of errors, correction of known systematic measurement errors - Calibration, verification, legal verification - Measurement precision, accuracy and trueness - Repeatability conditions and repeatability, intermediate precision condition and measurement precision, reproducibility condition of measurement and reproducibility - Error propagation law (old concept), measurement uncertainty, definitional uncertainty, overview of standard method

		of the GUM (measurement uncertainty), correct specification of a measurement result Mesurands of the SI system of units • **Measurement of electrical quantities:** SI base unit Ampere, resistance and voltage standards, measurement of current and voltage, Lorentz force, moving coil instrument, range adjustment - Resistance measurement, current and voltage correct measurement, Wheatstone bridge circuit (quarter, half and full bridge, differential method and compensation method) - Characteristic values of sinusoidal alternating quantities, moving iron instrument, alternating voltage bridge - Measuring signals, dynamic characteristic functions and characteristics, transfer functions (frequency responses) - Digitalisation chain, time and value discretization, aliasing, Shannon's sampling theorem, filter, operational amplifier (inverting amplifier, non-inverting amplifier, impedance converter, inverting summing amplifier, differential amplifier, integrating amplifier, differentiating amplifier, instrumentation amplifier), sample-and-hold device, analogue-digital conversion, errors of analogue-to-digital conversion - Universal measuring devices (digital multimeter, analogue and digital oscilloscopes) **Measurement of optical quantities:** Light and properties of light - Sensitivity spectra of the eye - Radiometry and photometry - SI base unit candela (cd, luminous intensity) - Radiant flux, radiometric (photometric) fundamental law, photometric and radiometric quantities - Radiation laws - Photo detectors (photo resistors, photo diodes, modes of operation, designs, CCD and CMOS sensors) •**Measurement of temperatures:** Temperature, SI base unit Kelvin, definition, heat transfer (conduction, convection, radiation) - Thermodynamic temperature - Primary and secondary temperature measurement methods, practical temperature scales, fixpoints (triple points, freezing points), fixpoint cells, classical temperature scales, International Temperature Scale (ITS-90) - Contact thermometers, thermal measurement errors, thermal expansion, gas thermometer, liquid thermometer, bimetal thermometer, metal resistance thermometers (characteristic curve, accuracy, designs, circuits), thermocouples (Seebeck effect, designs, extension wires, measurement circuits) – Radiation thermometer (principle, radiation laws, pyrometers, measurement errors) • **Time and frequency:** SI base unit second, time measurement (tasks, history, mechanical clocks, quartz clock, atomic clock) - Representation of time - Propagation of UTC - Global Positioning System (GPS) - Frequency and phase angle measurement Length: SI base unit metre - Calliper, Abbe comparator principle, micrometer, errors 1st and 2nd order - Length measurement with linear encoders (motion direction, output signals, differential signals, demodulation) - Absolute coding (V-Scan and Gray code) - Interferometry, Michelson interferometer, transversal electromagnetic waves, basics of interference, destructive and constructive interference, homodyne principle, heterodyne principle, interference on homodyne interferometer, demodulation at homodyne and heterodyne interferometer, influence of air refractive index, realisation of the metre definition, reflectors and

		assembly of interferometers, inductive length measurement, capacitive length measurement, time of flight measurement • **Mass, force and torque:** SI - base unit kilogram, definition of mass, force and torque - Mass standards (comparisons, types, deviation limits), principle of mass dissemination, stability of the unit and redefinition - Measurement principles of weighing, influences for mass determination (local gravitational acceleration, air buoyancy), beam balance (hanging pan balances, sensitivity, types, top pan balances, corner load sensitivity), spring balance, DMS, deformation elements, DMS balance, EMC balance, mass comparators - Measurement of torque (reactive and active) **Branches of industrial metrology** • **Process measurement technology:** Quantities of process measurement technology - Definition of pressure, pressure types (absolute pressure, overpressure, differential pressure) - Deadweight tester (piston manometer), U-tube manometer and barometer, bourdon tube gauge, diaphragm pressure gauge - Pressure sensors (with DMS, piezoresistive, capacitive, piezoelectric) - Flow measurement (volume flow and mass flow, flow of fluids) - Volumetric method, differential pressure method, magneto-inductive flowmeter, ultrasonic flow measurement - Mass flow rate measurement (Coriolis, thermal) • **Manufacturing metrology:** Tasks, methods, objectives and branches of manufacturing metrology - Form parameters of workpieces (micro-and macro-shape), geometrical product specification (GPS), geometrical tolerances - Comparison of classical manufacturing metrology and coordinate metrology, evaluation - Designs and basic structure of coordinate measuring machines - Procedure for measuring with a coordinate measuring machine
6	**Learning targets and skills**	•The students know basic statistical methods for the evaluation of measurement results and the determination of measurement uncertainties. •The students know basic measuring methods for the record of measured values for all SI units. •The students have basic knowledge of fundamentals of metrology and metrology activities. • The students have fundamental knowledge for methodological and operational approach to measuring tasks of static measurement types, to solve basic measurement tasks and to establishingmeasurement results from measurement values. **Understanding** • The students are able to describe the characteristics of measuring instruments and measurement processes. • The students are able to describe the international system of units (SI) and the traceability of measurement results **Applying** •The students are able to run basic measurements of static measurands. Evaluating •The students are able to evaluate measuring systems, measurement processes and measurement results.

		•Students are able to calculate the measurement uncertainty of complex measuring systems for given input variables.
7	**Suggested prerequisites**	• Knowledge of physics, mathematics and statistics • Lecture notes will be available for download on the learning platform StudOn (www.studon.uni-erlangen.de). The password will be disclosed in the first lecture.
8	**Integration in curriculum**	Semester 2 (summer semester)
9	**Module application**	– Bachelor IP, compulsory module – Module for incoming students (basic level)
10	**Method of examination**	Lecture and Exercise: written examination, 60 min.
11	**Grading procedure**	Written examination
12	**Course frequency**	Annual
13	**Work load**	Attendance: 60 h (= 4 SWS) Self-study: 90 h
14	**Duration**	1 Semester
15	**Lecture language**	Bilingual English/German
16	**Recommended literature**	Internationales Wörterbuch der Metrologie; Hrsg. DIN Deutsches Institut für Normung; Beuth-Verlag, Berlin 1994 Hoffmann, J.: Taschenbuch der Messtechnik, Carl Hanser Verlag, München 2004 Profos, P.; Pfeifer, T.: Handbuch der industriellen Messtechnik, Oldenbourg-Verlag, München, 2002 Bucher, J.: The Metrology Handbook, ASQ Quality Press, Milwaukee, 2004

2.3 Quality Management

1	**Module description**	**Quality Management**	**5 ECTS**
2	Course	SS: Quality Management	5 ECTS
3	Lecturers	Prof. Dr.-Ing. habil. Tino Hausotte	

4	**Head of module**	Prof. Dr.-Ing. habil. Tino Hausotte
5	**Contents**	Quality management I – quality techniques for product development • objectives, principles and strategies of process-oriented quality management, responsibility for quality, • basic and general tools of quality management and techniques within the product development • practice of quality management systems in requirements, structure and implementation Quality management II – cross stage quality management • Standard-conform design, certification, accreditation and auditing of quality management systems • Business excellence, total-quality management and continuous improvement process in industrial enterprises • Interdependencies of quality management with law, safety, environment, economy and software Advanced Seminar on International and Sustainable Production • Presentation of a topic in the field "International and Sustainable Production" (in english language) • Discussion about other students' presentations
6	**Learning targets and skills**	**Learning targets** - Basic knowledge, strategy and targets of process-oriented quality management - requirements to set up, implement and review a quality system - Business excellence, total- quality management and continuous improvement process in a company - Knowledge of quality management as a company- and product-lifecycle-oriented strategy for the production **Skills** - Selection and use of basic tools and phase-related techniques of quality management - Deficit and situation detection, deriving from principles of action with regard to motivation and organizational improvement, problem-solving and conflict resolution - Communication skills in English terminology
7	**Suggested prerequisites**	Lecture notes will be available for download on the learning plattform StudOn (www.studon.uni-erlangen.de). The password will be disclosed in the first lecture. For QM II:

		• Attendance at the course *Quality Management I - Quality Techniques for Product Development and Manufacturing* (QM I) is recommended. • Lecture notes will be available for download on the learning plattform StudOn (www.studon.uni-erlangen.de). The password will be disclosed in the first lecture.
8	**Integration in curriculum**	Semester 4 (summer semester)
9	**Module application**	– Bachelor IP, compulsory module – Module for incoming students (basic level)
10	**Method of examination**	Lecture and Exercise: written examination, 120 min.
11	**Grading procedure**	Written examination
12	**Course frequency**	Annual
13	**Work load**	Attendance: 60 h (= 4 SWS) Self-study: 90 h
14	**Duration**	2 Semester
15	**Lecture language**	Bilingual English/German
16	**Recommended literature**	DGQ e.V. (Hrsg.): DGQ-Schrift 11-04: Managementsysteme Begriffe, Beuth Verlag, Berlin 2002 DIN (Hrsg.): Internationales Wörterbuch der Metrologie, Beuth-Verlag, Berlin 1994 Masing, W.: Handbuch Qualitätsmanagement, Carl Hanser Verlag, München 2007 Weckenmann, A.; Gawande, B.: Koordinatenmeßtechnik, Carl Hanser Verlag, München 1999 Bauer, J. E.; Duffy, G. L.; Westcott, R. T.: The Quality Improvement Handbook, ASQ Quality Press, Milwaukee, 2006 Curtis, M. A.: Handbook of dimensional measurement, Industrial Press, New York 2007

2.4 Advanced Seminar on International and Sustainable Production

1	**Module description**	**Advanced Seminar on International and Sustainable Production**	**2,5 ECTS**
2	Course	WS and SS: “Advanced Seminar on International and Sustainable Production” (2 SWS)	2,5 ECTS
3	Lecturers	Prof. Dr.-Ing. Nico Hanenkamp e.a.	

4	**Head of module**	Nico Hanenkamp
5	**Contents**	- Presentation of a topic in the field "International and Sustainable Production" (in english language) - Discussion about other students' presentations
6	**Learning targets and skills**	Students can solve a problem with scientific methods independently within a specified period and display the results properly in a presentation, usually in English.
7	**Suggested prerequisites**	See examinations regulations
8	**Integration in curriculum**	Semester 4 (summer semester)
9	**Module application**	– Bachelor IP, compulsory module – Module for incoming students (advanced level)
10	**Method of examination**	Graded course achievement
11	**Grading procedure**	Overall grade of presentation and written paper
12	**Course frequency**	Every semester
13	**Work load**	Attendance: 30h (= 2 SWS) Preparation of presentation: 45h
14	**Duration**	1 Semester
15	**Lecture language**	English
16	**Recommended literature**	

2.5 Laser Technology

1	**Module description**	Laser Technology	**5,0 ECTS**
2	Course	WS: Lecture: Laser Technology	5,0 ECTS
3	Lecturers	Prof. Dr.-Ing. Michael Schmidt	

4	**Head of module**	Michael Schmidt
5	**Contents**	- Physical phenomena applicable in Laser Technology: EM waves, Beam Propagation, Beam Interaction with matter - Fundamentals of Laser Technology: Principals of laser radiation, types and theoretical understanding of various types of lasers - Laser Safety and common applications: Metrology, Laser cutting, Laser welding, Surface treatment, - Additive Manufacturing - Introduction to ultra-fast laser technologies - Numerical exercises related to above mentioned topics - Demonstration of laser applications at Institute of Photonic Technologies (LPT) and Bavarian Laser Centre (blz GmbH) - Possible Industrial visit (e.g. Trumpf GmbH, Stuttgart) - Optional: invited lecture about a novel laser application
6	**Learning targets and skills**	- would know the fundamental principles involved in the development of lasers. - will understand the design and functionality of various types of lasers, and be able to comprehend laser specifications. - will be able to design and analyse a free space laser beam propagation setup. - will gain knowledge about basic optical components used in laser setups such lenses, mirrors, polarizers, etc. - would be able to understand the basic interaction phenomena during laser-matter interaction processes. - would be able to determine the advantages and disadvantages of using laser process for industrial applications. - will know and be able to apply the safety principles while handling laser setups. - will be familiar with several most common industrial application of laser for material processing such - as cutting, welding, material ablation, additive manufacturing. - will be familiar with metrological applications of lasers. - will become familiar with and be able to use international (English) professional terminology.

7	**Suggested prerequisites**	
8	**Integration in curriculum**	Semester 5 (winter semester)
9	**Module application**	– Bachelor IP, International Elective Module – Module for incoming students (advanced level)
10	**Method of examination**	Written examination 120 min.
11	**Grading procedure**	Written examination
12	**Course frequency**	Annual
13	**Work load**	Attendance: 60 h Self-study: 90 h
14	**Duration**	1 Semester WS
15	**Lecture language**	English
16	**Recommended literature**	

2.6 Engineering of Solid State Lasers

1	**Module description**	**Engineering of Solid State Lasers**	**2,5 ECTS**
2	Course	SS: Lecture Engineering of Solid State Lasers	2,5 ECTS
3	Lecturers	Prof. Dr.-Ing. Michael Schmidt, Prof. Dr.-Ing. Christoph Plaum	

4	**Head of module**	Michael Schmidt
5	**Contents**	The targeted audience is master level students who are interested in expanding their theoretical and practical knowledge in the field of solid state laser engineering. - Introduction to physical phenomena used in development of modern solid state lasers - Practical approaches used in design of solid state lasers - Introduction to modeling and simulation of the lasing process - Modeling of basic solid state laser performance using a commercial software package - Practical familiarization with various optical, opto-mechnical, and opto-electrical components used - in solid state laser
6	**Learning targets and skills**	The students gain the following competences: - Setting up basic modeling of a solid state laser using ASLD software - Be able to apply modeling for evaluation of performance of a basic laser system - Apply basic optimization of the laser system model - Identification of an appropriate laser system for a given application - Performing basic characterization of laser beam output parameters - Enhanced understanding of the laser physics - Familiarization with modern design approaches used in solid state laser engineering - Improved understanding of linear and nonlinear effects relevant for linear and nonlinear laser beam - propagation;
7	**Suggested prerequisites**	
8	**Integration in curriculum**	Semester 4 (summer semester)
9	**Module application**	– Bachelor IP, International Elective Module – Module for incoming students (advanced level)
10	**Method of examination**	Written examination
11	**Grading procedure**	Written examination
12	**Course frequency**	Annual

13	**Work load**	Attendance: 30 h Self-study: 45 h
14	**Duration**	1 Semester
15	**Lecture language**	English
16	**Recommended literature**	

2.7 Integrated Production Systems (e-learning course)

1	**Module description**	**Integrated Production Systems (Lean Management)**	**5,0 ECTS**
2	Course	WS or SS: “Integrated Production Systems” (e-learning course at vhb)	5,0 ECTS
3	Lecturers	Prof. Dr.-Ing. Jörg Franke	

4	**Head of module**	Prof. Dr.-Ing. Jörg Franke
5	**Contents**	• Concepts and success factors of integrated production systems • Organization of production systems through the ages • The principle of Lean Production (Toyota Production System) • The 7 types of waste (Muda) in Lean Production • Visual management as a management and leadership tool • Demand leveling as a basis for stable processes • Process synchronization as a basis for capacity utilization • Kanban / pull principle as material control mechanism • Empowerment and Teamwork • Lean Automation – “Autonomation " • Zero-defects with Poka Yoke • Total Productive Maintenance • Value stream analysis and value stream design • Workplace optimization (lean manufacturing cells, U-Shape, Cardboard Engineering) • OEE analysis to increase efficiency • Fast exchange of dies (SMED) • Implementation and management of continuous improvement process (CIP, Kaizen) • Overview of quality management systems (e.g. Six Sigma, TQM, EFQM, ISO9000/TS16949) and analysis tools for process analysis and improvement (DMAIC, Taguchi, Ishigawa) • Waste in administrative processes • Specific configurations of the Toyota Production System (e.g. for flexible small-series production) and appropriate implementation in selected international companies
6	**Learning targets and skills**	Due to the technical synthesis of theory and industrial practice, the students receive an overview on "Integrated Production Systems". An orientation and preparation for working in the industry is achieved by the presentation of lean organizational principles, procedures and processes in a manufacturing plant, and its hands-on implementation in planning games.
7	**Suggested prerequisites**	Production Technology 1 + 2 Business Administration for Engineers **Registration via vhb (www.vhb.org) is necessary in order to gain access to the StudOn course.**
8	**Integration in curriculum**	Course at vhb (virtual university Bavaria) in winter or summer semester

9	**Module application**	– Bachelor IP, International Elective Module – Module for incoming students (advanced level)
10	**Method of examination**	Written examination, 90 min.
11	**Grading procedure**	Written examination
12	**Course frequency**	Annual
13	**Work load**	Attendance: 60 h (= 4 SWS) Self-study: 90 h
14	**Duration**	1 Semester
15	**Lecture language**	Bilingual English/German
16	**Recommended literature**	Not required

2.8 International Supply Chain Management (e-learning course)

1	**Module description**	**International Supply Chain Management**	**5 ECTS**
2	Course	WS or SS: “International Supply Chain Management” (e-learning course at vhb)	5 ECTS
3	Lecturers	Prof. Dr.-Ing. Jörg Franke	

4	**Head of module**	Prof. Dr.-Ing. Jörg Franke
5	**Contents**	The virtual course intents to give an overview on the main tasks of a supply chain manager in an international working environment: - Goals and tasks - Methods and tools - International environment - Knowledge and experience of industrial practice - Cutting edge research on SCM Topics of the course are: - Integrated logistics, procurement, materials management and production - Material inventory and material requirements in the enterprise - Analysis of cost reduction in materials management - Management of procurement and purchasing - Procurement strategies - Warehouse management, picking systems, in-plant material handling, packaging - Distribution logistics, global tracking and tracing - Modes of transport in international logistics - Disposal logistics - Logistics controlling - Global logistic structures and value chains - IT systems in supply chain management - Sustainable global structures of production and logistics - Summary For practical training, 3 additional Case Studies are executed as part of the course.
6	**Learning targets and skills**	Students get an overview of the profession of an international supply chain manager: - objectives and tasks - methods and tools - international environment - experience and knowledge of the industrial practice - and an overview of the status of science in the area of SCM.
7	**Suggested prerequisites**	Production Technology 1 + 2 Course at vhb (virtual university Bavaria) in winter and summer semester **Registration via vhb (www.vhb.org) is necessary in order to gain access to the StudOn course.**
8	**Integration in curriculum**	Course at vhb (virtual university Bavaria) in winter or summer semester

9	**Module application**	– Bachelor IP, International Elective Module – Module for incoming students (advanced level)
10	**Method of examination**	Written examination, 120 min
11	**Grading procedure**	Written examination
12	**Course frequency**	Every semester
13	**Work load**	Attendance: 60 h Self-study: 90 h
14	**Duration**	1 Semester
15	**Lecture language**	English
16	**Recommended literature**	Not required

2.9 Introduction to the Finite Element Method

1	**Module description**	**Introduction to the Finite Element Method**	**5,0 ECTS**
2	Course	SS: "Introduction to the Finite Element Method" (4 SWS)	5,0 ECTS
3	Lecturers	Dr.-Ing. Sebastian Pfaller	

4	**Head of module**	Sebastian Pfaller
5	**Contents**	• Basic concept of the finite element method • Application of the finite element method for the analysis trusses • Application of the finite element method for the analysis of frames and structures • Finite element method in heat transfer • Finite element method in elasticity • Finite element method in electrostatics
6	**Learning targets and skills**	The students • are familiar with the basic concept of the finite element method • are able to model linear problems in elasticity • are able to model linear problems in heat transfer • are familiar with the isoparametric concept • know different methods for numerical integration • know how to discretize and solve problems in continuum mechanics • can derive weak and discrete representations of boundary value problems
7	**Suggested prerequisites**	Basic knowledge of Mathematics
8	**Integration in curriculum**	Semester 6 (summer semester)
9	**Module application**	– Bachelor IP, International Elective Module – Module for incoming students (advanced level)
10	**Method of examination**	Written examination 60 minutes
11	**Grading procedure**	Written examination
12	**Course frequency**	Annual
13	**Work load**	Attendance: 60 h (= 4 SWS) Self-study: 90 h
14	**Duration**	1 Semester
15	**Lecture language**	English
16	**Recommended literature**	

2.10 Nonlinear Finite Elements

1	**Module description**	**Nonlinear Finite Elements**	**5,0 ECTS**
2	Course	WS: Lecture “Nonlinear Finite Elements” (4 SWS)	5,0 ECTS
3	Lecturers	Dr.-Ing. Sebastian Pfaller, Dominic Soldner	

4	**Head of module**	Sebastian Pfaller
5	**Contents**	- basics of nonlinear continuum mechanics - geometric and material nonlinearities - weak form in material and spatial formulation and its discretization - consistent linearization - iterative solvers for nonlinear problems - solvers for transient problems - discontinuous finite elements
6	**Learning targets and skills**	The students - are familiar with the basics of nonlinear continuum mechanics - are familiar with the ideas of nonlinear finite elements - can derive the discretized - know adequate solution methods for nonlinear problems - know solvers for transient problems
7	**Suggested prerequisites**	Basic knowledge in continuum mechanics and finite elements
8	**Integration in curriculum**	Semester 5 (winter semester)
9	**Module application**	– Bachelor IP, International Elective Module – Module for incoming students (advanced level)
10	**Method of examination**	Oral examination, 30 min or Written examination, 120 min.
11	**Grading procedure**	Written or oral examination
12	**Course frequency**	Annual
13	**Work load**	Attendance: 60 h (= 4 SWS) Self-study: 90 h
14	**Duration**	1 Semester
15	**Lecture language**	German/ English by arrangement
16	**Recommended literature**	Wriggers: Nichtlineare Finite Element Methoden, Springer 2001 Crisfield: Non-linear Finite Element Analysis of Solids and Structures, Wiley, 2003

2.11 Computational Dynamics

1	**Module description**	**Computational Dynamics**	**5,0 ECTS**
2	Course	WS : Lecture “Computational Dynamics” (4 SWS) Computational Dynamics: Tutorial	5,0 ECTS
3	Lecturers	Landkammer	

4	**Head of module**	Paul Steinmann
5	**Contents**	• Introduction to the Finite Element Method • Balance equations for dynamic analyses • Direct integral methods • Mode Superposition • Analysis of direct integral method • Solution of nonlinear equations • Solution of nonstructural problems
6	**Learning targets and skills**	The students • are familiar with the basic idea of the linear finite element method • know how to derive the weak and the discretized form of a given time-dependent differential equation • know how to derive the equations of motion • know how to formulate thermal problems • know how to formulate continuum mechanical problems • are familiar with direct time integration methods • are familiar with eigenvalue problems and stability analysis of various time integration methods • know how to solve time-dependent differential equations
7	**Suggested prerequisites**	Dynamics
8	**Integration in curriculum**	Semester 3 (winter semester)
9	**Module application**	– Bachelor IP, International Elective Module – Module for incoming students (advanced level)
10	**Method of examination**	written exam (90 minutes)
11	**Grading procedure**	100% written exam
12	**Course frequency**	Annual
13	**Work load**	Attendance: 60 h (= 4 SWS) Self-study: 90 h
14	**Duration**	1 Semester
15	**Lecture language**	English
16	**Recommended literature**	• Bathe: Finite Element Procedures, Prentice Hall 1995. • Bathe: Finite-Elemente-Methoden, Springer 2002.

2.12 Linear Continuum Mechanics

1	**Module description**	**Linear Continuum Mechanics**	**5,0 ECTS**
2	Course	WS: Lecture “Linear Continuum Mechanics” (2 SWS) Exercise “Exercises Linear Continuum Mechanics “ (2 SWS) Tutorial “Tutorial Linear Continuum Mechanics” (2 SWS)	5,0 ECTS
3	Lecturers	Prof. Dr.-Ing. Paul Steinmann, Jan Friederich	

4	**Head of module**	Prof. Dr.-Ing. Paul Steinmann
5	**Contents**	*Foundations of geometric linear continuum mechanics* • Kinematics • Stress tensor • Balance equations *Application to elastic problems* • Constitutive equations • Variational principles
6	**Learning targets and skills**	Continuum mechanics is a key discipline in the field of engineering mechanics and conveys a basic understanding on the strength of materials when designing structural components. Therefore, the lecture aims to clarify the fundamentals of linear continuum mechanics following a modern approach based on the use of tensor analysis and algebra. This lecture is a sequel to the basic knowledge acquired in lecture sessions of ’Engineering statics (Technische Mechanik) and serves as an ideal addendum for a first course in the finite element method.
7	**Suggested prerequisites**	Knowledge of the Module *"Statics, Elastostatics and Strength of Material"*
8	**Integration in curriculum**	Semester 5 (winter semester)
9	**Module application**	– Bachelor IP, International Elective Module – Module for incoming students (advanced level)
10	**Method of examination**	written exam (90 minutes)
11	**Grading procedure**	100% written exam
12	**Course frequency**	Annual
13	**Work load**	Attendance: 60 h (= 4 SWS) Self-study: 90 h
14	**Duration**	1 Semester
15	**Lecture language**	German/ English by arrangement

16	**Recommended literature**	• Malvern: Introduction to the Mechanics of a Continuous Medium, Prentice-Hall 1969 • Gurtin: An Introduction to Continuum Mechanics, Academic Press 1981 • Bonet, Wood: Nonlinear Continuum Mechanics for Finite Element Analysis, Cambridge University Press 1997 • Holzapfel: Nonlinear Solid Mechanics, Wiley 2000

2.13 Nonlinear Continuum Mechanics

1	**Module description**	**Nonlinear Continuum Mechanics**	**5,0 ECTS**
2	Course	SS: Lecture “Nonlinear Continuum Mechanics” (2 SWS) Exercise “Exercises Nonlinear Continuum Mechanics “ (2 SWS)	5,0 ECTS
3	Lecturers	Prof. Dr.-Ing. Paul Steinmann, Dominic Soldner	

4	**Head of module**	Prof. Dr.-Ing. Paul Steinmann
5	**Contents**	Kinematics • Displacement and deformation gradient • Field variables and material (time) derivatives • Lagrangian and Eulerian framework Balance equations • Stress tensors in the reference and the current configuration • Derivation of balance equations • Constitutive equations • Basic requirements, frame indifference • Elastic material behavious, Neo-Hooke Variational formulation and solution by the finite element method • Linearization • Discretization • Newton method
6	**Learning targets and skills**	The students • obtain profound knowledge on the description of field variables in non-linear continuum theory • know the relation/transformation between the Lagrangian and the Eulerian framework • are able to derive constitutive equations for elastic materials on the basis of thermodynamic assumptions • are familiar with the basic concept of variational formulations and how to solve them within a finite element framework
7	**Suggested prerequisites**	Knowledge of the Module *"Statics, Elastostatics and Strength of Material"*
8	**Integration in curriculum**	Semester 4 (summer semester)
9	**Module application**	– Bachelor IP, International Elective Module – Module for incoming students (advanced level)
10	**Method of examination**	written exam (90 minutes)
11	**Grading procedure**	100% written exam
12	**Course frequency**	Annual
13	**Work load**	Attendance: 60 h (= 4 SWS) Self-study: 90 h

14	**Duration**	1 Semester
15	**Lecture language**	German/ English by arrangement
16	**Recommended literature**	• Betten: Kontinuumsmechanik, Berlin: Springer 1993 • Altenbach, Altenbach: Einführung in die Kontinuumsmechanik, Stuttgart: Teubner 1994

3 Management (bachelor level)

3.1 Innovation

1	**Module description**	**Innovation & Entrepreneurship I**	**5 ECTS**
2	Course	SS: V: Innovation (2 SWS) Ü: Innovation (2 SWS)	2,5 ECTS 2,5 ECTS
3	Lecturers	Prof. Dr. Voigt	

4	**Head of module**	Prof. Dr. Voigt
5	**Contents**	The lecture and exercise deal with the most important fundamentals of technology and innovation management. The first part of the lecture deals with technologies in general as well as their analysis, assessment, and utilization. The second part on innovation management deals with a general introduction in the field of innovation and shows the components of the innovation process from idea management to product and process management, process development and ramp-up up to the final market launch. The exercise includes guest lectures by external industry experts and case studies on technology and innovation management.
6	**Learning targets and skills**	The students have a broad and integrated knowledge including the scientific basis for technology management and, in particular, methods of technology assessment. In addition, they are able to apply these methods. Students have relevant knowledge about the importance of innovation as a competitive advantage and about the organization of the innovation process as well as the interfaces to technology management. On both topics, students are able to retrieve their knowledge and, supplemented by examples, to express their knowledge in own words. Students can apply basic methods of technology and innovation management to new questions.
7	**Suggested prerequisites**	None
8	**Integration in curriculum**	Semester 4 (summer semester)
9	**Module application**	– Bachelor IP, International Elective Module – Module for incoming students (advanced level)
10	**Method of examination**	Written examination (90 Min., incl. multiple-choice questions)
11	**Grading procedure**	Written examination
12	**Course frequency**	Annual
13	**Work load**	Attendance: 60 h (= 4 SWS) Self-study: 90 h
14	**Module duration**	1 Semester
15	**Lecture language**	Bilingual English-German
16	**Recommended literature**	Voigt, K.-I.: Industrielles Management, Berlin 2008 Hauschildt, J. & Salomo, S.: Innovationsmanagement, München 2007 Gerpott, T.: Strategisches Technologie- und

		Innovationsmanagement, Stuttgart 2005

3.2 Sustainability Management: Issues, Concepts and Tools

1	**Module description**	**Sustainability management: Issues, Concepts and tools**	**5 ECTS**
2	Course	WS: V: Sustainability management: Issues, concepts and tools (2 SWS)	5 ECTS
3	Lecturers	Prof. Dr. Beckmann	

4	**Head of module**	Prof. Dr. Beckmann
5	**Contents**	Sustainability management is a multi-facetted concept that encompasses many topics and issues. These range from climate change to the fight against poverty. The purpose of this lecture is to gain a deeper understanding of such critical issues in sustainability management. To this end, the lecture does not only shed light on selected sustainability trends and the background of these challenges. More importantly, the course also aims at a systematic understanding of relevant management tools and novel instruments across all corporate functions to cope with these sustainability issues. The three sustainability issues addressed in this class will be climate change, resource scarcity as well as poverty and underdevelopment. For each of these issues, we will first provide background details, their positive and negative consequences as well as on their potential challenges and opportunities for businesses. Following, we will address broader concepts in sustainability management that aim at addressing the sustainability issue. In a third step, we will then introduce concrete tools and instruments that is 'how to' knowledge for implementation. For example, in the case of climate change, we look at the science, politics, economics and effects on companies. We then look at concepts such as "putting a price on carbon" or "decarbonizing value creation". In terms of management instruments, tools such as carbon accounting, carbon compensation, and carbon efficiency measures will be discussed. "Best-practice" and "worst practice" serve to illustrate the practical implementation of these instruments.
6	**Learning targets and skills**	Students - acquire advanced knowledge and skills in corporate sustainability management - learn to relate current societal challenges and trends with corresponding sustainability concepts and management tools in selected problem areas - acquire and advance critical thinking and discursive skills with regard to societal and stakeholder communication - advance their analytical and pragmatic decision - making skills in situations of high complexity - deepen their understanding of the business firm as a problem

		- solving entity
7	**Suggested prerequisites**	None
8	**Integration in curriculum**	Semester 2 (summer semester)
9	**Module application**	– Bachelor IP, International Elective Module – Module for incoming students (advanced level)
10	**Method of examination**	written examination (60 Min., incl. multiple-choice questions)
11	**Grading procedure**	written examination
12	**Course frequency**	Annual
13	**Work load**	Attendance: 30h (= 2 SWS) Preparation of presentation: 45h
14	**Module duration**	1 Semester
15	**Lecture language**	English
16	**Recommended literature**	All necessary materials will be provided via StudOn

3.3 Innovation Strategy III

1	**Module description** WISO1-00200-0	**Innovation strategy III** (Implementing innovation)	**2,5 ECTS**
2	Course	SS: Innovation strategy III (2 SWS)	2,5 ECTS
3	Lecturers	Prof. Dr. Möslein e.a.	

4	**Head of module**	Prof. Möslein
5	**Contents**	The lecture provides essential basics for supporting and designing innovation-oriented corporate and value creation strategies in an international context.
6	**Learning targets and skills**	The students - gain in-depth knowledge of the analysis, support and design of innovation-oriented corporate and value creation strategies, - know the strengths and weaknesses of alternative design concepts, - acquire practical insights into the implementation and methodical support of innovation projects, - acquire key qualifications through group work, - are encouraged to think critically and can give other students valuable feedback.
7	**Suggested prerequisites**	None
8	**Integration in curriculum**	Semester 4 (summer semester)
9	**Module application**	– Master MB/IP, International Elective Module – Module for incoming students (advanced level)
10	**Method of examination**	- Written assignment - Presentation
11	**Grading procedure**	- Written assignment (50 %) - Presentation, partly group work (50 %)
12	**Course frequency**	Annual
13	**Work load**	Attendance: 60 h Self-study: 90 h
14	**Duration**	1 Semester
15	**Lecture language**	English
16	**Recommended literature**	All necessary materials will be provided via StudOn

3.4 Innovation Design

1	**Module description** WISO1-00200-0	**Innovation design** (Implementing innovation)	**2,5 ECTS**
2	Course	WS: Innovation design (2 SWS)	2,5 ECTS
3	Lecturers	Prof. Dr. Möslein e.a.	

4	**Head of module**	Prof. Möslein
5	**Contents**	The lecture provides essential basics for supporting and designing innovation-oriented corporate and value creation strategies in an international context.
6	**Learning targets and skills**	The students - gain in-depth knowledge of the analysis, support and design of innovation-oriented corporate and value creation strategies, - know the strengths and weaknesses of alternative design concepts, - acquire practical insights into the implementation and methodical support of innovation projects, - acquire key qualifications through group work, - are encouraged to think critically and can give other students valuable feedback.
7	**Suggested prerequisites**	None
8	**Integration in curriculum**	Semester 5 (winter semester)
9	**Module application**	– Master MB/IP, International Elective Module – Module for incoming students (advanced level)
10	**Method of examination**	- Written assignment - Presentation
11	**Grading procedure**	- Written assignment (50 %) - Presentation, partly group work (50 %)
12	**Course frequency**	Annual
13	**Work load**	Attendance: 60 h Self-study: 90 h
14	**Duration**	1 Semester
15	**Lecture language**	English
16	**Recommended literature**	All necessary materials will be provided via StudOn

4 Management (Master level)

4.1 Global operations strategy

1	**Module description** MIM-3650	**Global operations strategy**	**5 ECTS**
2	Course	WS: Global operations strategy (Seminar 2 SWS)	5 ECTS
3	Lecturers	Prof. Voigt and research assistants	

4	**Head of module**	Prof. Voigt
5	**Contents**	During the past decades, operations have become increasingly international or even global in nature. Drivers of the globalization include increased competitiveness through offshore manufacturing and global sourcing. During this course, the increasing complexity and the challenges of operations on a global scale will be discussed together with the participants. The theory modules at the beginning of the course structure the options of a general operations strategy and illustrate its implementation in the organization. The subject specific modules, elaborated by the participants in the course, enable a profound understanding of single activity areas of global operations and their relation to the global operations strategy. Therewith the students will get insights in the importance of an integrated global operations strategy and will become familiar with the main strategic options in this field.
6	**Learning targets and skills**	Participation in the first seminar session is mandatory, as the topics for the teamwork are chosen during this session by the participants. In the following weeks, based on own research using scientific sources, key topics are elaborated in teams. Following predefined learning targets, the students need to structure the elaborated content in an academic presentation and present their results in class. Thereby, the teams are responsible for developing a didactic concept in order to support the understanding of the discussed topics. Furthermore, the participants are required to document their research method as well as their results. After the course, the participants are able to discuss the functions and impact of operations management in an international context.
7	**Suggested prerequisites**	none All participants have to register in advance on StudOn! The registration for GOS on StudOn starts mid-September. The number of participants is limited to 60.
8	**Integration in curriculum**	Master semester 1 or 3 (winter semester)
9	**Module application**	– Master MB/IP, International Elective Module – Module for incoming students (advanced level)

10	**Method of examination**	Written examination 60 min. (Klausur, 60 Min.); Presentation (group presentation) (around three to five minutes per participant)
11	**Grading procedure**	Written examination (50%), Presentation (50%)
12	**Course frequency**	Annual
13	**Work load**	Attendance: 30 h Self-study: 120 h
14	**Duration**	1 term
15	**Lecture language**	English
16	**Recommended literature**	Abele, E. et al. (2008): Global Production. A Handbook for Strategy and Implementation. Berlin: Springer. Reid, R. D. & Sanders N. R. (newest ed.): Operations Management. Hoboken: Wiley & Sons. Slack, N. & Lewis, M. (newest ed.): Operations Strategy. Harlow: PrenticeHall.

4.2 Technology and innovation management

1	**Module description** MIM-3450	**Technology and innovation management**	**5 ECTS**
2	Course	SS: V/Ü: Technology and innovation management (3 SWS)	5 ECTS
3	Lecturers	Prof. Voigt e.a.	

4	**Head of module**	Prof. Voigt
5	**Contents**	Technologies and innovations are important success factors for most companies. This course is about theories, concepts and tools of technology and innovation management. Special topics are e.g. economic decisions in the field of technology management or disruptive technological change, success factors of innovations, the design of innovation processes, timing strategies, open innovation approaches and business model innovation. Lecture contents are presented from a theoretical as well as a practical perspective.
6	**Learning targets and skills**	In this module, students acquire a comprehensive, detailed and specialized knowledge as well as the current state of knowledge in the field of technology and innovation management. Students know the importance of technology and innovation as a competitive advantage for industrial and service companies. Numerous examples illustrate the practical application. Students are able to transfer and to apply their knowledge to new concrete practical problems. Students can thus assess facts in the field of technology and innovation management and question them critically. The acquired analytical and conceptual skills enable students to independently deal with complex economic problems and to apply methods and structuring approaches successfully to overcome diverse tasks in the field of technology and innovation management.
7	**Suggested prerequisites**	None
8	**Integration in curriculum**	Master Semester 2 (summer semester)
9	**Module application**	– Master MB/IP, International Elective Module – Module for incoming students (advanced level)
10	**Method of examination**	Written examination (90 minutes)
11	**Grading procedure**	Written examination (100%)
12	**Course frequency**	Annual
13	**Work load**	Attendance: 45 h Self-study: 105 h
14	**Duration**	1 Semester
15	**Lecture language**	English and German
16	**Recommended literature**	- Ahmed, P.; Shepherd, C.: Innovation Management – Context, Strategies, systems and processes, Pearson, Essex, 2010. - Voigt, K.-I.: Industrielles Management, 1. Aufl., Berlin u. a., 2008.

4.3 Advanced Service Management

1	**Module description** IIS-3750	**Advanced Service Management**	**5 ECTS**
2	Course	SS: Lecture: Advanced Service Management Excercise: Advanced Service Management	2,5 ECTS 2,5 ECTS
3	Lecturers	Prof. Dr. Bodendorf and assistants	

4	**Head of module**	Prof. Dr. Bodendorf
5	**Contents**	**Lecture and exercise:** This course consists of two parts. Part one of the course provides an overview of service science. Characteristics of service design, production, and deployment are presented. The second part focuses on service businesses, such as finance, commerce, logistics, tourism, education, entertainment, healthcare and industrial services. Digital products and value added services are discussed as well as service engineering and service technologies (e.g., self service systems, multimedia, and security Systems).
6	**Learning targets and skills**	The students - can plan and develop services, as well as independently utilize ITaided methods to create services. - understand the special requirements of different industries and develop service concepts on this basis. - discuss problem solving approaches in groups and present their work results
7	**Suggested prerequisites**	none
8	**Integration in curriculum**	Master Semester 2 (summer semester)
9	**Module application**	– Master MB/IP, International Elective Module – Module for incoming students (advanced level)
10	**Method of examination**	Written examination 90 minutes
11	**Grading procedure**	100 % of exam score
12	**Course frequency**	Annual
13	**Work load**	Attendance: 60 h (= 4 SWS) Self-study: 90 h
14	**Duration**	1 Semester
15	**Lecture language**	English
16	**Recommended literature**	All relevant material will be provided during the lecture

4.4 Advanced Process Management

1	**Module description** IIS-3750	**Advanced process management**	**5 ECTS**
2	Course	WS: Lecture: Advanced Process Management Exercise: Advanced Process Management	2,5 ECTS 2,5 ECTS
3	Lecturers	Prof. Dr. Bodendorf and assistants	

4	**Head of module**	Prof. Dr. Bodendorf
5	**Contents**	**Lecture and Exercise:** This course is about strategic business process planning and business IT alignment. Additionally, it covers business process analysis, planning, engineering, monitoring and controlling. Furthermore, it provides a comprehensive understanding of workflow management systems, service-oriented architectures, intelligent agents and assistants as well as process portals.
6	**Learning targets and skills**	The students - select suitable process architectures and organizational structures within the scope of business process management. - can model, analyze, and implement (with the aid of IT) complex processes. - independently transfer business process management concepts to new use cases. - solve weekly exercises to deepen the understanding of the lecture content
7	**Suggested prerequisites**	none
8	**Integration in curriculum**	Master 1. or 3. Semester (winter semester)
9	**Module application**	– Master MB/IP, International Elective Module – Module for incoming students (advanced level)
10	**Method of examination**	Portfolio: Lecture: written exam Exercise: home work
11	**Grading procedure**	Written examination 90 minutes
12	**Course frequency**	Annual
13	**Work load**	Attendance: 60 h (= 4 SWS) Self-study: 90 h
14	**Duration**	1 Semester
15	**Lecture language**	English
16	**Recommended literature**	Fundamentals of Business Process Management, Springer, ISBN 978-3-642-33142. For more information see http://www.wi2.fau.de

4.5 Business strategy

1	**Module description** MIM-6280	**Business strategy**	**5,0 ECTS**
2	Course	**WS: Business strategy**	5,0 ECTS
3	Lecturers	Prof. Hungenberg and assistants	

4	**Head of module**	Prof. Hungenberg
5	**Contents**	This course focuses on selected theories, concepts and tools of strategic management. It is concerned with formulation and imple-mentation of strategies, focusing on the business level of strategy. At business level, customer value and competitive advantage are the central issues. The course uses a combination of lectures, discussions and case studies in order to provide the analytic and conceptual foundations for making strategic decisions at business level**.**
6	**Learning targets and skills**	By the end of the course students can appreciate the need for a comprehensive approach to strategy making and they are aware of top management's role in setting the direction of a company. Students develop knowledge of theories, concepts and tools of business strategy and they develop an under standing of the application of concepts and tools to real life cases.
7	**Suggested prerequisites**	None https://www.unternehmensfuehrung.rw.fau.de/studium-lehre/aktuelle-lehre/business-strategy/ Please register via StudOn
8	**Integration in curriculum**	Master Semester 1 (winter semester)
9	**Module application**	– Master MB/IP, International Elective Module – Module for incoming students (advanced level)
10	**Method of examination**	Written examination, 60 min.
11	**Grading procedure**	Written examination (100%) An improvement of the grade at the maximum of 0.3 / 0.4 can be achieved by class participation during the case sessions. The evaluation is based on the quality of statements, case and fact knowledge as well as the ability to reflect on contributions made by other students and the lecturer.
12	**Course frequency**	Annual
13	**Work load**	Attendance: 45 h Self-study: 105 h
14	**Duration**	1 Semester
15	**Lecture language**	Englisch
16	**Recommended literature**	Hungenberg, H.: Strategisches Management in Unternehmen, 8. Ed., Wiesbaden 2014 Dess, G., McNamara, G., Eisner, A.: Strategic management, 8. Ed., Maidenhead 2016

4.6 Change management

1	**Module description** MIM-6280	**Change management**	**5,0 ECTS**
2	Course	**SS: Change management**	5,0 ECTS
3	Lecturers	Prof. Hungenberg and assistants	

4	**Head of module**	Prof. Hungenberg
5	**Contents**	This course focuses on one of the most important management tasks: to achieve change in organizations. It deals with systematic approaches to influence individuals, teams and the organization as a whole in a desired way –in order to develop a company from its current to a future state. The course provides participants with a systematic approach in order to (1) successfully initiate and implement organizational changes and (2) successfully guide an organization through a change process. Participants will be provided with theoretical concepts and practical tools for managing organizational change (e.g. research on cognitive biases, trait theory, motivation theory, affective events theory, emotional intelligence, and organizational ambidexterity).
6	**Learning targets and skills**	At the end of this course, students are familiar with the tasks and challenges of managing change in organizations. The participants develop an understanding of the importance of successful leadership during organizational change as well as evaluate situations, which are related to organizational change.
7	**Suggested prerequisites**	None https://www.unternehmensfuehrung.rw.fau.de/studium/lehre/aktuelle-lehre/change-management/ Please register via StudOn
8	**Integration in curriculum**	Master Semester 3 (winter semester)
9	**Module application**	– Master MB/IP, International Elective Module – Module for incoming students (advanced level)
10	**Method of examination**	Written examination, 60 min.
11	**Grading procedure**	Written examination (100%)
12	**Course frequency**	Annual
13	**Work load**	Attendance: 45 h Self-study: 105 h
14	**Duration**	1 Semester
15	**Lecture language**	Englisch
16	**Recommended literature**	Robbins, S.: Organizational Behavior, 17th ed., Boston 2017. Greenberg, J.: Managing Behavior in Organizations, 6th ed., Boston 2013

4.7 Advanced Sustainability management and corporate functions

1	**Module description** MIM-6280	**Sustainability management and corporate functions**	**5,0 ECTS**
2	Course	WS: Advanced Sustainability management and corporate functions	5,0 ECTS
3	Lecturers	Prof. Dr. Beckmann	

4	**Head of module**	Prof. Dr. Beckmann
5	**Contents**	This lecture provides an advanced perspective on Corporate Sustainability Management. The lecture starts with a short recap about sustainability management basics (What is sustainability? Why is sustainability increasingly important for business? What are key concepts of sustainability management?) Following this brief recap of the concepts of sustainability and sustainability management, we take a closer look at a selective number of corporate functions such as strategy, marketing or supply chain management. For each function, we look at the key drivers for corporate sustainability, relevant management tools, best practice cases, and will discuss risks and opportunities involved for corporate management. Throughout the lecture we will follow the concept of integrated sustainability management, thus the integration of the three pillars of sustainability: economy, natural environment, and society into the core of a business.
6	**Learning targets and skills**	The students - advanced knowledge in sustainability management, especially in the selected functional areas - discursive and reflective competencies in regards to societally relevant questions - practical insights for implementing sustainability in real life applications - insights on potential challenges during the implementation of sustainability management
7	**Suggested prerequisites**	None Please register with StudOn
8	**Integration in curriculum**	Starting from Master Semester 3 (winter semester)
9	**Module application**	– Master MB/IP, International Elective Module – Module for incoming students (advanced level)
10	**Method of examination**	Written examination, 60 min.
11	**Grading procedure**	Written examination

12	**Course frequency**	Annual
13	**Work load**	Attendance: 30 h Self-study: 120 h
14	**Duration**	1 Semester
15	**Lecture language**	Englisch
16	**Recommended literature**	Readings will be provided via StudOn.

4.8 Global Retail Logistics (e-learning course)

1	**Module description** MIM-5291	**Global retail logistics**	**5,0 ECTS**
2	Course	WS or SS V: Global retail logistics (e-learning course at vhb)	5,0 ECTS
3	Lecturers	Prof. Hartmann and associates	

4	**Head of module**	Prof. Hartmann
5	**Contents**	This e-learning course offers specific insights on the logistic processes in the global retail industry. By attending the course, the students should understand the peculiarities of logistics for FMCGs [fast moving consumer goods] better and deeper. Every module consists of a video lecture and script. Additional material and exercises enhance the presented topics further. As the entire lecture, the readings, the additional material and the exam is in English, proficiency in German is not necessary. **Agenda:** □ Module 1: Overview □ Module 2: Characteristics & Basics □ Module 3: Trends & Challenges □ Module 4: POS Logistics □ Module 5: Interfaces □ Module 6: Load units & Transport logistics □ Module 7: Cross Docking □ Module 8: Warehousing & Distribution □ Module 9: Sourcing Challenges in Emerging Markets
6	**Learning targets and skills**	By completing the course, the students will understand the peculiarities of logistics in the retail industry better and deeper. The following learning objectives are anticipated: • Knowledge and understanding of the topic retail logistics and its specific requirements • Understanding of the influence and changes in retail logistics with regard to emerging markets • Based on various practical examples the students understand retail industry specific peculiarities relating to the usage of logistics processes • The students have the ability to apply the relevant methods of planning, control and monitoring of logistics processes in the retail industry • The self-study concept of the course encourages selforganization and -discipline as well as the self-dependent time management of the students
7	**Suggested prerequisites**	Produktions- und Supply Chain Management **Registration via vhb (www.vhb.org) is necessary in order to gain access to the StudOn course.**
8	**Integration in curriculum**	Master Semester 3 (winter semester)

9	**Module application**	– Master MB/IP, International Elective Module – Module for incoming students (advanced level)
10	**Method of examination**	Written examination (partly with MC-questions) (60 min.)
11	**Grading procedure**	Written examination (100%)
12	**Course frequency**	Annual
13	**Work load**	Attendance: 1 h Self-study: 149 h
14	**Duration**	1 Semester
15	**Lecture language**	Englisch
16	**Recommended literature**	John Fernie, Leigh Sparks (2014): Logistics and Retail Management: Emerging Issues and New Challenges in the Retail Supply Chain, 4th ed., Kogan Page. Rajesh Ray (2009): Supply Chain Management for Retailing; TBS. Manfred Krafft, Murali K. Mantrala (2005): Retailing in the 21st Century: Current and Future Trends, Springer. Torben Seiler (2012): Operative Transportation Planning: Solutions in Consumer Goods Supply Chains; Physica. Timm Gudehus & Herbert Kotzab (2012): Comprehensive Logistics, 2nd ed., Springer.

4.9 Designing Technology

1	**Module description IIS7073**	**Designing technology**	**5,0 ECTS**
2	Course	WS: Designing technology	5,0 ECTS
3	Lecturers	Prof. Möslein and colleagues	

4	**Head of module**	Prof. Möslein
5	**Contents**	This course aims to teach students on how to design innovative artifacts to extend human and organizational capabilities, following the design science paradigm. Understanding the design science paradigm and its application will enable students to develop knowledge on the management and use of information technology for managerial purposes and effectively communicate this knowledge. Students will also be introduced to innovation technologies in the context of artificial intelligence and augmented reality that can link and enable different types of innovation technologies across the boundaries of socio-technical systems. They will also be introduced to social and technological theories and literature such as systems theory, communication theory and basics of open innovation and user innovation. Students will use this knowledge on current technologies and theory to work on a (design science) project that solves human or organizational problems. The course requires analytical thinking, where students can identify and clearly articulate problems that they would like to solve and the process of solution finding. While existing technical knowledge from students is welcome, it is not a prerequisite for the course. Students can also contribute by conducting theoretical/empirical research, along with developing IT artifacts. To conclude, the course offers a balance between creativity and scientific thinking, which can be of immense help to students seeking to learn either skill or both.
6	**Learning targets and skills**	The students: • can develop knowledge on the management and use of information technology for managerial purposes • can differentiate between and assess the most important developments on the Web. • develop a research design for a design science project. • discuss theories, as well as the design and the progress of their project.
7	**Suggested prerequisites**	Basic knowledge of web technologies (i.e. basic html or understanding of web technology in general) **or** knowledge of empirical methods to evaluate designed artifacts
8	**Integration in curriculum**	Master semester 3 (winter semester)
9	**Module application**	– Master MB/IP, International Elective Module – Module for incoming students (advanced level)

10	**Method of examination**	Lect/Ex: Research project (70%) and written assignments (30%) (Vorlesung/ Übung: Projektarbeit (70%) und Hausarbeit (30%))
11	**Grading procedure**	Lect/Ex: Research project (70%) and written assignments (30%) (Vorlesung/ Übung: Projektarbeit (70%) und Hausarbeit (30%))
12	**Course frequency**	Annual
13	**Work load**	Attendance: 30 h Self-study: 120 h
14	**Duration**	1 Semester
15	**Lecture language**	Englisch
16	**Recommended literature**	Baldwin, C. Y., & Clark, K. B. (2004). Modularity in the Design of Complex Engineering Systems. In *Complex Engineered Systems Understanding Complex Systems*, 175–205. Kroes, P. (2010). Engineering and the dual nature of technical artefacts. *Cambridge Journal of Economics*, 34 (1), 51–62.Hevner, A. R., March, S. T., Park, J. & Ram, S. (2004). Design Science in Information Systems Research. *MIS Quarterly*: *Management Information Systems*, 28 (1), 75-106. Fichman, R., Dos Santos, B., & Zheng, Z. (2014). Digital Innovation as a Fundamental and Powerful Concept in the Information Systems Curriculum. *MIS Quarterly*: *Management Information Systems,* 38, 329–353.

4.10 Platform strategies

1	**Module description** IIS7110	**Platform strategies**	**5,0 ECTS**
2	Course	WS: Platform strategies	5,0 ECTS
3	Lecturers	Prof. Möslein and colleagues Prof. Srinivasan, guest lecturer from IIMB, India	

4	**Head of module**	Prof. Möslein
5	**Contents**	The course builds on the platform and network aspects in core strategy and aims to highlight the specific strategies for firms operating in multi-sided-markets. The course will cover most relevant concepts around platforms such as network effects, and how network effects impact/ create new business models. Core issues around platform-mediated network firms, such as standards, pricing, envelopment, and competition dynamics will be discussed. The course will be taught through a set of cases that ensures that participants appreciate the multi-dimensional nature of managing in network businesses.
6	**Learning targets and skills**	The students • can identify and unravel the business problem in a case study and actively take part in class discussions • can describe platform intermediation in two sided markets, platform dominance and Winner-takes-all dynamics • can develop strategies for creating platform mediated networks and understand pricing in these businesses
7	**Suggested prerequisites**	None
8	**Integration in curriculum**	Master semester 3 (winter semester)
9	**Module application**	– Master MB/IP, International Elective Module – Module for incoming students (advanced level)
10	**Method of examination**	Project report: Students develop a business plan about a platform business idea Handout: Students develop an essay about a platform of their choice, discuss key concepts encountered during the lectures and apply them to the chosen platform.
11	**Grading procedure**	-Project report (50%) and Handout (50%)
12	**Course frequency**	Annual
13	**Work load**	Attendance: 30 h Self-study: 120 h
14	**Duration**	1 Semester
15	**Lecture language**	English
16	**Recommended literature**	• Klemperer, P. 2005. Network effects and switching costs. In Durlauf, S.N. & Blume, L.E. (Eds.), The new palgrave dictionary of Economics, Palgrave Macmillan.

		• Eisenmann T., Parker, G., & Van Alstyne, M. 2006. Strategies for two-sided markets. Harvard Business Review Oct. 2006. • Hidding, G.J., Williams, J. & Sviokla, J.J. 2011. How platform leaders win, Journal of Business Strategy, 32, 2, 29- 37. • Suarez, F.F. & Kirtley, J. 2012. Dethroning an established platform, MIT Sloan Management Review, Summer 2012. The following books are suggested for the advanced reader on the basics on network economics. • Shy O. 2001. The Economics of Network Industries, Cambridge University Press: Cambridge, England. • Gawer A, Cusumano M. 2002. Platform Leadership: How Intel, Microsoft, and Cisco Drive Industry Innovation. Harvard Business School Press: Boston, MA. • Evans D, Hagiu, A, Schmalensee, R. 2006. Invisible Engines: How Software Platforms Drive Innovation and Transform Industries, MIT Press, Boston, MA. * The cases for each lecture are to be decided.

4.11 Organizing for digital transformation

1	**Module description** IIS-6420	**Organizing for digital transformation**	**5 ECTS**
2	Course	SS: Organizing for digital transformation (4 SWS)	5 ECTS
3	Lecturers	Prof. Dr. Möslein and colleagues	

4	**Head of module**	Prof. Möslein
5	**Contents**	The course focusses on dynamics in organizational transformation driven through information technology (IT) and consists of two parts. The first part introduces the topic from an industrial perspective and explores the re-organization of value streams in the course of the digital transformation. Teaching in this part includes contributions from a German automotive company. Students will work in a project-oriented mode for half the lecture and then present their results. The second part takes the perspective of academic research on the organization of the digital transformation. It introduces different theoretical frameworks to gain a deeper understanding of the phenomenon and explores its implications for global business structures. Students write a short essay to show what they have learned. Together, the lecture allows the students to gain theoretical knowledge on the digital transformation and acquire practical problem-solving skills as well to work effectively on innovative projects in the field.
6	**Learning targets and skills**	The students • are familiar with different theories of works systems and service systems and their practical application • know more about the contribution of information technology in managing complex innovation activities • have an improved understanding of the global IT Industry and various strategies that are used • can identify and unravel the business problem in a case study and actively take part in class discussions
7	**Suggested prerequisites**	None
8	**Integration in curriculum**	Master semester 2 or 4 (summer semester)
9	**Module application**	– Master MB/IP, International Elective Module – Module for incoming students (advanced level)
10	**Method of examination**	Presentation and seminar paper
11	**Grading procedure**	Presentation (30%) and seminar paper (70%)
12	**Course frequency**	Annual

13	**Work load**	Attendance: 60 h Self-study: 90 h
14	**Duration**	1 Semester
15	**Lecture language**	English
16	**Recommended literature**	None

4.12 International Technology Management Research Seminar

1	**Module description**	**International Technology Management Research Seminar**	**5 ECTS**
2	Course	WS or SS: SEM: International Technology Management Research (2 SWS, seminar)	5 ECTS
3	Lecturers	Prof. Dr. Alexander Brem and assistants	

4	**Head of module**	Prof. Dr. Alexander Brem
5	**Contents**	Technology management is an emerging and vibrant research field with a highly interdisciplinary nature. Within this course, current trends will be presented and discussed in an international context. Key concepts will be discussed and applied through course assignments. Furthermore students will learn about research methods and how to conduct scientific work. Importance will be attached to the teaching and improvement of presentation and communication skills. The goal is to deepen the understanding of state-of-the-art technology management approaches, the analysis and critical reflection on scientific literature as well as the presentation of findings and conclusions. Presentations and assignments will be done in (interdisciplinary) group works. This course includes – where applicable – also guest presentations from and discussions with visiting lecturers and industry representatives.
6	**Learning targets and skills**	Students will - attain a familiarity with the selected concepts of technology management, the respective scientific literature and the ability to view these concepts in the context of further research, - understand, reflect and apply their findings from a practical and academic perspective, - be able to conduct comprehensive scientific assignments and apply selected research methods, - improve their research, presentation, communication and team • work skills.
7	**Suggested prerequisites**	Successfully finished course in Technology and/or Innovation Management obligatory (at least bachelor level). The course is limited to 30 students. To ensure interdisciplinary teams, there might be restrictions for students of specific fields of studies. Registration for the seminar is only possible at the information meeting. Location and date for the meeting will be announced via UnivIS and the website of the Chair, as well as further details for the application process.
8	**Integration in curriculum**	Master Semester 2 or later (winter or summer semester) Recommended as preparation course for students interested in writing a master or project thesis at the Chair of Technology

		Management
9	**Module application**	– Master MB/IP, International Elective Module – Module for incoming students (advanced level)
10	**Method of examination**	Seminar Paper and Presentation (in groups)
11	**Grading procedure**	Seminar Paper (50%) and Presentation (50%)
12	**Course frequency**	Annual
13	**Work load**	Attendance 30 h Self-study: 120 h
14	**Duration**	1 Semester
15	**Lecture language**	English
16	**Recommended literature**	Will be announced

4.13 Strategic intellectual property management

1	**Module description** MIM-5370	**Strategic intellectual property management** (Case studies and projects in management VI / (Fallstudien und Projekte im Management VI)	**5 ECTS**
2	Course	WS or SS: Sem: Strategic intellectual property management (2 SWS, seminar)	5 ECTS
3	Lecturers	RA Peter M. Bican	

4	**Head of module**	Prof. Dr. Brem
5	**Contents**	In the contemporary economic environment, intellectual assets like Know-how, inventions, content, brands, trademarks (forms of intellectual property), contractual agreements etc. are the largest proportion of a firm's total wealth. In technology and innovation management, intellectual property rights can guide firms over the life-cycle of an offering and beyond. And yet, most firms do not proactively manage these assets. Focussing on English speaking countries, a "lifecycle" approach to the management of intellectual property rights is adopted, centering the intellectual property rights management at the heart of strategy and innovation management. Key concepts, theory and practice of intellectual property rights management will be investigated through lecture/class discussion and case study examination, covering firms of all sizes, from small start-ups to large multi-national players. The goal is to deepen the understanding of state-of-the-art strategic intellectual property rights management techniques for sustainable business development and commercialization. Groups will work interdisciplinary. This course includes – where applicable – also guest presentations from visiting lecturers/ industry representatives.
6	**Learning targets and skills**	Students will • attain a familiarity with the scientific literature and the ability to connect intellectual property rights with other concepts and theories, eventually embedding intellectual property rights management in the context of technology, marketing, and strategic management, • apply key concepts of strategic intellectual property management in various fields like technology and innovation management, general management, and marketing, • learn to make strategic intellectual property rights decisions as part of an interdisciplinary team (e.g. via assignments)
7	**Suggested prerequisites**	Successfully completed course in technology or innovation management obligatory (at least bachelor level). The course is limited to 50 students. To ensure interdisciplinary teams, there might be restrictions for students of specific fields of studies.

		Registration for the seminar is only possible at the information meeting. Location and date for the meeting will be announced via UnivIS and the website of the Chair, as well as further details for the application process.
8	**Integration in curriculum**	Master Semester 2 or later (winter semester)
9	**Module application**	– Master MB/IP, International Elective Module – Module for incoming students (advanced level)
10	**Method of examination**	Seminar paper and presentation
11	**Grading procedure**	Oral presentation (50%), seminar paper (50%)
12	**Course frequency**	Each semester
13	**Work load**	Attendance 30 h Self-study: 120 h
14	**Duration**	1 Semester
15	**Lecture language**	English
16	**Recommended literature**	Alexander Brem, Petra A. Nylund, and Emma L. Hitchen, (2017) "Open Innovation and Intellectual Property Rights: How do SMEs benefit from Patents, Industrial Designs, Trademarks and Copyrights?", *Management Decision*, 55/6: 1285-1306, https://doi.org/10.1108/MD-04-2016-0223. Peter M. Bican, Carsten Guderian, and Anne Ringbeck, (Accepted for Publication) “Managing Knowledge in Open Innovation Processes: An Intellectual Property Perspective”, *Journal of Knowledge Management*. James G. Conley, Peter M. Bican, and Holger Ernst, (2013) “Value Articulation – A Framework for the Strategic Management of Intellectual Property,” *California Management Review*, 55/4: 102-120. James G. Conley, Peter M. Bican, and Neil Wilkof, (2013) “Study on Patents and the Public Domain (II) - Impact of Certain Enterprise Practices,“ *World Intellectual Property Organization (WIPO) Discussion Paper*, <http://www.wipo.int/edocs/mdocs/mdocs/en/cdip_12/cdip_12_inf_2_rev.pdf>.

4.14 Internet of things and industrial services seminar

1	**Module description IIS-4350**	**Internet of things and industrial services seminar**	**5 ECTS**
2	Course	**WS or SS: SEM: Internet of things and industrial services seminar** (4 SWS, seminar)	5 ECTS
3	Lecturers	Prof. Matzner, Prof. Bodendorf and assistants	

4	**Head of module**	Prof. Bodendorf
5	**Contents**	Cyber-physical Systems (CPS) are physical products that are equipped with embedded hardware and software, that may interact with their environment through sensors and actuators, and that may be networked with remote computers. Examples are modern networked cars and production machines in the smart factory. CPS pave the way for new digital business models based on CPS-enabled service offerings. This seminar addresses the phenomenon of digital industrial services based on cyber-physical systems and the Internet-of-Things.
6	**Learning targets and skills**	The students • will learn about different uses of CPS in digital industrial service systems. • can adopt one of different research methods (literature-study, empirical or design research) in order to address a specific research question or research problem. • will gain theoretical knowledge about digital industrial service systems based on cyber-physical systems and the Internet-of- Thingsas well as relevant technologies in this domain • will train their research, writing, and presentation skills. • will learn how to set up and conduct an IoT project.
7	**Suggested prerequisites**	None
8	**Integration in curriculum**	Master semester 3 or later (winter or summer semester)
9	**Module application**	– Master MB/IP, International Elective Module – Module for incoming students (advanced level)
10	**Method of examination**	Seminar paper (20 ± 5 pages) Final presentation (20 minutes)
11	**Grading procedure**	Seminar paper (70%) Presentation (30%)
12	**Course frequency**	Each semester
13	**Work load**	Attendance: 30 h Self-study: 120 h
14	**Duration**	1 Semester
15	**Lecture language**	English

16	**Recommended literature**	All relevant material will be provided during the seminar.

5 Bachelor Thesis with Advanced Seminar

1	**Module description**	**Bachelor Thesis with Advanced Seminar**	**15,0 ECTS**
2	Course	WS/SS: Bachelor Thesis WS/SS: Advanced Seminar (2 SWS)	12,0 ECTS 3,0 ECTS
3	Lecturers	Lecturers of the department of mechanical engineering	

4	**Head of module**	One Lecturer of the department of mechanical engineering
5	**Contents**	Writing of a bachelor thesis with a presentation within a seminar (in english language)
6	**Learning targets and skills**	• master the basics of scientific work in their field of expertise and are able to work independently on a specific topic • critically examine scientific results and are able to assign them to the respective level of knowledge • are able to apply the relevant basics of research methodology, e.g. collect relevant information • especially in their own field of expertise, work independently on projects, interpret and evaluate • (empirical) data, information, and textsare able to present and discuss complex subject-related content clearly and target group specifically • in written and oral form are able to monitor and control their own progress
7	**Prerequisites**	• Successful completion of the assessment phase (“GOP") • Student obtained at least 110 ECTS
8	**Integration in curriculum**	Semester 6 (winter or summer semester)
9	**Module application**	Bachelor IP, compulsory
10	**Method of examination**	Written work and presentation
11	**Grading procedure**	cumulative grade of written work (12 ECTS) and presentation (3 ECTS)
12	**Course frequency**	Each semester
13	**Work load**	Written work (Bachelor thesis): 360 h Attendance seminar: 30 h (= 2 SWS) Preparation of presentation: 60 h
14	**Duration**	1 Semester
15	**Lecture language**	usually English
16	**Recommended literature**	

6 Project Thesis with Advanced Seminar (Master level)

1	**Module description**	**Project Thesis with Advanced Seminar**	**15,0 ECTS**
2	Course	WS/SS: Project Thesis WS/SS: Advanced Seminar (2 SWS)	12,0 ECTS 3,0 ECTS
3	Lecturers	Lecturers of the department of mechanical engineering	

4	**Head of module**	One Lecturer of the department of mechanical engineering
5	**Contents**	Writing of a project thesis with a presentation within a seminar (in english language)
6	**Learning targets and skills**	Students can write a technical or economic project thesis using scientific methods and can present the results, usually in English.
7	**Suggested prerequisites**	See examination regulations
8	**Integration in curriculum**	Master Semester 3 (winter or summer semester)
9	**Module application**	Master IP, compulsory
10	**Method of examination**	Written work and presentation
11	**Grading procedure**	cumulative grade of written work (12 ECTS) and presentation (3 ECTS)
12	**Course frequency**	Each semester
13	**Work load**	Written work (project thesis): 300 h Attendance seminar: 30 h (= 2 SWS) Preparation of presentation: 60 h
14	**Duration**	1 Semester
15	**Lecture language**	usually English
16	**Recommended literature**	

7 Master Thesis

1	**Module description**	**Master Thesis**	**30,0 ECTS**
2	Course	WS/SS: Master Thesis	30,0 ECTS
3	Lecturers	Lecturers of the department of mechanical engineering	

4	**Head of module**	One Lecturer of the department of mechanical engineering
5	**Contents**	Writing of a Master thesis
6	**Learning targets and skills**	Students can write a technical or economic master thesis using scientific methods, usually in English.
7	**Suggested prerequisites**	See examination regulations
8	**Integration in curriculum**	Master Semester 4 (winter or summer semester)
9	**Module application**	Bachelor IP, compulsory
10	**Method of examination**	Written work
11	**Grading procedure**	cumulative grade of written work (30 ECTS)
12	**Course frequency**	Each semester
13	**Work load**	Written work (master thesis): 900 h
14	**Duration**	1 Semester
15	**Lecture language**	usually English
16	**Recommended literature**	