Module Handbook

Information Technology M. Eng.

As of: 01.07.2017

HOCHSCHULE SRH HEIDELBERG

STAATLICH ANERKANNTE HOCHSCHULE

SRH University Heidelberg, course of studies: Information Technology (Informationstechnik) (M.Eng.)

Module name and module number: **M1 Information and Coding Theory**

This module is applied in the following other programs:

Information Technology (Informationstechnik) (M.Eng.),

5-week block	Frequency	Duration of module	Type *Deviations clarification in the "usability"	ECTSPoints	Student workload Note: Calculation bassis usually 1 ECTS = 25 hours. Deviations are regulated solely in App. 2 (Bachelor) or 2a (Master) of the SPO.
	2x annually	5 weeks	Compulsory subject	8	Workload total 200 h. (100%) Presence 80 h. (40 %) Self-study 100 h. (50 %) Supervisor Contact 20 h. (10 %)

Requirements for Participation	Usability	Form of Examination / Time of Examination	Teaching and Learning Methods	Module Lecturer
B. Engin. degree		1. Student Research Project 2. Written Exam	1. Lecture 2. Exercise 3. Laboratory	

Learning Outcomes

Learning Outcomes Expertise

Upon completion of the course, students will be able to deal with the following components

Information and Coding Theory:
- Explain important theoretical definitions and contexts of source and channel coding.
- Apply information theory descriptions of transmission channels.
- Implement the most important source encoding methods, channel coding methods and line coding methods.

Mathematical and Natural Science Methods I:
- Explain and analyse complex mathematical problems that require knowledge of physical and mathematical models.
- Apply analytical methods for solving differential equations.
- Explain and apply Fourier series, Fourier transformation, Laplace transformation models.

Learning Outcomes Methods Competence

Students can identify and professionally explain practice-relevant requirements for issues of Information and Coding Theory.

They can design and program appropriate software to solve a concrete problem.

Learning Outcomes social skills

Learning outcomes self-competence

Students check their learning progress in reference to the homework issued.

Students decide subsequently in which of the tasks offered they will participate.

Constructive Alignment

Together with Module 2, this module is the mathematical and technical basis for the processing of the subsequent modules.

The content is taught in input sessions, which are then practiced and applied within the following learning session.

Weekly, students receive subject-related homework tasks, of which they must have completed a certain number (academic performance).

This helps the students to self-check their learning success and to prepare for their written examination.

Learning Objectives

Information and Coding Theory:

- Information content, entropy, (Markhoff-) sources, information flow

- Transmission channels, BSC, the BSEC, AWGN, fading channel

- Channel capacity

- Code tree, run length, Huffman, arithmetic, LZW - Coding

- Still image, moving image, audio compression (JPEG, MPEG, MP3)

- ARQ, FEC methods, error detection and error correction

- Hamming code, cyclic code, CRC, BCH, Reed-Solomon codes

- Convolutional code, Viterbi decoder

- Binary and ternary performance codes such as Biphase and HDBn codes

Practical work:

Students test encoders and decoders in MATLAB / Simulink. Modeling, and study the performance based on different source and channel coding methods using MATLAB / Siumlink- simulations.

Mathematical and Natural Science Methods I:

Differential equations and systems of differential equations, Fourier series and FFT; Fourier transformation, Laplace transformation.

Introduction to Matlab and independent solution of mathematical problems of engineering mathematics using a computer.

Recommended reading

Optional Information: Distribution of lecturers in the sessions of this module

Courses		
Lecturer	**Course title within the sepcified module**	**Hours/ week**
	Information and Coding Theory	40
	Mathematical and Natural Sciences Methods	40

SRH University Heidelberg, course of studies: Information Technology (Informationstechnik) (M.Eng.)

Module name and module number: **M2 Transmission Technology**

This module is applied in the following other programs:

5-week block	Frequency	Duration of module	Type *Deviations clarification in the „usability“	ECTS-Points	Student workload Note: Calculation bassis usually 1 ECTS = 25 hours. Deviations are regulated solely in App. 2 (Bachelor) or 2a (Master) of the SPO.		
	2x annually	5 weeks	Compulsory subject	8	Workload total Present time Self-study Carer Contact	200 h. 80 h. 100 h. 20 h.	(100%) (40 %) (50 %) (10 %)

Requirements for Participation	Usability	Form of Examination / Time of Examination	Teaching and Learning Methods	Module Lecturer
B. Engin. degree		1. Student Research Project 2. Written Exam	1. Lecture 2. Exercise 3. Laboratory	

Learning Outcomes

Learning Outcomes Expertise

Upon completion of the course students will be able to:

- Explain and identify optimization and system aspects of telecommunication transmission links including important components.
- Analyse and explain complex mathematical problems that require knowledge of the physical and mathematical foundations.

Learning Outcomes Methods Competence

Students will be able to:

- Apply analytical methods for solving differential equations.
- Use important methods for transmitting in telecommunications networks.
- Perform simulations of transmission methods.

Learning Outcomes Social Skills

Learning Outcomes Self-Competence

Students check their learning progress in reference to the homework issued and decide subsequently in which of the tasks offered they will participate.

Constructive Alignment

Together with Module 1 this module is the mathematical and technical basis for the processing of the subsequent modules.

The content is taught in input sessions which are then practised and applied within the following learning session.

Weekly, students receive subject-related homework tasks, of which they must have completed a certain number (academic performance).

This helps the students to self-check their learning success and to prepare for their written examination.

Learning Objectives

Transmission technology:

- Principles of signal transmission, signal selection, signal detection, digital modulation
- Principle of binary transmission with additive white gaussian noise (AWGN)
- Maximum A Posteriori and maximum likelihood decision rule
- Ideal receiver concept for AWGN channels; Matched filter approach
- Noise statistics, white noise, colored noise
- Unipolar / Bipolar and orthogonal signal constellations
- SNR and Eb / N0
- Error rate calculation for transmission over AWGN
- Intersymbol interference
- Eye chart
- Nyquist ISI criterion
- Carrier signals
- Equivalent complex baseband area
- Band-pass-low-pass transform
- IQ modulator, Polar mixer
- Linear modulation: modulation types, transmitters, receivers, PSK, QAM, etc.
- Constellation diagram, trajectory
- Error rates for linear modulation schemes
- Continuous phase modulation (CPM), MSK, GMSK
- Asynchronous modulation, DPSK
- Multipath, frequency-selective behavior, Fading
- Muli-Carrier Modulation
- OFDM
- PAPR and peak reduction
- Efficiency, spectral efficiency, energy efficiency
- Digital predistortion

Practical work:

- Simulation of transmission methods via a noise-free channel in MatLab

Mathematical and Natural Sciences Methods II:

- Differential equations and systems of differential equations, (eg Maxwell equation).

- Numerical methods for solving differential equations, linear algebra, iteratives, num. Integration.

- Regression and correlation calculation.

- Introduction to Matlab and independent solution of mathematical problems of engineering mathematics using a computer.

Recommended reading:

Optional Information: Distribution of lecturers in the sessions of this module

Courses		
Lecturer	**Course title within the sepcified module**	**Hours/ week**
	Transmission Technology	40
	Mathematical and Natural Sciences Methods II	40

SRH University Heidelberg, course of studies: Information Technology (Informationstechnik) (M.Eng.)

Module name and module number: **M3 DSP in Image Processing**

This module is applied in the following other programs:

5-week block	Frequency	Duration of module	Art *Deviations clarification in the „usability“	ECTS-Points	Student workload Note: Calculation bassis usually 1 ECTS = 25 hours. Deviations are regulated solely in App. 2 (Bachelor) or 2a (Master) of the SPO.
	2x annually	5 weeks	Compulsory subject	8	Workload total 200 h. (100%) Present time 80 h. (40 %) Self-study 100 h. (50 %) Supervisor Contact 20 h. (10 %)

Requirements for Participation	Usability	Form of Examination / Time of Examination	Teaching and Learning Methods	Module Lecturer
B. Engin. degree		1. Student Research Project	1. Lecture 2. Exercise 3. Laboratory	

Learning Outcomes

Learning Outcomes expertise

Upon completion of the course students will be able to deal with the following,

Image processing :

- Apply the system theory to issues of image processing and in particular to analyze the interaction of hardware and software components for image processing systems.
- Select specific methods of image processing and pattern recognition for practical tasks and to project suitable methods for obtaining relevant image information.

Digital signal processing:

- Analyze analog and digital systems.
- Explain the practical implementation of a system design by means of hardware and software on the basis of a digital signal processor, a microcontroller, and / or programmable logic.
- Design linear, time-discrete systems and their implementation with signal processors.

Learning Outcomes Methods Competence

Students can identify requirements relevant to practice for problems of image processing and explain them professionally. Also, they can perform complete development cycles for signal processing systems. Students can program appropriate software for a concrete problem using DSPs in Image Processing.

Learning Outcomes social skills

Students are able to produce team-based solutions and to present the results to a professional audience.

Learning Outcomes self-competence

They are able to answer questions from a professional audience, to defend their solution and, if necessary, to check and modify it. They practice to apply working methods from the world of work in an industry and research environment.

Constructive Alignment
The focus of this module is dealing with concrete problems in the fields of DSP and image processing, in which the students develop solutions in a project, test them for feasibility, document and present the content and the operability. Typical industry-like approaches are simulated and practiced. The problems arise from current research projects. The topic-relevant contents are conveyed in input events. The related learning outcomes are reviewed by weekly homework (course achievement). This knowledge is the basis and precondition for successful project work. The project results will be developed mainly in teams and under mutual exchange of intermediate results. It is handed over as a single Student Research Project, or, depending on the project, as a group Student Research Project.
Learning Objectives
Digital signal processing: - The design of analog and digital filters, filter structures, transformation methods, multi-rate systems, the sigma-delta converter, signal processor systems and special blocks are presented. - Further programming exercises are performed for the design and simulation of signal processing systems in MATLAB. - In practical projects by 3-4 student teams, a self-chosen project with hardware and software development, based on a signal processor or microcontroller or other analog and / or digital electronic component is carried out.. **Image Processing:** 1. Overview of the PR algorithms 2. An overview of types of cameras, lighting, frame grabbers, software system 3. Pattern recognition; neural networks 4. Robot vision 5. Specific applications of the research results: - Contour Tracking - Surface measurement - Completeness check - Safety technology - Evaluation of moving images **Practical work:** - Testing different algorithms for pattern recognition (C language) **Recommended reading for the preparation**

Optional Information: Distribution of lecturers on the course of this module

Courses		
Lecturer	**Course title within the specified module**	**Hours/ week**

	Image Processing	40
	DSP	40

SRH University Heidelberg, course of studies: Information Technology (Informationstechnik) (M.Eng.)

Module name and module number: **M4 Real Time Programming**

This module is applicable in the following other programs:

5-week block	Frequency	Duration of module	Art *Deviations clarification in the „usability“	ECTS-Points	Student workload Note: Calculation bassis usually 1 ECTS = 25 hours. Deviations are regulated solely in App. 2 (Bachelor) or 2a (Master) of the SPO		
	2x annually	5 weeks	Compulsory subject	8	Workload total Present time Self-study Supervisor Contact	200 h. 80 h. 100 h. 20 h.	(100%) (40 %) (50 %) (10 %)

Requirements for Participation	Usability	Form of Examination /Time of Examination	Teaching and Learning Methods	Module Lecturer
B. Engin. degree		1. Student Research Project	1. Lecture 2. Exercise 3. Laboratory	

Learning Outcomes

Learning Outcomes expertise

After completion of the module, students will be able to: deal with the following

Real-time programming I:

- Explain the basic construction and operation of modern real-time operating system.

- Do measurements related to the performance with the goal to optimize the existing software.

Real-Time Programming II:

- Develop problem-specific real-time software, eg. programming a driver.

Learning Outcomes Methods Competence

They can perform complete software development cycles in Real Time Programming.

Learning outcomes of social competence

Students are able to develop solutions in teams and to present the results to a professional audience.

Learning outcomes self-competence

They are able to answer questions from a professional audience to defend their solution and, if necessary, to check and modify it. They practice to employ working methods from the world of work in industry and research.

Constructive Alignment

The focus of this module is dealing with concrete problems in the field of Real-Time Programming with hardware and software development, in which the students develop solutions in a project, test them for feasibility, document and present the content and the operability. Typical industry-like approaches are simulated and practiced. The problems arise from current research projects.

The topic-relevant contents are conveyed in input-events and the related learning outcomes are reviewed by weekly homework (course achievement). This knowledge is the basis and precondition for successful project work. The project results will be developed mainly in teams under mutual exchange of intermediate results. It is handed over as a single Student Research Project, or, depending on the project, as a group Student Research Project.

Learning Objectives

Real-Time Programming

- Introduction: Development of computer hardware and historical development of operating systems

- Processes and threads: process and thread states, process and thread management

- Scheduling: General algorithms, especially real-time scheduling

- Process synchronization: Critical areas, modeling of critical areas, semaphores, monitors

- Memory management: partitioning algorithms for memory management, virtual memory management, MMU

- IO and File System: Buffering, DMA, device drivers, file organization

- Distributed Systems: client server architectures, Message Passing, cluster

- Real-time programming: Interrupt, Synchronous and Asynchronous programming languages

Practical work (examples of possible practical experiments):

- Use of system calls for the use of typical operating system functions

- Performance tests on a real-time operating system

- Developing a simple device driver

Interprocess communication to implement a producer / consumer process

Recommended reading for preparation

Optional Information: Distribution of lecturers on the course of this module

Courses		
Lecturer	**Course title within the sepcified module**	**Hours/ week**
	Real-Time Programming I	40

	Real-Time Programming II	40

SRH University Heidelberg, course of studies : Information Technology (Informationstechnik) (M.Eng.)

Module name and module number: **M5 Embedded Systems**

This module is applicable in the following other programs:

5-week block	Frequency	Duration of module	Art *Deviations clarification in the „usability“	ECTS-Points	Student workload Note: Calculation bassis usually 1 ECTS = 25 hours. Deviations are regulated solely in App. 2 (Bachelor) or 2a (Master) of the SPO		
	2x annually	5 weeks	Optional subject	8	Workload total Present time Self-study Carer Contact	200 h. 80 h. 100 h. 20 h.	(100%) (40 %) (50 %) (10 %)

Requirements for Participation	Usability	Form of Examination / Time of Examination	Teaching and Learning Methods	Module Lecturer
B. Engin. degree		1. Student Research Project	1. Lecture 2. Exercise 3. Laboratory	

Learning Outcomes

Learning Outcomes expertise

Embedded Systems:

- Explain the functionality of embedded systems related to information technology in detail.

- Design systems with their own operating system.

Integrated circuits:

- Concepts that can be implemented as integrated digital and analog circuits.

- Designing, simulating, laying outand testing basic circuits.

Learning Outcomes Methods Competence

Learning outcomes of social competence

Students are treined in working in teams and to present solutions to to a professional audience.

Learning outcomes self-competence

They are able to answer questions from a professional audience, to defend their solution and, if necessary, to check and modify it. They are trained to apply working methods from the world of work in industry and research.

Constructive Alignment

The focus of this module are concrete problems in the fields of embedded systems and integrated circuits, in which the students develop solutions in a project, test them for feasibility, document and present the content and the operability. Typical industry-like approaches are simulated and practiced. The problems arise from current research projects.

The topic-relevant contents are conveyed in input events and the related learning outcomes are reviewed by weekly homework (course achievement). This knowledge is the basis and precondition for successful project work. The project results will be developed mainly in teams under mutual exchange of intermediate results. It is handed over as a single Student Research Project, or, depending on the project, as a group Student Research Project.

Learning Objectives

Embedded Systems:

- Introduction: Examples of Embedded Systems

- Microcontroller families and processor architectures for embedded systems

- Deepening of specialized hardware components: memory, timers, watchdog, UART, parallel ports, ADC…

- Setup of a typical development system: cross compiler, binary file formats, Telnet, FTP, remote debugging

- Operating Systems for Embedded Architectures

- InSystem programming and function of JATAG interface

- Bootloader and bootable systems

- Interfaces and bus systems in embedded architectures

- Direct Hardwareund memory access, hardware and driver protection

- Client- Server Architectures

- TCP / IP: IP, UDP, TCP, the socket interface, data transfer with UDP and TCP

- Simple http server for embedded architectures and CGI programming

- HTML and setting up websites

- Scripting languages, Java applets and dynamic websites

- Email in embedded architectures

- Remote Control for Embedded Architectures

- Safety aspects of Internet-based automation systems

Internship (examples of possible practical experiments):

- Communication via standard interfaces for a simple embedded system without an operating system

- Use of a socket interface for data transfer

- Http server and development of dynamic websites for operation and monitoring

- Data transfer with the CAN bus

Integrated Circuits:

- Integrated Digital Circuits

- Integrated Analog Circuits

- Analog chip project

- Test of integrated circuits
- Test of integrated circuits
- Digital Chip Internship
- Integrated CMOS RF circuits

Recommended reading for the preparation

Optional Information: Distribution of lecturers on the course of this module

Courses		
Lecturer	**Course title within the sepcified module**	**Hours/ week**
	Embedded Systems	40
	Integrated Circuits	40

SRH University Heidelberg, course of studies : Information Technology (Informationstechnik) (M.Eng.)

Module name and module number: **M6 Embedded Security**

This module is applicable in the following other programs:

5-week block	Frequency	Duration of module	Art *Deviations clarification in the „usability“	ECTS-Points	Student workload Note: Calculation bassis usually 1 ECTS = 25 hours. Deviations are regulated solely in App. 2 (Bachelor) or 2a (Master) of the SPO		
	2x annually	5 weeks	Compulsory subject	8	Workload total Present time Self-study Supervisor Contact	200 Std. 80 Std. 100 Std. 20 Std.	(100%) (40 %) (50 %) (10 %)

Requirements for Participation	Usability	Form of Examination / Time of Examination	Teaching and Learning Methods	Module Lecturer
B. Engin. degree		1. Student Research Project	1. Lecture 2. Exercise 3. Laboratory	

Learning Outcomes

Learning Outcomes expertise

After completing this module, students will be able to deal with the following,

Embedded Security :

- Apply cryptographic algorithms and protocols for embedded systems.
- Implement and analyze aspects of safety-critical function units in embedded systems.

Learning Outcomes Methods Competence

Select and evaluate useful countermeasures to different attacking patterns.

Learning outcomes of social competence

Students are trained in teamwork and in presenting the results to a professional audience.

Learning outcomes self-competence

They are able to answer questions from a professional audience to defend their solution and, if necessary, to check and modify it. They can apply working methods from the world of work in industry and research.

Constructive Alignment

The focus of this module is dealing with concrete problems in the fields of image processing and real-time programming, in which the students develop solutions in a project, test them for feasibility, document and present the content and the operability. Typical industry-like approaches are simulated and practiced. The problems arise from current research projects.

The topic-relevant contents are conveyed in input events and the related learning outcomes are reviewed by weekly homework (course achievement). This knowledge is the basis and precondition for successful project work. The project results will be developed mainly in teams under mutual exchange of intermediate results. It is handed over as a single Student Research Project, or, depending on the project, as a group Student Research Project.

Learning Objectives

Embedded Security

- Implementation forms of cryptographic algorithms and protocols
- Vulnerability of implementations
- Types of implementation attacks and appropriate countermeasures
- Side-channel attacks and appropriate countermeasures
- Security architectures and hardware modules of ICs
- Random number generators and random tests in embedded systems
- Physical Unclonable Functions (PUFs)
- Modular arithmetic and arithmetic of elliptic curves
- Storage of safety-critical data on ICs
- Protection against unauthorized manipulation of firmware and software
- Examples of safety-related applications:
- Smart cards, RFID Systems, Electronic Control Units (ECUs) in vehicles, access and loading
- Number systems, tachometers and tachographs, car infotainment, piracy
- Pay-TV-sets and set-top boxes
- Evaluation and certification of cryptographic modules
- Regulatory bodies, companies and information sources
- Post Quantum Cryptography, McEliece cryptosystem, Secure Protocols
- Stream Ciphers
- Data Encryption Standard DES
- Advanced Encryption Standard AES
- Block Ciphers
- Public Key Cryptography
- RSA CryptoStream
- Key Exchange Diffie-Hellman
- Hash Functions
- Message Authentication Codes

Recommended reading for preparation

Optional Information: Distribution of lecturers on the course of this module

Courses		
Lecturer	**Course title within the sepcified module**	**Hours/ week**
	Embedded Security	40
	Secure Protocols	40

SRH University Heidelberg, course of studies: Information Technology (Informationstechnik) (M.Eng.)

Module name and module number:: **M7 Robotic**

This module is applicalbe in the following other programs:

5-week block	Frequency	Duration of module	**Art** *Deviations clarification in the „usability“	**ECTS-Points**	**Student workload** Note: Calculation bassis usually 1 ECTS = 25 hours. Deviations are regulated solely in App. 2 (Bachelor) or 2a (Master) of the SPO.		
	2x annually	5 weeks	Optional subject	8	Workload total Present time Self-Study Carer Contact	200 h. 80 h. 100 h. 20 h..	(100%) (40 %) (50 %) (10 %)

Requirements for Participation	**Usability**	**Form of Examination / Time of Examination**	**Teaching and Learning Methods**	**Module Lecturer**
B. Engin. degree		1. Student Research Project	1. Lecture 2. Exercise	

Learning Outcomes

Learning Outcomes expertise

After completing this module, students will be able to,

- Build, use and handle a robotic system.

- Explain the domain of robotic systems, also in a compound with other systems of production automation.

- Perform configuration and programm robotic systems.

- Explain Modern control concepts.

- Perform an optimization of controlled systems.

- Declare Neural network schemes.

Learning Outcomes Methods Competence

Ability to select, assess and design robots. Assess ability of robotic automation solutions.

Learning Outcomes social skills

Students are trained to work on solutions in teams and to present the results to a professional audience.

Learning Outcomes self-competence

They are able to answer questions from a professional audience, to defend their solution and, if necessary, to check and modify it. They can apply working methods from the world of work in industry and research routine.

Constructive Alignment
Learning Objectives
Robotics: - Robotics Foundations - Robot Structures - Sensing and Perception - Manipulation and interfaces - Mobile and Distributed Robotics - Field and Service Robotics - Human Centered Life- like Robotics - Advanced control engineering 1.Basics (WDH) : - Transfer functions and block diagrams - Stability and frequency representation - Computer-aided Control (MATLAB / SIMULINK) - PID - rules (for example, Reswick) - State representation - Systematic modeling - System identification 2. Advanced Control Engineering - State controller - Observer - Digital control - Optimization - Fuzzy Control - Neural network schemes 3. Laboratory - Projects in Modern Control Design **Recommended reading for the preparation**

Optional Information: Distribution of lecturers on the course of this module

Courses		
Lecturer	**Course title within the sepcified module**	**Hours/ week**
	Robotic	40
	Advanced control technology	40

SRH University Heidelberg, course of studies : Information Technology (Informationstechnik) (M.Eng.)

Module name and module number:: **M8 Communication Networks**

This module ins applicable in the following other programs

- week block	**Frequency**	**Duration of module**	**Art** *Deviations clarification in the „usability“	**ECTS-Points**	**Student workload** Note: Calculation bassis usually 1 ECTS = 25 hours. Deviations are regulated solely in App. 2 (Bachelor) or 2a (Master) of the SPO		
	2x annually	5 weeks	Compulsory subject	8	Workload total Present time Self-study Carer Contact	200 h. 80 h. 100 h. 20 h.	(100%) (40 %) (50 %) (10 %)

Requirements for Participation	**Usability**	**Form of Examination / Time of Examination**	**Teaching and Learning Methods**	**Module Lecturer**
B. Engin. degree		1. Student Research Project	1. Lecture 2. Exercise 3. Laboratory	

Learning Outcomes

Learning Outcomes expertise

Upon completion of the course students will be able to deal with the following,

Communication laws:

- Identifying and explaining problems and challenges of optical communication networks.
- Designing modern communication networks and improve existing ones.
- Simulating and analyzing wireless networks.

Optical Communications:

- Explaining the essential components of optical communications and their interaction in an optical DWDM, CWDM or WWDM system.
- Identifying and applying new developments in the field of optical communications.

Learning Outcomes Methods Competence

Students can identify practice-relevant requirements for problems of optical communications and explain them professionally. They can program appropriate software for a concrete problem.

Learning outcomes of social competence

Students are able to work in teams and to present the results to a professional audience.

Learning outcomes self-competence

They are able to answer questions from a professional audience, to defend their solution and, if necessary, to check and modify it. They practice to employ working methods from the world of work in industry and research.

Constructive Alignment
Learning Objectives
Communication Networks The contents of this module are architecture, protocols and technologies of communication networks. Particular emphasis is placed on data-oriented, packet-switched networks for the Internet paradigm, as well as mobile communications networks. The basic architecture and the protocols of modern communication networks are considered from the viewpoint of specification, testing, security and the distribution of functionality. Particular emphasis is placed on the paradigms of Internet-based communications. Students should be enabled to understand complex communication systems and designs. The technology of modern communication networks is treated in terms of broadband communication in fixed networks and in the context of mobile communication systems (eg. local wireless networks or mobile cellular systems). These curricula are supplemented by procedures for the evaluation of communication networks. Additionally, this content will be expanded through seminars and projects, whose topics arise from recent developments in the communication networks. Optical Communications: 1. Introduction 2. Glass fibers 3. Optical transmitter and receiver 4. Interface and switch 5. Mode Theory 6. Integrated Optics 7. DWDM, CWDM, WWDM systems **Recommended reading for preparation**

Optional Information: Distribution of lecturers on the course of this module

Courses		
Lecturer	**Course title within the sepcified module**	**Hours/ week**

	Communication networks	40
	Optical communications engineering	40

SRH University Heidelberg, course of studies: Information Technology (Informationstechnik) (M.Eng.)

Module name and module number: **M9 Project**

This module is applicable in the following other programs:

5-week block	Frequency	Duration of module	Art *Deviations clarification in the „usability“	ECTS-Points	Student workload Note: Calculation bassis usually 1 ECTS = 25 hours. Deviations are regulated solely in App. 2 (Bachelor) or 2a (Master) of the SPO.
	2x annually	5 weeks	Compulsory subject	8	Workload total 200 h. (100%) Present time 10 h. (5 %) Self-study 170 h. (85 %) Supervisor Contact 20 h. (10 %)

Requirements for Participation	Usability	Form of Examination / Time of Examination	Teaching and Learning Methods	Module Lecturer
B. Engin. degree		1. Project Work	1. Project work	

Learning Outcomes

This module is dedicated to a real project task of medium size, where the knowledge and skills of the previous modules are applied.

Learning Outcomes expertise

Depending on the topic.

Learning Outcomes Methods Competence

Upon completion of this module, students will be able to,

- Develop a project of medium size successfully.

- Determine customer needs in interviews and to formulate these as use cases and requirements.

- Plan and control an iterative development process.

- Determine and create project-related documents.

Learning outcomes of social competence

Students are able to

- Edit a large system in several teams.

- Create their team structure and determine a team- and project-leader.

- Present the development of result.

Learning outcomes self-competence

Students can preform in- and develop a project of medium size and reflect the success of the project critically.

Constructive Alignment
In this module, a medium sized project task is presented and roughly described. The task controller acts as a client and consultant, not as a project leader. A world of work situations is simulated. Participants will have to develop their project, create their team structure, determine the team and the project, formulate and document requirements in detail. The architecture and any interface definitions are required. Documents and the progress of the project are reviewed in an iterative process until the project is accepted and the results can be presented.
Learning Objectives
Recommended reading for preparation

Optional Information: Distribution of lecturers on the course of this module

Courses		
Lecturer	**Course title within the specified module**	**Hours/ week**
	Project	80

SRH University Heidelberg, course of studies: Information Technology (Informationstechnik) (M.Eng.)

Module name and module number: **M10 Master-Thesis**

This module is applicable in the following other programs:

5-week block	Frequency	Duration of module	Art *Deviations clarification in the „usability“	ECTS-Points	Student workload Note: Calculation bassis usually 1 ECTS = 25 hours. Deviations are regulated solely in App. 2 (Bachelor) or 2a (Master) of the SPO.
	2x annually	5 weeks	Compulsory subject	26	Workload total 200 h. (100%) Present time 0 h. (0 %) Self-study 180 h. (90 %) Carer Contact 20 h. (10 %)

Requirements for Participation	Usability	Form of Examination / Time of Examination	Teaching and Learning Methods	Module Lecturer
B. Engin. degree		1. Thesis	1. Data search, analysis and processing	

Learning Outcomes

Learning Outcomes expertise

Leadership Skills

The students will be able to edit an extensive, practical problem independently and thereby apply the standards and methods of scientific work, as well as the usual ways of working in the sector of information technology. They will be able to handle a specific task comprehensively and to come up with a solution. They are able to professionally present their results and to convincingly represent their project.

Learning Outcomes Methods Competence

Learning outcomes of social competence

Learning outcomes self-competence

Constructive Alignment

This module summarizes all acquired skills from the previous modules that can be independently demonstrated in a synopsis now. The thesis shows the solution of an extensive problem of information technology, which was processed independently on a scientific basis. The thesis is presented by the students to a public audience. In a 20-minute colloquium it will be determined whether the student can answer related, also theoretical, issues.

Learning Objectives
Depending on the subject. **Reading list for preparation and follow** No specific records recommendated.

Optional Information: Distribution of lecturers on the course of this module

Courses		
Lecturer	**Course title within the sepcified module**	**week**
	Thesis/Kolloqium	