Module Handbook
Autonomous Vehicle Engineering

Faculty of Electrical Engineering and Computer Science

As per: 2021-02-15

Content

1 Introduction and overview

1.1 Study goal and qualification profile

The bachelor's programme Autonomous Vehicle Engineering deals with interaction of different technologies in order to qualify engineers for the development of automated mobility systems by teaching the scientific and engineering basics and methods. Students acquire skills in fields that are characteristic for automated mobility systems:

- Sense: sensor technology, sensor systems and sensor data fusion for detection and acquisition of the environment
- Think: Processing information obtained via sensors to create a driving strategy using software and intelligent algorithms
- Act: Safe implementation of the driving strategy with the aid of forces offered by power drive, steering and braking systems and utilized by actuators

Laboratory internships and practical phases promote methodological competence. Group projects and seminars strengthen social and personal competence. Later, graduates with a broad interest in interdisciplinary trends in digitalized mobility will find many meaningful fields of activity.

The language of instruction of the programme is English. By bringing students from all over the world together, we prepare them for cooperation in internationally composed teams and for a professional life in internationally operating companies.

1.2 Graduation

After successful completion of the study programme Autonomous Vehicle Engineering the Technische Hochschule Ingolstadt awards the academic degree:

Bachelor of Engineering (B.Eng.)

The Technische Hochschule Ingolstadt offers consecutive master programmes for graduates of Autonomous Vehicle Engineering:

- Elektrotechnik mobiler Systeme (German)
- Automatisiertes Fahren und Fahrzeugsicherheit (German)
- International Automotive Engineering (English)
- Applied Research (German/English)

Further information regarding the contents of the individual modules of these master programmes and the prerequisites for admission can be found in the respective programme and course descriptions as well as the programme and examination regulations.

1.3 Programme and examination regulations

Students, starting their studies in Autonomous Vehicle Engineering with the winter term 2020/21, are subject to the programme and examination regulations (Studien- und Prüfungsordnung (SPO)) issued 17.02.2020.

This programme and course description covers the course offerings of the upcoming term.

1.4 Basic structure

The programme Autonomous Vehicle Engineering usually starts in the winter semester only. For the summer term 2021 the programme was opened for new students by exception. The designated period of study is seven semesters. The study programme can be divided into two phases of study. The first phase comprehends two theoretical semesters. The second phase comprehends two theoretical and one practical semester, which is scheduled for the 5th semester. The 6th semester is reserved for a student project and specialized subjects. The study programme is completed with the 7th semester, which is reserved for elective subjects and the Bachelor’s thesis.

1.5 Study contents and requirements

The contents of the AVE study programme were defined in accordance to requirements from industry. Prerequisite for admission to study at Technische Hochschule Ingolstadt is either a general or subject-related higher education entrance qualification or the entrance qualification for studies at universities of applied sciences. In addition to the university entrance qualification (Hochschulzugangsberechtigung, HZB), the following suitability requirements must be fulfilled for this course of study:

- strong, solid knowledge of mathematics, in particular the ability to think abstractly, logically and system-oriented and to formalize approaches to solutions
- competencies in the fields of natural sciences, information technology and technology

The language of instruction of the programme is English. Therefore, sufficient proficiency of the English language is necessary. Individual courses of the study programme (especially within the second phase of study) might be offered in German. The Technische Hochschule Ingolstadt offers students the possibility to learn German or a foreign language.

1.6 Industry internship

All students have to complete an internship in a company which is scheduled for 5th semester.

1.7 Dual education programme

In close cooperation with our industry partners we also offer the possibility of work-study programmes. Students will work during the semester break for the respective supervising company and thus are able to supplement their acquired theoretical knowledge with practical experience.

1.8 Academic advisor

For all technical and functional questions and problems with regards to contents of the Autonomous Vehicle Engineering study programme please contact:

Prof. Dr. Martin Ebert, building B, room 205, Tel. 0841 / 93 48 –3804

Please adhere to the published consultation hours.

1.9 Internship commissioner

For all technical and functional questions and problems with regards to contents of the internships please contact:

Prof. Dr. Thomas Schiele, building A, room 116, Tel. 0841 / 93 48 – 2870

Please adhere to the published consultation hours.

1.10 Programme director

For questions concerning the organizational execution of the study programme please contact:

Prof. Dr. Martin Ebert, building B, room 205, Tel. 0 841 / 9348-3804

Please adhere to the published consultation hours.

2 Curriculum

2.1 First phase of studies

The first phase of studies comprehends two semesters containing mostly theoretical foundations and starts every winter term.

Module	No.	Subjects	Allocation to semesters			
			1. Sem.	2. Sem.	SWS	CP
Mathematics 1	1.1	Mathematics 1	5		7	8
	1.1	Exercise Course Mathematics 1	2			
Foundation of Computer Science	2.1	Foundation of Computer Science	4		6	7
	2.2	Practical Course Foundations of Computer Science	2			
Programming 1	3.1	Programming 1	4		6	7
	3.2	Practical Course Programming 1	2			
Foundations of Engineering Sciences	4.1	Foundations of Engineering Sciences	5		7	8
	4.2	Exercise Course Foundations of Engineering Sciences	2			
Mathematics 2	5.1	Mathematics2		4	5	6
	5.2	Exercise Course Mathematics 2		1		
Statistics	6.1	Statistics		3	4	5
	6.2	Exercise Course Statistics		1		
Algorithms and Data Structures	7	Algorithms and Data Structures		4	4	5
Programming 2	8.1	Programming 2		4	6	7
	8.2	Practical Course Programming 2		2		
Electronics, Signals and Measurement	9.1	Electronics, Signals and Measurement		4	6	7
	9.2	Practical Course Electronics, Signals and Measurement		2		
Sum					51	60

2.2 Second phase of studies

Semester 3 - 5

Module	No.	Subjects	Allocation to semesters 3. Sem.	4. Sem.	5. Sem.	SWS	CP
Model-based Software Engineering	10.1	Model-based Software Engineering	4			6	6
	10.2	Practical Course Model-based Software Engineering	2				
Vehicle Dynamics	11	Vehicle Dynamics	4			4	5
Modelling and Simulation	12.1	Modelling and Simulation	4			6	7
	12.2	Practical Course Modelling and Simulation	2				
Digital Signal Processing	13.1	Digital Signal Processing	4			6	7
	13.2	Practical Course Digital Signal Processing	2				
General Elective (Allgem.wissen. Wahlpflichtmodul)	14	General Elective	4			4	5
Software Development Processes	15	Software Development Processes		4		4	5
Foundations of Machine Learning	16.1	Foundations of Machine Learning		4		6	7
	16.2	Practical Course Foundations of Machine Learning		2			
Vehicle Electronics and Vehicle Communication Networks	17.1	Vehicle Electronics and Vehicle Communication Networks		4		6	7
	17.2	Practical Course Vehicle Electronics and Vehicle Communication Networks		2			
Control Engineering	18.1	Control Engineering		4		6	7
	18.2	Practical Course Control Engineering		2			
Scientific Seminar	19	Scientific Seminar		2		2	3

Internship	27	Internship					24
	28	Internship Seminar			1	1	2
	29	Business Management			2	2	4
Sum							90

Semester 6 - 7

Module	No.	Subjects	Allocation to semesters			
			6. Sem.	7. Sem.	SWS	CP
Vehicle-to-X-Communication	20	Vehicle-to-X-Communication	4		4	5
Team Project	21	Team Project	4		4	8
Sensor Data Processing and Sensor Data Fusion	22.1	Sensor Data Processing and Sensor Data Fusion	4		6	7
	22.2	Practical Course Sensor Data Processing and Sensor Data Fusion	2			
Planning and Decision-Making Algorithms	23	Planning and Decision-Making Algorithms	4		4	5
Vehicle Actuators	24	Vehicle Actuators	4		4	5
Science Elective (Fachwissenschaftliches Wahlpflichtmodul)	25	Science Elective (Fachwissenschaftliches Wahlpflichtmodul)		12	12	15
Bachelor Thesis	26.1	Seminar Bachelor Thesis		2	2	15
	26.2	Bachelor Thesis				
Sum					36	60

3 Module Descriptions

Mathematics 1			
Module abbreviation:	AVE_Math1	**Reg.no.:**	1
Curriculum:	**Programme**	**Module type**	**Semester**
	Autonomous Vehicle Engineering		1

Language of instruction:	English
Credit points / SWS:	8 ECTS / 7 SWS
Workload:	Contact hours: 82 h Self-study: 118 h Total: 200 h
Subjects of the module:	1.1 Mathematics 1 (AVE_Math1) 1.2 Exercise Course Mathematics 1 (AVE_ExMath_1)
Lecture types:	AVE_Math1: SU - lecture AVE_ExMath_1: Ü - exercise course

Objectives:

After successfully completing the module, students shall

- know the major mathematical techniques and their interrelations to solve engineering problems
- understand the underlying principles
- are able to apply the learned methods to solve tangible technical problems.

Content:

- Fundamentals: propositional logic, set theory, relation, function, inverse function, sequences, series, limits, convergence criteria
- Complex numbers: cartesian and polar/exponential coordinates, exponentiation, complex conjugate, fundamental theorem of algebra, polynomials, application: harmonic oscillation, AC current
- Linear algebra: Vector spaces, vector calculus, systems of linear equations, determinants, matrix algebra, eigenvalues and eigenvectors
- differential calculus with one variable: continuity, differential quotient, derivative, derivative of the inverse, derivation rules, basic functions, hyperbolic functions, position vector, tangent vector

Examinations:

1.1 schrP90 - written exam, 90 minutes

Literature:

- BIRD, John O., 2018. *Bird's comprehensive engineering mathematics*. S. edition. London; New York: Routledge. ISBN 978-0-8153-7814-3, 978-0-8153-7815-0
- RILEY, Kenneth F., Michael P. HOBSON and Stephen J. BENCE, 2006. *Mathematical methods for physics and engineering*. 3. edition. Cambridge [u.a.]: Cambridge Univ. Press. ISBN 978-0-521-86153-3, 0-521-86153-5
- CROFT, Anthony and Robert DAVISON, 2019. *Mathematics for engineers*. F. edition. Harlow, England: Pearson. ISBN 978-1-292-25364-0

Foundations of Computer Science

Module abbreviation:	AVE_CompSci	**Reg.no.:**	2
Curriculum:	**Programme**	**Module type**	**Semester**
	Autonomous Vehicle Engineering		1

Language of instruction:	English
Credit points / SWS:	7 ECTS / 6 SWS
Workload:	Contact hours: 70 h Self-study: 105 h Total: 175 h
Subjects of the module:	2.1 Foundations of Computer Science (AVE_CompSci) 2.2 Practical Course Foundations of Computer Science (AVE_PractCompSci)
Lecture types:	AVE_CompSci: SU/Ü - lecture with integrated exercises AVE_PractCompSci: Pr - laboratory

Objectives:

After successful participation in the module courses, students are able to

- present information of different kinds for processing by digital computers
- identify the elements of an instruction set architecture and assess their implications for programming, based on the representation of information in a manner appropriate to data processing and the principles of instruction-based execution of processing rules
- explain the interaction of hardware and software
- formulate basic elements of procedural programming in a machine language
- evaluate the effect of programming alternatives on the execution speed
- explain concepts for performance enhancement in modern processors and the problems associated with them

Content:

- Representation of information in computer systems
- Basic concepts of computer architecture, basic structure of universal computers, basic principles of program execution
- Instruction set architecture: instruction set, addressing modes, interrupts
- Basics of machine-oriented programming: memory planning, control structures, subprograms
- Concepts of modern computer systems: pipelining, superscalarity, memory hierarchy, cache memory, SIMD-processors, GPUs

Examinations:

2.1 schrP90 - written exam, 90 minutes
2.2 LN - participation without/with success

Literature:

- HENNESSY, John L. and David A. PATTERSON, 2019. *Computer architecture: a quantitative approach*. S. edition. Cambridge, MA: Morgan Kaufmann Publishers. ISBN 978-0-12-811905-1

Programming 1

Module abbreviation:	AVE_Progr_1	**Reg.no.:**	3
Curriculum:	**Programme**	**Module type**	**Semester**
	Autonomous Vehicle Engineering		1

Language of instruction:	English
Credit points / SWS:	7 ECTS / 6 SWS
Workload:	Contact hours: 70 h Self-study: 105 h Total: 175 h
Subjects of the module:	3.1 Programming 1 (AVE_Progr_1) 3.2 Practical Course Programming 1 (AVE_PractProg_1)
Lecture types:	AVE_Progr_1: SU/Ü - lecture with integrated exercises AVE_PractProg_1: Pr - laboratory

Objectives:

The module is designed to teach students to program in Python in a practical manner using industry standard methods, tools and technologies. It not only teaches students the Python programming language but also improves their algorithmic thinking and problem-solving capabilities so that they can write code that actually works and produces the desired functional results. Giving students enoughwell thoughtcoding exercises ensures this.

After completion of the module the students will be able to

- understand the programming basics (operations, control structures, data types, etc.)
- readily use the Python programming language
- apply various data types and control structure
- understand class inheritance and polymorphism
- understand the object-oriented program design and development
- understand and begin to implement code

Content:

The following topics are covered:

- Introduction: foundations of algorithms and information processing
- Information representation: Data Types, variables and basic data structures
- Control structures: conditional execution, loops, lists and list processing
- Procedural abstraction: functions modules and packages
- Objects and dlasses
- Advanced topics: exceptions, events and event-driven programming

Examinations:

3.1 schrP90 - written exam, 90 minutes
3.2 LN - participation without/with success

Literature:
• LAMBERT, Kenneth A. and Martin OSBORNE, 2019. *Fundamentals of Python: first programs*. S. edition. Boston, MA: Cengage. ISBN 1-337-56009-X, 978-1-337-56009-2 • BEAZLEY, David M. and Brian K. JONES, 2013. *Python cookbook: [recipes for mastering Python 3]*. 3. edition. Beijing [u.a.]: O'Reilly. ISBN 978-1-449-34037-7, 1-449-34037-7 • ZHANG, Yue, 2015. *An Introduction to python and computer programming* [online]. Singapore [u.a.]: Springer PDF E-Book. ISBN 978-981-287-609-6, 978-981-287-608-9. Available via: https://doi.org/10.1007/978-981-287-609-6.

Foundations of Engineering Sciences

Module abbreviation:	AVE_EngSci	**Reg.no.:**	4
Curriculum:	**Programme**	**Module type**	**Semester**
	Autonomous Vehicle Engineering		1

Language of instruction:	English	
Credit points / SWS:	8 ECTS / 7 SWS	
Workload:	Contact hours:	82 h
	Self-study:	118 h
	Total:	200 h
Subjects of the module:	4.1 Foundations of Engineering Sciences (AVE_EngSci) 4.2 Exercise Course Foundations of Engineering Sciences (AVE_ExEngSci)	
Lecture types:	AVE_EngSci: SU - lecture AVE_ExEngSci: Ü - exercise course	

Objectives:

After successful participation the students should be able to:

- Solve basic physical problems, validate calculations, estimate relevant input tolerances/errors and their impact on the results
- determine the center of gravity of multibody-problems, apply the sentences of conservation of momentum and energy
- Calculate the inertia of rotating bodies
- Solve problems with help of the Ideal Gas Law
- calculate damped and undamped oscillations
- Analyse and calculate wave problems
- Apply the fundamental equations of optics
- do calculations regarding simple electrical problems

Enable the students to actively apply their knowledge taught in the course Foundations of Engineering Sciences

Content:

- Physical properties
- Mechanics
- Reonances and waves
- deflection and interference
- Ideal Gas Law
- basic electrodynamics and electrics

examples and exercises to all problems discussed in the course

Examinations:

4.1 schrP90 - written exam, 90 minutes

Literature:

Mathematics 2

Module abbreviation:	AVE-Mathematics 2	**Reg.no.:**	5
Curriculum:	**Programme**	**Module type**	**Semester**
	Autonomous Vehicle Engineering		1,2

Language of instruction:	English
Credit points / SWS:	6 ECTS / 5 SWS
Workload:	Contact hours: 59 h Self-study: 91 h Total: 150 h
Subjects of the module:	5.1 Mathematics 2 (AVE-Mathematics 2) 5.2 Exercise Course Mathematics 2 (AVE-Exercise Course Mathematics 2)
Lecture types:	AVE-Mathematics 2: SU - lecture AVE-Exercise Course Mathematics 2: Ü - exercise course

Objectives:

After successfully completing the module, students shall

- Have gained advanced competences in applying mathematical methods
- Can analyse complex problems and decompose them in to solvable parts
- Have knowledge in order to combine various mathematical techniques in order to solve challenging, heterogeneous tasks
- Can judge the convenience of possible solution approaches and compare alternative methods to solve technical problems

Content:

- Power series, elementary functions: exponential function, trigonometric functions. Taylor series,
- integral calculus with one variable: definite and indefinite integral, primitive function, fundamental theorem of calculus, basic primitives, integration rules, partial fraction method, integration of rational functions, improper integral
- differential calculus with more than one variable: scalar functions with tow and more variables, potential function, partial derivative, gradient, total differential, implicit derivation, directional derivative
- Integral calculus with more than one variable: two- and three-dimensional area integral, polar coordinates, path integral over vector and scalar field, scalar potential and gradient field, path independent integral, spherical coordinates, surface integral over vector and scalar field, flux, divergence theorem with application, vortex field, curl, Stokes' theorem, Nabla operator, Maxwell equations
- Differential equations: ordinary DE, separation of variables, inhomogenous ODE of n-th orderFourier series, Fourier transform, Laplace transform

Examinations:

5.1 schrP90 - written exam, 90 minutes

Literature:

- BIRD, John O., 2014. *Understanding engineering mathematics: [SI units USED]*. F. edition. London; New York: Routledge. ISBN 978-0-415-66284-0, 0-415-66284-2
- RILEY, Kenneth F., Michael P. HOBSON and Stephen J. BENCE, 2006. *Mathematical methods for physics and engineering*. 3. edition. Cambridge [u.a.]: Cambridge Univ. Press. ISBN 978-0-521-86153-3, 0-521-86153-5

- JAMES, Glyn, Phil P. G. DYKE and John SEARL, 2020. *Modern engineering mathematics*. 6. edition.

Statistics			
Module abbreviation:	AVE-Statistics	**Reg.no.:**	6
Curriculum:	**Programme**	**Module type**	**Semester**
	Autonomous Vehicle Engineering		1,2

Language of instruction:	English	
Credit points / SWS:	5 ECTS / 4 SWS	
Workload:	Contact hours:	47 h
	Self-study:	78 h
	Total:	125 h
Subjects of the module:	6.1 Statistics (AVE-Statistics) 6.2 Exercise Course Statistics (AVE-Exercise Course Statistics)	
Lecture types:	AVE-Statistics: SU - lecture AVE- Exercise Course Statistics: Ü - exercise course	

Objectives:

After finishing this course including excercises students are able to:

- Choose and calculate appropriate metrics for describing a data set
- Understand different kinds of data and scaling
- Understand and interpret vizualizations of distributions
- Explain and analyze bivariate connections
- Understand fundamentals of probability and apply them to a given data set
- Explain and apply the concept of conditional probability and Bayes‘theorem
- Name the most important distributions and know appropriate applications
- Understand and use linear regression for analyzing a given dataset

Content:

Descriptive statistics

- Vizualization of distributions
- Scaling
- Metrics for descriptive analyses of a data set
- Metrics and models for bivariate connections

Probability theory and inductive statistics

- Probability space
- Conditional probability and Bayes
- Random variables
- Discrete and continuous distributions
- Selected hypothesis tests
- Linear regression
- Markov chains

Examinations:

6.1 schrP90 - written exam, 90 minutes

Literature:
• CARLTON, Matthew A., DEVORE, Jay L., 2017. *Probability with applications in engineering, science, and technology* [online]. Cham: Springer PDF E-Book. ISBN 978-3-319-52401-6. Available via: https://doi.org/10.1007/978-3-319-52401-6. • HASTIE, Trevor, Robert TIBSHIRANI and Jerome FRIEDMAN, 2001. *The elements of statistical learning: data mining, inference, and prediction*. 8. edition. New York, NY [u.a.]: Springer. ISBN 0-387-95284-5, 978-0387-95284-0 • RICE, John A., 2007. *Mathematical statistics and data analysis*. 3. edition. Belmont, Calif.: Brooks/Cole, Cengage Learning. ISBN 0-495-11868-0, 978-0-495-11868-8

Algorithms and Data Structures			
Module abbreviation:	AVE-Algorithms and Data Structures	**Reg.no.:**	7
Curriculum:	**Programme**	**Module type**	**Semester**
	Autonomous Vehicle Engineering	Compulsory Subject	2

Language of instruction:	English
Credit points / SWS:	5 ECTS / 4 SWS
Workload:	Contact hours: 47 h Self-study: 78 h Total: 125 h
Subjects of the module:	Algorithms and Data Structures (AVE-Algorithms and Data Structures)
Lecture types:	AVE-Algorithms and Data Structures: SU/Ü - lecture with integrated exercises

Objectives:

After successfully completing the module, students shall be able to

- analyze given algorithms concerning their timing behaviour and memory consumption.
- name the most important data structures and characterize their dominant advantages and disadvantages.
- choose suited data structures for practical problems.
- distinguish aspects relevant for implementation of algorithms and data structures and describe their impact.

Content:

- Complexity and efficiency
- Lists and sequences
- Graphs and relations
- Trees and hierarchies
- Hash maps
- Sorting algorithms
- Selected applications

Examinations:

schrP90 - written exam, 90 minutes

Literature:

- SEDGEWICK, Robert and Kevin WAYNE, 2011. *Algorithms*. 4. edition. Upper Saddle River, NJ [u.a.]: Addison-Wesley. ISBN 978-0-321-57351-3, 0-321-57351-X
- CORMEN, Thomas H., 2009. *Introduction to algorithms*. T. edition. Cambridge, Mass.: MIT Press. ISBN 978-0-262-27083-0

Programming 2

Module abbreviation:	AVE-Programming 2	**Reg.no.:**	8
Curriculum:	**Programme**	**Module type**	**Semester**
	Autonomous Vehicle Engineering		2

Language of instruction:	English	
Credit points / SWS:	7 ECTS / 6 SWS	
Workload:	Contact hours:	70 h
	Self-study:	105 h
	Total:	175 h
Subjects of the module:	8.1 Programming 2 (AVE-Programming 2) 8.2 Practical Course Programming 2 (AVE-Practical Course Programming 2)	
Lecture types:	AVE-Programming 2: SU/Ü - lecture with integrated exercises AVE-Practical Course Programming 2: Pr - laboratory	

Objectives:

After attending the module, students will be able to

- state and explain the essential features of an object-oriented programming language.
- use the basic programming constructs of C++ in concrete programmes.
- explain the most important functions of a modern development environment and use them to create programmes.
- explain the problem of proving the correctness of a program and describe and apply a systematic test methodology for error reduction.
- successfully demonstrate the practical application of the contents learned in a medium-sized programming task (=practical course)

Content:

- Introduction: Object Orientation and C++
- Development environment and runtime environment
- Memory management, references
- Classes, inheritance, polymorphism
- Dynamic Polymorphism in C++
- Generic modules based on templates
- Static polymorphism based on templates
- Metaprogramming, function objects and λ-expressions
- STL library, iostreams library
- Potentials and effects of optimising translators in C++

Examinations:

8.1 schrP90 - written exam, 90 minutes
8.2 LN - participation without/with success

Literature:
• ECKEL, Bruce, 1995. *Thinking in C++*. Englewood Cliffs, NJ: Prentice Hall. ISBN 0-13-917709-4 • STROUSTRUP, Bjarne, 2015. *Die C++-Programmiersprache: aktuell zum C++11-Standard*. München: Hanser. ISBN 978-3-446-43981-8, 978-3-446-43961-0

Electronics, Signals and Measurement

Module abbreviation:	AVE-Electronics, Signals and Measurement	**Reg.no.:**	9
Curriculum:	**Programme**	**Module type**	**Semester**
	Autonomous Vehicle Engineering		1,2

Language of instruction:	English
Credit points / SWS:	7 ECTS / 6 SWS
Workload:	Contact hours: 70 h Self-study: 105 h Total: 175 h
Subjects of the module:	9.1 Electronics, Signals and Measurement (AVE-Electronics, Signals and Measurement) 9.2 Practical Course Electronics, Signals and Measurement (AVE-Practical Course Electronics, Sign)
Lecture types:	AVE- Electronics, Signals and Measurement: SU/Ü - lecture with integrated exercises AVE-Practical Course Electronics, Signals and Measurement: Pr - laboratory

Objectives:

The course is designed to provide a practical - hands on - introduction to electronics with a focus on measurement and signals. The prerequisites are basic math courses including differential and integral calculus as well as electricity and magnetism. No prior experience with electronics is necessary. The aim of the course is to provide students with the theoretical and practical knowledge necessary to work in a modern science or engineering setting. The students will get the ability for basic electronic circuit design. The students are empowered to perform electric measurement and judge the correctness and accuracy of the measurement. The students are capable to analytically calculate and experimentally measure continuous current and time dependent voltage and current signals in electronic circuits. The student understands the time and frequency behavior of signals and the concept of time-frequency dualism.

Content:

The content of the course is the following:

- Introduction to Signals
- Fourier Transform and Fourier Series
- Sampling, and Aliasing
- Kirchhoff’s Laws, Resistor Networks, Resistive Circuit Analysis
- Circuit Analysis using the Node and Mesh Methods, Linear Circuits Analysis
- Equivalent Circuits, Power Transfer
- Dependent Sources, Op Amps, Current Sources
- Capacitors and Inductors
- Sinusoidal Steady State Response of RL and RC Circuits
- Sinusoidal Steady State Response: Impedance
- Filters, Bandwidth, Q Factor
- Transient Response

• Diodes, Signal Conditioning, Voltage Regulation • Transistors, Biasing and Amplification • Introduction to the Op Amp
Examinations:
9.1 schrP90 - written exam, 90 minutes 9.2 LN - participation without/with success
Literature: