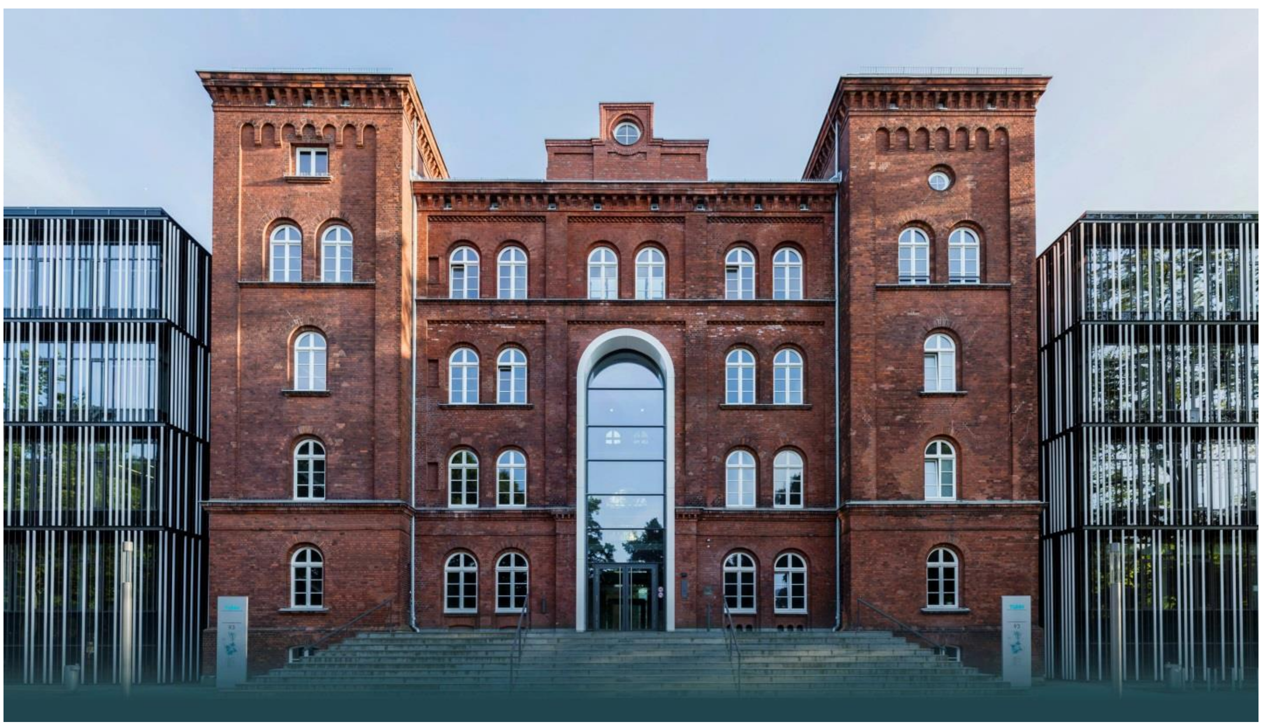
Hamburg University of Technology

Electrical Engineering, Computer Science and Mathematics

Bachelor-courses, taught in English



Last revision: February 14th, 2020

Dear Erasmus students,

welcome to Hamburg University of Technology (TUHH). We are a small but high-class university with a clear profile in research and with modern, practice-oriented learning methods. The School of Electrical Engineering, Computer Science and Mathematics offers a wide selection of ambitious classes at Master and Bachelor level. The intent of this brochure is to guide students of the European exchange program ERASMUS through their academic studies at TUHH.

The academic calendar in Germany differs from that of other European countries. The German academic year is divided into two semesters: the Wintersemester (WS) from October 1st to March 31st and the Sommersemester (SS) from April 1st to September 30th. Each semester consists of 14 weeks during which classes take place and a period when there are usually no classes. The first period is called Vorlesungszeit and the second vorlesungsfreie Zeit. The final exams for the classes are during the vorlesungsfreie Zeit. The periods of the Vorlesungszeit slightly vary from year to year. The exact dates you will find on the website of TUHH. In the WS, the Vorlesungszeit at TUHH begins in mid-October and ends in the middle of February with a break of about two weeks around Christmas. In the SS TUHH classes start at the beginning of April until middle of July with a break of one week after Pentecost.

All courses are either taught in the Wintersemester or in the Sommersemester. One exception to this rule are language courses. This brochure contains a list of all courses of the School of Electrical Engineering, Computer Science and Mathematics of our Bachelor programs that are taught in English. There are also a lot of courses that are only taught in German, they are not listed. The list gives a short overview about the content of each course. The list is divided into two parts: courses of the winter term and of the summer term. You also find the name of the lecture. You may also participate in courses taught by other faculties and languages courses. You will find information about these courses on TUHH's website.

The lecture rooms and the lecturing times vary from year to year, again please have a look at the website. In rare cases lectures of different courses may be given at the same time. In this case you have to change your course selection after your arrival in Hamburg. We advise you to participate in a German language course. This will enable you to get an insight into the German culture to get the most out of your stay.

Exams are held during the vorlesungsfreie Zeit. On occasion ERASMUS students have to be at their home university at that time. In this case it is advisable to contact the lecturer of the corresponding class and ask for alternatives.

For all questions regarding your academic stay in Hamburg please consult the International Office of TUHH. It provides a wealth of information through their web site at https://www.tuhh.de/alt/tuhh/education/contacts/international-office.html.

We hope that your stay at TUHH enriches your scientific and cultural views of the planet and we look forward to welcoming you in Hamburg!

Prof. V. Turau
ERAMUS coordinator
School of Electrical Engineering, Computer Science and Mathematics

List of Lectures

SUMMER TERM

WINTER TERM

SUMMER TERM

Course	Contents	Institute/Lecturer Period
	SUMMER TERM	
Automata Theory and Formal Languages Lecture, Exercise 6 ECTS 4 SWS	Students can explain syntax, semantics, and decision problems of propositional logic, and they are able to give algorithms for solving decision problems. Students can show correspondences to Boolean algebra. Students can describe which application problems are hard to represent with propositional logic, and therefore, the students can motivate predicate logic, and define syntax, semantics, and decision problems for this representation formalism. Students can explain unification and resolution for solving the predicate logic SAT decision problem. Students can also describe syntax, semantics, and decision problems for various kinds of temporal logic, and identify their application areas. The participants of the course can define various kinds of finite automata and can identify relationships to logic and formal grammars. The spectrum that students can explain ranges from deterministic and nondeterministic finite automata and pushdown automata to Turing machines. Students can name those formalism for which nondeterminism is more expressive than determinism. They are also able to demonstrate which decision problems require which expressivity, and, in addition, students can transform decision problems w.r.t. one formalism into decision problems w.r.t. other formalisms. They understand that some formalisms easily induce algorithms whereas others are best suited for specifying systems and their properties. Students can describe the relationships between formalisms such as logic, automata, or grammars.	E-5 Prof. Dr. Tobias Knopp Summer Term
Electrical Engineering II Lecture, Exercise 6 ECTS 5 SWS	The students know the basic theory, relations and methods of time dependent network theory and basic nonlinear circuit elements. This includes, in particular: • transients, • the use of complex numbers and phasors, • the concept of impedance, • steady state sinusoidal circuit analysis, • complex power and 3-phase systems, • transformers, • transfer function and filters, • the concept of resonance, • diodes and rectifiers, • bipolar transistors and operational amplifiers	E-6 Prof. Dr. Kasper Summer Term
Signals and Systems Lecture, Exercise	Language of the Lecture: GERMAN! Language of teaching materials: ENGLISH!	E-8

Course	Contents	Institute/Lecturer Period
6 ECTS, 5 SWS	The students are able to classify and describe signals and linear time-invariant (LTI) systems using methods of signal and system theory. They are able to apply the fundamental transformations of continuous-time and discrete-time signals and systems. They can describe and analyze deterministic signals and systems mathematically in both time and image domain. In particular, they understand the effects in time domain and image domain which are caused by the transition of a continuous-time signal to a discrete-time signal.	Prof. Dr. Gerhard Bauch Summer Term
Semiconductor Circuit Design Lecture, Excercise 6 ECTS 4 SWS	• Students are able to explain the functionality of different MOS devices in electronic circuits. • Students are able to explain how analog circuits functions and where they are applied. • Students are able to explain the functionality of fundamental operational amplifiers and their specifications. • Students know the fundamental digital logic circuits and can discuss their advantages and disadvantages. • Students have knowledge about memory circuits and can explain their functionality and specifications. • Students know the appropriate fields for the use of bipolar transistors.	E-9 Prof. Dr. Matthias Kuhl Summer Term
Mathematical Analysis Lecture, Exercises 8 ECTS 8 SWS	• Students can name the basic concepts in analysis. They are able to explain them using appropriate examples. • Students can discuss logical connections between these concepts. They are capable of illustrating these connections with the help of examples. • They know proof strategies and can reproduce them.	E-10 Prof. Dr. Daniel Ruprecht Summer Term
Seminar Technomathematics Seminar 4 ECTS 2 SWS	• Students acquire a deep understanding of the mathematical subject under consideration.	E-10 Prof. Dr. Anusch Taraz Summer Term Winter Term
Stochastics Lecture, Exercise 6 ECTS 4 SWS	• Students can explain the main definitions of probability, and they can give basic definitions of modeling elements (random variables, events, dependence, independence assumptions) used in discrete and continuous settings (joint and marginal distributions, density functions). Students can describe characteristic notions such as expected	E-10 Prof. Dr. Marko Lindner Summer Term

Course	Contents	Institute/Lecturer Period
	values, variance, standard deviation, and moments. Students can define decision problems and explain algorithms for solving these problems (based on the chain rule or Bayesian networks). Algorithms, or estimators as they are caller, can be analyzed in terms of notions such as bias of an estimator, etc. Student can describe the main ideas of stochastic processes and explain algorithms for solving decision and computation problem for stochastic processes. Students can also explain basic statistical detection and estimation techniques.	
Computability and Complexity Theory Lecture, Exercise 6 ECTS 4 SWS	• The students know the important machine models of computability, the class of partial recursive functions, universal computability, Gödel numbering of computations, the theorems of Kleene, Rice, and Rice-Shapiro, the concept of decidable and undecidable sets, the word problems for semi-Thue systems, Thue systems, semi-groups, and Post correspondence systems, Hilbert's 10-th problem, and the basic concepts of complexity theory.	E-13 Prof. Dr. Karl-Heinz Zimmermann Summer Term
Embedded Systems Lecture, Exercise 6 ECTS 4 SWS	Embedded systems can be defined as information processing systems embedded into enclosing products. This course teaches the foundations of such systems. In particular, it deals with an introduction into these systems (notions, common characteristics) and their specification languages (models of computation, hierarchical automata, specification of distributed systems, task graphs, specification of real-time applications, translations between different models). Another part covers the hardware of embedded systems: Sensors, A/D and D/A converters, real-time capable communication hardware, embedded processors, memories, energy dissipation, reconfigurable logic and actuators. The course also features an introduction into real-time operating systems, middleware and real-time scheduling. Finally, the implementation of embedded systems using hardware/software co-design (hardware/software partitioning, high-level transformations of specifications, energy-efficient realizations, compilers for embedded processors) is covered.	E-13 Prof. Dr. Heiko Falk Summer Term
Lab Cyber-Physical Systems Lab	Cyber-Physical Systems (CPS) are tightly integrated with their surrounding environment, via sensors, A/D and D/A converters, and actors. Due to their particular application	E-13 Prof. Dr. Heiko Falk Summer Term

Course	Contents	Institute/Lecturer Period
6 ECTS 4 SWS	areas, highly specialized sensors, processors and actors are common. Accordingly, there is a large variety of different specification approaches for CPS - in contrast to classical software engineering approaches. Based on practical experiments using robot kits and computers, the basics of specification and modelling of CPS are taught. The lab introduces into the area (basic notions, characteristical properties) and their specification techniques (models of computation, hierarchical automata, data flow models, petri nets, imperative approaches). Since CPS frequently perform control tasks, the lab's experiments will base on simple control applications. The experiments will use state-of-the-art industrial specification tools (MATLAB/Simulink, LabVIEW, NXC) in order to model cyber-physical models that interact with the environment via sensors and actors.	
Compiler Construction Lecture, Exercise 6 ECTS 4 SWS	Students explain the workings of a compiler and break down a compilation task in different phases. They apply and modify the major algorithms for compiler construction and code improvement. They can re-write those algorithms in a programming language, run and test them. They choose appropriate internal languages and representations and justify their choice. They explain and modify implementations of existing compiler frameworks and experiment with frameworks and tools.	E-16 Prof. Dr. Sibylle Schupp Summer Term
Software Engineering Lecture, Exercise 6 ECTS 4 SWS	Students explain the phases of the software life cycle, describe the fundamental terminology and concepts of software engineering, and paraphrase the principles of structured software development. They give examples of software-engineering tasks of existing large-scale systems. They write test cases for different test strategies and devise specifications or models using different notations, and critique both. They explain simple design patterns and the major activities in requirements analysis, maintenance, and project planning.	E-16 Prof. Dr. Sibylle Schupp Summer Term

Course	Contents	Institute/Lecturer Period
Software Development Lecture, Exercise 6 ECTS 4 SWS	Students explain the fundamental concepts of agile methods, describe the process of test-driven development, and explain how continuous integration can be used in different scenarios. They give examples of selected pitfalls in software development, regarding scalability and other non-functional requirements. They write unit tests and build scripts and combine them in a corresponding integration environment. They explain major activities in requirements analysis, program comprehension, and agile project development.	E-16 Prof. Dr. Sibylle Schupp Summer Term
Algebra and Control Lecture, Exercise 6 ECTS 4 SWS	Students can • Describe input-output systems polynomially • Explain factorization approaches to transfer functions • Name stabilization conditions for systems in coprime stable factorization.	E-19 Dr. Prashant Batra Summer Term

1 SWS = 45 minutes of teaching time per week

WINTER TERM

Course	Contents	Institute/Lecturer Period
	WINTER TERM	
Computer Networks and Internet Security Lecture, Exercise 6 ECTS 4 SWS	Students are able to analyze common Internet protocols and evaluate the use of them in different domains.	E-4 Prof. Dr. Andreas Timm-Giel Winter Term
Electrical Engineering I Lecture, Exercise 6 ECTS 5 SWS	The students know the basic theory, relations and methods of direct current networks and of electric and magnetic fields. This includes especially: • Kirchhoff's voltage and current laws, • Ohm's law, • methods to simplify and analyze direct current networks, • description of electric and magnetic fields by use of vectorial field quantities, • Basic material relations, • Gauss's law, • Ampère's law, • induction law, • Maxwell's equation in the integral form, • concept and definition of resistance, capacitance and inductance.	E-7 Prof. Dr. Manfred Kasper Winter Term
Introduction to Communications and Random Processes Lecture, Exercise 6 ECTS, 4 SWS	Language of the Lecture: GERMAN! Language of teaching materials: ENGLISH! • The students know and understand the fundamental building blocks of a communications system. They can describe and analyze the individual building blocks using knowledge of signal and system theory as well as the theory of stochastic processes. They are aware of the essential resources and evaluation criteria of information transmission and are able to design and evaluate a basic communications system.	E-8 Prof. Dr. Gerhard Bauch Winter Term
Combinatorial Structures and Algorithms Lecture, Exercise 6 ECTS 4 SWS	• Students can name the basic concepts in Combinatorics and Algorithms. They are able to explain them using appropriate examples. • Students can discuss logical connections between these concepts. They are capable of illustrating these connections with the help of examples. • They know proof strategies and can reproduce them.	E-10 Prof. Dr. Anusch Taraz Winter Term
Linear Algebra Lecture, Exercises 8 ECTS 8 SWS	• Students can name the basic concepts in linear algebra. They are able to explain them using appropriate examples.	E-10 Prof. Dr. Daniel Ruprecht Winter Term

Course	Contents	Institute/Lecturer Period
	• Students can discuss logical connections between these concepts. They are capable of illustrating these connections with the help of examples. • They know proof strategies and can reproduce them.	
Seminar Technomathematics Seminar 4 ECTS 2 SWS	• Students acquire a deep understanding of the mathematical subject under consideration.	E-10 Prof. Dr. Anusch Taraz Winter Term Summer Term
Algorithms and Data Structures Lecture, Excercise 6 ECTS 5 SWS	• Students can name the basic concepts in algorithm design, algorithm analysis and problem reductions. They are able to explain them using appropriate examples. • Students can discuss logical connections between these concepts. They are capable of illustrating these connections with the help of examples. • They know proof strategies and can reproduce them.	E-11 Prof. Dr. Matthias Mnich Winter Term
Computer Architecture Lecture, Exercises 6 ECTS 5 SWS	• This module presents advanced concepts from the discipline of computer architecture. In the beginning, a broad overview over various programming models is given, both for general-purpose computers and for special-purpose machines (e.g., signal processors). Next, foundational aspects of the micro-architecture of processors are covered. Here, the focus particularly lies on the so-called pipelining and the methods used for the acceleration of instruction execution used in this context. The students get to know concepts for dynamic scheduling, branch prediction, superscalar execution of machine instructions and for memory hierarchies.	E-13 Prof. Dr. Heiko Falk Winter Term
Introduction to Information Security Lecture, Exercise 6 ECTS 5 SWS	Students can • name the main security risks when using Information and Communication Systems and name the fundamental security mechanisms, • describe commonly used methods for risk and security analysis, • name the fundamental principles of data protection.	E-15 Prof. Dr. Dieter Gollmann Winter Term
Functional Programming Lecture, Exercises 6 ECTS 6 SWS	• Students apply the principles, constructs, and simple design techniques of functional programming. They demonstrate their ability to read Haskell programs and to explain Haskell syntax as well as Haskell's read-eval-print loop. They interpret warnings and find errors in programs. They apply the fundamental data structures, data types, and type constructors.	E-16 Prof. Dr. Sibylle Schupp Winter Term

Course	Contents	Institute/Lecturer Period
	They employ strategies for unit tests of functions and simple proof techniques for partial and total correctness. They distinguish laziness from other evaluation strategies.	

1 SWS = 45 minutes of teaching time per week