



Bachelor ICT Engineering

1 st Semester	2 nd Semester	3 rd Semester	4 th Semester	5 th Semester	6 th Semester
Basics of information technology (IT)	Algorithms and data structures	Introduction to communication in ICT systems	Operating systems	Optional course	Bachelor thesis
Electronics	Microcontrollers, digital design and architecture	Instrumentation	Signal processing	Optional course	
Mathematics 1	Mathematics 2	Mathematics 3	Optional course	Optional course	
Physics 1	Physics 2	Optional course	Optional course	Optional course	Optional course

The 3-year programme is structured in six semesters. The first five semesters each contain four equally sized (7.5 ECTS) courses. The sixth semester contains the bachelor thesis and one additional course. [Click](#) on a course to read the course description.



Semester 1

Information Technology (IT) - Basics

The information technology revolution experienced in the modern society is only the start of the total changing of society, industry and trade. This course is a general introduction to information technology principles and multiple application possibilities, including essentials of the Internet and the Web. Overview of components of the computer, as a central part of IT, including hardware, possible accessories, software, and user interface design are presented and exemplified by small programming projects.

Electronics

Electronics has been the cause of far-reaching changes in human life, and is the basis of all ICT equipment. Electronics has a crucial importance in connecting the physical world to information and communication systems, in addition to constituting by itself the technical foundation for computers, communication equipment, and an imponderable number of high-tech application devices. The course is an introduction to fundamentals of electronics principles, providing comprehensive understanding of digital and analogue techniques, components and circuits, being of vital importance for industrial and everyday equipment.

Physics 1: Mechanics and thermodynamics

Mechanics deals with motion and forces in the macroscopic world, e.g. on land, in the sea, in the air, in space and in different instruments and means of transport. It is fundamental for other branches of physics, like thermodynamics, which primarily studies the effects of changes in pressure, temperature and volume of physical systems at the macroscopic scale. Entropy is a thermodynamic measure of the unavailability of a system's energy to do work, but entropy is e.g. also a subject of information technology regarding expected information.

Mathematics 1

This course has high-school A-level mathematics as a prerequisite, including basic concepts such as real numbers, vectors and functions. The main topics treated are complex numbers, series, differentiation, integrals, vector spaces and matrices. These are then applied to describe and analyze phenomena in the natural sciences and technology. Besides using classical mathematical methodology the learning will be supported by software training (Maple).

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Semester 2

Algorithms and Data-structures

The concept of the algorithm is introduced as a definite list of well-defined instructions for completing a task of mathematical, administrative, linguistic or any other nature. Data structures are methods of storing data in computers for algorithms to be able to operate on the data in an efficient way. ICT systems are fundamentally based on the application of algorithms and data structures in the computer. This course introduces elementary algorithms, data structures, techniques and paradigms, such as sorting, hashing, graph algorithms, and public-key cryptosystems.

Microcontrollers, Digital Design and Architecture

Microprocessors and –controllers have become a natural integrated part of a large variety of devices and tools in the information society. Nearly every tool in daily life or in industry and trade has built-in microprocessors for functioning efficiently. The subject of this course combines fundamental information on computer architecture, digital design, general-purpose and dedicated microprocessors using novel methods and the hardware programming language VHDL.

Physics 2: Electromagnetism

Electromagnetism is an important subject in connection with e.g. wireless communication, computers, measuring instruments, supply of electrical energy, telemedicine and oil-and-gas exploration. Electromagnetic theory deals with electricity and magnetism, and with the relationship between them. Magnetic fields arise from electric charges in motion. Electric fields are found around all electrically charged particles. Time-varying electric and magnetic fields generate electromagnetic waves, e.g. light and radio waves.

Mathematics 2

This course is a continuation of the Mathematics 1 course. Differentiation and integration are used to describe physical properties, for instance how pressure and temperature change with time and position. Fundamental laws and relationships in physics and engineering are put forward in formulas and so called differential equations. Various techniques to solve such equations are presented.

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Semester 3

Introduction to communication and ICT

Communication networks are essentials of ICT systems, providing the capabilities for overcoming distance and time – two important business barriers. A hallmark of the information society is the astonishing advances in communication, involving rapid sending and receiving of data and information of immense magnitude over large distances. The course provides comprehensive understanding of the fundamental principles of digital and analogue systems, including an integrated view of data- and telecommunications, and important applications in e.g. the Internet and multimedia.

Instrumentation

Instrumentation is equipment used for measurements and presentation of measured physical entities. Instrumentation is the key for tests, investigations, e.g. for quality assurance, and frequently exhibits itself in automatically controlled systems for industrial processing, engineering and most facets of modern technology. Data are measured by electronic sensors placed in electronic systems, and will usually be transformed to digital data which can be analysed and presented by a computer and display system. This course includes basic methods of measurement, electronic sensors and systems, data acquisition, precision of measured results, and calibration of instruments.

Mathematics 3

Numerical methods are procedures for solving mathematical problems using computers, like calculating the value of an integral. Different types of equations, such as simultaneous equations and differential equations, involve different numerical methods. Probability and statistics explain events and phenomena that are ruled by uncertainty and chance. Basic concepts like distribution, sample, estimation etc. are treated with mathematical tools. Appropriate computer software will be used.

Optional courses in 3rd semester or later (select one course):

See the course descriptions:

Data analysis

Object oriented programming

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Semester 4

Operating systems

An operating system is part of any computer. The operating system is the important layer of software providing the user a simple model of the computer for managing the resources and the computer system. This course aims at introducing the structure and function of operating systems and providing the student with skills for handling computer systems.

Signal processing

Signal processing comprises analysis, interpretation, and manipulation of all types of signals, including e.g. technical and physical signals of analogue or digital character, and financial and administrative data. The signals can be either deterministic or random in nature. The course gives an introduction to analysis and processing of major importance to ICT systems applications, like telecommunications, multimedia, seismic, instrumentation, acquisition, telemedicine, and control systems. Usual applications are time and spectral analysis, filtering, and correlation processes of speech signals, seismic signals, signals in electronic circuits, radar signals, etc.

Optional courses in 3rd semester or later (select two courses):

See the course descriptions:

Physics 3: Modern Physics

Mathematics 4

Databases and system development

Web: design and communication

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Semester 5

Select four courses from the list of optional courses.

Semester 6

Bachelor project and thesis

The Bachelor programme is concluded by performing an original project on an optional subject in ICT engineering, and writing a comprehensive report about the work performed, according to standard norms for scientific technical reports.

Optional courses in 5rd and 6th semester – Click on a course to get the description of it:

- **Modern communication systems**
- **Distributed & embedded computer systems**
- **Mobile and wireless communication**
- **Control systems**
- **Electrical power systems**
- **Energy resources and application**
- **Data networks**
- **Software engineering**
- **Software architecture**
- **IT strategy**

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Optional courses

Optional courses for 3rd semester or later:

- **Data Analysis**

In natural sciences and technology there is a need for handling large and complex data sets, including e.g. spatial- and time-related data from automatic measuring instruments. Various computing and statistical methods are used to confirm certain models or to disclose possible unknown relations in the data material. A small course project will include the opportunity to analyse a real set of measurements within a particular field using suitable software.

- **Object-oriented programming**

Description to be written.

Optional courses for 4th semester or later:

- **Physics 3: Modern Physics**

Modern physics deals with matter and energy on scales where common-sense notions of space, time, matter and energy are no longer valid. Quantum theory is concerned with the discrete nature of phenomena at the atomic and subatomic scale, and with the complementary aspects of waves and particles in the description of such phenomena. The special theory of relativity contains two fundamental postulates: that the laws of physics are the same in all inertial frames of reference, and that the speed of light in vacuum is independent of the motion of the light source.

- **Mathematics 4**

This course is a continuation of the Mathematics 2 course. Partial differential equations describe a mathematical connection between a function of several variables and partial derivatives of the same function. The theory of complex variables includes functions of complex numbers and their properties. From this theory one derives several useful formulae and theorems on, for instance, series and integrals.

- **Databases and system development**

Description to be written.

- **The Web: design and communication**

Description to be written.

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Optional courses for 5th and 6th semester or later:

- **Modern communication systems**

Modern communication systems play a key role in the present and future information society. Emergence of new technologies, e.g. fiber optics, integrated optics, and microwave integrated circuits, has had an impact on implementation of advanced communication systems. Hence, the course focuses on an in-depth treatment of principles, signals and spectra in communication systems, including analogue and digital modulation, coding and transmission techniques applied in advanced information technology systems.

- **Distributed & embedded computer systems**

Widespread distribution and embedded computer systems, usually microcontrollers, are increasingly applied. These systems are designed to perform dedicated functions at distributed locations, usually as part of a complete device or system. They benefit efficient and economic mass production. Examples are portable devices like mobile phones, MP3 players, iPods, robots, factory and engine controllers, power-saving mechanisms, ship and car equipment etc. In the course, emphasis is on realtime purposes, and includes both hardware and software.

- **Mobile and wireless communication**

Mobile and wireless communication has become a ubiquitous part of modern life, from global cellular telephone systems, e.g. GSM, to local- and even personal-area networks. This course provides a comprehensive introduction to digital mobile and wireless networks for use in modern society.

- **Control systems**

In industry, electronic control systems are the key solution for efficient and reliable production and functions. In all modern advanced tools, in ships, aircraft, cars, and all types of robots, control systems are indispensable parts. Modern control systems are based on implementation of embedded computer systems, signal processing procedures, electronic sensors, and instrumentation systems.

- **Electrical power systems**

Electric power is indispensable for a modern society. Electric power engineering deals with problems in electric power and energy production, distribution, conversion, transmission, and applications. The present introductory presentation includes methods of modeling and calculation in one- and three-phase systems, transformers, DC and asynchronous machines and generators.

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- **Software engineering**

In modern ICT systems, software usually no longer consists of easily manageable, small, individually developed programmes, but of growing systems both in size and complexity, often requiring several persons for development for a multitude of applications, for a multitude of users and, in addition, deliverable in large quantities. Managing this complexity puts strong requirements on the system, on reliability, maintainability, efficiency and usability, which are fulfilled using software engineering methods that involve systematic software development and production.

- **Software architecture**

Software architecture has emerged as the set of principles for understanding large-scale structures of software systems. From its roots in qualitative descriptions of empirically observed useful system organizations, software architecture has matured to encompass a broad set of notations, tools, and analysis techniques. It offers concrete guidance for complex software design and development.

- **IT strategy**

The subject of IT strategy provides a strategic perspective on the development, use and management of IT, including strategic planning of IT in different business contexts, handling relevant tools and techniques for using IT, formulating strategies where IT plays an important role, and the relevance of IT for business leaders.

- **Energy resources and applications**

Description to be written.

- **Data networks**

Description to be written.

The list of optional courses will be changed in accordance with available courses. Subjects taken as courses or distance learning from other universities or higher education institutions can be refereed and approved. Small projects can also be approved as optional courses.

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