Curriculum description of

Bachelor

Electrical and Electronic Engineering (EEE)

With specialisations

Electrical Power and Automation (EEE-EPA)

Electronic Information Engineering (EEE-EIE)

Bachelor

Applied Computer Science (ACS)

2017-2018

Saxion University of Applied Sciences

Enschede, The Netherlands

Content

Introduction

Applied Computer Science (ACS) and Electrical and Electronic Engineering (EEE) are 4 years bachelor studies intended for the professional industrial field of Engineering. This document provides an overview of the curriculum design and is written for educational staff of Saxion as well as partner universities, and all students who take up a bachelor degree study in Applied Computer Science or Electrical and Electronic Engineering. For students who already started bachelor education in another country, Saxion offers a Short Degree Program (SDP). A SDP is tailor made to the specific student's situation.

Curriculum objectives

The curriculum is designed according to the international requirements of the credit transfer system (in total 240 EC). The curriculum is based on the Dublin descriptors (figure 1), which describe the learning outcomes of the bachelor degree level in the European Educational system.

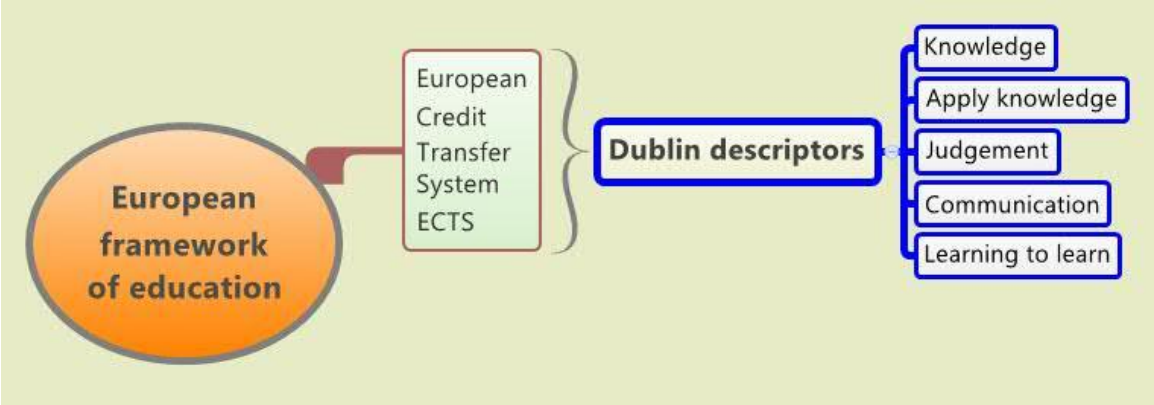


Figure 1 European framework of education Dublin descriptors

Dublin descriptors

The Dublin descriptors provide five internationally recognized learning outcomes:

Knowledge and understanding

Students have demonstrated knowledge and understanding that is founded upon and extends and/or enhances that typically associated with Bachelor's level, and that provides a basis or opportunity for originality in developing and/or applying ideas, often within a research context;

Applying knowledge

Students can apply their knowledge and understanding, and problem solving abilities in new or unfamiliar environments within broader (or multidisciplinary) contexts related to their field of study;

Making judgements
Students have the ability to integrate knowledge and handle complexity, and formulate judgements with incomplete or limited information, but that include reflecting on social and ethical responsibilities linked to the application of their knowledge and judgements;

Communication
Students can communicate their conclusions, and the knowledge and rationale underpinning these, to specialist and non-specialist audiences clearly and unambiguously;

Learning skills
Students have the learning skills to allow them to continue to study in a manner that may be largely self-directed or autonomous.

Body of knowledge and skills and competences

The body of knowledge and skills (BOKS) and competences are used as indicators for the reached level of education. For the engineering field 7 competences are defined (figure 2 Boks and competences)

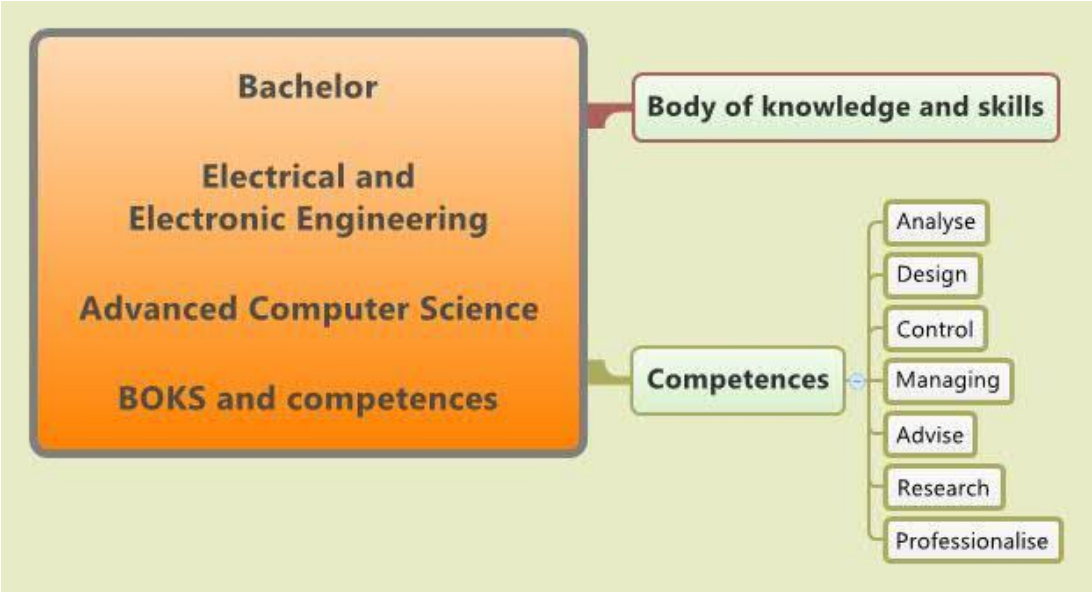


Figure 2 Body of knowledge and skills and competences

In the design of the curriculum both the Dublin descriptors and the BOKS and competences have been taken in account.

Curriculum phasing

The emphasis of the first two years (semesters 1,2,3 and 4) of the curriculum is on the gaining knowledge base and skills of electrical and electronic engineering and advanced computer science, while in year 3 and 4 (semesters 5,6,7 and 8) the attention focuses on application of knowledge, making of judgments and advanced learning skills. An overview is given in figure 3 semesters and Dublin descriptors.

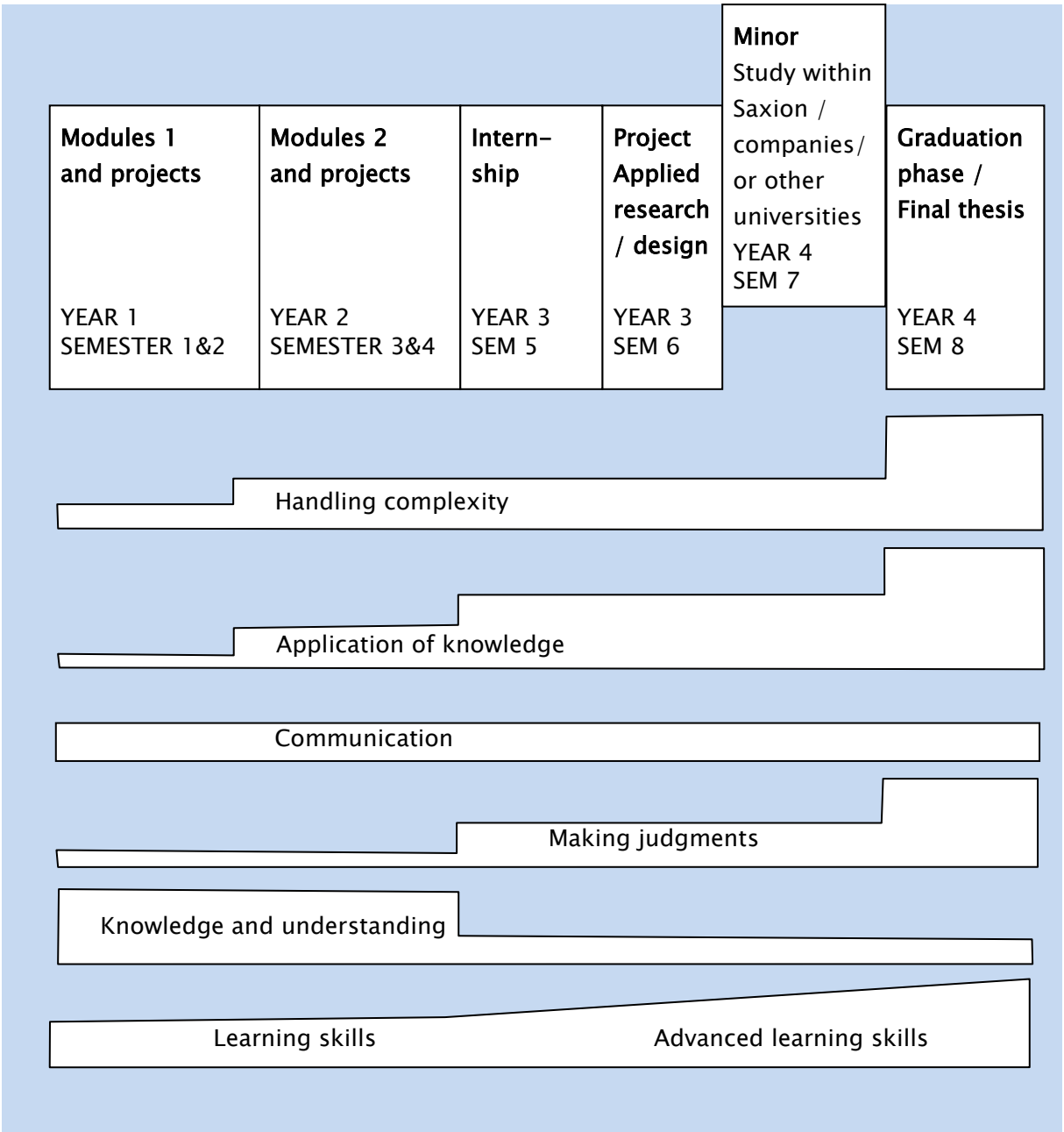


Figure 3 Semesters and Dublin descriptors

Student as manager of his own development

The Dutch education system is based on a pro-active student. Professors are available to help students for their own educational development. The professors will coach the students. Students can use the professional experience of professors.

Specialisation

Within Electrical and Electronic Engineering (EEE) the students can choose a specialization, Electrical Power and Automation (EPA)or Electronic Information Engineering (EIE) of

Field of work

An analysis of the field of work formed another input to the design of the curriculum. The work field of an engineer is wide; control and measurement systems, security systems, telecommunication, energy and automation, consumer electronics, medical electronics, transport systems multimedia and so on. Graduates work in the field of engineering as a hardware designer, software developer, technical advisor, group leader and many other positions.

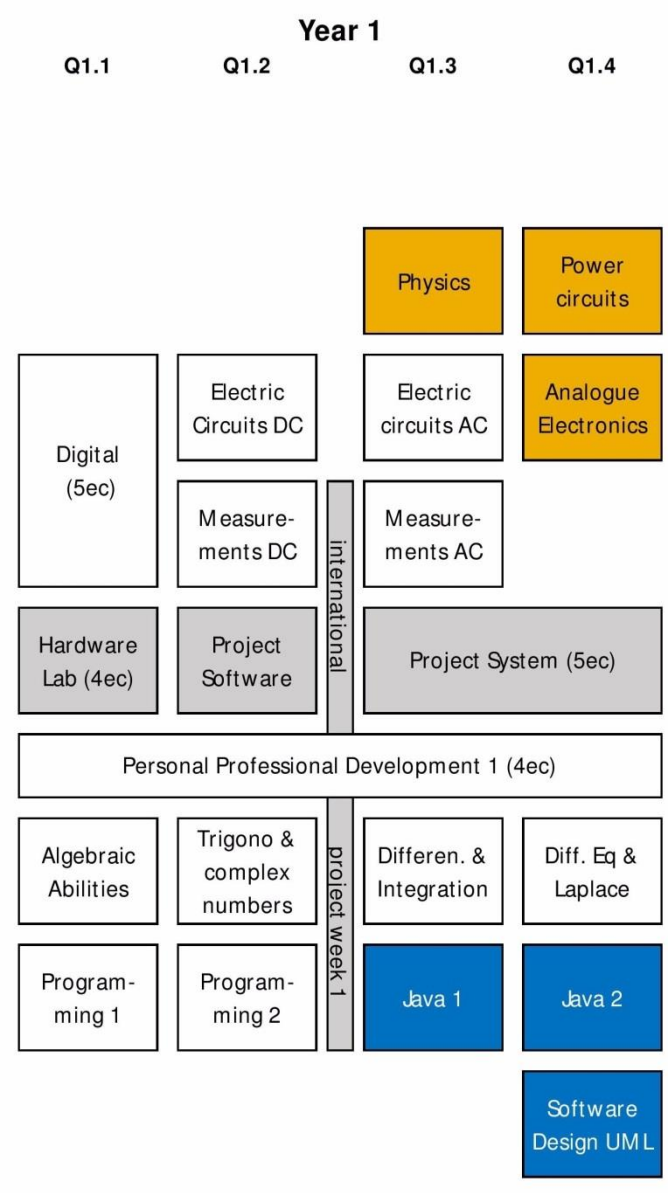
Short Degree Program (SDP)

A short degree program is a transition program for students who already started bachelor education in another country at another university. The curriculum of the Short Degree Program (SDP) focuses on the application of knowledge, making of judgments in a complex electrical engineering and advanced computer science environment. Every SDP is tailor made to the specific student's situation. Saxion offers SDPs EEE-EPA-EIE of 3, 4 and 5 semesters. In the shortest, 3 semester, format the SDP comprises of a set of modules and projects (semester 3 of the regular programme) , the living technology project (semester 6) and the graduation project (semester 8). Contact the admission officer for specific questions regarding your specific situation.

Program overview

The in-house curriculum consists of three main area's; theoretical courses, practical (laboratory) courses and projects.

First year (60 EC points)



The base of every engineering education is the mathematics and physics. From technical point of view you learn all about network analysis, analogue electronics, digital electronics, programming These courses contain as well as theoretical knowledge as practical lab-work.

Applying knowledge is done in the projects. Project Hardware handles about making an alarm system. In Project Software the knowledge of programming and is used to make safe and practice project management skills. Project System provides the introduction to design methodology.

The project work needs some special skills, the social skills witch will be trained in the projects. Beside that there is a special course on social skills and communication.

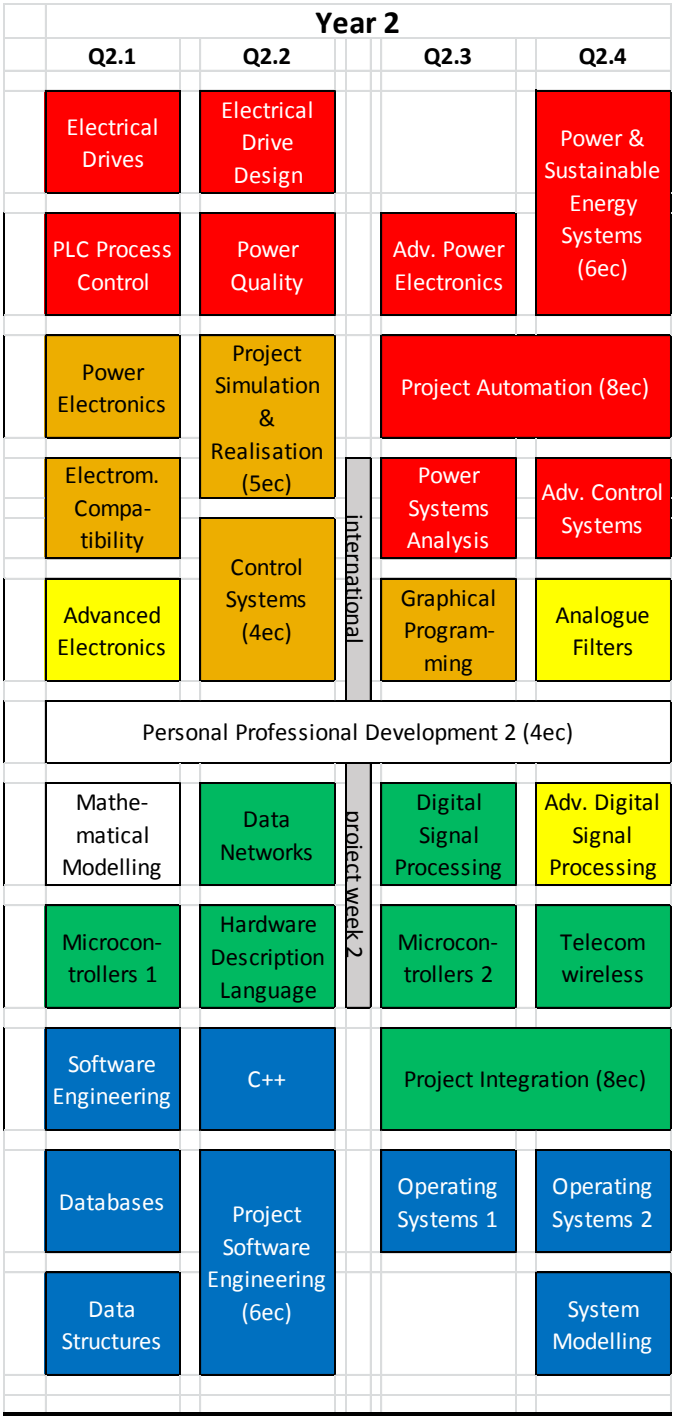
The coloured modules provide a limited specialisation One week every year is used for the "project week" in which students over various engineering department and all study years cooperate to solve projects for the local industry

After successfully completing the first year, students get a "certificate of the first-year examination", and continue in the second year, where they choose their specialisation.

White and grey= all students, orange = EPA and EIE students, blue = ACS students

Second year (60 EC points)

The field of EEE-EPA-EIE and ACS is very wide, the student can specialise in the 2nd year. All projects (bottom), basic courses (white) and Personal Professional Development 2 (bottom) should be done by every student. Beside that students can choose one of the three specialisations EPA, EIE or ACS;



Electrical Power and Automation EPA (red and orange in curriculum). This specialisation focuses on high power, high voltage, energy conversion and large scale automation.

Electronic Information Engineering EIE (orange yellow and green in the curriculum). This specialisation focuses on micro electronic intelligence, signal control, analysis and communications.

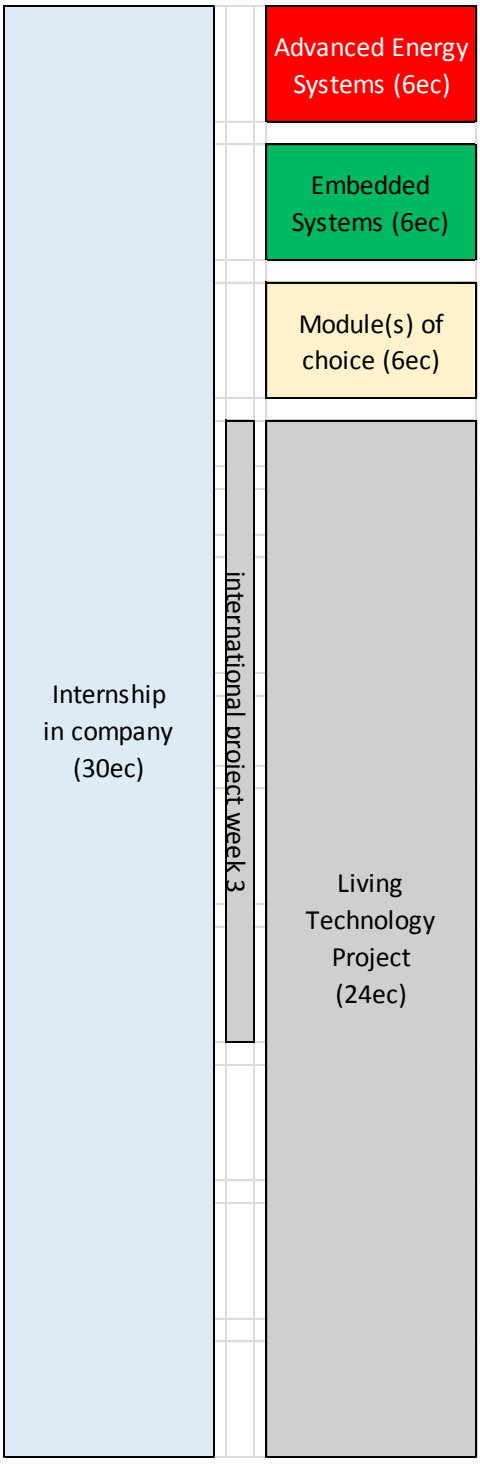
Applied Computer Science ACS (blue in curriculum) Software science.

In the projects students learn to work in accordance with a design methodology. The V design model is used to bring project from idea to realisation.Four different projects are defined, in two of them students of the different specialization work together.

The second year is an in depth training in the field of electrical and electronic engineering and also project work. All literature is in English and the curriculum is build up with help of professionals of companies working for companies. Changes of the curriculum will be on advice of these professional in the field of Electrical and Electronic Engineering.

The 2nd year is a real technical and social preparation for the first practical company test; the internship.

Third year (5th & 6th semester)



Internship (30EC)

This is a practical half year, internship. For the half year the student is working in a company. The student has got a company and an university coach. The company experiences are very important; How to integrate theoretical and practical work, how to co-operate with real colleagues, working in a multi-discipline team.
Questions for the student; what type of work fits me? What field of electronics I am interested in, or want to develop? The internship is ended with an internship report and a final presentation at the university.
Internship carries 30 EC points

Living technology project

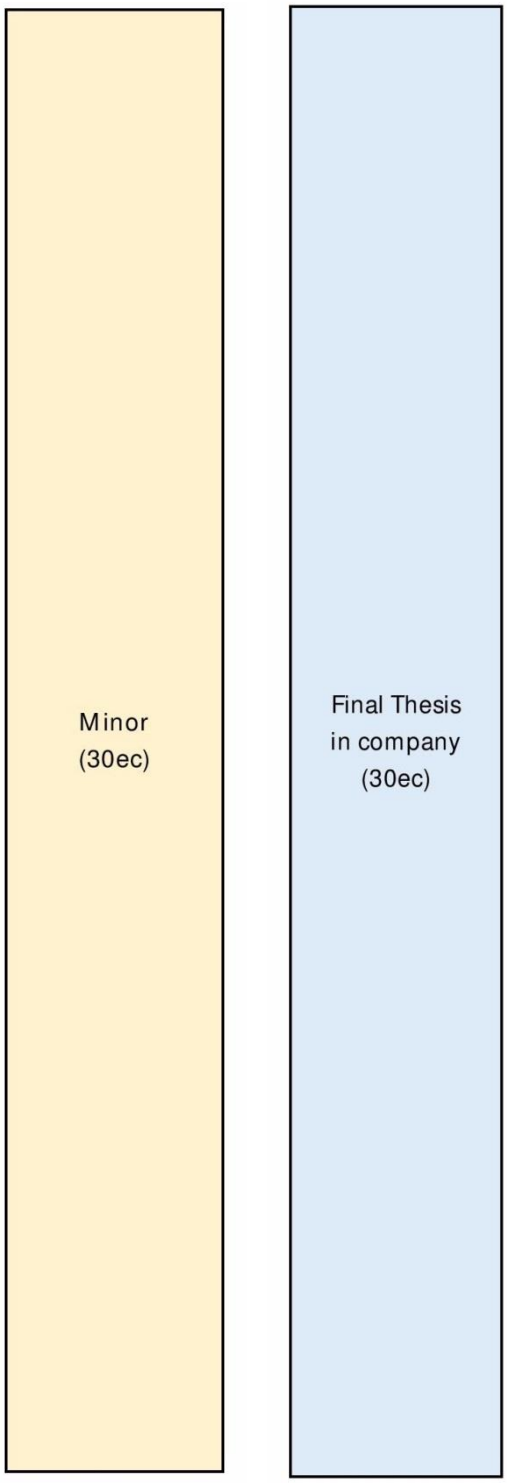
In the second part of the third year (6th semester) the student will learn how to carry out applied research in his specialisation. Further a large project is carried out in which the students will practice the steps (V-model) required to carry out large projects successfully.
Projects are dealing with the new developments in the field of electrical engineering in EPA as well as EIE.
Besides a specialised module of the specialisation offered during the 3rd year, students have a possibility to gain 6 EC by an activity of their own choice, such as:

- Cultural awareness & English
- External assignments
- Digital manufacturing & 3 D printing.
- Other choices approved exam board

As an alternative this semester can be replaced by the European Project Semester (EPS). Students carry out a project in one of the SAXION EPS partner universities elsewhere in Europe

The second part of the third year (7th semester) covers 30 EC.

Fourth year (7th and 8th semester 60 EC points)



The minor gives the student the opportunity to choose his own development, so it is an elective semester. Several minors are offered, to develop theoretical skills in depth, or one extra advanced internship is offered to develop some more practical company experience.

It is also possible to choose a pre-master at a technical university of sciences as a preparation for a master study. The minor gives a total of 30 EC.

In the second semester the student does his final thesis. Here the student will prove his/her bachelor level in company. The student is coached by a company coach and a university coach. The final thesis is ended with a report and a final presentation at the university. The final thesis will be assessed by 3 persons; the company coach, the university coach and a second university coach. At the end the student should meet all competences of a (professional) bachelor of engineering. Final thesis gives 30 EC.

All five learning outcomes required for the bachelor level have to be met by the student. in short;

1. Knowledge and understanding.
2. Applying knowledge and understanding.
3. Making judgments.
4. Communication.
5. Learning skills.

Graduation

As a bachelor student you graduate as a Bachelor of Science (Official degree BSc.)

Modules of year 1, year 2 and year 3

The theoretical and practical modules offered in the 1st and 2nd year provide the body of knowledge and skills of Electrical and Electronic Engineering and Applied Computer Science. For each modules a detailed description is available. In this overview a the purpose and general objectives of the modules are summarised. The modules of mostly 3 EC each, can be clustered in 10 groups:

Network theory

Electric Circuits DC (ACS & EEE)

Network components / Units and notation / / Ohm's law / Kirchoff's laws / Series and parallel connection / Voltage, current, resistance, power and energy/op-amp (basis amplifier circuits) /Voltage and current divider / Thevenin, Norton and superposition theorems / Ohm's law / Kirchoff's laws / Time response of RC and RL circuits (Integrators and differentiators) / Op amp.

Electric Circuits AC (ACS & EEE)

Complex number system and calculations / Application of electrical laws in AC circuits / Impedance of series and parallel circuits / Resonance (parallel and series) / Bode diagram / Filters (RC low-pass, RL low pass, RC high-pass, RL high-pass).

Power Circuits (EEE)

Transformers: Ideal transformers, Real transformers (hysteresis, eddy currents, Leakage flux, Equivalent circuit. losses), Cores (Laminated steel, Solid, Toroidal) / AC power: P, Q, S, power factor, power factor correction / 3 phase systems: Line-Line voltages, Line-Neutral, Delta-Why configurations and connections, Balanced loads, Unbalanced loads, Three phase loads, ... / Rectifiers (AC → DC): Diode, single phase rectifiers, Full bridge, Ripple voltage, Capacitor calculation, 3 phase rectifier / Invertors (DC → AC): Single phase topologies (H-bridge, half and full), 3 phase topologies / Rotating DC machine.

Physics & Mathematics

Physics (ACS & EEE)

Harmonic motion / reflection & transmission / Coulomb's law / electrical field / charged particles / magnetic principles / induction / force / inducted EMP/ generator / Eddy current.

Algebraic Abilities (ACS & EEE)

calculate with numbers / calculate with symbols / fractions with symbols / formulas, graphs and lines / quadratic functions / rational functions / power functions / square roots / exponential functions / logarithmic functions.

Trigonometry & Complex Numbers (ACS & EEE)

Circular functions / Trigonometry: graphs and equations / Inverse circular functions / the number e, natural logarithm, hyperbolic functions / Complex numbers, Argand diagram, complex calculations, modulus and argument, conjugated, Polar form, Euler formula, powers of complex numbers, equations / Alternating Current (AC) using complex calculation / Scalars and vectors, calculations with vectors, scalar product, vector product / Matrix algebra: definitions, properties, basic operations, matrix multiplication / solve linear systems of equations using Matlab.

Differentiation & Integration (ACS & EEE)

Techniques of differentiation / Chain rule / Special functions and their derivatives / Integration as anti-derivative / Rational functions: partial fraction / Integration by parts / Substitution.

Differential Equations & Laplace (ACS & EEE)

Classification of differential equations / First order ode: separable and linear / Higher order ode: linear ode, homogeneous and non-homogeneous / Applications in electrical circuits / Laplace-transforms / Inverse transform / Differential equations with Laplace.

Mathematical Modelling (ACS & EEE)

Use of Mat-lab software package to make mathematical models

Personal professional development

Personal professional development 1 (ACS & EEE)

- International project week 1 (project with fellow students of other engineering disciplines)
- Projects skills (planning, roles, meetings and presentation skills)
- Personal skills (study coach meetings / study skills / excursions / orientation on the profession / reflection on personal behaviour / curriculum, competences and specialisation).
- Research skills (defining research questions)
- Writing skills (Correct spelling and punctuation at $B2^{+}$ level, individual writing task)

Personal professional development 2 (ACS & EEE)

- International project week 2 (project with fellow students of other engineering disciplines)
- International project week 3 (project leader: leading a multidisciplinary team)
- Personal skills (study coach meetings / excursions / orientation on the profession / reflection on personal behaviour).
- Transferring to the “work of work”, Internship and final thesis preparations, Curriculum Vitae, application letters.
- Research skills (Research assignment, preparation for living technology project)

Programming

Programming 1 (ACS & EEE)

Variables and datatypes, expressions and operators, if-else statements and conditional expressions, loops, Arduino I/O, arrays, functions and global variables, write loop, write function, draw flowchart

Programming 2 (ACS & EEE)

Functions, Pointers, Memory / bit operations, Casting / automatic conversion, Strings / ASCII / string manipulation / Arduino string object, Recursive functions

Visual Programming (EEE)

Object oriented programming in Java: Inheritance / Collections / Threads / Exceptions / Graphical User Interface (GUI).

Java 1 (ACS)

Object oriented programming in Java: Data types and operators, Program control statements, Classes, objects and methods, Inheritance

Java 2 (ACS)

Object oriented programming in Java: Threads /Graphical User Interface (GUI).

UML software design (ACS)

Design methodology / Diagrams (Class, Sequence, Use case, State and Activity).

Software Engineering (ACS)

Scrum and XP, Belbin team roles, Version control, Make files & Maven, Continuous Integration, Software Quality, Requirement Engineering, Test Driven Development & Behavioural Driven Development, Tools (like: Git, Jenkins, Maven, Sonic Cube)

Data structures (ACS)

Advanced programming in C: Pointers / Data structures.

C++ (ACS)

Advanced Object oriented programming in C++ / operator overloading.

Operating systems 1 (ACS)

Boot sequence / File Systems / Memory management.

Operating systems 2 (ACS)

Concurrency / Threads / Synchronization and Semaphores.

Analogue electronics

Electronics (EEE)

Theory: Fundamental characteristics of diode, Op. Amp. as a building block (linear & non-linear), Characteristics Bipolar transistor, Biasing transistors, Small signal model of Transistor, Transistor as an amplifier.
Practical: Implementation of an OpAmp. amplifier en measuring its performance. Biasing the BJT circuit (CEC) configuration.

Advanced Electronics (EEE-EIE)

Multistage Bipolar amplifier stages (Common collector and Common base), Frequency dependency of Bipolar amplifier stages, Switching with semiconductors (J-FET & MOS), MOS amplifier, Differential amplifier with bipolar transistors (Common mode gain, Differential mode gain, Current mirror), Oscillators, PLL.

Analogue filters (EEE-EIE)

Historical overview (analogue, digital, noise, filter examples), Sources, Filter specification (type and order), data conservation, filter tables, Selection in Amplitude, Frequency or Phase domain, Filtering systems (Cascade, Parallel, Direct), Fundamentals of Transfer Function, Circuit component sensitivities, BiQuad (high order filtering systems). Trans Linear Circuits, General Impedance converters (GIC, NIC), Current mode design vs. Voltage mode design

Digital electronics

Digital (ACS & EEE)

Boolean Algebra / Logic Gates / Gray code / binary coding and calculation. / Introduction FPGA / State machines / Latches / D-A (Digital/ Analogue converter) and A-D / HDL basics.

Microcontroller 1 (ACS & EEE-EIE)

Microprocessor architecture / instruction set / Machine code / Assembler / memory systems / direct and indirect addressing modes / data path and control / Interrupt, memory mapped and programmed Input / Output / Direct Memory access / ADC.

Microcontroller 2 (ACS & EEE-EIE)

Microprocessor block diagram / Memory Map / LCD Character display / serial communication RS232 / Delays / Bouncing / ADC, DAC / PWM / SPI theory / SPI Chips temperature sensor , I/0 expander, serial eeprom / I2C theory / I2C Chips I/O expander.

Hardware description language (HDL) (EEE-EIE & ACS)

Data Types and operators / Synthesis / Multiplexer in VHDL / Structured description / Behavioral description / Register Level description. / Timing Level Description / Logic / Sequential logic / Memory / Hierarchy in VHDL.

Digital signal processing (EEE-EIE & ACS)

Signals in time and frequency domain, harmonics, THD, Fourier transform, odd and even functions, Sampling / ADC/DAC / Fast Fourier Transform.

Advanced digital signal processing (EEE-EIE)

Digital signal processing and the frequency domain. / Z-transform / Inverse Z-transform / Difference equations / Programming form: Serial Direct and Parallel. / Programming in a microcontroller.

Embedded systems (EEE-EIE & ACS)

Verilog / NIOS programming environment / Functions and Tasks / Video and Audio processing / Implement a larger program on a development board / system on chip.

Control theory

Control systems (EEE)

Block diagrams, modeling, analogies, system linearization / PID controller construction / Overshoot, rise time, peak time and settling time.

System modelling (ACS

Control theory, block diagrams, modeling / PID controller / Software implementation of control systems

Advanced control systems (EEE-EPA)

Mathematical models of physical systems / Graphical presentations (Bode diagram, Nyquist, Pool Zero plots) / Phase and gain margin / Ziegler and Nichols / Fuzzy controller.

Tele- and data communication

Data networks (EEE-EIE & ACS)

TCP/IP reference model & protocols: application layer, transport layer, network layer / datalink layer / Simple socket programming / high level wireless protocols.

Telecommunication (EEE-EIE & ACS)

Datalink & Physical layer of TCP/IP reference protocol / Medium Access Control / channel properties/ Analogue modulation principles / Digital modulation principles / Line transmission Attenuation, level diagram / Noise floor, Signal to Noise ratio, amplifier with noise.

Tests and measurement / Applied research / Design- and development methodology

Measurements (DC) (EEE-EIE & ACS)

Application and handling of measurement equipment / Use of oscilloscope, multi-meter, generator. Use of virtual measurement instruments (My-Daq) / Measurements to support understanding of network theory (DC) Measurement techniques / Analysis of measurement data / Measurement report and reporting skills.

Measurements (AC) (EEE-EIE & ACS)

Measurement methods, accuracy and faults. / Measurements to support understanding of network theory (AC) / Measurement techniques / Analysis of measurement data / Measurement report and reporting skills.

Electromagnetic Compatibility (EEE)

Introduction to EMC; EMC basics, Passive components, Crosstalk, Cables, Earth and reference, Transmission lines; Screening by metal enclosures.

Project & Practical's YEAR1

Practicum hardware (EEE & ACS)

Soldering exercises, knowledge of components, measurements, functional description, introduction to the V-model / Realisation of simple circuits Tests and measurements hardware realisation workshop and instruction.

Project software (EEE & ACS)

Project Safe and electronic lock: uC project / UC workshops / hardware realisation / Team work / project work.

Project System (EEE & ACS)

Design of a basis system e.g. coffee maker, autonomous vehicle or other: Use of V-model / Team work / Customers requirements / PCB design / competence assessment/ housing design.

Projects YEAR 2:

Project Simulation Realisation (EEE)

Design, build and test a switch mode power supply: Implementing bottom, part of the V-model (Technical design, Simulation Unit/Device Test, Realisation)

Project Software system (ACS)

Software design project using Scrum

Project Automation (EEE-EPA)

Industrial automation project: Implementing the V-model /SCADA / industrial networks.

Project Integration (EEE-EIE & ACS)

Realisation of electronic systems / Schematic realisation / PCB designing / System integration - heartbeat monitor / Implementing the V-model.

Project YEAR 3

Living technology project (EEE & ACS)

Applied research in electronic systems or energy systems

Competences:
Systems thinking / Analysing and detailing requirements / Making a functional design / Integrating different techniques / Learning independently / Professional and Methodological working.

Learning objectives:
Designing a small system using a methodological method (V-model) / Writing intermediate documents such as a Project Plan, Design Requirements and Functional Design / Independently learning something new.

Automation, Energy distribution, conversion and drives

PLC control (EEE-EPA)

Three layer model of a factory / Traditional control versus PLC control / PLC control: Analog I/O, Digital Filtering, PID control / PLC programming / Programming basics / ST language / FBD language / SFC language.

Power systems analysis (EEE-EPA)

Generation of electrical energy (coal, hydro, gas, sun, water, etc.) / Power and power factor calculations in single phase and three phase power / Network calculations for balanced and unbalanced, star and delta connected, ABC and CBA sequence three phase networks / Load

flow calculations / The per unit system representation / Single line equivalent diagrams / Numeric solving of non-linear equations (in power flow calculations) / Load flow calculations. / Short circuits in power networks.

Power & sustainable energy systems engineering (EEE-EPA)

Sustainable energy / Distribution and transmission networks /Load flow in power networks / Feed-in of decentral generated energy / Smart grid approach/ Simulation of electrical power networks

Advanced energy systems (EEE-EPA)

Applied research in energy systems / Analysis a an energy systems and its application / Research questions and research processes for applied research / Methodology for designing processes for research / Research process control / Effective involvement of field experts if required.

Power electronics (EEE)

Linear DC regulators, Buck converter, Boost converter, Buck-Boost converter, DC- DC converters with electrical isolation, Transformers for galvanic isolated DC-DC converters

Advanced power electronics (EEE-EPA)

Diode rectifiers, Line Frequency Phase Controlled Rectifiers and Inverters, Voltage source converters, Resonant Converters.

Power Quality (EEE-EPA)

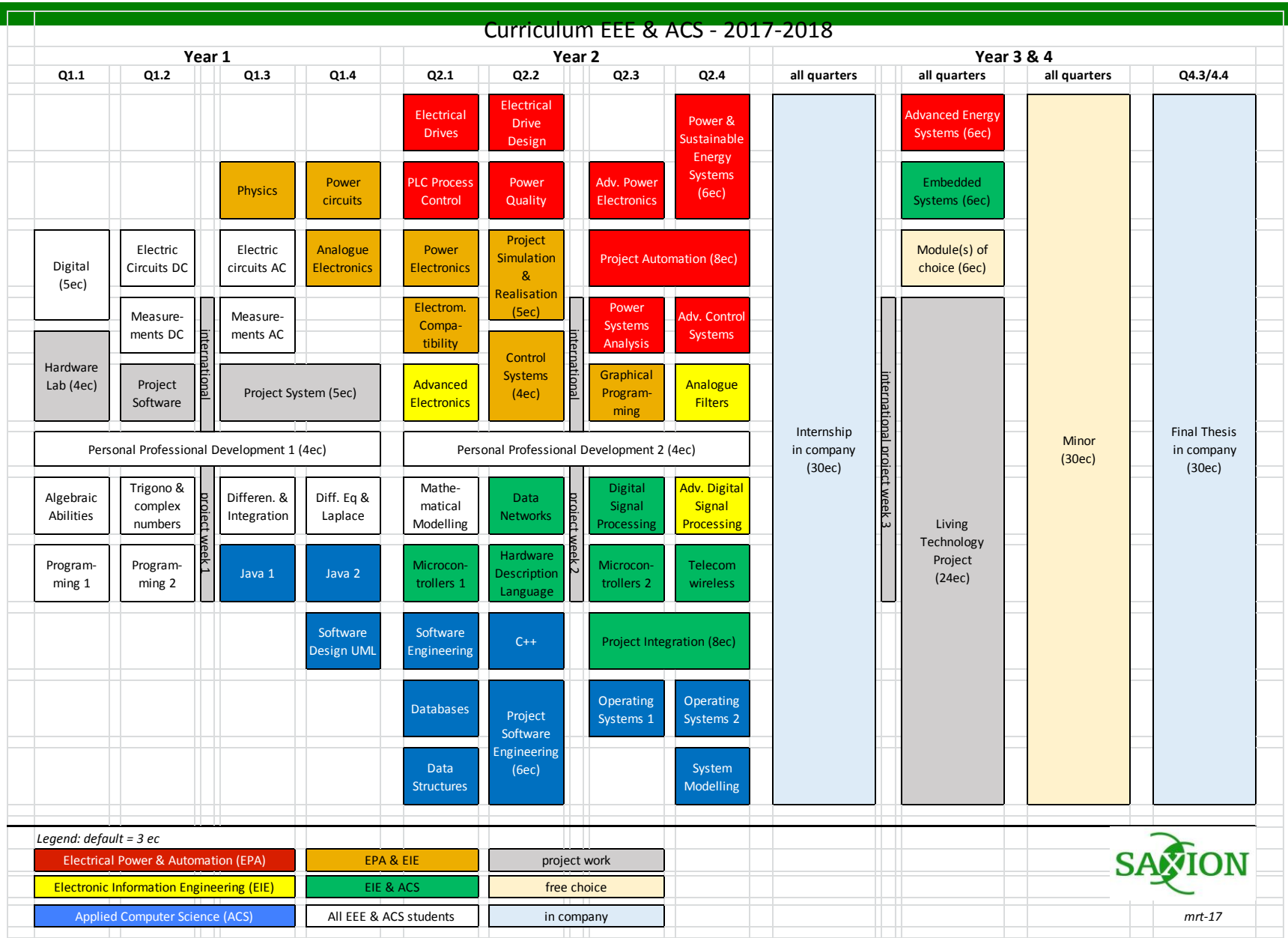
Introduction Power Quality, Fourier Analysis, Rectifiers, Electric Utility Application, Power Factor controlled single phase rectifier, Uninterruptable Power Supplies (UPS)

Electrical drives (EEE-EPA)

Introduction to electrical drives, Magnetic circuit concepts, Power transformer theory, Electromechanical systems (dynamics and analogies), Motor/load interactions, Standard DC machines, Brushless DC machines Induction Machines, Synchronous Machines.

Electrical Drive Design (EEE-EPA)

Control of Electrical AC Machines, drive design by using simulation software.


Curriculum EEE & ACS - 2017-2018
Year 1
Year 2
Year 3 & 4
Q1.1
Q1.2
Q1.3
Q1.4
Q2.1
Q2.2
Q2.3
Q2.4
all quarters
all quarters
all quarters
Q4.3/4.4
Digital (5ec)
Electric Circuits DC
Electric circuits AC
Analogue Electronics
Physics
Power circuits
Electrical Drives
Electrical Drive Design
Power & Sustainable Energy Systems (6ec)
Advanced Energy Systems (6ec)
Embedded Systems (6ec)
Module(s) of choice (6ec)
Measure-ments DC
Measure-ments AC
Power Electronics
Project Simulation & Realisation (5ec)
Project Automation (8ec)
Electrom. Compa-tibility
Power Systems Analysis
Adv. Control Systems
Hardware Lab (4ec)
Project Software
Project System (5ec)
Advanced Electronics
Control Systems (4ec)
Graphical Program-ming
Analogue Filters
international
international
international
Personal Professional Development 1 (4ec)
Personal Professional Development 2 (4ec)
Internship in company (30ec)
Minor (30ec)
Final Thesis in company (30ec)
Algebraic Abilities
Trigono & complex numbers
Differen. & Integration
Diff. Eq & Laplace
Mathe-matical Modelling
Data Networks
Digital Signal Processing
Adv. Digital Signal Processing
project week 1
project week 2
project week 3
Program-ming 1
Program-ming 2
Java 1
Java 2
Microcon-trollers 1
Hardware Description Language
Microcon-trollers 2
Telecom wireless
Living Technology Project (24ec)
Software Design UML
Software Engineering
C++
Project Integration (8ec)
Databases
Project Software Engineering (6ec)
Operating Systems 1
Operating Systems 2
Data Structures
System Modelling
Legend: default = 3 ec
Electrical Power & Automation (EPA)
Electronic Information Engineering (EIE)
Applied Computer Science (ACS)
EPA & EIE
EIE & ACS
All EEE & ACS students
project work
free choice
in company
SAXION
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