

During the first two years of the graduate program, the students deepen their knowledge and insight into the specific field, and learn to apply this knowledge in research. The learning aims during this phase are listed in appendix A. For the NDS graduate program the priority in the M.Sc. phase is on gathering the essential basic knowledge and skills in:

a. physics

- quantum mechanics,
- thermodynamics (BIOS, MCS, TST, MFI) or solid state physics (ICE, IOMS, SC, NE)

b. system / circuit analysis,

c. micro/nanofabrication,

d. material science,

e. device physics and design (micron scale, nano scale)

Subjects c, d, e are characteristic for the program and form the four core courses in the first year. Subjects a and b should be scheduled depending on the background (B.Sc.) of the student and form the homologation program.

During the Ph.D phase deepening of the knowledge and skills in close relation with the Ph.D. research is aimed at. In this phase an important aspect is a philosophical reflection on the logic and methodology of performing scientific research.

*Year 1*

*Compulsary (20 EC)*

- Technology (121073) or Fabrication of Nanostructures (340015) 5EC
- At least 5 EC Device Physics/ Design courses:
  - {MEMS design (121130) 5 EC, LOC (121112) 5EC, Integrated Optics (121088) 5EC, Nano-electronics (340014), Integrated Circuit Technology (121144) 10 EC}
- Material Science (142013, 121074, 353002)
- Nano-Devices Case Studies (new course)

*Homologation:*

A sound basis in the following subject is required and an individual homologation program should be made for the students depending on his/her background

a. physics

- quantum mechanics
- thermodynamics / statistical mechanics (BIOS, MCS, TST, MFI) or solid state physics (ICE, IOMS, SC, NE)

b. system / circuit analysis

***Possible Electives in addition to above***

For example: Nanofluidics (340012), Introduction to quantum mechanics (141128), Physics of Fluids (147023), EMStatics (121169), Theory of EM fields (121129), Electrodynamics (144006), Characterization of Nanostructures (340016), Introduction to Superconductivity (353000), Correlated Electrons, Statistical Physics (141002), Design principles for precision mechanisms (113136), mechatronic design of motion systems (121110), Control Engineering (121044) 5 EC, Statics + Mechanics of Materials I (115717, 115718) 5 EC, Nanophysics (353001) 5 EC, Wish: New course on Physical Chemistry for Micro/Nanofluidic Systems

***Year 2***

***International Training/Internship (20 EC)***

The trainee-ship is an important part of the Master program. We put a high value on an international trainee-ship, as besides the technical and scientific development it contributes to the personal development of the students and relates to many of the non-technical learning goals for the Master phase.

***Master Thesis Project (40 EC (EE, NT) or 50 EC (APH))***

Right after returning from the trainee-ship, the students start their MSc thesis project. The subject and thesis supervisor are defined well before the students leave for their trainee-ship, so that we can prepare for their return. It is important to make a coherent program out of the elective courses, trainee-ship and thesis work. Through the master-phase mentorship we support the student in his choices and planning.

***Year 3 - 6***

***General aspects***

This phase is dedicated to the research project that must lead to the Ph.D. thesis. In addition to the technical and scientific skills that have to be further developed attention is paid to personal development of the student in terms of critical scientific attitude, an international perspective on science, and a broad perspective on the role science and technology play in modern society. To support this development the program offers in the 4<sup>th</sup> and 5<sup>th</sup> year courses on philosophical and societal aspects of science and technology, as well as an international internship or exchange with a foreign research group. Moreover the students will assist the staff members in teaching under the motto “to teach is to learn”. The main learning aims for this period are listed in appendix A.

**Year 3 + 4+ 5**

***Educational programme related to research (at least 20 EC):***

- At least 15 EC Elective courses in relation with research: examples see list year 1

**5 – 10 EC Conferences, colloquia, courses related to personal skills**

- Participation in at least two international conferences including poster or oral presentations. Highlights of the conference to be presented in the research group or SRO meetings. (2 EC)
- Participation in all group, SRO and MESA+ colloquia (2 EC)
- Courses related to personal skills, like: Personal Effectiveness (3 EC), technical writing and editing (2 EC), academic presentations (1 EC)

***Educational programme aimed at widening the perspective of the student on philosophy, ethical and societal aspects of technology, as well as innovation and entrepreneurship (10 EC)***

- Courses offered by UT/STW/NWO ( $\geq 10$  EC)
- Wish: New course in philosophy of science and scientific methodologies (5 EC)

***Educational tasks (3 EC courses + 12 EC teaching activities)***

Introductory courses to education (Quick start teaching (1EC) , Teaching and learning workshop (1EC), Supervising final projects (1EC)). After the training, students will be assist staff with supervision of BSc/MSc students, assisting in tutorials and practicals and possible with some lectures if students show interest in teaching activities.

***International internship / exchange (20 EC)***

In the second or third year of the Ph.D. project the student will perform a 4 month internship in a different institution. It will stimulate the development of the student towards becoming an independent researcher, to build an international network, to learn new techniques and approaches in the performance of science in their field of interest.

**Year 6**

Fully dedicated to research and completion of thesis. Participation in at least one international conference is anticipated.