IMPLEMENTATION REGULATIONS
of the Teaching and Examination Regulations for the Master programme "Applied Physics"

Delft University of Technology
2013-2014

Section 1 CORE PROGRAMME AND SPECIALISATIONS

The programme Applied Physics is a two-year master programme and comprises 120 EC.
The programme has a core-specialisation structure. Within this structure, there is a choice of research tracks. The core programme comprises 90 EC and has the same structure for all Master students.
Combining the core programme with a 30 EC specialisation completes the master programme.
Courses that form part of the students bachelor programme cannot be part of the master programme

Tracks
The tracks within the Applied Physics core programme are:

- Bionanoscience (BN)
- Imaging Science and Technology (IST)
- Quantum Nanoscience (QN)
- Radiation Science and Technology (RST)
- Transport Phenomena and Fluid Flow (TPFF)

Specialisations
Eight specializations of 30 EC each can be chosen. These specialisations sometimes imply restrictions on the core programme. The restrictions will be described in detail below.

1. Research and Development (R&D)
2. Astronomy and Instrumentation (AI)
3. Sustainability in Technology (SiT)
4. Education (Ed1/Ed2)
5. Management of Technology (MoT)
6. Annotation in Entrepreneurship (AE)
7. Nuclear Science and Engineering (NSE)
8. Casimir specialisation (Cas)

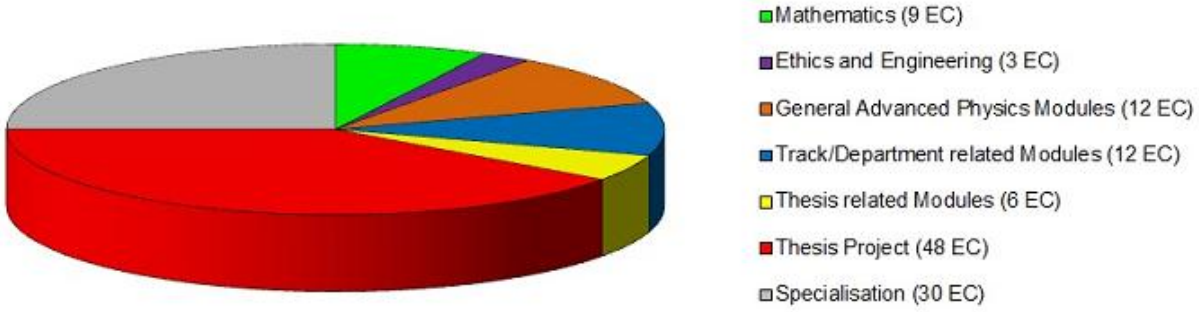
Special programmes
Special programmes within Applied Physics are:

- The Erasmus Mundus programme Optics in Science and Technology (OpSciTech): This programme consists of one year spent at Delft University of Technology and one year spent at one of the partner universities.
- Casimir pre-PhD: This programme, which is linked to the Casimir specialisation and the tracks Bionanoscience and Quantum Nanoscience, focuses on educating students for a PhD position and is designed to respond to the increased mobility of students after their BSc.
- Excellence track on Fluid and Solid Mechanics: This programme, linked to the Transport Phenomena and Fluid Flow track and R&D specialisation, focuses on educating excellent students for a PhD position. It fits within the Mechanical-, Aerospace- and Civil Engineering en Applied Physics master programmes.

Programme additions

- Honours track: This is an individual programme for talented students.
- Double degree programmes: These are three year programmes Applied Physics – Management of Technology, and Applied Physics – Applied Mathematics.

The programme



Article 1 Core Programme

1.1 Obligatory Modules, 12 EC:

The Applied Physics core programme includes compulsory math and ethics modules.

WI4243AP, Mathematical Methods for Physics, 9EC
WM0320TU, Ethics and Engineering, 3EC

Students that have passed the Partial Differential Equation modules WI3150TU and WI4150TU in their bachelor programme, e.g. as part of their minor, have two options with respect to WI4243AP:
1: Complete the three parts of WI4243AP, including the PDE part.
2: Voluntary skip the PDE part of WI4243AP and choose a different course module of at least 3EC (either an AP GDRM-list course, a math course, or another course).

Students that have passed the Complex Analysis module WI2602 in their bachelor programme, have two options with respect to WI4243AP:
1: Complete the three parts of WI4243AP, including the Complex Analysis part.
2: Voluntary skip the Complex Analysis part of WI4243AP and choose a different course module of at least 3EC (either an AP GDRM-list course, a math course, or another course).

It is not possible to get an exemption in the master programme based on courses passed in a bachelor programme without doing an alternative master course module (Teaching and Examination Regulations, article 8).

1.2 General Advanced Physics Modules (G-list): 12 EC must be chosen from the 'G' list, the advanced modules aim at breadth as well as depth in general physics knowledge, following on from the Bachelor's programme. At least two modules must be chosen from this list.

AP3021, Advanced Statistical Mechanics, 6EC
AP3032, Continuum Physics, 6EC
AP3051, Advanced Quantum Mechanics, 6EC
AP3071, Advanced Electrodynamics, 6EC

1.3 Track/Department related Modules (D-list): 12 EC must be chosen from the 'D' list of technical and science subjects relating to the departments and tracks BN, IST, QN, RST and TPFF. D-list courses are more specialised than G-list courses. They are in most cases representative for the research areas of one of the physics departments, although some D-list courses combine research areas of more than one department. The latter are denoted "Interdepartmental". The student must choose at least one module that belongs to the track of his or her choice.

AP3011, Chaotic Processes, 6EC, interdepartmental
AP3081, International Masters Course on Computational Physics, 6EC, interdepartmental
AP3091, Elementary Particles, 6EC, interdepartmental
AP3141, Environmental Physics, 6EC, interdepartmental
UL-TGR, General Theory of Relativity, 6EC, interdepartmental
AP3161, Cellular Dynamics: Stochasticity and Signalling, 6EC, BN
AP3511, Molecular Biophysics, 6EC, BN
AP3691, Evolution and Engineering of Living Systems, 6EC, BN
AP3061, Advanced Wave Propagation, 6EC, IST
AP3111, Quantum Electronics and Lasers, 6EC, IST
AP3121, Imaging Systems, 6EC, IST
AP3231, Medical Imaging, 6EC, IST
AP3671, Optical Wave Guiding, Photonic Crystals and Optical Functions, 6EC, IST

AP3191, Physics of Semiconductor Nanodevices, 6EC, QN
AP3211, Advanced Solid State Physics, 6EC, QN
AP3221, Nanotechnology, 6EC, QN
AP3261, Mesoscopic Physics, 6EC, QN
AP3281, Quantum Transport, 6EC, QN
AP3311, Neutrons, X-Rays and Positrons for Studying Microscopic Structures and Dynamics, 6EC, RST
AP3341, Nuclear Reactor Physics, 6EC, RST
AP3371, Radiological Health Physics, 6EC, RST
CH3792, Introduction to Nuclear Science and Engineering, 6EC, RST
AP3171, Advanced Physical Transport Phenomena, 6EC, TPFF
AP3181, Applied Multiphase Flow, 6EC, TPFF
WB1422A, Advanced Fluid Dynamics A, 6EC, TPFF
WB1424A, Turbulence A, 6EC, TPFF

1.4 Thesis related elective from G, D, R and M list: 6 EC chosen freely from subjects within or outside of the faculty, under the condition that the thesis supervisor gives permission. Possible subjects include those from the 'G', 'D', 'R' or 'M' list. Subjects on the R list are highly specialised research topics. Subjects on the M list are mathematical topics which may be of interest for different research groups. If, following the advice of his or her supervisor, a student wishes to follow a subject that is not on the G, D, R or M lists, prior approval from the Board of Examiners should be obtained.

Research list (R-list)

AP3461, The Origins of Life, 6EC, BN
LM3512, Systems Biology, 3EC, BN
LM3691, iGEM, 18EC*, BN
UL-AB, Advanced Biophysics, 6EC, BN
UL-TB, Theoretical Biophysics, 6EC, BN
AP3382, Advanced Photonics, 6EC, IST-OP
AP3391, Geometrical Optics, 6EC, IST-OP
AP3401, Introduction to Charged Particle Optics, 6EC, IST-DO
AP3531, Acoustical Imaging, 6EC, IST-AK
AP3701, Submm and Terahertz Physics and Applications, 6EC, IST + QN
ET4283, Advanced Digital Image Processing, 6EC, IST-QI
IN4085, Pattern Recognition, 6EC, IST-QI
SC4025, Control Theory, 6EC, IST (DCSC)
SC4110, System Identification, 5EC, IST (DCSC)
SC4120, Special Topics in Signal Processing & Control, 3EC, IST (DCSC)
AP3251, Nano- and biomaterials for nanotechnology applications, 6EC, QN
AP3271, Molecular Electronics, 6EC, QN
AP3291, Quantum Information Processing, 6EC, QN
AP3302, Special Topics in Quantum Mechanics, 3EC, QN
AP3652, Electronics for Physicists, 3EC, QN
AP3661, Quantum Entanglement, 6EC, QN
AP3681, Fairy Tales of Theoretical Physics, 6EC, QN
ET4340, Electronics for Quantum Computing, 6EC, QN
AP3551, Computational Multiphase Flow, 6EC, TPFF
AP3562, Turbulent Reacting Flows, 3EC, TPFF
AP3571, Radiative Heat Transfer, 6EC, TPFF
CH3053, Applied Transport Phenomena, 6EC, TPFF
WB1428, Computational Fluid Dynamics, 3EC, TPFF

AP3242, Particle Therapy Holland, 3EC, RST Health
AP3322, Computational Neutron Transport for Nuclear Reactors, 3EC, RST Energy
AP3361, Clinical Physics of Medical Imaging, 6EC, RST Health
AP3581, Medical Physics & Radiation Technology: Radiotherapy, 6EC, RST Health
AP3631, Nuclear Reactor Kinetics, 3EC, RST Energy
AP3641, Nuclear Reactor Thermal Hydraulics, 3EC, RST Energy
CH3581, Materials for the Nuclear Fuel Cycle, 3EC, RST Energy
CH3771, Nuclear Chemistry, 6EC, RST General
CH3782, Chemistry of the Nuclear Fuel Cycle, 3EC, RST Energy
WB4422, Thermal Power Plants, 6EC, RST Energy

*) LM3691 (iGEM) : a maximum of 12 EC of this module can be included in the AP Master programme; 6 EC must be done outside the 120 EC programme.
If done, the module is part of the R&D specialisation together with an Industrial Internship (AP3911):

- 6 EC freely chosen from the G-,D-,R-,M- or S-lists.
- 6 EC chosen from courses within or outside the faculty under the condition that the thesis supervisor gives permission. Possible courses include those from the G-, D-, R-and M-lists.

For the Bionanoscience track permission of the thesis supervisor for LM3691 is not required; it's always implicitly given. For other tracks permission of the thesis supervisor is required for the second 6 EC. Without permission only 6 EC can be done as part of the AP master programme.

Mathematical list (M-list)

WI4005, Wavelets, 6EC
WI4006, Special Functions, 6EC
WI4141, Matlab for Advanced Users, 3EC
WI4201, Scientific Computing, 6EC
WI4211, Advanced Topics in Analysis, 6EC
ET4389, Complex Networks from Nature to Man-made Networks, 4EC

1.5 Master's Thesis Work: to a total of **48 EC** (AP3901) in a research section of one of the physics Departments or affiliated groups:
BN track – Bionanoscience department;
IST track – Imaging Science and Technology department, or Centre for Systems and Control (3mE);
QN track – Quantum Nanoscience department, or the Opto-electronic Materials section (ChemE);
RST track – Radiation Science and Technology department;
TPFF track – Chemical Engineering department, Fluid Mechanics section (3mE), or Clouds and Climate group (CiTG).
The prior approval of the Board of Examiners should be obtained if the thesis work is performed outside the mentioned departments or affiliated groups. The Board of Examiners may then appoint a supervisor from one of the physics departments.
For the Casimir pre-PhD programme, the master thesis work has a different structure, see below.

Article 2 Specialisations

Combining the core programme with a 30 EC specialisation completes the master programme.

2.1 Research and Development (R&D)

The R&D specialisation consists of an internship outside TU Delft - often abroad – and additional electives. It is the most popular specialisation, and the only specialisation that allows for incorporating bridging/homologation courses in the programme (see Article 4).

18 EC internship in a R&D institution (AP3911), in industry or a foreign research institution.
6 EC, freely chosen from the G, D, R, M or S lists. The S (Society) list can be found at: http://studiegids.tudelft.nl/a101_displayProgram.do?program_tree_id=11788
6 EC, freely chosen from subjects within or outside of the faculty, under the condition that the thesis supervisor gives his or her permission. Possible modules include those from the G, D, R or M list. If, following the advice of his or her supervisor, a student wishes to take a module that does not appear on these lists, prior approval should be obtained from the Board of Examiners.

Note: an option for a Study Abroad semester is to complete the whole R&D specialisation at a foreign partner university. The 30 EC programme should consist of a combination of a 15-25 EC research project and one or more course modules.
Another option for Study Abroad is to do 30 EC of course modules that fit in the (core) programme.
A Study Abroad programme must always be approved by the board of examiners in advance.

2.2 Astronomy and Instrumentation (AI)

Coordinator: Prof.dr.ir. T.M. Klapwijk.
This specialisation is a joint undertaking of the Observatory of Leiden University and the Faculty of Applied Sciences of TU Delft. The master thesis project should be related to astronomical research or some other form of space research. The programme should be approved by the AI coordinator.

10-14 EC Astrophysics Modules, chosen from: AE4890, Planetary Sciences, 4EC UL30, Galactic Structure, Dynamics and Evolution, 6EC UL31, Interstellar Matter, 6EC UL-SD, Stellar Dynamics, 3EC UL39, Star and Planet Formation, 6EC UL42, Stellar Structure and Stellar Evolution, 6EC UL46, Origin and Evolution of the Universe, 6EC UL-CA, Computational Astrophysics, 3EC UL-LSSGF, Large Scale Structure and Galaxy Formation, 6EC UL-OC, Observational Cosmology, 3EC UL-TGR, Theory of General Relativity, 6EC
10-14 EC Instrument-related Astronomy Modules, chosen from: AP3091, Elementary Particles, 6EC AP3121, Imaging Systems, 6EC AP3391, Geometrical Optics, 6EC AP3701, Submm and Terahertz Physics and Applications, 3EC ET4147, Signal Processing for Communications, 4EC ET4235, Digital Signal Processing, 4EC ET4283, Advanced Digital Image Processing, 6EC SC4120, Special Topics in Signal Processing & Control, 3EC UL7, Detection of Light, 6EC UL36, Radio Astronomy, 3EC

UL-PSSI, Physics of Scientific Space Instruments, 4EC UL-SA, Astronomy from Space, 3EC
6 EC, freely chosen from subjects within or outside of the faculty, under the condition that the thesis supervisor gives his or her permission. Possible modules include those from the G, D, R or M list. If, following the advice of his or her supervisor, a student wishes to take a module that does not appear on these lists, prior approval should be obtained from the Board of Examiners.

Required bachelor prerequisites: students who followed a minor in astronomy may enroll in this specialisation without any further preparation. Students who did not follow a major or minor programme in astronomy in their BSc education should study the courses TN1751 and UL44 before starting this programme.
Required bachelor prerequisites (for certain modules):

TN1751, Inleiding Sterrenkunde, 3EC TN2545, Systemen en Signalen, 6EC UL43, Galaxies and Cosmology, 5EC UL44, Radiative Processes, 5EC UL45, Astronomical Observing Techniques, 6EC

2.3 Technology in Sustainable Development (TiSD)

Coordinator: Prof.dr.ir. C.R. Kleijn
This is a university initiative. Approval of the Master's thesis work and the internship by the coordinator is required. The thesis project must be focussed on sustainable development or the development of knowledge and technology aimed at a more sustainable future.

15 EC internship within a R&D institution (AP3922), preferably in industry or a foreign research institution. The internship should have a clear relation to sustainability.
5 EC colloquium 'Technology in Sustainable Development' (WM0939TU).
6 EC Environmental Physics (AP3141).
4 EC of modules from the TiSD cluster-A and cluster-B list. At least 3EC must be chosen from the cluster B list. The lists can be found at www.tudelft.nl/tisd

2.4 Education (Ed1/Ed2)

Coordinator: M.A.F.M. Jacobs.
The educational programmes are aimed at Dutch-speaking students only, because they are oriented towards the Dutch school system and because it includes internships (Schoolpracticum) at Dutch schools. Consequently the educational specialisation modules are taught in Dutch. The programme consists of Basisdeel/Ed1 (30 EC) and Verdiepingsdeel/Ed2 (30 EC).
The minor Education (Basisdeel/Ed1) can be done during the bachelor programme and leads to certification as a tweedegraads secondary school teacher with limited qualification (beperkte bevoegdheid). If a student has done the minor Education, only the Verdiepingsdeel/Ed2 of 30 EC remains for the master programme specialisation. The combination of the minor Education and Ed2 specialisation leads to certification as a fully-qualified eerstegraads (grade-one) secondary school teacher. The certificate will be attached to the master diploma.
Students that did not take the minor Education can follow the Basisdeel/Ed1 specialisation as part of their master programme and then do the Verdiepingsdeel/Ed2 as a post-master course in order to become fully qualified.
The programme should be approved by coordinator.

30 EC Education - Basisdeel (Ed1) SL3031, Didactical Skills, 3EC SL3041, Orienterende Stage, 3EC SL3111, Research Methodology in Social Sciences, 3EC SL3122, Didactics Physics 1, 2EC SL3164, Field Orientation Physics A, 9EC SL3332, Didactics Physics 2, 4EC SL3462, Educational Science, 6EC
30 EC Education - Verdiepingsdeel (Ed2) SL3012, Integration SC/SE, 3EC SL3021, The Designing of Communication and Education Products, 6EC SL3311, Research of Education, 6EC SL3371, Didactics Physics 3, 3EC SL3414, Field Orientation Physics B, 12EC If, due to changes in the programmes, SL3111 (Research Methodology in Social Sciences, 3EC) has not been done as part of the minor or basisdeel, it has to be done additionally for the certification as a fully-qualified eerstegraads (grade-one) secondary school teacher.

2.5 Management of Technology (MoT)

Coordinator: Dr. R.M. Verburg

This specialisation is offered by the faculty of Technology, Policy and Management. The programme consists of either the first semester or the second semester of the MSc Management of Technology. A mixture of courses from both semesters is only permitted if it is a coherent set of modules that is approved by the MoT programme coordinator in advance.

1st SEMESTER MoT Modules (30 EC) MOT1001, Integration Moment I, 4EC MOT1411, Technology Dynamics, 4EC MOT1420, Economic Foundations, 6EC MOT1460, Corporate Finance, 4EC MOT1523, Leading and Managing People, 4EC MOT1530, High-tech Marketing, 4EC MOT2311, Quantitative Research Methods, 4EC
2nd SEMESTER MoT Modules (30 EC) MOT1002, Integration Moment II, 4EC MOT1432, Technology and Strategy, 6EC MOT1441, Values in MOT: from empirical research to corporate social responsibility, 4EC MOT1451, Inter- and intra-organisational decision making, 5EC MOT1531, Business Process Management & Technology, 5EC MOT2420, Innovation Management, 6EC

2.6 Annotation in Entrepreneurship (AE)

Coordinator: Dr. L. Kamp

The student makes a proposal for the courses to be followed and for the final thesis and will discuss the proposal with the coordinator of the Delft Centre for Entrepreneurship (DCE) and a coordinator from the faculty. The programme should be approved by the programme coordinator and must always be approved by the board of examiners in advance.

An Annotation in Entrepreneurship certificate will be granted during the graduation ceremony.

2 EC Entrepreneurship Annotation Week (WM4001TU).
8 EC Annotation Entrepreneurship Final Thesis (WM4003TU).
14 EC Modules on Entrepreneurship, suggestions:

ET4247, HighTech Start Ups, 5EC ID4315, New Product Commercialization, 6EC ID4330, New Product Economics, 3EC ID5600SET, Smart Energy Products, 4EC MOT9556, Corporate Entrepreneurship, 6EC WM0506TU, Ready to startup, 6EC WM0516TU, Turning Technology into Business, 6EC WM0521TU, Business Analysis of Entrepreneurship, 6EC WM0563TU, Starting New Ventures, 3EC
6 EC Free Elective Either an additional module on Entrepreneurship, or a regular Applied Physics G-,D-,R- or M-list module.

2.7 Nuclear Science and Engineering (NSE)

Coordinator: dr.ir. M. Rohde
Nuclear Science and Engineering has to be a core issue in the graduation project and the internship. Approval of the thesis work and the internship by the coordinator is required. Nuclear Science and Engineering may have a focus on either "health" or on "energy".
An NSE certificate will be granted during the graduation ceremony.

18 EC internship (AP3911)
12 EC NSE electives 6EC to be approved by the master thesis supervisor from these lists. 6EC free choice from these lists. **General NSE Modules** AP3091D, Elementary Particles, 6EC AP3311D, Neutrons, X-Rays and Positrons for Studying Microscopic Structures and Dynamics, 6EC AP3371D, Radiological Health Physics, 6EC CH3771, Nuclear Chemistry, 6EC CH3792, Introduction to Nuclear Science and Engineering, 6EC **NSE Energy Modules** AP3322, Computational Neutron Transport for Nuclear Reactors, 3EC AP3341D, Nuclear Reactor Physics, 6EC AP3631, Nuclear Reactor Kinetics, 3EC AP3641, Nuclear Reactor Thermal Hydraulics, 3EC CH3581, Materials for the Nuclear Fuel Cycle, 3EC CH3782, Chemistry of the Nuclear Fuel Cycle, 3EC WB4422, Thermal Power Plants, 6EC **NSE Health Modules** AP3231TU D, Medical Imaging, 6EC AP3242, Particle Radiotherapy, 3EC AP3361TU, Clinical Physics of Medical Imaging, 6EC AP3581TU, Medical Physics & Radiation Technology: Radiotherapy, 6EC

2.8 Casimir specialisation

This specialisation implies participation in the special Pre-PHd programme described in detail in subsection 3.2. A selection procedure takes place before entrance into this special programme.

Article 3 Special programmes

3.1 Erasmus Mundus programme Optics in Science and Technology (OpSciTech)

Coordinator: Dr. F. Bociort.
This programme is an Erasmus Mundus programme jointly given by TU Delft and partner universities, i.e. Friedrich Schiller University Jena (Germany), Université Paris-Sud 11/Institut d'Optique Graduate School (Paris, France), Warsaw University of Technology (Poland), University of Eastern Finland Joensuu, and Imperial College London (United Kingdom). The course consists of one year spent at Delft University of Technology and one year spent at one of the partner universities. Each year students must complete 60 EC.

The **first year** of the EMM programme TU Delft consists of:

Obligatory Modules, 30 EC:

WI4243AP, Mathematical Methods for Physics, 9EC
WM0320TU, Ethics and Engineering, 3EC
AP3071G, Advanced Electrodynamics, 6EC
AP3931, Summer School EMM Optics in Science and Technology, 0EC
AP3941, Internship Optics Research Group, 12EC

Electives, 30 EC:

AP3061D, Advanced Wave Propagation, 6EC
AP3111D, Quantum Electronics and Lasers, 6EC
AP3121D, Imaging Systems, 6EC
AP3231D, Medical Imaging, 6EC
AP3361, Clinical Physics of Medical Imaging, 6EC
AP3382, Advanced Photonics, 6EC
AP3391, Geometrical Optics, 6EC
AP3401, Introduction to Charged Particle Optics, 6EC
AP3671D, Optical Wave Guiding, Photonic Crystals and Optical Functions, 6EC
ET4283, Advanced Digital Image Processing, 6EC
IN4085, Pattern Recognition, 6EC

The **second year** of the EMM programme TU Delft consists of:

48 EC Master's Thesis Work (AP3091)
0 EC AP3931, Summer School EMM Optics in Science and Technology
12 EC Modules from the G, D, R or M list that must be approved by the master thesis supervisor.

3.2 Casimir pre-PhD special programme

Coordinator: Dr. A.F. Otte
This programme, linked to the BN and QN tracks, focuses on preparing and educating MSc students for a PhD position within the Leiden Institute of Physics (LION) or the Kavli Institute of nanoscience (or elsewehere). It is also designed to respond to the increased mobility of students after their BSc and entering an MSc programme.
Leiden University and Delft University of Technology have established in 2004 the Casimir graduate school (http://casimir.researchschool.nl) which accommodates PhD students within the Kavli Institute for Nanoscience in Delft and the Leiden Institute of Physics (LION). The research within the school is

grouped into six themes, each covering theoretical, experimental and applied research areas both at Leiden and Delft.
For Applied Physics students in Delft, admission into this programme proceeds as follows. Students within the Applied Physics degree courses inform the coordinator that they are interested in following the Casimir special programme in the course of their first semester. After the first examination period in January, a special committee consisting of staff members from both Leiden and Delft decides on definite admission into the programme. Students who are declined can continue with the regular AP programme without incurring delays.
For a limited number of students completing this special programme successfully, a PhD position is guaranteed. In order to qualify for one the PhD positions, students should complete this programme within two years. In cases where students incur substantial delays without good reason, the admission into the special programme can be withdrawn.
Participation in the Les Houches summer school (France) which is organized jointly with French Universities in Grenoble and Lyon. This course is not compulsory although it is strongly encouraged to participate. Participation is free for students admitted into the Casimir special programme.

The Casimir special programme comprises:

- **Obligatory Modules, 12 EC:**

WI4243AP, Mathematical Methods for Physics, 9EC
WM0320TU, Ethics and Engineering, 3EC

- **General Advanced Physics Modules (G-list), 12 EC:**

AP3021G, Advanced Statistical Mechanics, 6EC
AP3051G, Advanced Quantum Mechanics, 6EC

- **One course from the 'Foundational' list, 6-9 EC:**

AP3032G, Continuum Physics, 6EC
AP3071G, Advanced Electrodynamics, 6EC
AP3211D, Advanced Solid State Physics, 6EC
AP3511D, Biophysics, 6 EC
AP3681, Fairy Tales of Theoretical Physics, 6EC
UL-AB, Advanced Biophysics, 6EC
UL-EFT, Effective Field Theory, 3EC
UL-QFT, Quantum Field Theory, 6EC
UL-TCM, Theory of Condensed Matter, 9EC
UL-TGR, Theory of General Relativity, 6EC
UL-TTP, Topics of Theoretical Physics, 9EC

- **Two courses from the 'Topical' list, 12 EC:**

AP3311D, Quantum Electronics and Lasers, 6 EC
AP3161D, Cellular Dynamics: Stochasticity and Signalling, 6EC
AP3191D, Physics of Semiconductor Nanodevices, 6EC
AP3261D, Mesoscopic Physics, 6EC
AP3271, Molecular Electronics, 6EC
AP3281D, Quantum Transport, 6EC
AP3291, Quantum Information Processing, 6EC
AP3302, Special Topics in Quantum Mechanics, 3EC
AP3461, The Origin of Life, 6EC
AP3661, Quantum Entanglement, 6EC
AP3691D, Evolution and Engineering of Living Systems, 6EC

UL-APP, Introduction to Astro-Particle Physics, 6EC
UL-ECQO, Experimental Classical and Quantum Optics, 6EC
UL-SMO, Single Molecule Optics, 6EC
UL-SP, Surface Physics, 6EC

- **One course from the 'Methods' list, 3-6 EC:**

AP3081D, International Masters Course on Computational Physics, 6EC
AP3221D, Nanotechnology, 6EC
AP3652, Electronics for Physicists, 3EC
WI4201, Scientific Computing, 6EC
UL-CP, Computational Physics, 9EC
UL-PSSI, Physics of Scientific Space Instruments, 6EC
UL-SPM, Scanning Probe Microscopy, 6EC

- **A research project of 36 EC** (AP3902CAS) in a department in of the Kavli Institute in Delft or the LION in Leiden.
- **Two smaller projects of 8 EC** each (AP3961, AP3971), to be carried out in different groups, and in a different group than where the 36 EC Research project takes place.
- **Writing a PhD research proposal** (AP3952, 8EC), possibly based on the large or on the smaller research projects.
- The remaining EC's (9-15) are filled with **elective modules** from the topical, foundational or methods lists; 6 EC must be agreed upon by the supervisor of the long research project.

3.3 Excellence track on Fluid and Solid Mechanics

Coordinator: Prof.dr.ir. C.R. Kleijn

This programme, linked to the TPFF track, focuses on educating excellent students for a PhD position. It fits within the Mechanical-, Aerospace- and Civil Engineering en Applied Physics master programmes. The programme is an initiative of the J.M. Burgers Centre (JMBC) and Engineering Mechanics (EM) interuniversity research schools. It provides master students a chance to write a PhD-project proposal at the end of the MSc phase and acquire funding for it. The programme is focuses on the central role of Fluids and Solids in Engineering.

The programme comprises:

- **Obligatory Modules, 12 EC:**

WI4243AP, Mathematical Methods for Physics, 9EC
WM0320TU, Ethics and Engineering, 3EC

- **General Advanced Physics Modules (G-list), 12 EC:**

AP3032G, Continuum Physics, 6EC
One module from: AP3021G, Advanced Statistical Mechanics, 6EC AP3051G, Advanced Quantum Mechanics, 6EC AP3071G, Advanced Electrodynamics, 6EC

- **Track/Department related Modules (D-list), 18 EC:**

AP3171D, Advanced Physical Transport Phenomena, 6EC
WB1422A, Advanced Fluid Dynamics A, 6EC
One module from: AP3181D, Applied Multiphase Flow, 6EC WB1424A, Turbulence A, 6EC

- **Fluid and Solid Mechanics Electives, 12 EC:**

CIE5142, Computational Methods in Non-Linear Solid Mechanics, 3EC ME1302, Structure and Properties of Materials, 8EC AE4117, Fluid-Structure Interaction, 4EC WB1428, Computational Fluid Dynamics, 3EC WB1451, Engineering Mechanics Fundamentals, 4EC

- **A thesis project of 48 EC** (AP3901) in a department or group linked to the TPFF track, or in another group, with the consent the track coordinator.
- **An internship of 18 EC** (AP3911), to be carried out in one of the companies represented in the Industrial Advisory Board of the JMBC, or in another company or institution, with the consent of the track coordinator

3.4 Honours track

The Honours Track consists of at least 20 EC on top of the regular master programme of 120 EC. The full Applied Physics programme including the additional honours track should be finished according to schedule. It is an individual programme that contains a 5 EC specially developed course for all TU Delft honours track students plus a coherent package of at least 15 ec of challenging course modules or projects composed by the student.
Access to the honours track and the programme of the honours track should be submitted to the Board of Examiners after approval by the Applied Physics' programme director Dr. J.M. Thijssen. As a guideline students have to meet the following requirements: bachelor finished in 4 years or less with an average grade of at least 7.5.

Collective Part (5 EC) WM0355HT, Critical Reflection on Technology, 5EC, obligatory
Individual Part (15 EC)

3.5 Double degree programme[1] Applied Physics – Management of Technology

This is a three year programme Applied Physics – Management of Technology of the Faculties of Applied Sciences (AS) and Technology, Policy and Management (TPM).
Students finishing a Master AP degree with specialisation MoT may decide to do an additional year of Master MoT courses and thesis in order to obtain a double degree in both AP and MoT. Access to this double degree programme is decided upon by the Board of Examiners after approval by Applied Physics' programme director Dr. J.M. Thijssen and MoT coordinator Dr. R.M. Verburg. The programme consists of:

Programme	**EC**
The AP Core Programme	90
The AP Specialisation MoT / 1st semester MoT modules (list of modules in art. 2.5)	30
2nd semester MoT modules (list of modules in art. 2.5)	30
MOT2003, Preparation for the Master Thesis	6
MoT MSc Thesis Project (MOT2910)	30

The 120EC Applied Physics part of the programme consists of the 90EC AP Core Programme and the 30EC first semester MoT modules.

[1] More generally, double degree programmes combining applied physics with other master courses taught at Delft are possible, but always subject to the restrictions imposed by the university. The main restrictions are that the double degree programme comprises at least 180 EC and that there are two identifiable final project reports for both degrees. Formal permission from the deans of the faculties is required in advance.

3.6 Double degree programme Applied Physics – Applied Mathematics

This is a three year programme Applied Physics – Applied Mathematics.
Access to this double degree programme requires formal approval by Applied Physics' programme director Dr. J.M. Thijssen and Applied Mathematics' programme director Dr. J.W. van der Woude. A double bachelor programme or a bridging programme is required to enter this programme.

The programme consists of:

Option 1 - two different thesis projects:

Programme	**EC**
AP courses: G-list courses – 12 EC D-list courses – 12 EC WM0320TU (Ethics and Engineering) – 3 EC WI4243AP (Mathematical Methods for Physics) – 0-6 EC GDR-list courses instead of WI4243AP parts already covered* – 3-9 EC Thesis related AP GDR-list course – 6 EC	42
AP Thesis Project	48
AM courses: Common courses (WI4201, WI4202, WI4203) – 18 EC Orientation courses (from list) – 12 EC Computational Science and Engineering courses – 18 EC -or- Probabillity, Risk and Statistics courses – 18 EC	48
AM Thesis Project	42

*If applicable Applied Physics bridging/homologation courses can also be included in the programme here.
WI4243AP parts are covered by (list is not complete):
Complex Analysis : WI2602, WI4244AP
Finite Elements : WI4014TU, WI4205
Partial Differential Equations : WI2607, WI3150TU+WI4150TU

The 120EC Applied Physics programme consists of the 90EC AP courses and thesis project and 30EC of AM commion and orientation courses.

Option 2 - combined thesis project and industrial internship:

Programme	**EC**
AP courses - as above	42
AM courses - as above	48
Double Degree Combined Thesis Project (AP3909)	60
Industrial Internship (AP3911 or WI5118)	18
Additional AP GDR-list course	6
Additional AM elective course	6

The 120EC Applied Physics programme consists of 42+6 EC of AP courses, 18 EC Industrial Internship, 48 EC for the Thesis Project and 6 EC WI4201.

3.7 free study programme

Students may compile a free curriculum concluded by a final exam. Such a curriculum must consist entirely or mainly of modules given in conjunction with the programme. It has to comply with the final attainment levels of the programme. The curriculum must be accompanied by a justified request and submitted to the Board of Examiners for approval.

Section 2 ADMISSIONS

Article 4 Admissions

4.1 Admission requirements

For admissions see article 5 of the Teaching and Examination Regulations. Applicants seeking admission to the MSc programme in Applied Physics must, in most cases, possess a Bachelor of Science degree in either Physics or Applied Physics, or have met the standard requirements thereof. The admission of students not holding a Bachelor degree mentioned in article 5 of the Teaching and Examination Regulations will be decided upon by the admissions officer of the Applied Physics master programme. University-wide requirements concerning minimum GPA (Grade Point Average) and/or GRE (Graduate Record Examination) in addition to minimum scores for either TOEFL or IELTS tests on English proficiency, apply to all applicants.

4.2 Bridging and homologation programmes

Article 5.4a of the Teaching and Examination Regulations mentions that students holding a Bachelor degree in Physics from a Dutch university can be admitted to the programme with a homologation programme of at most 6 credits. Examples of modules that can be assigned in a homologation programme are:

TN2545, Systemen en Signalen, 6EC
TN2785, Fysische Transportverschijnselen, 6EC

If a homologation module is assigned it can be incorporated in the Master programme as freely chosen elective in the R&D specialisation.
Students holding a Bachelor of Science degree in Aerospace Engineering, Applied Mathematics, Electrical Engineering, Mechanical Engineering or Molecular Science and Engineering from a Dutch Technical University may apply, but, if admitted, will be required to follow a bridging and/or homologation programme to provide them with the required background to allow them to complete the Master programme. Bridging modules must be completed before a student can be admitted in the Master programme; homologation modules can be done as part of the Master. The bridging and/or homologation programmes are listed below. The final decision about a bridging or homologation programme, also in other cases, is made on an individual basis.
Students can be admitted to the Master programme if the extent of their deficiencies is limited to a maximum of 18 credits. If deficiencies extend this size, students can only be admitted to the bridging programme. Students can then be admitted in the master programme if all remaining deficiencies can be incorporated in the master programme. The remaining modules become part of the master programme. Completion of the bridging programme by students formally admitted to it guarantees admission to the Master programme.
A maximum of 18 credits of homologation modules can be incorporated in the Master programme, if an exemption is obtained for the Industrial Internship (AP3911); otherwise 6 credits of homologation modules can be done as freely chosen elective in the R&D specialisation.
The same applies to students holding a Bachelor of Engineering degree in Physics Engineering, from a Dutch University of Professional (Technical) Education. For students holding a Bachelor of Engineering (HBO) degree in applied physics, the bridging/homologation programme is:

TN2053, Electromagnetisme 1, 6EC
TN2302, Kwantummechanica 1, 3EC
TN2312, Kwantummechanica 2, 3EC
TN2321, Klassieke Mechanica, 3EC
TN2345, Inleiding Golven, 3EC
TN2421, Optica, 3EC
TN2545, Systemen en Signalen, 6EC
TN2953SK, Research Practicum, 2EC
TN2953DV, Practicum Differentiaalvergelijkingen, 1 EC *
WI1142TN, Lineaire algebra deel 1, 3EC *
WI2240TN, Differentiaalvergelijkingen, 3EC *
WI2242TN, Lineaire algebra deel 2, 3EC *

*These modules can not be incorporated in the master programme.

Required bridging/homologation courses for TU Delft BSc Aerospace Engineering:

TN2053, Electromagnetisme, 6EC
TN2211, Electronische Instrumentatie, 6EC
TN2302, Kwantummechanica 1, 3EC (or TN2303, 3EC)
TN2312, Kwantummechanica 2, 3EC
TN2321, Klassieke Mechanica, 3EC
TN2421, Optica, 3EC
TN2612, Relativiteitstheorie, 3EC (or TN1612SK, 2EC)
TN2624, Statistische Fysica, 6EC
TN2844, Vaste Stof Fysica, 6EC
TN2953SK, Research Practicum, 2EC
TN4780TA, Fysische Transportverschijnselen, 4EC (or WB3550, 3EC)

Required bridging/homologation courses for TU Delft BSc Applied Mathematics:

TN2053, Electromagnetisme, 6EC
TN2211, Electronische Instrumentatie, 6EC
TN2302, Kwantummechanica 1, 3EC (or TN2303, 3EC)
TN2312, Kwantummechanica 2, 3EC
TN2321, Klassieke Mechanica, 3EC
TN2421, Optica, 3EC
TN2612, Relativiteitstheorie, 3EC (or TN1612SK, 2EC) - not required if TN1612WI is done
TN2624, Statistische Fysica, 6EC
TN2844, Vaste Stof Fysica, 6EC
TN2953SK, Research Practicum, 2EC
TN4780TA, Fysische Transportverschijnselen, 4EC (or TN2785, 6EC)

Required bridging/homologation courses for TU Delft BSc Civil Engineering:

TN1201, Thermodynamica, 3EC
TN2053, Electromagnetisme, 6EC
TN2211, Electronische Instrumentatie, 6EC
TN2302, Kwantummechanica 1, 3EC (or TN2303, 3EC)
TN2312, Kwantummechanica 2, 3EC
TN2321, Klassieke Mechanica, 3EC
TN2345, Inleiding Golven, 3EC
TN2421, Optica, 3EC
TN2545, Systemen en Signalen, 6EC
TN2612, Relativiteitstheorie, 3EC (or TN1612SK, 2EC)
TN2624, Statistische Fysica, 6EC
TN2844, Vaste Stof Fysica, 6EC
TN2953SK, Research Practicum, 2EC
TN4780TA, Fysische Transportverschijnselen, 4EC (or WB3550, 3EC)

Required bridging/homologation courses for TU Delft BSc Electrical Engineering:

TN1201, Thermodynamica, 3EC
TN2302, Kwantummechanica 1, 3EC (or TN2303, 3EC)
TN2312, Kwantummechanica 2, 3EC
TN2321, Klassieke Mechanica, 3EC
TN2421, Optica, 3EC
TN2612, Relativiteitstheorie, 3EC (or TN1612SK, 2EC)
TN2624, Statistische Fysica, 6EC
TN2844, Vaste Stof Fysica, 6EC - not required if ET2908 is done
TN2953SK, Research Practicum, 2EC
TN4780TA, Fysische Transportverschijnselen, 4EC (or TN2785, 6EC)

Required bridging/homologation courses for TU Delft BSc Marine Technology:

TN2053, Electromagnetisme, 6EC
TN2211, Electronische Instrumentatie, 6EC
TN2302, Kwantummechanica 1, 3EC (or TN2303, 3EC)
TN2312, Kwantummechanica 2, 3EC
TN2321, Klassieke Mechanica, 3EC
TN2345, Inleiding Golven, 3EC
TN2421, Optica, 3EC
TN2612, Relativiteitstheorie, 3EC (or TN1612SK, 2EC)
TN2624, Statistische Fysica, 6EC
TN2844, Vaste Stof Fysica, 6EC
TN2953SK, Research Practicum, 2EC
TN4780TA, Fysische Transportverschijnselen, 4EC (or WB3550, 3EC)

Required bridging/homologation courses for TU Delft BSc Mechanical Engineering:

TN2053, Electromagnetisme, 6EC
TN2211, Electronische Instrumentatie, 6EC
TN2302, Kwantummechanica 1, 3EC (or TN2303, 3EC)
TN2312, Kwantummechanica 2, 3EC
TN2321, Klassieke Mechanica, 3EC
TN2345, Inleiding Golven, 3EC
TN2421, Optica, 3EC
TN2612, Relativiteitstheorie, 3EC (or TN1612SK, 2EC)
TN2624, Statistische Fysica, 6EC
TN2844, Vaste Stof Fysica, 6EC
TN2953SK, Research Practicum, 2EC

Required bridging/homologation courses for TU Delft BSc Molecular Science and Technology:

TN2053, Electromagnetisme, 6EC
TN2211, Electronische Instrumentatie, 6EC
TN2302, Kwantummechanica 1, 3EC (or TN2303, 3EC)
TN2312, Kwantummechanica 2, 3EC
TN2321, Klassieke Mechanica, 3EC
TN2345, Inleiding Golven, 3EC
TN2421, Optica, 3EC
TN2545, Systemen en Signalen, 6EC
TN2612, Relativiteitstheorie, 3EC (or TN1612SK, 2EC)
TN2624, Statistische Fysica, 6EC
TN2844, Vaste Stof Fysica, 6EC
TN2953SK, Research Practicum, 2EC

Section 3 Examinations

Article 5 Order of the exams

5.1 Graduation Project, Master's thesis

You may start your Master Thesis Project if you:

- have been admitted to the master programme Applied Physics,
- have passed bridging/homologation modules or other obligations from the bachelor programme,
- have passed all obligatory (12EC), G-list (12 EC) and D-list (12EC) modules,
- have made a project plan with your thesis supervisor; this project plan should be handed in at enrollment.

At the start of the final project, the appropriate registration form must be filled in and handed in at the thesis project office.

The date and time of the master project presentation is determined by the thesis supervisor, after hearing the student. In exceptional cases, the programme director may be involved in setting this date and time.

Further rules governing the MSc graduation projects can be found in article 26 to 29 of the Rules and Guidelines of the Board of Examiners

Article 6 The form of the examinations and the methods of assessment

The form of the examinations and the methods of assessment are described in the (digital) study guide.

Section 4 Additional Rules

Article 7 Transition ruling

The core programme described in article 1 is compulsory for students who enrolled after 30-06-2011 for the first time in the master Applied Physics.
Students who enrolled before 01-07-2011 can choose between the previous programme (instead of WI4243AP a choice of at least 6 credits from WI3150TU, WI4014TU, WI4143TN, and WI4150TU, and 3 credits from the S-list) and the new programme.
Students who enrolled before 01-07-2011 can put the modules AP3011, AP3061, AP3081 and AP3091 on their G-list even if they apply for the new programme, provided they have passed those modules before 01-09-2012.
If WI4243AP is part of a student's programme WI3150TU, WI4014TU, WI4143TN, and WI4150TU can't be chosen as optional modules.

Before 2010-2011 AP3241TU (Particle Therapy Holland) was a D-list module; from 2010-2011 it's on the R-list.
Before 2011-2012 CH3771 (Nuclear Chemistry) was a D-list module; from 2011-2012 it's on the R-lists.

Equivalences:
NS3501 = AP3221 Nanotechnology, 6EC
NS3511 = AP3511 Biophysics, 6EC
NS3521 = AP3261 Mesoscopic Physics, 6EC
NS3531 = AP3271 Molecular Electronics, 6EC
NS3571 = AP3281 Quantum Transport, 6EC
NS3611 = AP3251 Nano- and Biomaterials for Nanotechnology Applications, 6 EC
NS3621AP = AP3291 Quantum Information Processing, 6EC
TN2881 = UL-TGR Theory of General Relativity, 6EC
WI2607 = WI3150TU + WI4150TU Partial Differential Equations 1-2, 6 EC
WI4244AP = WI4243AP complex analysis partial examination, 3 EC

WM0922TU, 4EC = WM0939TU, 5EC. Difference in EC to be compensated by TiSD electives.

Bridging programmes:
TN2303, 3 EC = TN2302 Kwantummechanica 1, 3 EC
TN1612SK, 2 EC = TN2612 Relativiteitstheorie, 3 EC
TN2622, 4 EC = TN2624 Statistische Fysica, 6 EC
TN2843, 5 EC = TN2844 Vaste Stof Fysica, 6 EC
TN4780TA, 4 EC = TN2785 Fysische Transportverschijnselen, 6 EC
WI2140TN, 4 EC = WI2240TN, 3 EC + TN2953DV

Article 8 Degree supplement
An overview of the study modules taken is given on the certificate. The degree supplement is issued in English.

Article 9 Date of commencement
This regulations will come into effect on 1 September 2013.