IMPLEMENTATION REGULATIONS

2017-2018

MASTER OF SCIENCE
APPLIED PHYSICS

DELFT UNIVERSITY OF TECHNOLOGY

Administrative data

Nomenclature in CROHO	**MSc Applied Physics**
CROHO registration number	**60436**
Orientation and level of the programme:	**Higher education, Academic Master level**
Number of credits	**120 ec, 2 years**
Mode(s) of study	**Fulltime**
Period of NVAO accreditation	**1 January 2015 till 31 December 2020**

THIS DOCUMENT

These Implementation Regulations apply to the teaching and the examinations related to the Master's degree programme in Applied Physics. This document is part of the Teaching and Examination Regulations.

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Article 1 – The programme's final attainment levels

In addition to the general attainment levels described in article 4 of the teaching and examination regulations, MSc Applied Physics graduates should possess the following kinds of competence:

1. Mastery of Applied Physics at an advanced academic level. This means mastery of advanced general physics subjects (such as Quantum Mechanics, Solid State Physics, Fluid Dynamics, Quantum Electronics and Electrodynamics) and the necessary mathematics, in addition to a choice of advanced technical subjects (such as Linear System Theory, Computer Science, Materials Science, Electronics, Data Analysis, Process Management and Control), as well as skills in the field of experimental techniques, theoretical analysis, simulation and modelling. This knowledge and these skills should be mastered at a level that is considered at least equal to that of other comparable Master's degrees at international, top-quality, educational institutions.
2. In-depth knowledge of at least one area within Applied Physics, so that international research literature can be understood.
3. Thorough experience of research in (Applied) Physics and complete awareness of the applicability of research in technological developments.
4. Capable of understanding a wide variety of different problems and being able to formulate these at an abstract level, whilst being able to see the relation between diverse problems at this abstract level and to contribute creatively to their solution, focusing on practical applications.
5. Capable of creating innovative technical designs, taking feasibility issues into account.
6. Capable of working in a (possibly interdisciplinary) team of experts, performing the aforementioned activities and communicating easily in both written and spoken English.
7. Capable of working independently and taking initiatives where necessary. Identifying areas where expertise is lacking and resolving the situation.
8. Capable of making Dutch and/or English language presentations of personal research activities to varied audiences. Capable of adapting to the background and interest of the audience.
9. Knowledge of technology-related developments in society, such as sustainability issues. Capable of developing and defending opinions in this area.

Article 2 – Admission to the programme

1. All students possessing a certificate proving that they have successfully completed their Bachelor of Science studies in Applied Physics in 4TU or at the Rijksuniversiteit Groningen will be admitted to the programme.

2. Students who do not possess the degree mentioned in paragraph 1 are required to obtain proof of admission to the programme from the dean, who will seek the advice of the admissions officer on this matter.

3. In order to obtain proof of admission, the student must meet or, as the case may be, possess:
   a. The general relevant criteria set by the executive board in the "Policy on fees and enrolment", laid down in Appendix 1 of the Student Charter (central part), and clarified in Part 1.2 " Entrance and admission" of the mentioned Student Charter.
   b. A certificate, together with the accompanying list of marks, proving that he/she possesses know-ledge of a sufficiently high level and broad scope to successfully complete the Master programme within the allotted period.
   c. Notwithstanding the general relevant criteria set by the executive board, laid down in Part 1.2 " Entrance and admission" (central part) and appendix 1 "Policy on fees and enrolment" of the Student Charter students holding a Bachelor of Engineering (HBO) degree in Physics Engineering are not obliged to do a preliminary exam 'VWO wiskunde B'.

4. Students in possession of
   a. a Bachelor of Science degree in (Applied) Physics or equivalent from a foreign university can be admitted to the programme provided that he/she has a minimum Grade Point Average of 75% (guideline).
   b. a Bachelor of Science degree in Physics from a Dutch university can be admitted to the programme with a homologation programme of at most 6 credits.
   c. Bachelor of Science degree in Aerospace Engineering, Applied Earth Sciences, Applied Mathematics, Civil Engineering, Electrical Engineering, Marine Technology, Mechanical Engineering, Molecular Science and Technology, or Nanobiology from a Dutch Technical University admitted to and having passed the TU Delft Applied Physics bridging (minor) programme will be admitted to the programme.
   d. a Bachelor of Engineering degree in Applied Physics from a Dutch university of Applied Sciences (HBO), admitted to and having passed the TU Delft Applied Physics bridging (minor) programme as part of their degree will be admitted to the programme.
   e. a Bachelor of Engineering degree in Applied Physics from a Dutch university of Applied Sciences (HBO), not having past the TU Delft Applied Physics bridging minor programme as part of their degree, can be admitted to the bridging programme provided he/she has a minimum Grade Point Average of 75% and no delay of study (guidelines). Completion of the bridging programme after admission to it, guarantees admission to the programme.

Article 3 – Structure of the programme.

1. The Applied Physics programme is a two-year master programme and comprises 120 EC. The programme has a core-orientation structure. Within this structure, there is a choice of research tracks. The core programme comprises 90 EC and has the same structure for all students. Combining the core programme with a 30 EC orientation completes the programme.

2. **Tracks.** The tracks within the Applied Physics core programme are:
   - Bio-nanoscience (BN)
   - Imaging Physics (ImPhys)
   - Quantum Nanoscience (QN)
   - Radiation Science and Technology (RST)
   - Transport Phenomena and Fluid Flow (TPFF)

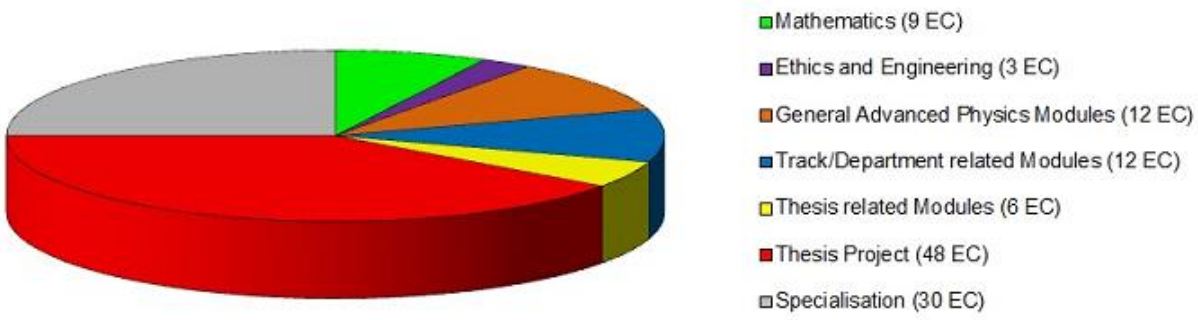
3. **Orientations.** Four orientations of 30 EC each can be chosen:
   - Research and Development (R&D)
   - Education (Ed1/Ed2)
   - Management of Technology (MoT)
   - Study Abroad (SA)

4. **Special programmes.** A special programme within the MSc Applied Physics is:
   - Casimir pre-PhD programme. This programme, linked to the Bio-nanoscience and Quantum Nanoscience tracks, focuses on preparing and educating students for a PhD position within the Leiden Institute of Physics (LION), the Kavli Institute of Nanoscience Delft, or elsewhere.

5. **Programme additions.**
   - Honours programme. This is an additional challenging individual programme for students with higher than average performance (>7.5 weighted average and no study delay).
   - Double degree programmes. These are three year programmes: Applied Physics – Management of Technology, and Applied Physics – Applied Mathematics.

Article 4 – Composition of the programme.

4.1 The core programme comprises 90 ec and has the same structure for all tracks and students:



4.1.1 Master Thesis Project: 48 EC (AP3902; 6ec preparation, 42ec thesis work) in a research section of one of the physics Departments or affiliated groups. The track of the programme is determined by the department where the thesis work is done:
- BN track – Bionanoscience department;
- ImPhys track – Imaging Physics department, Centre for Systems and Control (3mE);
- QN track – Quantum Nanoscience department, Opto-electronic Materials section (ChemE);
- RST track – Radiation Science and Technology department;
- TPFF track – Chemical Engineering department, Fluid Mechanics section (3mE), Clouds & 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.
For the Casimir pre-PhD programme, the master thesis work has a different structure; see 4.3.1.

4.1.2 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 module TW2070, WI2607 or WI3150TU+WI3155TU/ 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 TW2040 or 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 isn't 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 10.3).

4.1.3 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

4.1.4 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, ImPhys, 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".

AP3082, Computational Physics, 6EC, interdepartmental
AP3091, Elementary Particles, 6EC, interdepartmental
AP3141, Environmental Physics, 6EC, interdepartmental
4403TGR64, Theory of General Relativity, 6EC, interdepartmental
AP3162, Physics of Biological Systems: Mathematical modelling in Systems Biology, 6EC, BN
AP3511, Biophysics, 6EC, BN
AP3691, Evolution and Engineering of Living Systems, 6EC, BN
AP3061, Advanced Wave Propagation, 6EC, ImPhys
AP3112, Quantum Optics and Lasers, 6EC, ImPhys & QN
AP3121, Imaging Systems, 6EC, ImPhys
AP3132, Advanced Digital Image Processing, 6EC, ImPhys
AP3232, Medical Imaging Signals and Systems, 6EC, ImPhys & RST
AP3211, Advanced Solid State Physics, 6EC, QN
AP3222, Nanotechnology, 6EC, QN
AP3261, Mesoscopic Physics, 6EC, QN
AP3281, Quantum Transport, 6EC, QN
AP3421, Fundamentals of Quantum Information, 4EC, QN
AP3421-PR, Quantum Information Project, 2EC, 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
CH3053, Applied Physical Transport Phenomena, 6EC, TPFF
ME45031, Turbulence for AP, 6EC, TPFF
ME45041, Advanced Fluid Dynamics for AP, 6EC, TPFF

4.1.5 G,D,R,M-list elective: 6 EC. The remaining course(s) can be chosen from subjects from the G-, D-, R- or M-lists. 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 a student wishes to follow a subject, within or outside of the faculty, that's not on the lists approval from the Board of Examiners should be obtained. This is intended for courses related to the thesis project and the board may ask the thesis supervisor for advice.
A minimum of 12 EC of D- and/or R-list subjects must be done from the department/track where the thesis project is done.

Research list (R-list)

AP3461, The Origins of Life, 6EC, BN
LM3512NB, Systems Biology, 6EC, BN
LM3691, iGEM, 18EC*, BN
NB4020, High-Resolution Imaging, 4EC, BN
NB4070, Soft Matter Physics, 6EC, BN
4403ADBPL, Advanced Biophysics, 6EC, BN
4403THBPH, Theoretical Biophysics, 6EC, BN
AP3382, Advanced Photonics, 6EC, ImPhys
AP3392, Geometrical Optics, 3EC, ImPhys
AP3401, Introduction to Charged Particle Optics, 6EC, ImPhys
AP3531, Acoustical Imaging, 6EC, ImPhys
AP3701, Submm and Terahertz Physics and Applications, 3EC, ImPhys + QN
IN4085, Pattern Recognition, 6EC, ImPhys
SC42030, Control for High Resolution Imaging, 3EC, ImPhys
SC42065, Adaptive Optics Design Project, 3EC, ImPhys
AP3101, The Interpretation of Quantum Mechanics, 3EC, ImPhys + QN
AP3192, Physics of Semiconductor Nanodevices, 3EC, QN
AP3202, Topology in Condensed Matter, 6EC, QN
AP3252, Electron Microscopy Characterization of the Nanoscale, 3EC, QN
AP3271, Molecular Electronics, 6EC, QN
AP3292, Quantum Hardware, 6EC, QN
AP3303, Applications of Quantum Mechanics, 3EC, QN
AP3652, Electronics for Physicists, 3EC, QN
AP3681, Fairy Tales of Theoretical Physics, 6EC, QN
CH3672, Computational Materials Science, 3EC, QN
CS4090, Quantum Communication and Cryptography, 5EC, QN
EE4575, Electronics for Quantum Computation, 5EC, QN
AP3323, Computational Techniques for Neutron Transport and Radiative Heat Transfer, 3EC, RST
AP3332, Physics of Energy Materials, 3EC, RST
AP3582, Medical Physics of Photon and Proton Therapy, 6EC, RST
CH3582, Chemistry and Physics of Actinides, 3EC, RST
CH3771, Nuclear Chemistry, 6EC, RST
CH3782, Chemistry of the Nuclear Fuel Cycle, 3EC, RST
AE4180, Flow Measurement Techniques, 3EC, TPFF
AP3551, Computational Multiphase Flow, 6EC, TPFF
CH3061, Multiphase Reactor Engineering, 4EC, TPFF
CH3151, Molecular Transport Phenomena, 3EC, TPFF
CH3421, Computational Transport Phenomena, 6EC, TPFF
ME45000, Advanced Heat Transfer, 3EC, TPFF

ME45160, Advanced Applied Thermodynamics, 5EC, TPFF
WI4011, Computational Fluid Dynamics, 6EC, TPFF

*) 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 orientation together with an Industrial Internship (AP3911).

Mathematical list (M-list)

WI4006, Special Functions, 6EC
WI4141, Matlab for Advanced Users, 3EC
WI4201, Scientific Computing, 6EC
WI4211, Advanced Topics in Analysis, 6EC
WI4415, Approximation Theory, 6EC
EE4389, Modeling and Data Analysis in Complex Networks, 4EC

4.2 Orientations

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

4.2.1 Research and Development (R&D)

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

18 EC internship in Industry (AP3911).
6 EC G-, D-, R-, or M-list elective.
6 EC G-, D-, R-, M-, or S-list elective; or assigned homologation courses The S- (Society) list example courses: AS3111, ATHENS, 2EC AS3121, Scientific Writing and Argumentation, 3EC WM0516TU, Turning Technology into Business, 6EC WM0916TN, Logics for Empirical Sciences, 6EC WM0939TU, Technology in Sustainable Development, 5EC WM0943TU, Sustainable Business Game, 5EC WM0203TU-Eng, Oral Presentations , 2EC WM1101TU, English for Academic Purposes 3, 3EC WM1102TU, Written English for Technologists 2, 3EC WM1112TU, Spoken English for Technologists 2, 3EC WM1115TU, Dutch Elementary 1, 3EC WM1116TU, Dutch Elementary 2, 3EC WM1117TU, Dutch Intermediate 1, 3EC WM1135TU, English for Academic Purposes 4, 3EC WM1136TU, Written English for Technologists 1, 3EC WM1137TU, Spoken English for Technologists 1, 3EC WM4019TU, The Journey, 6EC WM4028TU, Experience Entrepreneurship, 5EC Full list: http://studiegids.tudelft.nl/a101_displayProgram.do?program_tree_id=19005 Only subjects marked as 'Category MSc level' are accepted. In addition electives for the annotation 'Technology in Sustainable Development' (www.tudelft.nl/tisd) and for the annotation 'Entrepreneurship' (www.tbm.tudelft.nl/en/about-faculty/departments/values-technology-and-innovation/sections/economics-of-technology-and-innovation/dce/education/master-annotation-entrepreneurship/) are allowed.

Within the R&D orientation, students can fulfil the requirements for the Technology in Sustainable Development (TiSD), Nuclear Science and Engineering, and Entrepreneurship annotations. Certificates will be granted during the graduation ceremony upon request of the student:

4.2.1.a Technology in Sustainable Development (TiSD)

This is a university initiative. Approval of the Master's thesis work and the internship by the coordinator (W.G. Bouwman) is required. The thesis project must be focussed on sustainable development or the development of knowledge and technology aimed at a more sustainable future.

The **thesis project** must be focussed on sustainable development or the development of knowledge and technology aimed at a more sustainable future.
The **internship**, in industry or a foreign research institution, 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

4.2.1.b Nuclear Science and Engineering (NSE)

Nuclear Science and Engineering has to be a core issue in the graduation project and the internship. Approval of the Master's thesis work and the internship by the coordinator (M. Rohde) is required. Nuclear Science and Engineering may have a focus on either "health" or on "energy".

The **thesis project** must be focussed on nuclear science and engineering
The **internship**, in industry or a foreign research institution, must be focussed on nuclear science and engineering
12 EC NSE electives, in addition to the general requirements of the core programme: **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 CH3582, Chemistry and Physics of Actinides, 3EC CH3771, Nuclear Chemistry, 6EC CH3792, Introduction to Nuclear Science and Engineering, 6EC **NSE Energy Modules** AP3171D, Advanced Physical Transport Phenomena, 6EC AP3323, Computational Techniques for Neutron Transport and Radiative Heat Transfer, 3EC AP3332, Physics of Energy Materials, 3EC AP3341D, Nuclear Reactor Physics, 6EC **NSE Health Modules** AP3232D, Medical Imaging Signals and Systems, 6EC AP3582, Medical Physics of Photon and Proton Therapy, 6EC

4.2.1.c Annotation Entrepreneurship (AE)

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.
Minimum requirements for the Annotation Entrepreneurship certificate (15EC compulsory, plus 5EC electives):

MOT9610, Entrepreneurship basic course, 5EC MOT9611, Project Entrepreneurship thesis related, 5EC MOT9612, Business Development Lab (short), 5EC Elective(s) on entrepreneurship, 5EC

If the requirements for the Annotation Entrepreneurship certificate are fulfilled, sufficient experience with (startup) companies is present in the courses done, and the total number of credits done is at least 120EC, the industrial internship may be dropped from the programme if the Board of Examiners gives permission.

4.2.2 Education (Ed1/Ed2)

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 orientation 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 qualification 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 orientation. The combination of the minor Education and Ed2 orientation leads to qualification as a fully-qualified eerstegraads (grade-one) secondary school teacher.

Students that did not take the minor Education can follow the Basisdeel/Ed1 orientation 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 the coordinator, M.A.F.M. Jacobs.

30 EC Education - Basisdeel (Ed1)
SL3031, Didactical Skills, 3EC SL3041, Orienterende Stage, 3EC SL3116, Research Methodology in Social Sciences for Education, 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, SL3116 (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 qualification as a fully-qualified eerstegraads (grade-one) secondary school teacher.

4.2.3 Management of Technology (MoT)

This orientation 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, R.M. Verburg, in advance.

1st SEMESTER MoT Modules (30 EC)
MOT1412, Technology Dynamics, 5EC MOT1421, Economic Foundations, 5EC MOT1442, Social and Scientific Values, 5EC MOT1461, Corporate Finance, 5EC MOT1524, Leading and Managing People, 5EC MOT1532, High-tech Marketing, 5EC
2nd SEMESTER MoT Modules (30 EC)
MOT1003, Integration Moment, 5EC MOT1435, Technology Strategy and Entrepreneurship, 5EC MOT1451, Inter- and Intra-organisational Decision Making, 5EC MOT1531, Business Process Management & Technology, 5EC MOT2312, Research Methods, 5EC MOT2421, Emerging and breakthrough Technologies, 5EC

4.2.4 Design

Under construction. Individual proposals of sets of courses and projects totaling 30 EC from students for technical design are possible, and must be approved by the programme management and the board of examiners.

4.2.5 Study abroad

This programme consists of a semester at a foreign university. A package of 30 EC of courses (optionally including a research project of a maximum of 20 EC) must be done. Note that an industrial internship (AP3911) is not required if this orientation is chosen.
Another option for an exchange semester at a foreign university is to do 30 EC of course modules that fit in the (core) programme and select one of the other orientations.
A Study Abroad programme must always be approved by the board of examiners in advance.

4.3 Special programmes

4.3.1 Casimir pre-PhD special programme

Coordinator: C. Danelon
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 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
4403ADBPL, Advanced Biophysics, 6EC
4403CONDE, Theory of Condensed Matter, 9EC
4403EFTH3, Effective Field Theory, 3EC
4403QFTH6, Quantum Field Theory, 6EC
4403TGR64, Theory of General Relativity, 6EC

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

AP3101, The Interpretation of Quantum Mechanics, 3EC
AP3112D, Quantum Optics and Lasers, 6EC
AP3162D, Physics of Biological Systems: Mathematical modelling in Systems Biology, 6EC
AP3192D, Physics of Semiconductor Nanodevices, 3EC
AP3202, Topology in Condensed Matter, 6EC
AP3252, Electron Microscopy Characterization of the Nanoscale, 3EC
AP3261D, Mesoscopic Physics, 6EC
AP3271, Molecular Electronics, 6EC
AP3281D, Quantum Transport, 6EC
AP3292, Quantum Hardware, 6EC
AP3303, Applications of Quantum Mechanics, 3EC
AP3421D, Fundamentals of Quantum Information, 4EC
AP3421-PR, Quantum Information Project, 2EC
AP3461, The Origin of Life, 6EC
AP3691D, Evolution and Engineering of Living Systems, 6EC
CS4090, Quantum Communication and Cryptography, 5EC
NB4070, Soft Matter Physics, 6EC
4403ADVOP, Advanced Optics, 6EC
4403SIMOP, Single Molecule Optics, 6EC
4403SBIOM, Soft and Biomechanics, 6EC
4403THBPH, Theoretical Biophysics, 6EC

- **One course from the 'Methods' list, 5 EC:**

AP3082D, Computational Physics, 6EC

AP3222D, Nanotechnology, 6EC
AP3652, Electronics for Physicists, 3EC
EE4575, Electronics for Quantum Computation, 5EC
WI4201, Scientific Computing, 6EC
4403CMPH6, Computational Physics, 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 (12) are filled with **elective modules** from the topical, foundational or methods lists.

4.3.2 Skipped (was Excellence track on Fluid and Solid Mechanics)

4.3.3 Honours Programme

The Honours Programme 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.

Programme			**Credits**
Collective Part - obligatory UD2010, Critical Reflection on Technology			5
Individual Part **Examples:** Company Oriented HPM AS1011HPM AS1021HPM Research Oriented HPM AS1031HPM x Coherent package of courses example: AP3932HPM	 Applied Sciences Company Project Applied Sciences Honours Classes Applied Sciences Research Project Project related course Summer School Casimir pre-PhD programme	 12 3 9-15 0-6 5	15

4.3.4 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 orientation 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 programme directors of the MSc Applied Physics and the MSc Management of Technology. The programme consists of:

Programme	**EC**
The AP core programme	90
The AP orientation MoT / 1st semester MoT modules (list of modules in art. 4.2.3)	30
2nd semester MoT modules (list of modules in art. 4.2.3)	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 second semester MoT modules.

[1] More generally, double degree programmes combining applied physics with other master courses taught at TU 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 admission by the programme directors is required in advance.

4.3.5 Double degree programme Applied Physics – Applied Mathematics

This is a three year programme Applied Physics – Applied Mathematics.
Access to this double degree programme is decided upon by the programme directors of the MSc Applied Physics and the MSc Applied Mathematics. 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: WI4243AP (Finite Elements) – 3 EC WM0320TU (Ethics and Engineering) – 3 EC G-list courses – 12 EC D-list courses – 12 EC GDR-list courses instead of WI4243AP parts already covered* – 6 EC AP GDR-list course – 6 EC	42
AP Thesis Project	48
AM courses: Common courses (from WI4201, WI4203, WI4227, WI4430, WI4455) – 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, WI4243AP-CA, 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 common 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	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.

4.3.6 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.

Article 5 Bridging and homologation programmes

Article 2.4b 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, a maximum of 6EC can be incorporated in the Master programme in the R&D orientation.
Students holding a Bachelor of Science degree in Aerospace Engineering, Applied Earth Sciences, Applied Mathematics, Civil Engineering, Electrical Engineering, Marine Technology, Mechanical Engineering, Molecular Science and Engineering, or Nanobiology 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. 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 in the R&D orientation.

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

TN2054, Electromagnetisme, 6EC
TN2304, Kwantummechanica 1, 3EC (or TN2305, 4EC)
TN2314, Kwantummechanica 2, 3EC
TN2321, Klassieke Mechanica, 3EC
TN2421, Optica, 3EC
TN2612, Relativiteitstheorie, 3EC
TN2624, Statistische Fysica, 6EC
TN2844, Vaste Stof Fysica, 6EC
TN2953SO, Research Practicum, 3EC

Required bridging/homologation courses for TU Delft BSc Applied Earth Sciences:

TN2054, Electromagnetisme, 6EC
TN2211, Electronische Instrumentatie, 6EC
TN2304, Kwantummechanica 1, 3EC (or TN2305, 4EC)
TN2314, Kwantummechanica 2, 3EC
TN2321, Klassieke Mechanica, 3EC
TN2421, Optica, 3EC
TN2612, Relativiteitstheorie, 3EC
TN2624, Statistische Fysica, 6EC
TN2844, Vaste Stof Fysica, 6EC
TN2953SO, Research Practicum, 3EC

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

TN2054, Electromagnetisme, 6EC
TN2211, Electronische Instrumentatie, 6EC
TN2304, Kwantummechanica 1, 3EC (or TN2305, 4EC)
TN2314, Kwantummechanica 2, 3EC
TN2321, Klassieke Mechanica, 3EC

TN2421, Optica, 3EC
TN2612, Relativiteitstheorie, 3EC (not required if TN1531TW is done)
TN2624, Statistische Fysica, 6EC
TN2785, Fysische Transportverschijnselen, 6EC (or 4052FYSTRY, 6EC)
TN2844, Vaste Stof Fysica, 6EC
TN2953SO, Research Practicum, 3EC

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

TN1201, Thermodynamica, 3EC
TN2054, Electromagnetisme, 6EC
TN2211, Electronische Instrumentatie, 6EC
TN2304, Kwantummechanica 1, 3EC (or TN2305, 4EC)
TN2314, Kwantummechanica 2, 3EC
TN2321, Klassieke Mechanica, 3EC
TN2345, Inleiding Golven, 3EC
TN2421, Optica, 3EC
TN2545, Systemen en Signalen, 6EC
TN2612, Relativiteitstheorie, 3EC
TN2624, Statistische Fysica, 6EC
TN2844, Vaste Stof Fysica, 6EC
TN2953SO, Research Practicum, 3EC

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

TN1201, Thermodynamica, 3EC
TN2304, Kwantummechanica 1, 3EC (or TN2305, 4EC)
TN2314, Kwantummechanica 2, 3EC
TN2321, Klassieke Mechanica, 3EC
TN2421, Optica, 3EC
TN2612, Relativiteitstheorie, 3EC
TN2624, Statistische Fysica, 6EC
TN2844, Vaste Stof Fysica, 6EC
TN2953SO, Research Practicum, 3EC
TN2785, Fysische Transportverschijnselen, 6EC (or 4052FYSTRY, 6EC)

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

TN2054, Electromagnetisme, 6EC
TN2211, Electronische Instrumentatie, 6EC
TN2304, Kwantummechanica 1, 3EC (or TN2305, 4EC)
TN2314, Kwantummechanica 2, 3EC
TN2321, Klassieke Mechanica, 3EC
TN2345, Inleiding Golven, 3EC
TN2421, Optica, 3EC
TN2612, Relativiteitstheorie, 3EC
TN2624, Statistische Fysica, 6EC
TN2844, Vaste Stof Fysica, 6EC
TN2953SO, Research Practicum, 3EC

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

TN2054, Electromagnetisme, 6EC
TN2304, Kwantummechanica 1, 3EC (or TN2305, 4EC)
TN2314, Kwantummechanica 2, 3EC

TN2321, Klassieke Mechanica, 3EC
TN2345, Inleiding Golven, 3EC
TN2421, Optica, 3EC
TN2612, Relativiteitstheorie, 3EC
TN2624, Statistische Fysica, 6EC
TN2844, Vaste Stof Fysica, 6EC
TN2953SO, Research Practicum, 3EC

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

TN2054, Electromagnetisme, 6EC
TN2211, Electronische Instrumentatie, 6EC
TN2304, Kwantummechanica 1, 3EC (or TN2305, 4EC)
TN2314, Kwantummechanica 2, 3EC
TN2321, Klassieke Mechanica, 3EC
TN2345, Inleiding Golven, 3EC
TN2421, Optica, 3EC
TN2545, Systemen en Signalen, 6EC
TN2612, Relativiteitstheorie, 3EC
TN2624, Statistische Fysica, 6EC
TN2785, Fysische Transportverschijnselen, 6EC (not if 4052FYSTRY) is done
TN2844, Vaste Stof Fysica, 6EC
TN2953SO, Research Practicum, 3EC

Required bridging/homologation courses for TU Delft BSc Nanobiology:

TN2054, Electromagnetisme, 6EC
TN2304, Kwantummechanica 1, 3EC (or TN2305, 4EC)
TN2314, Kwantummechanica 2, 3EC
TN2321, Klassieke Mechanica, 3EC
TN2345, Inleiding Golven, 3EC
TN2421, Optica, 3EC
TN2612, Relativiteitstheorie, 3EC
TN2624, Statistische Fysica, 6-3EC
TN2785, Fysische Transportverschijnselen, 6EC (or 4052FYSTRY, 6EC)
TN2844, Vaste Stof Fysica, 6EC
TN2953SO, Research Practicum, 3EC

For students holding a Bachelor of Engineering (HBO) degree in applied physics, the bridging/ homologation programme is:

TN2054, Electromagnetisme 1, 6EC
TN2244WI, Lineaire Algebra en Differentiaalvergelijkingen, 6EC
TN2304, Kwantummechanica 1, 3EC
TN2314, Kwantummechanica 2, 3EC
TN2321, Klassieke Mechanica, 3EC
TN2345, Inleiding Golven, 3EC
TN2421, Optica, 3EC
TN2545, Systemen en Signalen, 6EC
TN2953SO, Research Practicum, 3EC
WI1142TN, Lineaire algebra deel 1, 3EC

The quantum mechanics subjects TN2304 and TN2314 form a module. The minimum pass grade for these subjects is 5.0, provided that the weighted average of the two subjects is at least 5.8.

Article 6 Examinations

6.1 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, http://ap.msc.studyguide.tudelft.nl.

6.2 Order of the exams

6.2.a 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 board of examiners 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 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.
Students enrolled before 01-09-2016 starting the thesis work after 01-07-2017 will do AP3902 instead of AP3901.

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-list.
AP3132D (Advanced Digital Image Processing) is a D-list module; before 2017-2018 ET4283 was on the R-list.
Either AP3421D (from 2017-2018) or AP3292D (before 2017-2018) counts as a D-list module; not both.

Equivalences:
4403TGR64 = UL-TGR = TN2881
4403MOLE6 = AP3271
AP3081D = AP3082D
AP3111D = AP3112D
AP3161D = AP3162D
AP3191D = AP3192
AP3231D = AP3232D
AP3241 = AP3242
AP3292D = AP3292
AP3381 = AP3382
AP3391 = AP3392
AP3421 = AP3421D
AP3581 +AP3242 = AP3582
AP3651 = AP3652
ET4283 = AP3132D
NS3501 = AP3221D = AP3222D
NS3511 = AP3511D
NS3521 = AP3261D
NS3531 = AP3271
NS3571 = AP3281D
NS3611 = AP3251
NS3621AP = AP3291
SL3111 = SL3116
WI2607 = WI3150TU + WI4150TU
WM0355HT = UD2010
WM0922TU = WM0939TU

WI4243AP-CA = WI4244AP = WI4143TN = WI2602 = TW2040
WI4243AP-FE = WI4014TU = WI4205
WI4243AP-PDE = WI3151TU = WI4150TU = WI2607 = TW2070

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

Bridging programmes:
TN1612SK, 2 EC = TN2612, 3 EC
TN2053 = TN2054
WI2140TN, 4 EC = WI2240TN, 3EC + TN2953DV, 1 EC
TN2244WI, 6 EC = WI2240TN, 3EC + WI2242TN, 3 EC
TN2301 = TN2302 = TN2303 = TN2304 = TN2305
TN2311 = TN2312 = TN2314
TN2622, 4 EC = TN2624, 6 EC
TN2843, 5 EC = TN2844, 6 EC
TN4780TA, 4 EC = TN2785, 6 EC = SET3021, 4 EC = 4052FYSTRY, 6EC

TN2953SK, 2 EC + TN2953DV, 1 EC = TN2953SO, 3 EC (voor HBO schakelaars)
TN2953SK, 2 EC = TN2953SO, 3 EC (voor overige schakelaars)