

***Programme-specific appendix
to the programme part of the students' charter,
including the education and examination regulations
of the Applied Physics (AP)
Master's Programme
(art. 7.13 and 7.59 WHW)***

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Preamble

1. The rules in this appendix apply to the full-time master's programme Applied Physics (No. 60436).
2. Together with the general section, this programme-specific appendix forms the programme section of the student charter including the Education and Examination Regulations for the master's programme Applied Physics of the faculty Science and Technology at the University of Twente.
3. The programme is subject to the legislation of the Dutch Higher Education and Research Act (WHW).

Reference: TNW20.485/esk/vdh

Date: 14 July 2020

Article 1 Programme Objective

1. Designing of physics instruments for research and industrial applications.
2. Performing fundamental research with a view to applications.

The programme aims to provide knowledge, skills and insight in the field of Applied Physics that enables graduates to enter into an independent profession or to qualify for further training as a teacher, scientific researcher or technical designer.

Article 2 Intended Learning Outcomes

The required level of physics during and after the programme is determined nationally and internationally. In view of the objectives of the programme, education is aimed at acquiring:

- Thorough knowledge of the basic theories in the domain of physics and mathematics;
- Thorough knowledge of one or more sub-areas in the physics domain;
- Knowledge of physics technology, including skills for designing and using measurement instruments and experimental techniques;
- Orientation into the application areas of Applied Physics;
- Insight in the interrelation between sciences and the relationship between sciences, and the resulting responsibilities;
- Skills such as being able to independently acquire knowledge; being able to creatively and systematically contribute to resolving problems in the field; being able to cooperate with colleagues and non-colleagues; and communicational, social and organizational skills.

Article 3 Admission Board

1. An admission board is appointed by the dean of the faculty of Science and Technology for the admission to the master's programme of students who are not directly admissible in accordance with Art. 4, section 2a of this appendix.
2. The executive board has delegated the authority to accept or reject students (decision reference: S&C/387.191/lk) to the board mentioned under section 1.
3. The admission board is chaired by the programme director. In case of foreign students or students with a qualification in higher professional education respectively the internalization coordinator or the higher professional coordinator is a member of the admission board.
If the chair deems it necessary, the secretary of the board of examiners and/or the study adviser can join the admission board.

Article 4 Admission to the Programme

1. The programme has two intake moments: 1 September and 1 February.
2. Direct admission to the programme is granted to students who possess:
 - a. a degree in one of the bachelor's programmes in Applied Physics or Physics at a Dutch university, or
 - b. a proof of admission to the programme, issued by the admission board.
3. During assessment of the application for admission to the master's programme, the admission board can demand that some subjects must be passed before the proof of admission to the master's programme can be issued.
4. When a proof of admission to the master's programme is issued, the admission board may decide to grant exemption for particular parts of the programme, with exception of the final master's assignment.
5. A proof of admission to the master's programme issued by the admission board may impose conditions on the specific content of the student's master's programme.
6. The decisions of the admission board in sections 4 and 5 of this article require the approval of the board of examiners.
7. The following applies for students with a qualification in higher professional education (University of Applied Sciences; hbo) in Applied Physics or Electrical Engineering:
 - a. They can be admitted to a transfer programme of 30 EC,
 - b. The transfer programme is compiled by the programme board. More detailed information can be found on the website of the programme (www.utwente.nl/ap).
 - c. Students must complete the transfer programme within a period of 1 year and will be given two opportunities to take the exam. The courses must be completed with a minimum grade of 6.0
 - d. Instead of the transfer programme mentioned above, students with a qualification in higher professional education can also attend a transfer minor of 30 EC (Kies-Op-Maat) during their higher professional education. The transfer minor is identical to the transfer programme.
 - e. After completion of the transfer programme, the candidates can be admitted to the master's programme. The master's programme for students with a qualification in higher professional education in Applied Physics or Electrical Engineering is defined in Art. 6 of this programme-specific appendix.
8. Students in possession of a bachelor's degree in Applied Mathematics (AM), Advanced Technology (AT), Biomedical Technology (BMT), Chemical Science and Technology (CSE), Electrical Engineering (EE), Mechanical Engineering (ME), Technical Medicine (TM) or University College Twente (UCT) may be admitted to the regular master's programme if their bachelor's programme meets the conditions specified in Article 8 of this programme-specific appendix¹.
9. Students with a previous education at a foreign institution must demonstrably have sufficient language skills in spoken and written English. A requirement for their admittance to the programme may be a sufficient score in a recognized test. This means a total score of 6.5 or higher for the IELTS test, or a score of 90 or higher for the Internet-based TOEFL test². Students in possession of a bachelor's degree from a country where English is the main language in higher education³ are exempt from this requirement.

¹ This applies for programmes at the University of Twente, but also to equivalent programmes at other Dutch universities.

² IELTS: International English Language Testing System; TOEFL: Testing of English as a Foreign Language; see the UT website on admittance to the master's programmes: <https://www.utwente.nl/en/education/master/admission-requirements/international-degree>

³ The list of countries can be found at <https://www.utwente.nl/en/education/master/admission-requirements/language-requirement/>

Article 5 General Master's Programme

The master's programme consists of;

- 5 compulsory courses (20 EC) in the first year;
- 20 EC specialization courses⁴;
- 10 EC elective courses at master level within the technical or physics domain;
- 10 EC free electives⁵;
- An external internship of 20 or 30 EC; If the 30 EC internship is chosen then the elective courses are reduced by 10 EC;
- A final master's assignment of 40 EC.

The Applied Physics curriculum contains a list of recommended (elective) courses for each Applied Physics chair.

Capita Selecta courses can be used for activities done for a chair that are not part of regular courses. The contents, method and scope are determined by the chair. For this purpose, a [registration form](#) must be completed, on which the course code, name, amount of EC's as well as the subject, material used, the assessment and the title are recorded.

A student who has already passed one or more compulsory courses of the master's programme during the bachelor's degree or has passed courses that can be approved as an elective course in the master's programme, can be exempted for these courses. The student does not receive a reduction in the total amount of EC's that has to be passed in the master's programme.

The study programme requires the approval by the graduation professor and the programme's board of examiners. The graduation professor approves when the study programme is compiled in accordance with the conditions of the master's programme.

The final master's assignment is assessed with two grades: One for physics aspects, and one for general aspects. The physics aspects include theoretical insight, experimental skills, problem-solving capability and originality, and scientific relevance in terms of physics and/or technology. The general aspects comprise independence, commitment, ability to collaborate, creativity, level of the presentation and the final report, and accessibility and usability of the results.

Compulsory courses

Quartile	Course Code	Course Name	EC
1A	191411291	Applied Quantum Mechanics (Kelly)	5.0
1B	201900080	Mathematical and Numerical Physics (Stevens)	5.0
2A	191470241	Heat and Mass Transfer (Krug)	5.0
2B	201900282	Small Signals and Detection (Marpaung)	4.0
2B	201900281	Ethical and Cultural Awareness (Offerhaus)	1.0
-	19359901 or 201700185	Internship (Folkers)	20 or 30
-	201800344 201800345	Master's Assignment, Physical Aspects (Kooij) (20 EC) Master's Assignment, General Aspects (Kooij) (20 EC)	40

⁴ The specialization courses depend on the chair in which the final assignment is done. See Curriculum AP.

⁵ The free electives should be filled with specialization courses of other chairs from the Applied Physics programme, courses of other master's programmes (see websites of the other programmes) and/or extra Applied Physics courses shown in the table on the next page.

Applied Nano-Photonics

Quartile	Code	Course	EC	SC ⁶	RC ⁶
1A	201300139	Laser Physics (Boller)	5.0	LPNO, OS	AQO, COPS, NBP, IMS
	193515000	Quantum Optics (Pinkse)	5.0	AQO, COPS	LPNO OS
	202000663	Molecular Struct. and Spectr. (Huijser) ⁷	2.5		
	193400131	Nano-Optics (Garcia-Blanco)	5.0		NBP, OS
1B	193520030	Nonlinear Optics (Boller)	5.0	LPNO, OS	AQO, COPS
	193400141	Nano-Electronics (v.d. Wiel)	5.0		OS
2A	201300141	Wave Optics (vd Slot)	5.0	AQO, BMPI, COPS, LPNO, OS	NBP, XUV
	201100074	Nanophotonics (Vos)	5.0	COPS	AQO
	191210880	Integrated Optics (Garcia Blanco)	5.0	OS	AQO, LPNO
	201700034	Introduction to PDE (Akkaya)	5.0		COPS
2B	201400196	Quantum Emitters (Vos)	5.0		COPS, NBP
-	201100075	Nanophotonic Experiments (Vos/Pinkse) ⁸	5.0	COPS	AQO
	193520040	Exp. Laser Physics and Nonlinear Optics (Bastiaens for LPNO / Offerhaus for OS) ⁸	5.0	LPNO	COPS, NBP, OS

Energy Materials and Systems

Quartile	Code	Course	EC	SC ⁶	RC ⁶
1A	193530000	Intr. to Superconductivity (Dhalle)	5.0	EMS, ICE, QTM	IMS
1B	201100214	Applications of Superconductivity (Dhalle)	5.0	EMS	
	193530040	Introduction to High Energy Physics (v. Eijk)	5.0		EMS
	201700026	Electr. Power Eng. and Sys. Integr. (Dhalle)	5.0		EMS
2A	201400037	Linear Solid Mechanics (Ellenbroek)	5.0		EMS
2B	201100146	Cryogenic Science and Techn. (ter Brake)	5.0	EMS	

⁶ SC is Specialization Courses, RC is Recommended Courses, see also [Curriculum AP](#)

⁷ Part of AT Module 09 Condensed Matter Physics

⁸ Students who want to participate in this course, please contact the teaching staff.

Nano-Electronic Materials

Quartile	Code	Course	EC	SC ⁶	RC ⁶
1A	193530010	Nanophysics (Zandvliet)	5.0	CMS, ICE, PIN, QTM, XUV	EMS, IMS
	193530000	Intr. to Superconductivity (Dhalle)	5.0	EMS, ICE, QTM	IMS
	193700010 202000694	AMM - Characterization (Huijser) Classical Mechanics	5.0 4.0	IMS	NBP CCP
1B	193510040	Theoretical Solid State Physics (Kelly)	5.0	CCP, CMS, ICE, QTM	COPS, EMS, IMS, PIN, XUV
	193570050	Advanced Quantum Mechanics (Brocks)	5.0	CCP	AQO, COPS, CMS, XUV, LPNO
	191210730	Technology (Kovalgin)	5.0		XUV
2A	193550020	Surfaces and Thin Layers (Wormeester)	5.0	IMS, PIN, XUV	EMS
	193510030	Electronic Structure Theory 2 (Brocks) ⁹	5.0	CMS	
	202000713	Computational Physics (Filippi)	2.5/ 5.0	CCP	
	193700040	AMM - Inorganic Materials Science (Koster)	5.0	IMS, XUV	
	201700025	Solar Energy (Reinders)	5.0	IMS	
2B	201500167 193570040	MTCMP (van Houselt) Theory of General Relativity (v. Damme)	5.0	PIN	CCP
	200900066	Introduction to the Physics of Correlated Electrons (Golubov)	5.0		CCP, CMS, ICE, PIN, QTM, IMS
	201500405	Theory of Complex Functions (Jeurnink)	3.0		COPS, CMS, LPNO, OS, PoF
-	193510020	Electronic Structure Theory 1 (Kelly) ⁹	5.0	CMS	

Physics of Fluids

Quartile	Code	Course	EC	SC ⁶	RC ⁶
1A	193570010	Advanced Fluid Mechanics (Huisman)	5.0	PoF	EMS, PCF
	191560430	Nonlinear Dynamics (Meijer)	5.0		PoF
1B	193580010	Turbulence (Lohse)	5.0	PoF	
	193572010	Physics of Bubbles (Versluis)	2.5	PoF	
2A	193580020	Experimental Techniques in PoF (Marin)	5.0	PoF	EMS
	201400194 202001413	Granular Matter (v.d. Meer) Soft Matter Physics (Lemay)	5.0 5.0	PoF BE, PCF	CCP, NBP, PoF
	193542070	Medical Acoustics (Versluis)	5.0	BMPI, PoF	
2B	201400195	Fluids and Elasticity (Snoeijer)	2.5	PoF	
	193565000 201800131	Capillarity Phenomena (Mugele) Numerical Meth. for Engineers (Lammertink)	5.0 5.0	PCF, PoF PoF	BE
	191154731	Computational Fluid Dynamics (Venner)	5.0	PoF	
	201500405	Theory of Complex Functions (Jeurnink)	3.0		COPS, CMS, LPNO, OS, PoF

⁹ Electronic Structure Theory 1 and 2 can be done independently. Electronic Structure Theory 1 is not required as preknowledge for Electronic Structure Theory 2.

Soft Matter

Quartile	Code	Course	EC	SC ⁶	RC ⁶
1A	202001414	Physical Biology (Claessens/Kocer)	5.0	BE, NBP	
	201700187	Soft and Biological Techniques (Duits) ¹⁰	5.0		BE, NBP, PCF
	201800083	Advanced Colloids and Interfaces (Wood)	5.0		BE, PCF
	193640020	Biophysical Techn. and Mol. Imaging (Otto)	5.0	NBP	BMPI
2A	193400121	Nano-Fluidics (Siretanu)	5.0	BE, PCF	PoF
	202001413	Soft Matter Physics (Lemay)	5.0	BE, PCF	CCP, NBP, PoF
	193542070	Medical Acoustics (Versluis)	5.0	BMPI, PoF	
	193400111	Bionanotechnology (Bennink)	5.0		NBP
	191210910	Image Processing and Computer Vision (Abayazid)	5.0		BMPI
2B	193565000	Capillarity Phenomena (Mugele)	5.0	PCF, PoF	BE
	193500000	Biomedical Optics (Vellekoop)	5.0	BMPI	
	201800114	Imaging Technology in Radiology (Simonis)	5.0		BMPI
	201500405	Theory of Complex Functions (Jeurnink)	3.0		COPS, CMS, LPNO, OS, PoF
	201100254	Adv. Comp. Vision and Pattern Recognition (Spreeuwiers)	5.0		BMPI
	201500583	Machine Learning for Medical Applications (Van der Heijden)	1.5		BMPI
-	201300137	Ions and Devices (Lemay)	5.0	BE	

¹⁰ Soft and Biological Techniques requires previous knowledge, depending on your specific background. In addition, there is a maximum number of students that can participate. Please contact the teaching staff.

Article 6 Programme for Students with a Qualification in Higher Professional Education

The standard programme for students with a qualification in higher professional education (University of Applied Sciences; hbo) in Physics or Electrical Engineering is summarized in the table below.

The study programme requires the approval by the graduation professor and the board of examiners. The graduation professor approves when the study programme is compiled in accordance with the conditions of the master's programme

First and second year (M1 and M2)		EC
Course code	Name	
General physics courses (31 EC)		
202000698	Quantum Mechanics	6
202000702	Statistical Physics	6
202000706	Electrodynamics	6
202000705	Physics of Fluids	7
202000697	Hilbert Space	2
202000703	Partial Differential Equations	2
202000707	Numerical Methods for PDE	2
4 compulsory courses (20 EC) in the first year; 20 EC specialization courses ¹¹ ; 10 EC elective courses at master level in the technical or physics domain ¹² ;		
Compulsory courses (40 EC)		
201800345	Master's Assignment: General Aspects	20
201800344	Master's Assignment: Physical Aspects	20
Total master		121

¹¹ The specialization courses depend on the chair in which the graduation assignment is done. See [curriculum AP](#).

¹² The free electives should be filled with specialization courses of other chairs from the Applied Physics programme, courses of other master's programmes (see websites of the other programmes) and/or extra Applied Physics courses shown in the table mentioned in Art. 5 of this appendix.

Article 7 Standard Programme for Double Master's Programme

A double master's programme is a combination of two separate master's programmes, which the student follows in parallel and involves a combined final master's project and a combined internship.

The standard programme combining two masters 1 and 2 is summarized in the table below.

To comply with requirements of the other master's programme, deviations from this programme may be required.

The study programme requires the approval by the graduation professor and the board of examiners. The graduation professor approves when the study programme is compiled in accordance with the conditions of the master's programme

General set up for double master programme (180 EC)
30-45 EC Compulsory courses Master 1 ¹
30-45 EC Compulsory courses Master 2 ¹
30 EC Combined Internship
60 EC Combined Master Assignment
0-30 EC Elective courses ^{2,3}
¹ Courses part of both compulsory master programmes are placed in the most appropriate programme.
² To a maximum of 15 EC preMaster courses can be part of the double programme
³ The electives can be used to do separate internships

Article 7a Master's Programme with First-Degree Teaching Qualification

A student can obtain a first-degree teaching qualification in Physics by enrolling in the Dutch taught master's programme 'Science Education and Communication' (SEC). There are also several options to combine a master's programme Applied Physics with a first-degree teaching qualification in Physics:

1. For students without a second-degree teaching qualification in Physics, the double master's programme comprises a total of 180 EC, consisting of a combination of the 120 EC M-AP programme (art. 5) and a 60 EC educational part of the first-degree teaching programme. The internship (20 EC) and free electives (10 EC) of the M-AP programme can be used for the educational part resulting in a 150 EC double master's programme.
2. For students with a second-degree teaching qualification in Physics, the double master's programme comprises a total of 150 EC, consisting of a combination of the 120 EC M-AP programme and a 30 EC educational part (due to a 30EC exemption) of the first-degree teaching programme.
3. Students with a second-degree teaching qualification in Physics can obtain their first-degree teaching qualification by using the internship (20 EC) and free electives (10 EC) in the M-AP programme for the 30 EC educational part. This does not lead to a double master's degree.

In all three cases, the student receives a master's degree in Applied Physics, including a first-degree teaching qualification. The content of the various programmes can be found on the website of the M-AP programme www.utwente.nl/ap/

The study programme requires the approval by the graduation professor and the board of examiners. The graduation professor approves when the study programme is compiled in accordance with the conditions of the master's programme

Article 8 Admission Requirements for BSc AM/AT/BMT/CSE/EE/ME/TM/UCT students

Students with a bachelor's degree in various programmes listed in the table below must complete the indicated courses to be admitted to the master's programme Applied Physics:

Course code	Name	Module	EC	Language	AM	AT	BMT	CSE	EE	ME	TM	UCT
202000682	Electromagnetism	TN3	5	EN				x		x	x	x
202000683	Instrumentatie, or	TN3	4	NL				x		x	x	x ¹³
202000624	Basic Elect. and Instru.	AT4	4	EN								
202000684	Analytical Progr.	TN3	1	EN				x		x	x	x
202000660	Intro SSP, or	AT9	5	EN	x	x	x	x	x	x	x	x ¹³
202000701	Inl Vastestoffysica	TN7	7	NL								
202000661	Statistical Physics, or	AT9	5	EN	x	x	x	x	x	x	x	x
202000702	Statistische Fysica	TN7	6	NL								
202000698	Quantum Mechanics	TN6	6	EN	x	x	x	x	x	x	x	x
202000699	Hilbert Space	TN6	2	EN		x	x	x	x	x	x	x
202000706	Electrodynamics ¹⁴	TN8	6	EN	x	x	x	x		x	x	x
202000697	Optics, or	TN6	7	EN	x	x	x		x	x	x	x ¹³
202000705	Physics of Fluids	TN8	7	EN								

Depending on the specialization in the M-AP programme, other courses can be added in consultation with the study adviser.

Article 9 Transition Arrangement

1. In the event of a change to the programmes included in Artt. 5, 6, 7 and 7a in this appendix, or of a change to one of the other articles included in the general part or in this programme-specific appendix, a transition arrangement will be defined and announced by the programme director.
2. Art. 8. sub 4 of the general part states the conditions to be met by a transition arrangement.
3. The transition arrangement will be published on the website of the master's programme Applied Physics.

Article 10 Safety

Working in a laboratory is subject to safety requirements. Students must acquaint themselves with these rules¹⁵ and abide by them.

¹³ For UCT students, the Basic Lab course of AT is mandatory in order to participate in one of the lab courses required for admission to the M-AP programme.

¹⁴ Electrodynamics is not necessary for admission to the M-AP programme. When this course is not a part of the bachelor programme, it will be a compulsory course of the M-AP programme.

¹⁵ See the rules on occupational health and safety and the environment, at <http://www.utwente.nl/tnw/intra/diensten/amh/> and the information of the Practicum Group of the Faculty of Science and Technology, at <http://www.utwente.nl/tnw/slt/>.

Article 11 Sequence of Study Units

1. Prior to starting a programme unit, the student must meet the knowledge requirements of the programme unit.
2. The student can only start the final master's assignment when he/she has successfully completed at least 50 EC of the M1 master's programme.
3. Prior to the final examination, the student must have successfully completed all other programme units.
4. The programme board is authorized, after consultation with the board of examiners, to grant exemption from the conditions in sections 1 to 3 of this article if strict application of those terms would result in an unreasonable delay in study progress. The student can submit a request to this end to the programme board.

Article 12 Flexible Degree Programme

Contrary to the provisions in Artt. 5, 6, 7 and 7a of this appendix the student can request permission of the board of examiners to compose a flexible degree programme in the sense of Artt. 7 sub 3h of Higher education and Research Act (WHW). The board of examiners assesses whether the programme fits within the domain of the programme, is coherent and whether the level is sufficient in terms of the programme intended learning outcomes.

Article 13 Student Counselling

1. The task of the study adviser is to individually advise students on their studies, and to inform the programme director on the study progress of the students.
2. Once a graduation chair has been selected, the daily supervisor, in consultation with the professor, will monitor the student's progress and maintains contact with the programme board and/or the study adviser.

Article 14 Quality Assurance and Evaluation

1. The programme board is responsible for the evaluation of the programme.
2. The execution of the evaluation of the education of the master's programme is dedicated to the coordinator quality assurance of the Science & Technology faculty and the programme director. They are supported by students from the Educational Quality Committee Applied Physics. The coordinator quality assurance is the chair of the Educational Quality Committee Applied Physics.
3. The following evaluation tools are used:
 - a. Panel meetings with students;
 - b. Web surveys of the master's courses¹⁶;
 - c. Web survey of the final master's assignment.
4. The results of the internal quality assurance activities will be published in the following manner:
 - a. Summary of the web surveys and response of the lecturers regarding the evaluation will be sent to the programme committee;
 - b. Summary of web surveys and the response of the lecturer will be placed in the Canvas course 'TN/AP Quality assurance and evaluation' which is accessible for all students and lecturers of the programme.

To evaluate the curriculum and the master's programme in its entirety the following internal and external evaluations are used:

- c. The exit survey about the entire master's programme;
- d. The National Student Survey (NSE)¹⁷;

¹⁶ Compulsory master courses are evaluated annually; other master courses are not evaluation each year. Intended is a frequency of at least once every three years.

¹⁷ The NSE is taken annually.

e. The National Alumni Survey (NAE)¹⁸.

The programme board will respond to the evaluations and provide a plan for improvement. The evaluation including the plan for improvement will be presented to the programme committee.

5. The programme board draws up an annual improvement plan, based on internal and external evaluations and new insights.
 - a. The improvement plan will be discussed with the programme committee;
 - b. The improvement plan will be included in the faculty's annual report;
 - c. The faculty's annual report will be discussed with the executive board by the dean and the portfolio holder education

Article 15 Effectuation and Changes

These regulations will come into effect on 1 September 2020 and replace the regulations dated 19 July 2019.

Established by the board of the Faculty Science & Technology, after advice from the Faculty Council and the Programme Committee Applied Physics and after consent of the Programme Committee Applied Physics with Artt. 2, 5, 6, 7, 7a, 10 and 14.

Enschede, 14 July 2020.

¹⁸ The NAE is taken annually.