Assessment plan for the curriculum of the Master's degree programme in Applied Physics, 2026-2027

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Date of advice by the Board of Examiners: April 30, 2026

Date approval Faculty Board:

1. Vision on assessment

Objectives:
The vision driving the Master of Applied Physics program is to provide a balanced blend of fundamental research and potential industrial applications, striking a balance between theoretical knowledge and practical relevance. The programme is designed to equip the next generation of applied physicists with the capacity to operate seamlessly across and beyond disciplinary boundaries. The international environment of the programme, especially within the research groups, is both inspiring and challenging. The Master's degree programme in Applied Physics is open to students who already have a solid background in physics or applied physics, and who are eager to expand their knowledge and skills to obtain a MSc degree in a modern applied physics research environment. The increasing demand for applied physicists propelled by technology-driven industries, notably within the context of the energy transition, helps the graduates to secure direct employment opportunities. At the same time, enrolling in a PhD program is also a viable option for those seeking to deepen their understanding and expertise in applied physics.

Assessment vision statement:
- Assessment guides and evaluates student learning in a diverse manner, emphasizing content knowledge and essential skills, including problem-solving, group work, practical application, and relevance to real-world scenarios.
- Assessment motivates students by offering constructive feedback, promoting active learning from mistakes, and encouraging the integration of specific knowledge and skills.
- Assessment serves as a guiding principle for lifelong learning and as an instrument in shaping students' future careers by facilitating skill enhancement, adaptive growth, and decision-making.
- All assessments and feedback, final and day-to-day, are provided in English to prepare students for a career with an international job market.

2. Assessment guidelines

Please explain the general assessment procedures that are used in the programmes. For example, 4-eyes principle in test design, standardised grading forms, rubrics.

Guidelines for assessment quality:
- The course assessment scheme should be communicated to the students during the introduction to the course at the first lecture, and also included in the course webpage and Ocasys. The assessment scheme might not be changed during the course.
- The courses are assessed through written or oral exams as assigned in the assessment plan. For resits, the examiner can always choose for oral examination.
- If the course includes several parts taught by different instructors, the course coordinator determines how these components are integrated into the final assessment and their respective contributions to the overall grade.
- Written exams must contain the following information on the first page: the course title and code, when and where the exam takes place, the number of questions/pages, exam conditions (what is allowed and not allowed to use) and the grading scheme
- A clear and explicit rubric or a comprehensive grading scheme is drawn up by the course coordinator to promote fairness and transparency in the grading process.
- For courses with a written exam, a mock exam (for example, an exam from a previous year) must be available from the start of the course.
- Oral exams are graded using the dedicated oral exam grading form. At the beginning of the exam, the student should be informed of the topics to be examined (pre-indicated in the grading form). An independent observer (preferably the preassigned second examiner) must be present during the full exam. The examination material (photos of the blackboard or paper sheets with student’s answers) should be collected and added to the examination form.

- For courses with hands-on practicals, the grade of the report might be a (weighted) part of the final grade. The grade might also be binary (pass/no pass); a pass grade is required to be admitted to the exam.
- If the practical work is performed in teams, the team report might be handed in and graded for the whole team unless exceptional circumstances (e.g., a student did not participate in report writing). Individual reports might also be requested by the course coordinator. This should be clearly communicated to the students during the first lecture.
- All practicals are assessed through a written report with feedback to the students on development points. This is provided as explicit feedback written for each individual student on the grading form.
- To impart to students the practical significance of meeting deadlines and guarantee equitable grading, a “fail” grade is assigned to reports not handed in on time, and the highest grade that can be obtained for the report is reduced from 10 to 7.5. Upon a second fail to meet a deadline, the highest grade is further reduced to 6.5.

Master research project:

- The first examiner may delegate daily supervision, but is ultimately responsible for the smooth flow and outcome of the research project.
- To ensure standardized and fair grading, the master research project should be assessed by the first examiner and an independent second examiner. They should not be from the same research unit, and not closely involved in the master project.
- The master's thesis is required to incorporate a valorization section, delineating potential real-life applications derived from the research.
- For the research project, midterm assessment with specific feedback on development points and self-reflection of the student must be provided. The feedback is documented on the dedicated form
- In research projects, regular progress meetings (at least every week) with the daily supervisor should take place, in which the student is given feedback and instructions on the day-to-day research. Progress meetings (at least every four weeks) with the supervisor should also take place, in which the students will be given clear feedback on their progress.
- Supervisors should provide feedback on at least one full draft version of the master thesis, provided the student meets the agreed deadline for handing in the full draft.
- The master thesis must be checked by the supervisor for plagiarism before grading.
- The students should be instructed on the possible use and misuse of AI and online information tools with the focus on ethics and critical thinking. The use of such tools may not be explicitly recognized in the acknowledgment section.
- If the research project is awarded a negative grade or there is a substantial delay, a remediation trajectory should be drawn by the supervisor and the student. The programme management should be informed promptly about this development.

Internship:

- The internship is graded by the appointed examiner on the binary (pass/no pass) basis; a pass grade is required
- The grading should be based on the student’s internship report and the report of the company supervisor
- If the internship fails or there is a substantial delay, a remediation trajectory should be drawn by the local supervisor, the company supervisor (if applicable) and the student. The programme management should be informed promptly about this development.

3. Learning outcomes of the degree programme

Learning Outcome:	
A. Knowledge and understanding	
A1	An Applied Physics master's graduate understands the advanced concepts of physics, including the necessary mathematics and computer science, at a level which permits admission to a PhD programme;
A2	An Applied Physics master's graduate is familiar with the advanced quantitative character of physics and with the relevant research methods;
A3	An Applied Physics master's graduate has operational knowledge and design skills in the field of applied physics;
A4	An Applied Physics master's graduate has a thorough understanding of the current state of the art in materials science, more specifically of structure, functional properties and characterisation of advanced materials;
A5	An Applied Physics master's graduate has basic knowledge in the present field of business and management.
B. Application of knowledge and understanding	
B1	An Applied Physics master's graduate is capable of carrying out research, aimed at understanding of physical phenomena that are potentially usable in applications, or is capable of developing applications of physical phenomena;
B2	An Applied Physics master's graduate is capable of analyzing a (new) complex applied problem, and to use modelling skills to develop a structured and well-planned research approach;
B3	An Applied Physics master's graduate is capable of applying his/her specific knowledge and mathematical, experimental, and computer skills to solve physical problems in his/her own and related subject areas and fields;
B4	An Applied Physics master's graduate has developed an attitude aimed at seeking new applications;
B5	An Applied Physics master's graduate has experience with the use of complicated apparatus and/or with the use of advanced programming tools;
B6	An Applied Physics master's graduate has experience in application of applied physics in an industrial environment or in an applied physics research environment abroad;
B7	is capable of collaborating in a (multi-disciplinary) research and design team.
C. Judgement	
C1	An Applied Physics master's graduate is capable of obtaining relevant information using modern information channels, and to interpret this information critically;

C2	An Applied Physics master’s graduate is capable of managing and judging his/her and others' actions within a highly scientific and professional context, taking societal and ethical aspects into account;
C3	An Applied Physics master’s graduate is able to draw conclusions on the basis of limited or incomplete information, and is able to realize and formulate the limitations of such conclusions.
D. Communication skills	
D1	An Applied Physics master’s graduate is capable of communicating clearly in English, both verbally and in writing, on his/her subject and relevant applications, at a level which is understandable to experts and non-experts, and using modern communication tools.
E. Learning skills	
E1	An Applied Physics master’s graduate is capable of addressing issues inside as well as outside his/her main subject area, therefore and thereby gaining new knowledge and skills;
E2	An Applied Physics master’s graduate is able to recognize potential applications of recent advances in physics.

4. Overview of assessment methods, test moments for course units, and examiners

The abbreviations for the relevant teaching methods are explained in the legend of the table. Examples of assessment methods include:

- *Written Exam (WE)*
- *Midterm (MT)*
- *Multiple Choice (MC)*
- *Oral Exam (OR)*
- *Report (R)*
- *Presentation (P)*
- *Practical Work (PR)*
- *Assignment (AST)*

Applied Physics (core programme)

Year	Period	Course	EC	Assessment methods	Incl. Formative Assessment?	Test moment(s)	First examiner	Second examiner
1	1A	Computational Physics (WMPH007-05)	5	R	Yes	continuous assessment, exam week	P.R. Onck	A. Giuntoli
1	1B	Mechanical Properties (WMPH023-05)	5	AST, PR, P, R	Yes	continuous assessment, exam week	P.R. Onck	A. Giuntoli
1	1B	Structure at Macro, Meso and Nano Scale (WMPH020-05)	5	AST, WE	Yes	continuous assessment, exam week	L. Protesescu	B.J. Kooi
1	2A	Characterisation of Materials (WMPH021-05)	5	WE	Yes	exam week	G.R. Blake	B.J. Kooi
1	2A	Properties of Functional Materials (WMPH051-05)	5	WE	Yes	continuous assessment, exam week	J. Ye	R. lo Conte
1	2B	Nanoelectronics and Mesoscopic Physics (WMPH058-05)	5	AST, WE	Yes	continuous assessment, exam week	B.J. van Wees	T. Banerjee
1	2B	Physics with Industry (WMPH041-05)	5	AST, P, R	Yes	continuous assessment, exam week	R.A. Hoekstra	P.R. Onck
2	-	Industrial Internship (WMPH003-20)	20	AST, PR, P	Yes	continuous assessment, exam week	*B.J. Kooi, see list examiners research projects below*	
2	-	Applied Physics Master Research Project (WMPH901-40)	40	R, P	Yes	continuous assessment	*R. Hildner, see list examiners research projects below*	

Applied Physics (Optional courses)

Year	Period	Course	EC	Assessment methods	Incl. Formative Assessment?	Test moment(s)	First examiner	Second examiner
1	1A	Multibody and Non-Linear Dynamics (WMME009-05)	5	PR, WE, P, R	Yes	continuous assessment, exam week	A.O. Krushynska	B. Jayawardhana
1	1A	Physics of Lasers (WMPH027-05)	5	WE, AST, R, PR	Yes	continuous assessment, exam week	R. Hildner	M. S. Pchenitchnikov
1	1A	Robotics and Automation (WMIE038-05)	5	WE, R	Yes	continuous assessment, exam week	B. Haghighat	B. Jayawardhana
1	1B	Bioinspired Designer Materials (WMCH009-05)	5	WE, P	Yes	continuous assessment, exam week	M.M.G. Kamperman	G. Portale
1	1B	Quantum Technology (WMPH057-05)	5	AST, P	Yes	continuous assessment	S.A. Jones	L. Willmann
1	1B	Surface Interactions in Electromechanical Systems (WMPH045-05)	5	AST, WE	No	continuous assessment, exam week	G. Palasantzas	H. Waalkens
1	1B	Theoretical Condensed Matter Physics (WMPH031-05)	5	WE	Yes	continuous assessment	M.V. Mostovoy	J.L. Slawinska
1	2A	Memristive Devices (WMPH043-05)	5	AST, WE	Yes	continuous assessment, exam week	B. Noheda Pinuaga	T. Banerjee
1	2A	Optoelectric Devices (WMPH042-05)	5	OR, AST	Yes	continuous assessment, exam week	M.A. Loi	L.J.A. Koster
1	2A	Smart Materials for Engineering (WMME021-05)	5	WE, P, PR	Yes	continuous assessment, exam week	M.I. Acuautla-Meneses	B.J. Kooi
1	2B	Neuromorphic Circuit Design (WMPH044-05)	5	AST, OR, PR	Yes	continuous assessment, exam week	E. Chicca	T. Banerjee
1	2B	Nanoscale Material Modeling (WMPH053-05)	5	WE, AST	Yes	continuous assessment	A. Giuntoli	J.L. Slawinska

Year	Period	Course	EC	Assessment methods	Incl. Formative Assessment?	Test moment(s)	First examiner	Second examiner
1	2B	Polymer Physics (WMCH025-05)	5	WE, P, PR	Yes	continuous assessment, exam week	G. Portale	K. Loos
1	2B	Surfaces and Interfaces (WMPH014-05)	5	AST, WE	Yes	continuous assessment, exam week	A. Grubisic-Cabo	P. Rudolf

Examiners for the Master's Research Project and Industrial Internship

Zernike Institute
Banerjee, prof. dr. T.
Bari, prof.dr. S.
Chicca, prof.dr. E.
Diniz Guimaraes, dr. M.H.
Ehrler, dr. B.
Giuntoli, dr. A.
Grubisic-Cabo, dr. A.
Hoekstra, prof.dr.ir. R.A.
Kooi, prof.dr.ir. B.J.
Koster, prof.dr. J.A.
Lo Conte, dr, R.
Loi, prof.dr. M.A.
Noheda Pinuaga, prof.dr. B.
Onck, prof.dr.ir. P.R.
Palasantzas, prof.dr. G.
Protesescu, dr. L.
Schlathölter, dr. T.A.
Vlijm, dr. R.
Wal, prof.dr.ir. C.H. van der
Wees, prof.dr.ir. B.J. van
Wel, prof.dr. P.C.A. van der
Ye, prof.dr. J.
Zaag, dr. P.J. van der

VSI
Bethlem, dr. H.L.
Even, dr. J.
Hoekstra, prof.dr. S.
Jones, dr. S.
Willmann, dr. L.

ENTEG
Krushynska, dr. A.O.
Maresca, dr. F.

ESRIG
Lentink, prof.dr.ir. D.
Purushothaman Vellayani, prof.dr. A.

PARTREC/UMCG
Dendooven, dr. P.G.
Gerbershagen, prof,dr. A.
Luijk, dr. P. van
Ortiz Catalan, dr. R.

SSE
Biegun, dr. A.K.
Blijleven, dr. J.S.
Fontana, dr. M.
Klein-Douwel, dr. R.H.J.
Rigollet, dr. C.E.

An examiner for the Master’s Research Project of Physics or Astronomy may act as second supervisor for the Master’s Research Project in Applied Physics.

5. Relationship between course units and details of the learning outcomes

Learning outcomes	A1	A2	A3	A4	A5	B1	B2	B3	B4	B5	B6	B7	C1	C2	C3	D1	E1	E2
Characterization of Materials	X		X	X						X							X	
Computational Physics	X	X					X	X		X						X		
Nanomaterials Synthesis and Engineering	X			X									X			X	X	
Properties of Functional Materials	X			X					X								X	X
Mechanical Properties	X		X	X												X	X	
Nanoelectronics and Mesoscopic Physics	X			X					X									X
Physics with Industry	X	X	X	X	X			X	X				X	X	X		X	
Structure at Macro, Micro and Nano Scale	X			X													X	
Optional courses	X	X	X	X		X	X	X	X	X	X	X	X	X	X	X	X	X
Industrial Internship	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Applied Physics Master Research Project	X	X	X	X		X	X	X	X	X	X	X	X	X	X	X	X	X