



Programme-specific Section of the Curriculum for the MSc Programme in Physics with a minor subject at the Faculty of Science, University of Copenhagen 2010 (Rev. 2021)

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1 Title, affiliation and language

A shared section that applies to all BSc and MSc Programmes at the Faculty of Science is linked to this programme-specific curriculum.

1.1 Title

The MSc Programme in Physics with a minor subject leads to a Master of Science (MSc) in Physics and minor in [the minor subject] with the Danish title: *Cand.scient.* (*candidatus/candidata scientiarum*) i fysik med sidefag i [the minor subject].

It will appear from the diploma that the study programme has been completed as an MSc in two subjects and, provided that the requirements pertaining to the Upper Secondary School course packages (*gymnasiefagpakkerne*) have been met, that academic qualifications (*faglig kompetence*) for teaching at the Danish Upper Secondary School in the subjects have been achieved.

1.2 Affiliation

The programme is affiliated with the Study Board of Physics, Chemistry and Nanoscience, and the students can both elect, and be elected, to this study board.

1.3 Corps of external examiners

The following corps of external examiners is used for the central parts of the MSc Programme:

- Corps of External Examiners for Physics (*fysik*)

1.4 Language

The language of this MSc Programme is English.

2 Academic profile

2.1 Purpose

The overall goal of the two year MSc education in Physics with a minor subject is to train the students to a level where they can think as a physicist and have the special required competences to teach in physics at the Danish High school level. In order to achieve this goal, the Master of Science Programme in Physics is a research based education that allows the student to specialise within a certain area of physics as chosen by the student. The student follows a curriculum composed by high level academic courses in theoretical and experimental physics, by courses in the minor subject and by courses in the didactics of physics. In addition the student makes an independent thesis project. This way the student obtains a broad insight into physics, the minor subject and didactics of physics along with in-depth insight within a highly specialised area at the research forefront of physics.

2.2 General programme profile

The MSc Programme in Physics with a minor subject is a research-based education composed by 45 ECTS physics and didactics subject elements, 45 or 75 ECTS subject elements in the minor topic (depending on whether the minor subject is within science or not) and a 30 ECTS thesis project. The course component of the education will give the student a profound overview of the state of the art established knowledge within the chosen specialisation areas. The thesis will allow the student to specialise further within a specialised topic of physics. By the end of the studies the student will have an understanding of what it requires to perform independent research and be in a position where he/she can teach and develop teaching material within physics and the minor subject.

Physics is the key subject area of the programme. Mathematics and computer science are also subject areas of the programme.

2.3 General structure of the programme

The MSc Programme is set at 120 or 150 ECTS depending on whether the minor subject is within the field of sciences or not.

Exercise and Sport Sciences is in this regard considered as being outside the field of science.

The MSc Programme in Physics with a minor subject consists of the following elements:

- Basic study program, 120 ECTS including the thesis.
- Extension of the minor subject, 30 ECTS, if the minor subject is outside the field of science.

There are no defined specialisations in this MSc Programme.

2.4 Career opportunities

The MSc Programme in Physics with a minor subject qualifies students to become professionals within:

- High school teacher in the Danish system (*gymnasium*).
- Teaching and communications.
- PhD-student in different profession directions at science and medical science faculties or in industry.
- Petro Physicist in the oil industry.
- Biophysicist in the pharmaceutical industry.
- Hospital physicist.
- Meteorologist.
- Risk Manager or Analyst in the bank sector or insurance companies.
- A wide range of job opportunities within Danish and international high-tech companies, international agencies, national authorities or teaching at the high-school level.
- Various jobs within research and development using physics as the basis of modern technology, for example high-tech companies, software companies and consultancy industry.

3 Description of competence profiles

Students following the MSc Programme acquire the knowledge, skills and competences listed below. Students will also acquire other qualifications through elective subject elements courses and other study activities.

3.1 Competence profile

On completion of the programme, an MSc in Physics with a minor subject has acquired the following:

Knowledge about:

- The basic physical laws in classical physics disciplines, i.e. classical mechanics, thermodynamics, electromagnetism, quantum mechanics, and their interrelationships, and within selected fields specialized to the highest level.
- Knowledge about didactics in the context of Physics.

- The construction of materials at both macro- and micro-level, and the fundamental principles for the various forces that operate on each length scale for physical systems within selected field.
- Quantification methodology.
- Up-to-date, specialist knowledge of a given field of research within physics, built up through research-based teaching and the thesis.
- Mathematical methods for solving a wide range of problems, both linear and non-linear.
- Numerical methods for data processing and solving mathematical models.

Skills in/to:

- Organise demonstration observations and experiments for studies of systems in which physical entities play a role, including electrical, electromagnetic, optical, and thermodynamic entities.
- Reflect on different classical and modern teaching styles in physics and the role they play for the learning of the student.
- Engage in constructive partnerships on the basis of their scientific background in order to solve academic and didactic problems.
- Set up and apply relevant models for a physical system based on the laws of physics.
- Explain and communicate specialist knowledge and the general contexts of physics, both orally and in writing.
- Seek out and summarise the latest knowledge within a particular subject area.
- Discuss the application of the subject's results in a wider context, e.g. industrial or social context.
- Take independent responsibility for their own academic development, specialisation and skills development.
- Use English as a working language.
- Make use of IT as a tool for both information- and data-processing, and in other contexts where it is academically relevant, e.g. in developing numerical models and experiments.

Competences in/to:

- Setting up and applying models and developing quantification methods for use in physical systems and their adjacent areas, e.g. biological, geophysical, chemical or economic systems.
- Work with others, both by playing an active role within research teams and by working closely with fellow students. Working on the thesis and being involved in the day-to-day operations of a research team will provide graduates with solid experience of a research environment's different methods and forms of work.
- Communicate an issue in plain language, on both a general and a scientific level, both orally and in writing.
- Communicating and teaching physics. Both to younger students and to broader audiences. This includes adapting the level to the target group.
- A general understanding of scientific methods.

4 Admission requirements

With a Bachelor's degree in Physics from the University of Copenhagen the student is granted reserved access and guaranteed a place on the MSc Programme in Physics with a minor subject if the student applies in time to begin the MSc Programme within three years of the completion of the Bachelor's degree.

The admission requirements for the MSc Programme in Physics with a minor subject is the same as the admission requirements listed in paragraph 4 in “Programme-specific Section of the Curriculum for the MSc Programme in Physics” supplemented with the following:

- At least 105 ECTS from the Upper Secondary School course package (*gymnasiefagpakken*) are included in the BSc programme.
- At least 45 ECTS from the minor subject is included in the BSc programme.
 - If the minor subject is *within* the field of sciences (with the exception of Exercise and Sport Sciences) the 45 ECTS must be contained in the minor subject Upper Secondary School course package (*den reducerede gymnasiefagpakke*).

5 Prioritisation of applicants

If the number of qualified applicants to the programme exceeds the number of places available the applicants will be prioritised according to paragraph 5 in “Programme-specific Section of the Curriculum for the MSc Programme in Physics”.

6 Structure of the programme

The compulsory subject elements, restricted elective subject elements and the thesis constitute the central parts of the programme (Section 21 of the Ministerial Order on Bachelor and Master’s Programmes (Candidatus) at Universities).

6.1 Programme components

The programme is set at 120/150 ECTS and consists of the following:

- Compulsory subject elements, 7.5 ECTS
- Restricted elective subject elements, 37.5 ECTS.
- The minor subject
 - 45 ECTS (minor subject within the field of science).
 - 75 ECTS (minor subject outside the field of science).
- Thesis, 30 ECTS.

6.1.1 Compulsory subject elements within the major subject

All of the following subject elements are to be covered (15 ECTS):

• NNDK15001U	Naturfagsdidaktik for Fysik (DidFys)	Block 2	7.5 ECTS
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6.1.2 Restricted elective subject elements within the major subject

37.5 ECTS are to be covered as subject elements from one or both of the following lists:

1) Up to 15 ECTS are to be covered as subject elements from the following list, if they were not passed as part of the BSc programme:

• NFYB16000U	Astronomiens fundament (Astro1)	Block 1	7.5 ECTS
• NFYA10009U	Fysiske undervisningsforsøg (FUF)	Block 3	7.5 ECTS

2) Up to 37.5 ECTS are to be covered as subject elements from the following list:

• NFYK15003U	Advanced Quantum Mechanics(Quant3)	Block 1	7.5 ECTS
• NFYK14011U	Theoretical Astrophysics	Block 1	7.5 ECTS
• NFYK15008U	Earth and Climate Physics	Block 1	7.5 ECTS
• NFYK15006U	Biophysics of Cells and Single Molecules	Block 1	7.5 ECTS
• NDAA07012U	Scientific Computing	Block 1	7.5 ECTS

• NFYA04022U	General Relativity and Cosmology (GR)	Block 1	7.5 ECTS
• NFYK18005U	Complex Physics	Block 1	7.5 ECTS
• NFYA04034U	Inverse Problems	Block 1	7.5 ECTS
• NFYK13011U	Applied Statistics: From Data to Results	Block 2	7.5 ECTS
• NFYA04036U	Elementary Particle Physics	Block 2	7.5 ECTS
• NFYK14024U	Turbulence	Block 2	7.5 ECTS
• NFYK21004U	Computational Astrophysics	Block 2	7.5 ECTS
• NFYK15007U	Condensed Matter Experiments	Block 2	7.5 ECTS
• NFYK13013U	Experimental X-ray Physics (X-ray)	Block 3	7.5 ECTS
• NFYK10005U	Continuum Mechanics	Block 3	7.5 ECTS
• NNDK16001U	History of Physics	Block 3*	7.5 ECTS
• NFYK13021U	Neutron Scattering	Block 4	7.5 ECTS
• NFYK10006U	Diffusive and Stochastic Processes	Block 4	7.5 ECTS

*The course is offered next time in 2022/23

6.1.3 Restricted elective subject elements within the minor subject

45 ECTS are to be covered as subject elements from the minor subject if the minor subject is within the field of science.

75 ECTS are to be covered as subject elements from the minor subject if the minor subject is outside the field of science.

If the student lacks less than 45 or 75 ECTS of the minor subject when the MSc Programme begins the difference must be covered as elective subject elements.

6.1.4 Elective subject elements

The elective subject elements are generally covered by the subject elements which the student follows on the minor subject.

It is, however, possible to release elective subject elements if the academic minimum requirements for the minor subjects have been met – this will, e.g., be the case if one or both of the following two conditions are present:

- A subject elements forms part of both the major and minor Upper Secondary School course packages (*gymnasiefagpakker*). The subject elements should only be passed once, and the student has full freedom of choice in terms of the remaining ECTS.
- If less than 45 or 75 ECTS within the minor subject are missing when entering the MSc Programme.

BSc subject elements corresponding to 15 ECTS may be included in the MSc Programme as elective subject elements.

Projects outside the course scope may be included in the elective section of the programme by up to 15 ECTS. Note that Projects outside the course scope may not exceed 15 ECTS in total on the restricted elective and elective section of the programme. The regulations are described in Appendix 5 to the shared section of the curriculum.

Projects in practice may be included in the elective section of the programme by up to 15 ECTS. Note that Projects in practice may not exceed 15 ECTS in total on the restricted elective and elective section of the programme. The regulations are described in Appendix 4 to the shared section of the curriculum.

Thesis preparation projects may not be included in the elective section of the programme. The regulations are described in Appendix 6 to the shared section of the curriculum.

6.1.5 Thesis

The MSc Programme in Physics with a minor subject includes a thesis corresponding to 30 ECTS, as described in Appendix 2 to the shared curriculum. The thesis must be written within the academic scope of the programme.

6.1.6 Academic mobility

The academic mobility is generally covered by the subject elements which the student follows on the minor subject.

The student has the possibility to arrange academic mobility during the programme according to rules and regulations regarding pre-approvals and credit.

7 Exemptions

In exceptional circumstances, the study board may grant exemptions from the rules in the curriculum specified solely by the Faculty of Science.

8 Commencement etc.

8.1 Validity

This subject specific section of the curriculum applies to all students enrolled in the programme – see however Appendix 2.

8.2 Transfer

Students enrolled on previous curricula may be transferred to the new one as per the applicable transfer regulations or according to an individual credit transfer by the study board.

8.3 Amendment

The curriculum may be amended once a year so that any changes come into effect at the beginning of the academic year. Amendments must be proposed by the study board and approved by the Dean.

Notification about amendments that tighten the admission requirements for the programme will be published online at www.science.ku.dk one year before they come into effect.

If amendments are made to this curriculum, an interim arrangement may be added if necessary to allow students to complete their MSc Programme according to the amended curriculum.

Appendix 1 Tables

Tables for students admitted to the programme in September (summer):

Table – MSc Programme in Physics with a minor subject within SCIENCE

	Block 1	Block 2	Block 3	Block 4
1st year	Minor subject	Minor subject	Minor subject	Minor subject
	Minor subject	Minor subject	Restricted elective	Restricted elective
2nd year	Restricted elective	Naturfagsdidaktik for Fysik	Thesis	
	Restricted elective	Restricted elective		

Compulsory
 Restricted elective
 Minor subject
 The table illustrates the recommended academic progression. The student is allowed to plan an alternative progression within the applicable rules.

Table – MSc Programme in Physics with a minor subject outside SCIENCE

	Block 1	Block 2	Block 3	Block 4
1st year	Minor subject	Minor subject	Minor subject	Minor subject
	Minor subject	Minor subject	Minor subject	Minor subject
2nd year	Restricted elective	Naturfagsdidaktik for Fysik	Minor subject	Minor subject
	Restricted elective	Restricted elective	Restricted elective	Restricted elective
3rd year	Thesis			

Compulsory
 Restricted elective
 Minor subject
 The table illustrates the recommended academic progression. The student is allowed to plan an alternative progression within the applicable rules. Note that minor subjects outside SCIENCE may have a fixed progression.

Tables for students admitted to the programme in February (winter):

Table – MSc Programme in Physics with a minor subject within SCIENCE

	Block 3	Block 4	Block 1	Block 2
1st year	Minor subject	Minor subject	Minor subject	Minor subject
	Minor subject	Minor subject	Restricted elective	Naturfagsdidaktik for fysik
2nd year	Restricted elective	Restricted elective	Thesis	
	Restricted elective	Restricted elective		



Compulsory
 Restricted elective
 Minor subject
 The table illustrates the recommended academic progression. The student is allowed to plan an alternative progression within the applicable rules.

*This table is only relevant for students who begin the MSc Programme in February (block 3)

Table – MSc Programme in Physics with a minor subject outside the field of science*

	Block 3	Block 4	Block 1	Block 2
1st year	Minor subject	Minor subject	Minor subject	Minor subject
	Minor subject	Minor subject	Minor subject	Minor subject
2nd year	Minor subject	Minor subject	Restricted elective	Naturfagsdidaktik for fysik
	Restricted elective	Restricted elective	Restricted elective	Restricted elective
3rd year	Thesis			

 Compulsory

 Restricted elective
 Minor subject

The table illustrates the recommended academic progression. The student is allowed to plan an alternative progression within the applicable rules. Note that minor subjects outside SCIENCE may have a fixed progression.

*This table is only relevant for students who begin the MSc Programme in February (block 3)

Appendix 2 Interim Arrangements

The Shared Section of the BSc and MSc Curricula for Study Programmes applies to all students.

The interim arrangements below only consist of parts where the current curriculum differs from the rules and regulations that were previously valid. Therefore, if information about relevant rules and regulations are missing, it can be found in the curriculum above.

1 General changes for students admitted in the academic year 2020/21

Students admitted to the MSc Programme in the academic year 2020/21 must finish the programme as listed in the curriculum above with the following exceptions:

Restricted elective subject elements within the major subject

37.5 ECTS are to be covered as subject elements from one or both of the following lists:

1) Up to 22.5 ECTS are to be covered as subject elements from the following list, if they were not passed as part of the BSc programme:			
• FYB16000U	Astronomiens fundament (Astro1)	Block 1	7.5 ECTS
• NFYA10009U	Fysiske undervisningsforsøg (FUF)	Block 3	7.5 ECTS
• NDIA10001U	Grundkursus i de naturvidenskabelig fags didaktik	Block 4	7.5 ECTS

2) Up to 37.5 ECTS are to be covered as subject elements from the following list:			
• Restricted elective subject elements offered as part of the list 2) in this curriculum (see above)			
• NFYK14018U	Computational Astrophysics: Star and Planet Formation	Discontinued*	7.5 ECTS

*See course specific changes below

2 Course specific changes

Discontinued course	Interim arrangement
<ul style="list-style-type: none"> Computational Astrophysics: Star and Planet Formation (NFYK14018U), 7.5 ECTS 	<p>The course was restricted elective in the academic year 2020/21 and earlier.</p> <p>Offered for the last time: 2020/21 Last exam if applicable (cf. SCIENCE's Teaching and exam rules): 2020/21</p> <p>The course is replaced by the identical course Computational Astrophysics (NFYK21004U), 7.5 ECTS</p>

Appendix 3 Description of objectives for the thesis

After completing the thesis, the student should have:

Knowledge about:

- How to identify scientific problems within the study programme's subject areas.
- How to summarise a suitable combination of methodologies/theories based on international research for use in his/her work with the problem formulation.
- How to discuss theories/models on the basis of an organised value system.

Skills in/to:

- Apply and critically evaluate theories/methodologies, including their applicability and limitations.
- Assess the extent to which the production and interpretation of findings/material depend on the theory/methodology chosen and the delimitation chosen.
- Discuss academic issues arising from the thesis.
- Draw conclusions in a clear and academic manner in relation to the problem formulation.

If the thesis includes experimental content/own data production, the student will also be able to:

- Substantiate the idea of conducting experimental work/producing own data in order to shed light on the topic as formulated in the problem formulation.

Competences in/to:

- Initiating and performing academic work in a research context.
- Solving complex problems and carrying out development assignments in a work context.