UiT The Arctic University of Norway

Program description
Master of Science in Photonics and Nanotechnology

120 credits/Tromsø
The program description has been approved by the board of the Faculty of Science and Technology, 25.09.2025



Study programme name	English: Photonics and nanotechnology - master Bokmål: Fotonikk og nanoteknologi – master Nynorsk: Fotonikk og nanoteknologi - master
Degree obtained	Master of Science in Photonics and nanotechnology
Target group	Master of Science in Photonics and nanotechnology are aimed at students who have an interest in the science of light and how nanostructures can be made and analysed.
Admission requirements, required prerequisite, recommended prerequisite knowledge	Admission to the program requires a bachelor's degree in physics, chemistry, nanotechnology, or another degree following a program of study of at least three years' duration, or similar education approved in accordance with the Norwegian Universities Act section 3-4. The education must contain: • Knowledge in physics, minimum 30 ECTS and including mechanics and electromagnetism. • Knowledge in mathematics, including multivariable calculus and linear algebra • Basic knowledge in chemistry and informatics (e.g. KJE-1001, INF-0101 and INF-0102) In total, the degree must include minimum 120 ECTS in mathematics, informatics, chemistry, physics or statistics. It is recommended to have an introductory course in optics. An average mark of C (3.0) or better is required in the bachelor's degree or similar basis of admission.
The study programme's Learning Outcome	*Knowledge - The candidate:* • has advanced knowledge of theory and methods in photonics, quantum chemistry, materials science and fabrication processes in nanotechnology • has knowledge of the scientific method and how to conduct scientific research, with in-depth knowledge of how research is performed in state-of-the-art photonics and nanotechnology. • can apply the knowledge acquired on new areas of research

- can analyse and assess scientific literature and research in the field

Skills - The candidate:

- can simulate, design and fabricate devices for nanotechnology
- can master techniques for advanced processing and characterization typical in nanotechnology, such as deposition, lithography, etching, SEM/AFM imaging, etc.
- is familiar with cleanroom work and safety routines
- can characterise optical components and materials for nanotechnology using suitable set-ups and state-of-the-art equipment
- is trained to use scientific software for nanotechnology and computational chemistry
- can work independently following scientific methods to solve specific problems
- can evaluate and analyse published theories, methods and experiments in relevant literature
- can carry out an independent, limited research or development project under supervision in photonics, nanotechnology, quantum chemistry or material science

Competences - The candidate:

- has acquired good theoretical and experimental insight, and the ability to apply theory, methods, and techniques to solve problems within and beyond photonics and nanotechnology
- possesses necessary qualifications for work within academic or industrial research, teaching, production, development and technical professions
- can cooperate in an interdisciplinary way with other specialists
- has an overview of the innovation process and Norwegian industry within nanotechnology
- can find precise and scientific formulations, in oral and written language
- displays good working habits and follows the code of ethics in scientific work
- can contribute to new thinking and innovation processes in the fields of photonics and nanotechnology

Academic content and description of the study programme	**Programme description Photonics and Nanotechnology** Nanotechnology is at a core of all modern digital technologies with ever-increasing demands on education and employment within both research and industry. Competent workforce is sought for development of new nanotechnological solutions, as well as for operation, and service of existing infrastructures (e.g. nanotechnology foundries). Photonics, and especially nanophotonics, is a branch of nanotechnology strongly supported by the European Union. When high-speed, high-sensitivity and high-throughput are required at an affordable price, the answer is often photonics and photonic integrated circuits (PICs). It is a dynamic and vibrant industrial sector with huge opportunities for rapid market growth, including research-based, small start-ups. The design of novel materials is at the core of several societal challenges: the energy chain (production, storage, utilization), environment and sustainability, health, all benefit from enhanced materials with specific properties. Through the materials science component of the program, the students will learn the fundamental physics governing materials properties and how it relates to their structure. In Tromsø, nanotechnology and photonics builds on several strong research groups, notably the Hylleraas Centre of Excellence in computational chemistry and several ERC Starting Grants and EU-projects in photonics. The first semester of the study plan contains courses in quantum chemistry and nanotechnology. These two courses give the theoretical and experimental foundations for nanotechnology. The nanotechnology course introduces work in a cleanroom, including necessary health and safety training. For students without an introductory course in optics, an individual curriculum will be offered as self-study to fill this gap. Students with optics in their bachelor degree are recommended to take a course that complements their background in this slot. Optics and chemistry are prerequisites for the photonics and the material science courses, respectively, in the second semester. The second semester contain two courses that are at the core of the program: a photonics-course going into the science of light, and a material science course. An optional 10 ECTS course (or several smaller courses) should be chosen based on the interests of the student and the planned direction of the master thesis. The

topic of the master thesis must be chosen at the end of the semester.

The semester third contains a course on sustainability and innovation, that will put the study into a larger perspective and give knowledge about intellectual property. This can be useful for students who want to commercialise their work. An optional course (or courses) can be chosen as for the second semester. In this semester, the work on the master thesis starts. Students who do an experimental master-thesis are required to take necessary courses on first aid and safety. The first chapters of the thesis, with a literature review, introduction to the topic and plans for the next semester, must be handed in at the end of the semester.

Compulsory course either before starting or as part of the program, corresponding to:

- FYS-2022 Waves and optics

Compulsory courses in the program:

- FYS-/KJE -3902 Master's thesis in photonics and nanotechnology
- FYS-3009 Photonics
- FYS-3038 Nanotechnology
- KJE-3503 Material science
- TVR-3000 Activating Transformations for Sustainability

Recommended optional courses for the program:

- FYS-2008 Measurement techniques
- FYS-2010 Image analysis
- FYS-3037 Radiation and biomedical imaging
- FYS-3029 Optical nanoscopy
- FYS-3810 Individual special curriculum in physics
- KJE-3810 Individual special curriculum in chemistry
- KJE-3102 Computational Chemistry

Optional courses should be determined in collaboration with your supervisor in connection with choice of research topic for the Master's thesis. Other optional courses may be approved on application or if recommended by your supervisor.

<table>
<tr><td>Table: programme structure</td><td>
<table>
<tr><th>Semester</th><th>10 credits</th><th>10 credits</th><th>10 credits</th></tr>
<tr><td>1. semester</td><td>KJE-3101

Quantum chemistry</td><td>FYS-3038

Nanotechnology</td><td>Optional courses or FYS-2022 Waves and optics (self-study)</td></tr>
<tr><td>2. semester</td><td>FYS-3009 Photomics</td><td>KJE-3503

Material science</td><td>Optional courses</td></tr>
<tr><td>3. semester</td><td>FYS-/KJE-3902 Master’s Thesis in Photonics and Nanotechnology (40 ECTS)</td><td>TVR-3000 Activating Transformations for Sustainability</td><td>Optional courses</td></tr>
<tr><td>4. semester</td><td colspan="3">FYS-/KJE-3902 Master’s Thesis in Photonics and Nanotechnology (40 ECTS)</td></tr>
</table>
</td></tr>
<tr><td>Learning activities, examination and assessment</td><td>The study program should mainly consist of courses at the master’s level (3000 level). No more than 20 ECTS are allowed from relevant 2000 level courses.

The study program includes a variety of teaching methods, like lectures, laboratory work and problem solving. Courses can include project work, teamwork and presentations. The courses are evaluated in different ways, including written and oral exams, assignments and project presentations. The course description gives details on teaching and evaluation methods for each course.

If the master’s thesis involves work in a laboratory, it is mandatory to conduct a course in safety education prior to commencing the thesis.</td></tr>
<tr><td>The study programme’s relevance</td><td>The program gives the necessary qualifications for a career within academic or industrial research, teaching, production, development and technical professions.

Completed Master’s degree studies qualify for admission to PhD studies in physics, depending on satisfactory marks in the Master’s</td></tr>
</table>

	and Bachelor's degree. PhD studies in physics and chemistry are offered at UiT The Arctic University of Norway.
Work scope	The program consists of 120 ECTS. Full time students are expected to allocate a normal work week to study, which is 40 hours a week. Throughout the year, it reflects a workload of 1500-1800 hours.
For master's theses/independent work in master's degrees	The student completes a master thesis (40 ECTS) that consists of an individual research project with assistance from a supervisor. Detailed information about the master thesis can be found in the course description and the regulations for master theses at the Faculty of Science and Technology.
Language of instruction and examination	The language of instruction and examinations is English.
Internationalisation	The language of instruction is English, and all of the syllabus material is in English. The students will meet teachers, guest lecturers and course material from different countries. The study program has international admission, so the students are both Norwegian and international. In addition, the courses are in many cases open to exchange students.
Student exchange	Exchange studies abroad can be recognized in the Master's degree if recommended by your supervisor, and only if the external courses are validated prior to departure. The exchange will typically be in the second semester and should be planned in collaboration with the student advisor and the student's supervisor. Several exchange agreements and stipend arrangements are available. For this program, the Czech Technical University in Prague is particularly recommended. For more information and an overview of all exchange agreements, see UiT's student exchange webpage: https://uit.no/utdanning/studentutveksling.
Supervised professional training	No supervised professional training is required.
Administrative responsibility and academic responsibility	The Department of Physics and Technology has the administrative responsibility for the program. The study program has a program board with representatives from Department of Physics and Technology and Department of Chemistry responsible for quality assurance and for managing questions related to the study program. Students are represented in the program board.

Quality assurance	The program will be evaluated in accordance with the System for Quality in Education at UiT – The Arctic University of Norway and the Faculty of Science and Technology regulations.
Other regulations	Supplementary provisions for the two-year master's degree program (120 credits) at the Faculty of Science and Technology

