Reg.no. HNT 2021/68 Approved 4 February 2021
Reg-no. HNT 2022/658, changed 1 December 2022

Faculty of Health, Science and Technology

Programme Syllabus

Master of Science in Engineering Physics

Programme Code:	TACTF
Programme Title:	Master of Science in Engineering Physics
Credits:	300
Programme Approval:	The programme syllabus was approved by the Faculty Board of Health, Science and Technology on 4 February 2021 and applies as of the autumn semester of 2021. Changed on 1 December 2022.
Language of Instruction:	Swedish and English
Education Cycle:	Second
Degree Type:	Professional
Degree Title:	Master of Science in Engineering Physics
Entry Requirements:	General entry requirements and Physics 2, Chemistry 1, Mathematics 4/Mathematics E

Introduction

This programmes leads to a Degree of Master of Science in Engineering Physics. Graduates from the Engineering Physics programme will have a broad expertise, and their knowledge of fundamental and applied physics is useful within many areas of engineering. Due to their expertise in the theoretical understanding of physical phenomena, graduates can provide vital contributions to the development of new technological applications that are part of a sustainable development. One example is the field of nanotechnology, in which the structure of matter is used to develop new applications in, for example, different types of photovoltaic cells, nanoelectronics and quantum computers.

The programme focuses on the development of the students' engineering excellence and ability to cooperate with others. Graduates from the Engineering Physics programme at Karlstad University will be able to work with planning, development, design, production and application of systems where advanced technology is central.

The programme provides insight into the engineer's role in social and economic societal development, and prepares students to work responsibly in their future profession. The programme provides knowledge and skills that are in demand both in Sweden and abroad, as well as a good foundation in natural sciences, technology and mathematics. The programme will also develop the students' personal characteristics and approaches.

Programme Outcomes

The Higher Education Ordinance, System of Qualifications, specifies the outcomes required for certain degrees. The outcomes for a Degree of Master of Science in Engineering are as follows:

- General outcomes: For a Degree of Master of Science in Engineering, the student shall demonstrate the knowledge and skills required to work autonomously as a graduate engineer.

- Knowledge and understanding

For a Degree of Master of Science in Engineering the student shall

- demonstrate knowledge of the disciplinary foundation of and proven experience in his or her chosen field of technology as well as insight into current research and development work, and
- demonstrate both broad knowledge of his or her chosen field of technology, including knowledge of mathematics and the natural sciences, as well as a considerable degree of specialised knowledge in certain areas of the field.

 Competence and skills

For a Degree of Master of Science in Engineering the student shall

- demonstrate the ability to identify, formulate and deal with complex issues autonomously and critically and with a holistic approach and also to participate in research and development work and so contribute to the formation of knowledge,
- demonstrate the ability to create, analyse and critically evaluate various technological solutions,

- demonstrate the ability to plan and use appropriate methods to undertake advanced tasks within predetermined parameters,
- demonstrate the ability to integrate knowledge critically and systematically as well as the ability to model, simulate, predict and evaluate sequences of events even with limited information, – demonstrate the ability to develop and design products, processes and systems while taking into account the circumstances and needs of individuals and the targets for economically, socially and ecologically sustainable development set by the community,
- demonstrate the capacity for teamwork and collaboration with various constellations – demonstrate the ability to clearly present his or her conclusions and the knowledge and arguments on which they are based in speech and writing to different audiences in both national and international contexts.

 Judgement and approach

For a Degree of Master of Science in Engineering the student shall

- demonstrate the ability to make assessments informed by relevant disciplinary, social and ethical aspects as well as awareness of ethical aspects of research and development work,
- demonstrate insight into the possibilities and limitations of technology, its role in society and the responsibility of the individual for how it is used, including both social and economic aspects and also environmental and occupational health and safety considerations, and
- demonstrate the ability to identify the personal need for further knowledge and undertake ongoing development of his or her skills.

• Independent project (degree project)

A requirement for the award of a Degree of Master of Science in Engineering is completion by the student of an independent project (degree project) for at least 30 credits.

In addition to the learning outcomes specified in the System of Qualifications outlined in the Higher Education Ordinance and the regulations of Karlstad University, the Master of Science of Engineering Physics includes the follow specific qualitative targets:

• Knowledge and understanding

- demonstrate specialised knowledge of the laws of physics and their use in engineering regarding the development of applications, particularly related to the areas of materials science and nanoscience,

 Competence and skills

- demonstrate the ability and experience to actively participate in research and development work in connection to the industry or other relevant organisation,
- demonstrate ability to retrieve and assess current scientific findings in engineering physics, particularly in the form of articles published in international journals, and
- utilising theoretical knowledge and experimental skills in analysis, simulation and modelling technological applications, particularly in the areas of materials science and nanoscience.

 Judgement and approach

- demonstrate the ability to employ perspectives that contribute to a sustainable development, for example in selection of materials and processes in the field of engineering physics.

Programme Structure

The programme is divided into two educational cycles: **first cycle** (180 credits) and **second cycle** (120 credits). The first two semesters comprises joint studies with several degree programmes and are mainly focused on mathematics, fundamentals of natural sciences and engineering. The advantage of joint studies between several specialisations within the engineering programme is that this promotes knowledge insights related to various aspects of the broad field of engineering, as well as providing the opportunity for students to switch specialisations. This is done primarily during the first year of studies, subject to availability.

The programme includes blocks of elective and optional courses. Students should ensure that they have acquired the necessary information and consult the programme coordinators before making choices about these courses, as it may affect the subsequent courses as well as the nature of the degree obtained.

The programme comprises six semesters at **bachelor's level** and includes studies in mathematics, natural sciences and engineering, as well as an introduction to the humanities and social sciences. Students also develop skills in project work, writing reports and communication. These courses prepare students for Master's level studies, but they also have the opportunity to earn a Degree of Bachelor of Science in Engineering.
The programme's four semesters at **master's level** comprises courses within the main field of study of at least 60 credits, including a degree project of 30 credits.
All students admitted to the programme are guaranteed a place on the master's level courses, provided that they meet the entry requirements for the master's courses.
Progression is ensured by the implementation of increasingly complex learning outcomes, which are designed to both provide specialisation and form the basis for assessment.
Different teaching methods, approaches and examination formats are used in the programme, ensuring the development of academic expertise, methodological knowledge, language proficiency and professional skills. Establishing a strong connection to current research is particularly important for scientific and methodological specialisation.
Karlstad University's continual quality development is ensured by enthusiastic lecturers offering quality courses. Student evaluations, contact with alumni, and student representation in preparatory and decision-making bodies play an important role in this respect. Through partnerships and the inclusion of external representatives in preparatory and decision-making faculty bodies, the degree programme maintains its relevance in relation to the wider community.

Internationalisation

Karlstad University wants to promote collaboration and exchange with other universities. Karlstad University has partnerships with many other universities in Sweden and abroad, and has an organisation in place to support students who want to make use of this opportunity. Students are therefore encouraged to complete part of the programme at a university abroad.

Programme Curriculum

Bachelor's Level (first cycle):

An introductory course in mathematics is followed by several mandatory courses, following a logical progression. The courses comprise a total of 52.5 credits and deal with subjects such as single variable analysis, multiple variable analysis, stochastic methods, complex transforms and numerical methods.

Physics include introductory courses in mechanics and experimentation and data analysis (15 credits), followed by introductory modern physics, thermal dynamics, electromagnetic field theory, solid state physics, quantum physics and nanoscience. In the sixth semester, students have the option to take additional physics courses or write an independent degree project (15 credits), adding up to a total of 90 higher education credits in physics.

Within the field of engineering, courses in programming techniques, solid mechanics, materials engineering, electrical technology and project management are offered – comprising 37.5 higher education credits.

Master's Level (second cycle):

Students will choose between either an experimental or theoretical specialisation in nanomaterials. Both specialisations include courses in computational physics, as well as specialisation courses in mathematical physics, quantum physics and nanoscience. The experimental specialisation proceeds with experiment-focused courses in characterisation of materials, physical electronics, surface physics and functional materials. The theoretical specialisation, on the other hand, comprises courses on analytical mechanics, symmetries and quantum field theory with a specialisation in condensed matter physics.

Additional options for individual specialisation are provided in semester 9, through elective courses in engineering physics comprising 15 higher education credits, as well as optional courses comprising 15 credits. The programmes concludes with a degree project in engineering physics, worth 30 credits.

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Transfer of Credits

Students have the right to transfer credits from previously completed university courses in Sweden or abroad, subject to approval according to the current regulations. Students have the right to transfer credits from previously completed university courses in Sweden or abroad, subject to approval according to the current regulations.

Further Information

The local regulations for first and second cycle education at Karlstad University stipulate the obligations and rights of students and staff.

This programme syllabus will replace the previous version, approved 9 December 2016, reg.no. HNT 2016/337.