Faculty of Technology and Science

STUDY PLAN

Engineering Programme with a Broad Curricular Base

Programme Code	TACBR
Programme Approval	The Programme Study Plan was approved by the Faculty Board of Technology and Science on 19 April 2012 and is valid from the autumn semester of 2012 at Karlstad University.
Programme Title	Master of Science in Engineering Specialisations: Computer Engineering, Environmental and Energy Engineering Industrial Engineering and Management Chemical Engineering Mechanical Engineering Engineering Physics
Credits	300 ECTS
Language of Instruction	Swedish yrs 1-3, English or Swedish yrs 4-5
Degree Level	Master
Degree Type	Professional degree
Prerequisites	General admission requirements plus upper secondary school level Mathematics E, Physics B, and Chemistry A, alternatively Mathematics 4, Physics 2, and Chemistry 1.
Field-specific eligibility	9, alternatively A9

Introduction
The programme leads to a Master of Science Degree in the area of Computer Science, Environmental and Energy Engineering, Industrial Engineering and Management, Chemical Engineering, Mechanical Engineering or Engineering Physics.

A central objective of the programme is that students develop technological excellence in their selected area along with highly developed skills in working with others. An Engineering graduate from Karlstad University can work with planning, development, design, production and technologically advanced systems.

The programme develops an understanding of the roles of technology and engineering in society, economically and socially, and prepares the students for positions involving great responsibility. Students acquire nationally and internationally competitive knowledge and skills, sound theoretical and practical knowledge of basic sciences, engineering sciences and mathematics as well as developing personal qualities and attitudes.

The progression requirements for the Master's degree are satisfied by expected learning outcomes that are designed to provide successive specialisation throughout the programme as well as to be possible to examine and assess. The programme employs a variety of pedagogical models for teaching and modes of learning and assessment, all of which contribute to the successive specialisation in science, methodology, subject, language and engineering. Research is of special importance to the students' gradual progression in science and methodology development.

Quality assurance is on-going and based on the University's ambition to provide good education and committed teachers. Course evaluations, alumni networks and student representation in governing bodies are important means to assure quality of education. Professional relevance is maintained through outreach and activities in cooperation with external representation in governing bodies.

Aims
Upon completion of the Master of Science in Engineering Programme, students are prepared for further studies in the field and have acquired a basis for life-long learning and the ability to keep up with technological developments.

For a Master of Science Degree in Engineering, students at Karlstad University must meet with the requirements specified in the *Higher Education Ordinance, SFS* 2006:1053 as follows:

• General qualifications: For a degree of Master of Science in Engineering, students must demonstrate the knowledge and skills required for them to work independently as a graduate engineer.

• Knowledge and understanding
For a degree of Master of Science in Engineering students must

- demonstrate knowledge of the scientific basis and proven experience of their chosen area of engineering, together with insight into current research and development work; and
- demonstrate both broad knowledge in their chosen area of engineering, including knowledge of mathematics and natural sciences, and substantially deeper knowledge in certain parts of the field.

• Competence and skills
For a degree of Master of Science in Engineering students must
- demonstrate an ability, from a holistic perspective, to critically, independently and creatively identify, formulate and deal with complex issues, and to participate in research and development work so as to contribute to the development of knowledge;
- demonstrate an ability to create, analyse and critically evaluate different technical solutions;
- demonstrate an ability to plan and, using appropriate methods, carry out advanced tasks within specified parameters;
- demonstrate an ability to integrate knowledge critically and systematically and to model, simulate, predict and evaluate events even on the basis of limited information;
- demonstrate an ability to develop and design products, processes and systems taking into account people's situations and needs and society's objectives for economically, socially and ecologically sustainable development;
- demonstrate an ability to engage in teamwork and cooperation in groups of varying composition; and
- demonstrate an ability to clearly present and discuss their conclusions and the knowledge and arguments behind them, in dialogue with different groups, orally and in writing, in national and international contexts.

• Judgement and approach
For a degree of Master of Science in Engineering students must
- demonstrate an ability to make assessments, taking into account relevant scientific, social and ethical aspects, and demonstrate an awareness of ethical aspects of research and development work;
- demonstrate insight into the potential and limitations of technology, its role in society and people's responsibility for its use, including social and economic aspects, as well as environmental and work environment aspects; and
- demonstrate an ability to identify their need of further knowledge and to continuously upgrade their capabilities.

• Independent project (Degree project)
For a degree of Master of Science in Engineering students must have completed an independent project (Degree project) worth at least 30 higher education credits, within the framework of the course requirements.

Programme Structure
The programme is divided into two levels, Bachelor's level (1st cycle, 180 ECTS credits) and Master's level (2nd cycle, 120 ECTS credits). During the first year all

students take the same courses in Mathematics, Basic natural science and Technology. The benefits of common study as a basis for different specialisations are the enhancement of understanding and knowledge of various aspects of engineering graduates' broad professional field and the opportunities provided for students to be acquainted with the major fields before choosing a specialisation. The first year is called Broad Curricular Base in Engineering.

Students can choose a specialisation when they apply for admission, or after the first year. Information of the main fields of study, that is, courses included, research activities and future prospects are provided during the first year. Below is a description of the broad curricular base and the respective specialization in terms of course focus and course of study. The programme includes opportunities for optional or elective course of study. Students are recommended to stay informed and consult with the Director of Studies concerning optional/elective courses as the choices can affect subsequent courses and the profile of the degree to be issued.

Successful completion of the Master's level programme gives eligibility for doctoral studies,

Throughout the programme students will be in contact and work in cooperate with the community and possible future professions, to further their capacities and opportunities.

The Bachelor's level comprises three academic years (six terms, 180 ECTS cr.) and covers studies in mathematics, natural science, engineering, and some courses in the humanities and social sciences. At this level students also develop skills in project work, report writing and communication. Students prepare for Master-level studies while having the opportunity to earn a Bachelor's degree in Computer Science, Chemical Engineering, Mechanical Engineering, Environmental and Energy Engineering or Engineering Physics.

The Master's level comprises two academic years (four terms, 120 ECTS cr.) and consists of studies in a chosen specialisation field of at least 60 ECTS cr. including a Degree project of at least 30 ECTS cr.

All students admitted to the programme at Karlstad University are guaranteed enrollment on the Master's level, provided that they meet the requirements of the master-level courses for their chosen engineering specialization.

Internationalisation

Karlstad University promotes cooperation and exchange with other universities and has agreements with many universities in Sweden and abroad as well as a support organisation for incoming and outgoing students.

Programme students who choose to study a period abroad, often at Master-level courses and degree project, are supported by the University and Programme Administration.

Programme Curriculum

Broad curricular base (first year Bachelor-level)
The first year, students on the Master of Science programme, the specialisation programmes and broad curricular base programme, together start with natural science, technology and engineering courses as a basis for the chosen and planned degree qualifications and as an introduction to the appropriate approaches and methods of the engineering profession. Students are also introduced to and informed about the specialisation areas that they can choose. Semesters 1 and 2 are devoted to basic subjects, a good foundation for any engineering specialisation offered at Karlstad University, namely computer science, environmental and energy engineering, industrial engineering and management, chemical engineering, mechanical engineering and engineering physics. Students can indicate their pathway choice when applying or simply opt for broad curricular base and decide on a specialisation after the first year. Students who choose or have chosen industrial management must also choose one of the area profiles of computer science, environment and energy engineering, chemical engineering or mechanical engineering.

Semester 1 includes mathematics, experimental scientific methods and computer-based problem-solving, programming and project methodology and planning. Report writing, communication and presentation skills are integrated course components. The courses in computer-based problem-solving and programming support each other as the emphasis is on the use of computers and programming in experimental problem-solving.

Semesters 2 and 3 focus on mathematics and the foundational engineering subjects of mechanics, electrical engineering, physics, materials engineering, chemistry, thermodynamics and energy technology.

The following profile courses are included in Broad Curricular Base and in all specialisation pathways in the first two semesters plus the first study period of semester 3:

Year 1
Mathematics, Basics
Project methodology and group dynamics
Experimental scientific methods and computer supported problem-solving
Programming techniques, Calculus, one variable Calculus, several variables calculus
Mechanics
Matter
Wave physics and electrical engineering

Year 2
Linear algebra and vector calculus

Thermodynamics and energy technology

Courses are normally accredited 7.5 ECTS cr. and after study period 4 in semester 3 the curricular base is completed and students start their chosen engineering specialisation.

Computer Science

Development is rapid in the field of computer science, which is why students at Karlstad University are trained to develop abilities quickly to retrieve and apply new knowledge. Students learn to develop, design and evaluate computer-based systems for different purposes.

Aims

In addition to the objectives stated in the *Higher Education Ordinance, SFS* 2006:1053 and to the local stipulations, for a Master of Science degree in Computer Science students at Karlstad University, must be able to

Knowledge and understanding

- demonstrate in-depth knowledge of computer technological principles and their employment in engineering to develop applications in computer communication, computer security and program design,

Abilities and skills

- define, handle and solve engineering tasks in a multidisciplinary way,
- design appropriate testing and analysis methods for computer products and analyse the outcome,
- To demonstrate ability to and experience of active participation in research and development work on computer products and services and cooperation with others.

Judgement and approach

- present human-computer interaction in a holistic perspective and its contribution to sustainable development,

The first academic year and the first half of the second years first semester, involve broad curricular base studies in mathematics, science and programming. The rest of the second year consists of basic courses in computer technology and specialised mathematics. The third year focuses on central computer science areas such as operative systems, computer structures and algorithms, computer communication and database techniques. The third year also allows for optional courses and is normally concluded with a Bachelor's Degree project.

The autumn semester of the fourth year focuses on specialisation courses in computer communication, computer security and software design. Courses in the spring semester are optional. Thus, the semester is open for studies abroad. The fifth year autumn semester offers optional courses in computer science and preparatory courses for the spring semester Master's Degree project.

From the second half of semester 3, the courses offered are specialisations in computer science.

Besides the joint courses in year 1 and 2, the following course profiles are included (optional and electives courses are indicated):

Year 2
Programming techniques, continued
Discrete mathematics
Computer engineering
Digital electronics
Stochastic methods
Theoretical computer science

Year 3
Operating systems
Data structures and algorithms
Optional courses in the field of computer science 15 ECTS cr.
Computer networking
Programming languages alt. Database techniques
Bachelor's Degree project 15 ECTS cr. or optional courses in Computer Science 15 ECTS cr.

Year 4
Computer security
Computer networking, continued
Compiler construction
Perspectives on computer science
Optional courses 30 ECTS cr. (*students are recommended to choose on the basis of the prerequisites for optional courses in semester 9)*.

Year 5
Optional courses in computer science at Master's level 15 ECTS cr.
Engineering projects in computer science 15 ECTS cr.
Master's Degree project in the field of Computer Science 30 ECTS cr.

Courses are normally accredited 7.5 ECTS cr. but variations occur.

Environmental and Energy Engineering

A graduate in Environmental and Energy Engineering at Karlstad University has modern and specialized knowledge of energy and purification engineering, other environmental technologies, measuring techniques and modeling as well as the optimisation of energy systems. The broad and flexible qualifications are attractive to employers.

Aims
In addition to the objectives stated in the *Higher Education Ordinance, SFS* 2006:1053 and to the local stipulations, for a Master of Science degree in Environmental and Energy Engineering students at Karlstad University, must be able to:
• Knowledge and understanding

- demonstrate specialised knowledge in the field of environmental and energy engineering corresponding to the course requirements for a Bachelor's degree (90 ECTS cr.) and for a Master's degree (90 ECTS cr.),
- demonstrate specialised knowledge of the conditions for economically, socially and ecologically sustainable development and of sustainable application of technology

• Abilities and skills

- demonstrate ability to and experience of active participation in industrial research and development work,
- demonstrate ability to design and write a project report according to standard academic and technical requirements,
- demonstrate ability to search for, compile and assess current research results reported in international journal articles in the field of environmental and energy engineering,

• Judgement and approach

- demonstrate ability to make assessment in the environment field with consideration given to relevant scientific, social and ethical aspects,
- demonstrate further insight into the potentials and limitations of environment technology, its role in society and our responsibility for its use, including social and economic aspects,
- demonstrate the ability to identify knowledge gaps and to formulate action alternatives in view of these.

Following on the two semesters of broad curricular base courses, the environmental and energy Bachelor's level specialisation consists of four terms (120 ECTS cr.) and includes basic studies of environment and energy engineering, mathematics, engineering and some social science and humanities components. Students also develop skills in project work, report writing and communication. Students prepare for Master-level studies while having the opportunity to earn a Bachelor's degree in Environmental and Energy Engineering.

The Master's level comprises four terms, 120 ECTS cr. and consists of specialisation courses in Environmental and Energy Engineering of at least 90 ECTS cr. including a degree project of 30 ECTS cr.

In the choice of pedagogical methods and content of courses, the student learning process is at the focus. Instruction is designed to support the learning process. The result of the learning process, i.e. meeting the learning outcome requirements is the starting-point for the programme and the course design which also offers a variety of pedagogical models and forms of instruction and examination. Students are trained successively to take responsibility for their own learning and encouraged to emphasise deep learning instead of surface learning. Close cooperation with industry and research are important factors in the learning process. Authentic professional practice, such as projects, and work situations are systematically used in teaching and examination. The many written examinations and reports provide writing practice for students. Oral skills will also be practised.

The most important factors in the continuous quality assurance efforts are respect for student opinion in course evaluations and the established alumni networks.

Besides the joint courses in year 1 and 2, the following courses are required for the Environmental and Energy Engineering profile (optional and electives courses are indicated):

Year 2
Environmental engineering
Thermal fluid sciences
Building services engineering
Environmental chemistry
Stochastic methods

Year 3
Energy and environmental systems
Purification technology
Bachelor's Degree project 15 ECTS cr. or optional courses of 15 ECTS cr.

Year 4
Optional courses 15 ECTS cr.
Elective courses 15 ECTS cr.
Measurement technology and modeling
Energy and environmental optimisation

Year 5
Thermal and mass transport
Research and development project in the field of energy and environmental engineering
Master's Degree project in the field of Energy and Environmental Engineering, 30 ECTS cr.

Courses are normally accredited 7.5 ECTS cr. but variations occur.

Industrial Engineering and Management

A Degree in Industrial Engineering and Management from Karlstad University means having qualifications in engineering and science combined with the knowledge of business and leadership required to solve problems relating to managing and controlling technologically-based enterprises. Such graduates can function as a link, in an organisation or between organisations', between engineers and scientists on the one hand and business administration on the other.

Aims
In addition to the objectives stated in the *Higher Education Ordinance, SFS* 2006:1053 and to the local stipulations, for a Master of Science degree in Industrial Engineering and Management students at Karlstad University, must be able to
• Knowledge and understanding

- demonstrate the knowledge and understanding required in one of the areas of computer science, environmental and energy engineering, chemical engineering or mechanical engineering to be able to follow and contribute to the development in the area with an understanding of economic circumstances,
- demonstrate broad knowledge of economy and specialised knowledge in some areas, and
- demonstrate the ability to critically review and assess decisions based on economic and technological perspectives.

• Abilities and skills and competence

- demonstrate the ability to define and analyse problems in industrial research and development based on economic models and knowledge of the management and control of organisations and projects, and
- demonstrate the ability to work in groups in international and interdisciplinary environments.

• Judgement and approach

- demonstrate insight into the potential and limitations of the economic sciences, their role in society and our responsibility for their use, and
- demonstrate insight into the importance of leadership and its performance.

Following on the two terms of broad curricular base courses, the Industrial Engineering and Management programme offers a number of courses in the profile area chosen by the students for their Master's degree in Industrial Management. The profiles are Computer Science, Environmental and Energy Engineering, Chemical Engineering and Mechanical Engineering.

Besides the joint courses in year 1 and 2, the following courses are required for the respective profile (optional and electives courses are indicated):

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Profile Computer Science

Year 2

Industrial management
Programming techniques, continued
Economics
Financial analysis
Stochastic methods
Datology

Year 3

Organisation
Marketing
Optional courses in the field of computer science 15 ECTS cr.
Optimisation
Production economy
Project management
Database technology
Digital technology

Year 4
Operative systems
Computer system technology
Optional courses in the field of computer science 15 ECTS cr.
Optional courses in the field of industrial management 15 ECTS cr.
Optional courses in the field of computer science 15 ECTS cr.

Year 5
Computer technology project with economic emphasis
Optional courses in the field of industrial management 15 ECTS cr.
Master's Degree Project in the field of Industrial Management 30 ECTS cr.

Profile Environmental and Energy Engineering

Year 2
Industrial management
Environmental engineering
Economics
Financial analysis
Stochastic methods
Environmental chemistry

Year 3
Organisation
Design and sustainable development
Thermal fluid sciences
Marketing
Optimisation
Production economy
Project management
Purification technology

Year 4
Energy and environmental systems
Environmental impact assessment for energy and environmental systems
Optional course in the field of industrial management
Energy and environmental optimisation
Environmental and Natural Resource Economics

Year 5
Research and development project in the field of energy and environmental engineering
Optional course in the field of industrial management
Optional course in the field of technology
Master's Degree Project in the field of Industrial Management 30 ECTS cr.

Profile Chemical Engineering

Year 2
Industrial management
Organic chemistry
Economics
Financial analysis
Stochastic methods
Chemical engineering, introduction with project

Year 3
Organisation
Marketing
Chemical calculations
Control engineering
Optimisation
Production economy
Project management
Heat and mass transfer with chemical reactors
Separation processes

Year 4
Pulp, paper, surface treatment and graphic technology
Advanced course in paper and pulp technology
Optional course in the field of chemistry or chemical engineering
Optional courses in the field of industrial management 15 ECTS cr.
Optional courses in the field of chemistry or chemical engineering 15 ECTS cr.

Year 5
Optional course in the field of Chemical Engineering 15 ECTS cr.
Optional course in the field of Industrial Management 15 ECTS cr.
Degree project in the field of Industrial Management 30 ECTS cr.

Profile Mechanical Engineering

Year 2
Industrial management
Thermal fluid sciences
Economics
Financial analysis
Stochastic methods
Materials engineering

Year 3
Organisation
Marketing

Manufacturing engineering
Strength of materials
Optimisation
Production economy
Project management
Construction and design
Optional course

Year 4
Constructive design and CAD
Project on the design process
Materials selection
Control engineering
Optional courses in the field of Industrial Management 15 ECTS cr.
Optional courses in the field of engineering 15 ECTS cr.

Year 5
Optional courses in the field of Engineering 15 ECTS cr.
Optional courses in the field of Industrial Management 15 ECTS cr.
Degree project in the field of Industrial Management 30 ECTS cr.

Courses are normally accredited 7.5 ECTS cr. but variations occur.

Chemical Engineering

A Chemical Engineering graduate from Karlstad University can work in many areas. A common area is the pulp and paper industry but also industries such as the petrochemical, the pharmaceutical, the food industry or environmental control services are likely employers. A chemical engineer combines the properties of microscopic building blocks into new materials or substances with completely different properties – first in small-scale laboratory experiments and then in large-scale industrial production.

Aims
In addition to the objectives stated in the *Higher Education Ordinance, SFS* 2006:1053 and to the local stipulations, for a Master of Science degree in Chemical Engineering students at Karlstad University, must be able to

• Knowledge and understanding
- demonstrate specialized knowledge of the principles of chemistry and their usefulness in development of chemical engineering applications corresponding to the coursework requirements for the Bachelor's degree (90 ECTS cr.) and the Master's degree (90 ECTS cr.) in the subject,

• Abilities and skills
- demonstrate ability to define, handle and solve engineering tasks,
- present a holistic perspective on how the choice of raw material and processing affect the properties of products, energy consumption and the environment,
- plan the use of appropriate testing and analysis methods for chemical products and analyse and interpret readings,

- use computer tools for chemical engineering calculations,
- structure and write a project report adapted to different customer requirements, including the standard form required for scientific publication,
- demonstrate ability to search for, compile and assess current research results reported in international journal articles in the field of chemical engineering,
- demonstrate ability to and experience of active participation in industrial research and development work on chemical engineering products and processes, in Swedish and English,

• Judgement and approach

- apply a sustainable development perspective in the choice of materials and processes and in the use of field-specific advanced knowledge of the technological development of the professional chemical engineering field.

Following on the two terms of broad curricular base courses, students study the basics of chemistry including stoichiometry and thermodynamics in the second half of the third term. The fourth term covers chemical engineering and mathematics and in the fifth term students continue studying the basics of chemistry and chemical engineering while also broadening the knowledge base with courses in automatic control and industrial management. In the sixth term students choose optional courses to suit their planned Master-level profile and the Bachelor degree requirements.

At the Master's level students can choose to specialise in *Pulp technology, Paper technology and Surface treatment and paper material printing,* alternatively *Molecular Chemical Engineering.* Each profile consists of advanced studies in the specialisation area of at least 90 ECTS cr. including a Degree project of 30 ECTS cr.
Besides the joint courses in year 1 and 2, the following courses are required (optional and electives courses are indicated):

Profile Pulp Technology, Paper Technology and Surface Treatment and Paper Material Printing

Year 2
Chemical calculations
Organic chemistry
Chemical engineering, introduction, with project
Heat and mass transfer with chemical reactors
Separation processes
Stochastic methods

Year 3
Biochemistry
Chemical engineering specialisation
Control engineering
Industrial management
Thermodynamics
Optional course

Bachelor’s degree project in Chemical engineering 15 ECTS cr, or Organic chemistry continuation course and Analytical chemistry

Year 4
Pulp technology, paper technology, surface treatment and graphic technology
Pulp technology, specialisation
Paper technology, specialisation
Surface treatment and graphic technology, specialisation
Optional courses in the profile area 22.5 ECTS cr.

Year 5
Optional courses in technology and the natural sciences 30 ECTS cr.
Degree project in the field of Pulp technology, Paper technology and Surface treatment and Paper material printing 30 ECTS cr.

Profile Molecular Chemistry

Year 2
Chemical calculations
Organic chemistry
Chemical engineering, introduction, with project
Heat and mass transfer with chemical reactors
Separation processes
Stochastic methods

Year 3
Biochemistry
Chemical engineering specialisation
Control engineering
Industrial management
Thermodynamics
Optional course
Bachelor’s degree project in Chemical Engineering 15 ECTS cr., or Organic Chemistry continuation course and Analytical Chemistry

Year 4
Specialisation courses in chemistry and bio engineering 60 ECTS cr.
Optional courses in technology and the natural sciences 30 ECTS cr.

Year 5
Specialisation courses in chemistry and bio engineering 60 ECTS cr. (cont. year 4)
Optional courses in technology and the natural sciences 30 ECTS cr. (cont. year 4)
Degree project in relevant Chemical Engineering area 30 ECTS cr.

Courses are normally accredited 7.5 ECTS cr. but variations occur.

Mechanical Engineering

The Karlstad graduate in Mechanical Engineering has a technologically broad base in construction, production and materials for the manufacturing, application and development of mechanical products and processes.

Aims

In addition to the objectives stated in the *Higher Education Ordinance, SFS* 2006:1053 and to the local stipulations, for a Master of Science degree in Mechanical Engineering students at Karlstad University, must be able to

• Knowledge and understanding
- participate in applying and developing new technology for product and process design,
- demonstrate basic knowledge of construction and manufacturing techniques and materials technology,
- present an overall picture of the construction process including the relation between materials engineering, construction and manufacturing techniques to which a sustainable, environment-friendly perspective can be applied,
- give an account of and discuss specialised knowledge in the mechanical engineering field based on a materials technological foundation,

• Abilities and skills
- apply basic principles of mechanical engineering, follow and use knowledge development in the field,
- apply a creative and critical approach to defining and exploring problems while using modern methods and tools in the field,
- use theoretical knowledge and experimental skills in analysing, simulating and modelling for construction, production and materials use,
- handle choice of material, materials development and materials use based on industrially environment-friendly and sustainable perspective,
- demonstrate the ability to actively participate in industrial research and development.

• Judgement and approach
- apply a perspective that contributes to sustainable development for clients, for instance, in the choice of materials and processes to be used in the Mechanical Engineering field.

In the first three years students acquire basic knowledge of mechanical engineering related to materials, design and computation. There are also courses in energy and environmental engineering and economy.

At Master's level the focus is on materials engineering in an overall mechanical engineering perspective including design and manufacturing techniques. Students develop a solid engineering basis by practising computer aided design (CAD) and computations using the finite element method, by acquiring broad knowledge of materials and by practising advanced materials analysis including functional materials and construction materials in manufacturing processes, designs and products. Studies include the themes i) materials, design and manufacturing, ii)

materials, models and simulation, iii) materials and mechanical properties and a concluding degree project. Students also work with group projects.

Besides the joint courses in year 1 and 2, the following courses are required for the Mechanical Engineering profile (optional and electives courses are indicated):

Year 2
Thermal fluid sciences
Environmental engineering
Solid mechanics
Materials engineering
Construction and design
Stochastic methods

Year 3
Industrial management
Manufacturing engineering
Materials in industrial applications
Optional course in engineering
Numerical methods
Finite element method, basic
Bachelor's Degree project in Mechanical engineering 15 ECTS cr. or the courses Hydraulics and pneumatics and Production systems

Year 4
Materials selection
Constructive design and CAD
Project on the design process
Control engineering
Deformation and fracture
Simulation and modelling of materials
Project management
Project on simulation and modelling of materials

Year 5
Polymers and composite materials
Project on the materials of the future
Surface technology and tribology
Materials characterisation
Degree project in the field of Mechanical Engineering 30 ECTS cr.

Courses are normally accredited 7.5 ECTS cr. but variations occur.

Engineering Physics
An Engineering Physics graduate has the broad qualifications in basic and applied physics that are useful in many technological areas. Advanced theoretical understanding of physical phenomena is vital to the development of new technological applications. One such example is nanotechnology in which the quantum structure of material is used to find new areas of application, for instance, molecular electronics, organic solar cells and quantum computers.

Aims
In addition to the objectives stated in the *Higher Education Ordinance, SFS* 2006:1053 and to the local stipulations, for a Master of Science degree in Engineering Physics students at Karlstad University, must be able to

• Knowledge and understanding
- demonstrate advanced knowledge of the laws of physics and their use in engineering to develop technical applications, especially in materials engineering and in the nanotechnology area,

• Skills and competence
- demonstrate the ability to and experience of active participation in industrial research and development,
- demonstrate the ability to search for and assess current research results in physics engineering, especially in the form of articles in international journals,
- use theoretical knowledge and experimental skills in the analysis, simulation and modelling of technological applications, especially in the area of nano technology,

• Assessment and approach
- apply an approach that contributes to sustainable development for clients in the field of engineering physics, for instance, in the choice of material and processes.

The profile Engineering Physics follows on the Broad curricular base course, which ends with study period IV in semester 3, offering a number of courses designed for the profile.

Besides the joint courses in year 1 and 2, the following courses are required for the Physics Engineering profile (optional and electives courses are indicated):

Year 2
Thermal fluid sciences
Mathematical physics
Quantum physics
Electromagnetic field theory
Stochastic methods
Materials engineering

Year 3
Industrial management
Solid state physics
Nanoscience
Control engineering or analytical mechanics

Solid mechanics
Numerical methods
Bachelor's Degree project in Engineering physics, 15 ECTS cr. or modern experimental physics and
Project management

Year 4
Mathematical physics, continued
Materials characterisation
Quantum physics, continued
Physical electronics
Computational physics
Nanoscience, continued
Functional materials
Surface physics

Year 5
Optional courses in the fields of Engineering physics and Engineering, 15 ECTS cr.
Optional courses, 15 ECTS cr.
Degree project in the field of Engineering Physics, 30 ECTS cr.

Courses are normally accredited 7.5 ECTS cr. but variations occur.

Degree Title
Students who meet the requirements for a degree may request that the university issue a degree certificate. Requests should be submitted to the Degree Office.

The degree title is:

Degree of Master of Science in Engineering, Computer Engineering

Degree of Master of Science in Engineering, Environmental and Energy Engineering

Degree of Master of Science in Engineering, Industrial Engineering and Management

Degree of Master of Science in Engineering, Chemical Engineering

Degree of Master of Science in Engineering, Mechanical Engineering

Degree of Master of Science in Engineering, Engineering Physics

Credit Transfer
According to the *Higher Education Ordinance* (Ch. 6, § 12-14), students may transfer credits from previously completed university courses subject to approval. Transfer of credits for a course module, or university studies generally, is subject to the approval

by the course examiner. Transfer of credits for a full course is subject to the approval by the Rector.

Additional Information

Students who enrolled in the programme before 1 July 2007 will complete their studies in accordance with the requirements of the earlier curriculum. Upon completion students may request degree and course certificates to be issued under the current ordinance if they meet its requirements.