JÖNKÖPING UNIVERSITY
School of Engineering

PROGRAMME SYLLABUS
Preliminary, not confirmed

Digital Engineering and Product Development (master), 120 credits

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Programme Code:	TADEA	Programmestart:	Autumn 2028
Confirmed:		Education Cycle:	Second-cycle level

Title of Qualification

Degree of Master of Science (120 credits) with a major in Product Development, specialisation in Digital Engineering Design

Teknologie Masterexamen med huvudområdet Produktutveckling, inriktning Digital Engineering Design

Programme Overview

Main field of study

Product development includes the study of products as technical systems and the business process of activities that from identified needs and/or technological advancements, develop, define, validate, and over time improve a product, including its associated services. Product development is built on technical knowledge and systematic methods combined with creative processes. Product development requires multi-disciplinary collaboration between e.g. mechanical engineering, design, materials, information technology, electronics, construction, production and industrial economics. The application of simulation and management of development activities are also important.

Product development combines a technical perspective, with a scientific basis in mathematics and physics, with a context of humanistic and social science, in which business and sustainability aspects are important areas for the subject. Methods for research includes, among others, empirical studies, modelling, case studies, action research and constructive methods. The studies are based on knowledge in an application area of mechanical engineering, design, materials, information technology, electronics and construction, individually or in combination.

Studies in product development fosters knowledge in the application area, see above, in combination with knowledge of products as technical systems in combination with systematic and creative development methods as well as methods for simulation and management of development activities. Knowledge in different fields, such as industrial economics, ergonomics, aesthetics, quality, socio-technical systems are in parts complementary subjects for studies in product development. Skills that are developed include ability to analyse needs, establish requirements specification, development of functional description and system structure, generate alternative solutions, designing individual subsystems, analysing the characteristics and requirements fulfilment, as well as perform system integration and validation. Ability work interdisciplinary and in a development organisation is important as well as the application of a holistic perspective on the different phases of the product life cycle and its various stakeholders.

Background

There is an increasing necessity of sustainable products for the circular economy, and at the same time, the digitalization and servitization of products and product systems is rapidly advancing. This is having profound effects on the way products are designed and developed. Product development is becoming vastly more complex and multidisciplinary than it used to be. Much more data and information are available and must be handled and processed to be considered in product development. This far exceeds the capabilities of traditional engineering methods. Hence, future engineers need to understand value chains, circular manufacturing, and product life cycles, as well as new legislation and stakeholder demands on sustainability, and be able to quantify them and add to the requirement set. The way forward is to use digital technology such as artificial intelligence to handle the complexity. This is a key skill of future engineers and is the primary motivation for the programme – Digital Product Development (DPD).

Objectives
The DPD programme gives master-level engineers in product development broad knowledge of product realization, allowing them to understand all parts of the value chain and product life cycles. Students will learn about engineering materials, manufacturing processes, production systems, and the integration of these domains. In the DPD programme, students will use state-of-the-art software and computer programming for automation, virtual modeling, and management of data, information, and knowledge. They will learn how to use data-driven methods such as machine learning and other AI tools to manage vast amounts of data and information and process it into products and product systems. Students will learn to design and engineer products that fulfill new needs stemming from the ongoing changes in our society for different purposes, such as sustainability, circularity, and manufacturability. One important objective that sets the DPD programme apart from other programmes is that students will learn how to improve the engineering design process itself by using product and production platforms and programming, making knowledge and information available for re-use and automating parts of the engineering design process. This will allow engineers from the programme to set up engineering design processes with high output and superior quality, creating higher value for companies than ordinary engineers.

Post-graduation employment areas
After graduation the engineers will be prepared to take on complex and multidisciplinary tasks in product development. They will be able to prescribe and develop working procedures and IT support for product development in industrial companies resulting in products with predicted sustainability ready for the circular economy based on life cycle data. The program is also preparatory for a role as a PhD student in Universities and institutes. Students will in the program get insight in research methods and they will also write a scientific thesis.

Objectives

Common learning outcomes
After the completion of the programme, students must meet the intended learning outcomes, as described in The Higher Education Ordinance by Degree of Master, and also the intended learning outcomes, as described by JTH:

Knowledge and Understanding
1. demonstrate knowledge and understanding in the main field of study, including both broad knowledge of the field and a considerable degree of specialised knowledge in certain areas of the field as well as insight into current research and development work
2. demonstrate specialised methodological knowledge in the main field of study

Competence and skills
3. demonstrate the ability to critically and systematically integrate knowledge and analyse, assess and deal with complex phenomena, issues and situations even with limited information
4. demonstrate the ability to identify and formulate issues critically, autonomously and creatively as well as to plan and, using appropriate methods, undertake advanced tasks within predetermined time frames and so contribute to the formation of knowledge as well as the ability to evaluate this work
5. demonstrate the ability in speech and writing both nationally and internationally to clearly report and discuss his or her conclusions and the knowledge and arguments on which they are based in dialogue with different audiences
6. demonstrate the skills required for participation in research and development work or autonomous employment in some other qualified capacity

Judgement and Approach
7. demonstrate the ability to make assessments in the main field of study informed by relevant disciplinary, social and ethical issues and also to demonstrate awareness of ethical aspects of research and development work
8. demonstrate insight into the possibilities and limitations of research, its role in society and the responsibility of the individual for how it is used
9. demonstrate the ability to identify the personal need for further knowledge and take responsibility for his or her ongoing learning

JTH. prove ability to embrace interdisciplinary approaches

Programme-specific learning outcomes
Upon completion of the programme, the intended learning outcomes provided for programme must also be met.

Knowledge and Understanding
11. display knowledge on integrating the different parts of the product realization process
12. demonstrate specialized knowledge of engineering materials and manufacturing processes and their relation to engineering design.

Competence and skills
13. demonstrate the skills to use software tools and computer programming in the development of products and production processes
14. demonstrate the skills to make life-cycle assessments on product and manufacturing processes for including sustainability and circularity in development
15. demonstrate an ability to improve the engineering design processes using tools and methods for automation and management

Judgement and Approach
16. demonstrate the ability to integrate product and production development by organizational and technological means
17. demonstrate an ability to analyze the product realization processes and propose and evaluate changes for improvement.

Contents

Programme Principles
The main principle of the program is that the engineers who graduate from the program will not only have the knowledge and skill to apply tools and methods for product realization to drive products and production towards improved performance in various aspects such as circularity and sustainability, but they will also be able to improve on the process of industrial product development itself, making it more up to date and efficient. This includes new lifecycle and circular scenarios, new user behavior, new stakeholders, use of data and information combined with digital methods and AI, and organizational aspects. It may entail integrating systems used in product development and production and managing information, keeping it up-to-date and available to be used more efficiently in the development process.

Research basis
The programme spans three active research areas: Product development, production systems, and materials and manufacturing. This ensures that the programme has a broad research base covering the whole value chain in product realization, from the conceptual design of products to the choice of materials and manufacturing processes to the product and production development to the user phase and end-of-life treatment of products. There is currently an active research strand into sustainability and the circular economy, as well as designing and developing products and production systems for sustainability and the circular economy. It is centered around methods and tools for realizing sustainable products and production systems in industrial companies. Another research strand is data-driven methods and AI to go from data to decisions in development. These research strands influence the courses in the DPD programme. The courses “Materials and Process Selection in Performance Design” and “Sustainable Product Realization” discuss some of these tools and methods. AI and data-driven methods are, for example discussed in the course “Applied AI in Product and Production Development”

Equal terms, gender equality and diversity
The School of Engineering (JTH) strives in all its activities to ensure that all individuals are given equal opportunities and treated equally. At both the JU and JTH levels, this is reflected in governing documents concerning organizational and personnel matters, the establishment and delivery of programmes and courses, as well as the monitoring of educational quality. At JTH, student influence is also ensured through student representation in various educational and industry councils.

The digital product development programme welcomes anyone who meets the admission requirements and strives to maintain an open, inclusive, and friendly environment throughout the whole education. Gender equality and diversity are also discussed from a product perspective as a part of understanding the users of the products.

Study abroad
The School of Engineering has internationalization as a focus area where the educational programmes include opportunities for both international experiences at home as well as various opportunities to do internships and study abroad, giving students valuable experiences and skills to prepare them for a global labour market.

The third semester is an exchange semester when it is possible to study outside of Sweden. The courses in the semester are substituted with similar courses at a receiving university. The student needs to assemble the replacement courses for approval by JU. The replacement package of courses must be equivalent to at least one semester of full-time work. A margin should be added should any courses be canceled at the receiving university.

Programme Progression

YEAR 1

The program starts with the applied engineering design course. One of the objectives of this course is for students to get a perception of the product development process to realize what the challenges are and thus, creating a need and motivation for the courses to follow. There is an interaction between this course and the Multidisciplinary Optimization course. The optimization course will enable an understanding of how to handle conflicting requirements and trade-offs from the applied course. The two courses in the next segment, Production Preparation and Industrialization and Integrated Product and Production Development, deal with both technical and organizational aspects for the integration of product development and production and preparing for producing the products. In the next segment, in the Digitalization and Automation in Engineering Processes, the students will learn how to set up the development process for higher performance using automation and information management techniques. In parallel, there is a course materials and process selection in performance design. In this course, students learn how to systematically select materials and manufacturing processes to fulfill the requirements of products. The progression on productivity started in the digitalization course is continued in the Product and Production Platforms course, dealing with how to organize knowledge and other assets into platforms facilitating their reuse. The Sustainable Product Realization course builds on the Materials and Process Selection for Product Design course . The second course cannot be taken without the first. In this course, students use the knowledge from the Materials and Process Selection for Product Design to develop their own products for sustainability and circularity, considering the whole life cycle and operationalizing sustainability strategies.

YEAR 2

In the beginning of year two, there is a Research Methodology in Product Realization course. This will give the students skills and knowledge on scientific methodology and the practical aspects of scientific work and procedures. This will support the students in theProject Course, where they develop a multidisciplinary project. This course will also prepare the students for the last course in the program, the final thesis work. In the Applied AI in Product and Production Development course, students will learn how to use data-driven AI methods such as machine learning to let data from sensors in the product life-cycle direct the development of products and production.

Courses

Course changes can occur, as long as they do not substantially affect the programme's content and learning goals.

Mandatory Courses

Semester	Course Name	Credits	Main field of study	Specialised in	Course Code
1	Digitalization and Automation in Engineering Processes	7.5	Product Development	A1N	TDAR22
1	Multidisciplinary Optimization	7.5		A1N	TMOR25
1	Integrated Product and Production Development	7.5	Product Development, Production Systems	A1N	TPPR25
1	Applied Engineering Design	7.5	Product Development	A1N	TTKR22
2	Sustainable Product Realisation	7.5	Product Development	A1F	THFS25
2	Materials and Process Selection for Product Design	7.5	Product Development	A1N	TMPR25
2	Production preparation and industrialization	7.5	Product Development	A1N	TPBR23
2	Product and Production Platforms	7.5	Product Development, Production Systems	A1F	TPDS22
3	Possibility to study abroad	30			
3	Research Methodology on Advanced Level	7.5	Product Development, Production Systems	A1N	T2FPAN
3	Project Course	15	Product Development, Production Systems	A1N	TPJS22
3	Applied AI in Product and Production Development	7.5	Product Development, Production Systems	A1N	TTAR26
4	Final Project Work in Product Development	30	Product Development	A2E	TETT23

Teaching and Examination

The academic year is divided into two semesters, and the semesters into two study periods. In each study period two courses are generally taken in parallel. Assessment is part of each course or module. Modes of assessment and grades are shown in each course syllabus.

Entry Requirements

The applicant must hold the minimum of a bachelor’s degree (i.e the equivalent of 180 ECTS credits at an accredited university) with at least 90 credits in Mechanical Engineering, Product Development, Materials Engineering, Manufacturing Engineering, or equivalent. The bachelor’s degree should comprise a minimum of 15 credits in mathematics. Proof of English proficiency is required.

Continuation Requirements

In order to begin the second year, at least 37,5 credits from the programme's first year must be completed.

Qualification Requirements

To obtain a Degree of Master of Science (120 credits) with a major in Product Development, specialisation in Digital Engineering Design, students must complete a minimum of 120 credits in accordance with the current programme syllabus, at least 60 of which must be in the main field of study Product Development and 21 credits in Mathematics.
In addition a Degree of Bachelor of Science in Engineering/Degree of Bachelor of Science or an equivalent Swedish or foreign qualification is required.

Quality Development

At JTH, systematic quality assurance is carried out within JU's established quality system. This system, based on the requirements of the Higher Education Act, the Higher Education Ordinance, and the Standards and Guidelines for Quality Assurance in the European Higher Education Area, has been reviewed and approved by the Swedish Higher Education Authority.

Active and continuous course evaluation, including student feedback through course surveys, forms one of the cornerstones of this system. Annual programme evaluations and student representation in JTH's various educational and industry councils are two additional examples.

Other Information

Admission is under ‘Admission regulations for first- and second cycle courses and study programmes at Jönköping University (Admission regulations)’.

This syllabus is based on ‘Regulations and guidelines for first-, second- and third-cycle education at Jönköping University’.