JÖNKÖPING UNIVERSITY
School of Engineering

PROGRAMME SYLLABUS

Master of Science in Product Development, specialisation Software Product Engineering, 120 credits

Programmestart: Autumn 2015

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PROGRAMME SYLLABUS

Master of Science in Product Development, specialisation Software Product Engineering, 120 credits

Teknologie master i Produktutveckling med inriktning Mjukvaruprodukter, 120 högskolepoäng

Programme code:	TAPM5	**Programmestart:**	Autumn 2015
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Title of qualification

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

Programme overview

Background

Software is everywhere – as a product or service in its own right, or as a component of a wider system. As technology continues its inexorable advance the scope for computers to take on ever more responsibility seems undiminished whilst new technical capabilities offer the means to enhance or replace existing applications. The software industry faces two major inter-related challenges: to grow the resource base of skilled software developers whilst improving their individual and team productivity. Over the last two decades Agile techniques have emerged to quicker releases. However, speedier delivery is sometimes at the expense of the quality of the delivered code or its longevity. Thinking of the code base in product terms at the outset can ensure that the delivered software is successful both in its initial release and as a platform for product evolution over the longer term.

Sweden has contributed significantly to the evolution of software engineering practices and has a sound tradition in developing successful software-based products, both in the context of major engineering companies and amongst innovative start-ups. The difficulty of reconciling sound engineering approaches with market-driven or organisational pressures on time and budget is faced by all stakeholders across the software development spectrum. A key challenge for software engineers – and for their customers and bosses – is the constantly changing technological context of the programming work. Pragmatic software practitioners must balance the benefits of the latest technical innovations with the risks of abandoning established practices.

Intentions

The aim of the Master Programme in Software Product Engineering is to develop in students the knowledge, skills and experience required to be able to work in companies and organisations that deliver goods and services with substantial software content. The programme offers an engineering approach to software product development with a main focus on modelling within an Agile context. By considering systems thinking, software architecture, software product assurance and requirements engineering the programme provides a deep understanding of the

software product life cycle from inception, through coding, to maintenance and withdrawal. The programme also aims at giving a good understanding of more specialist areas such as: safety and security; knowledge engineering; the use of mathematics to enhance programming skills; the interaction of software with both hardware and people; and the technologies underpinning distributed systems. During the programme students are expected to engage in both practical work and technical research.

Post-graduation employment areas

This Master's degree enables graduates to aim for the more senior roles in the development of software products. Graduates will be equipped to focus on areas such as software architecture, testing, project management, requirements management, and the specification of socio-technical systems. Graduates will have developed the capabilities needed to work in both large corporations and smaller specialized software shops. They will be comfortable with delivering major enterprise systems or specialized embedded software components across the spectrum of software development from back-end data processing to Internet-related front-ends.

This Masters degree also qualifies graduates to apply for further third-cycle education leading to a licentiate or doctoral degree.

Research

A Masters degree qualifies graduates to apply for further third-cycle education leading to a licentiate or doctoral degree.

Research supporting the Programme

Product Development is a major area of research within the School of Engineering and includes investigations into the enhanced use of software in computer aided design. Within the Department of Computer Science & Informatics there is a strong focus on research related to the use of models to support product development in general and the development of software products in particular. One example is research into improving the testing of software products through the automated generation of test cases by exploiting ontology technologies. Another investigation addresses a model-based approach to automated code generation, translational software engineering, which offers much potential for supporting software product evolution. The software research also embraces an interest in developing and improving the algorithms that underpin application effectiveness and efficiency.

Educational concept at the School of Engineering

All educational training at the School of Engineering in Jönköping (JTH), is determined by an educational concept. The concept offers a holistic perspective, where Business Community Contacts, Internationalisation and Entrepreneural Drive are key words. Besides technical knowledge within the programme, Leadership and Communication, Professional Attitude and Sustainable Development are important parts of the concept.

Business Community Contacts means that JTH has an established collaboration with the business communtiy in various forms throughout the training. An example is the course located directly in the business community (Näringslivsförlagd kurs, NFK), which is part of all programmes. The aim with this course is to provide the students with an understanding for future professional tasks, and the ability to relate these to the training.

Internationalisation means that students e.g. are given the opportunity to train languages and intercultural communication through exchanges with foreign universities. JTH has approximately 70 partner universities all over the world, and participates in several international exchange programmes for students. There are opportunities to spend parts of the training abroad and account to the foreign credits in the exam. Due to this student exchange, a great

number of courses at JTH are given in English.

Entrepreneural Drive is received through the holistic perspective of the training programme. Significant is the exchange with the business community, the leadership training, the association with professional work in project based courses, and the economy elements, among other things.

Leadership and Communication includes e.g. training in verbal and written communication, project based work, leading and motivating people and also to understand decision processes in companies and organizations.

Professional Attitude comes through basic knowledges in economics, marketing, and business planning. These knowledges are further developed and integrated in technical contexts. Engineers and technicians with such experiences are useful within a great number of areas in the business community.

Sustainable Development includes understanding of compatibility with a sustainable society and environmental and human aspects in the future productivity and products. The instructions are fully integrated in their technical context and treat social, economical and ecological aspects of sustainable development.

Project based Training is also a part of the educational concept. Assuming responsibility for projects of various sizes frequently occurs as a professional. As a preparatory step, the students are responsible for real projects in connection with the business community in some of the courses.

Student influence is a great and important part in JTH's continuous quality development. Through student representatives in all boards, councils and decision-making committees, the students actively influence their education.

Objectives

After the completion of the programme, students must meet the intended learning outcomes, as described in the Ordinance by Higher Education (m), and also the intended learning outcomes, as described by JTH (j):

Common learning outcomes

Knowledge and understanding

1. demonstrate knowledge and understanding in their main field of study, including both broad knowledge in the field and substantially deeper knowledge of certain parts of the field, together with deeper insight into current research and development work; and,(m)
2. demonstrate deeper methodological knowledge in their main field of study.(m)

Skills and Abilities

3. demonstrate an ability to critically and systematically integrate knowledge and to analyse, assess and deal with complex phenomena, issues and situations, even when limited information is available,(m)
4. demonstrate an ability to critically, independently and creatively identify and formulate issues and to plan and, using appropriate methods, carry out advanced tasks within specified time limits, so as to contribute to the development of knowledge and to evaluate this work,(m)
5.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; and,(m)
6. demonstrate the skill required to participate in research and development work or to work independently in other advanced contexts.(m)
7. prove ability to independently apply acquired knowledge in practical work, and insights in

future professional positions,(j)

Judgement and Approach

8. demonstrate an ability to make assessments in their main field of study, taking into account relevant scientific, social and ethical aspects, and demonstrate an awareness of ethical aspects of research and development work,(m)
9. demonstrate insight into the potential and limitations of science, its role in society and people's responsibility for how it is used; and(m)
10. demonstrate an ability to identify their need of further knowledge and to take re-sponsibility for developing their knowledge.(m)
11. prove insights in the professional engineering role and responsibility in the society, assuming human conditions and needs and the goals for economical, social and ecological sustainable development in the society,(j)
12. prove immersed ability to interdisciplinary manners and to apply a system perspective,(j)

Programme-specific learning outcomes

The intended learning outcomes provided for programmes, must also be met.

Knowledge and Understanding

13. display knowledge of the life cycle models and methods available to carry out software product development.
14. demonstrate comprehension of how to capture the requirements for a software product.
15. demonstrate knowledge of methods for ensuring the quality of a software product.

Skills and Abilities

16. demonstrate an ability to design a software architecture that satisfies the quality requirements of a software product.
17. demonstrate the skills required to be able to systematically generate and carry out development of
software-intensive systems.
18. demonstrate an ability to independently implement and utilise findings from analyses, formalization and representation of a well-defined domain.
19. demonstrate the skills required to be able to independently specify, plan, carry out and present a
research assignment on an academic level.

Judgement and Approach

20. demonstrate understanding of how to reconcile Agile development techniques with established software engineering principles,
21. demonstrate an ability to evaluate existing codebases to determine their reusability and scope for evolution.

Contents

Programme principles

A key principle for the programme is the treatment of software as a product, rather than constraining software development to a narrow project viewpoint. In this context, modelling is regarded as a vital tool for capturing product stakeholder requirements and viewpoints.
The product perspective is complemented by the programme's emphasis on growing the competence of the students as professional engineers. This is manifest in several ways. The CDIO Initiative™ underpins a new vision for engineering education. By mapping to the Curriculum Guidelines for Graduate Degree Programs in Software Engineering and to the Software Engineering Body of Knowledge, the degree builds upon the work of professional software bodies. A commitment to "evidence-based software engineering" helps students to understand the importance of sound research over hype and myth in the software field. Collaboration with businesses and institutions ensures that the programme reflects "real-world" product development needs while lectures from external software engineers provide a counterpoint to the academic view of software development. The programme embraces the Agile

Manifesto philosophy which favours a flexible approach to the frequent delivery of working code over a rigid adherence to processes and plans.
Instruction is in the form of lectures, seminars, exercises, laboratory sessions and project work. All courses are held in English. All final course examinations are in English.

The program´s progression

Two introductory courses start the programme. Industrial Product Realization, Process – Methods – Leadership provides all Masters students at the School of Engineering with a shared conceptual, organizational and research framework for product realization within their individual disciplines. In parallel, Software Engineering – a Product Perspective, gives students the foundations for developing software in a systematic and controlled way. The core topics of the programme follow in sequence: Engineering of Socio-Technical Systems introduces students to systems thinking, modelling and simulation as ways of understanding software in relation to its environment; Software Product Architectures – from Chip to Enterprise teaches the students the principles behind architectural design, looking at partitioning and layering across the spectrum of software product types; Software Product Quality Assurance ensures that students have a deep and sophisticated understanding of the different influences on software quality, transcending the simplistic view of testing as a final step before shipping the code; Software Product Specification and Requirements Engineering, drawing on lessons from earlier courses, makes students aware of the important role of requirements in ensuring successful software product development.

Alongside these core topics, other courses address more specialised areas: Safe and Secure Software Products (elective); Knowledge Modeling and Knowledge Management (elective); Mathematics for Software Engineers; Software Entrepreneurship and Business Planning; Cloud Computing and Data Analytics; and User Experience Design.

Four courses enhance the strong practical focus of the programme. Towards the end of Software Engineering – a Product Perspective students will agree with an external organisation upon a product-oriented project that they will follow as a track through the programme. Project work starts in Semester 2 with Product Development in Cross-Discipline Teams. During the Industrial Placement Course (NFK) they will gain real work place experience with the collaborating organisation. The product project is brought to completion and the results are presented in Product Development in Cross-Discipline Teams 2. Finally, based upon on a topic identified during this practical work, students will carry out academic research in Masters Thesis (Ex-jobb).

Courses

Mandatory courses

Course Name	Credits	Main field of study	Specialised in	Course Code
Final Project Work in Product Development	30	Product Development	A2E	TEUV24
Industrial Product Realization, Process - Methods - Leadership	9	Production Systems, Product Development	A1N	TIFR23
Software Product Quality Assurance	6	Product Development	A1F	TKSS26
Mathematics for Software Engineers	6		G1F	TMMK16
Software Product Architectures	7.5	Product Development	A1F	TMVS26

Software Engineering - a Product Perspective	9	Product Development	A1N	TMUR25
Industrial Placement Course in Product Development	9	Product Development	A1F	TNFS24
Product Specification and Requirements Management	6	Product Development	A1F	TPKS26
Product Development in Cross-discipline Teams	3		A1F	TPCS26
Product Development in Cross-discipline Teams - 2	9		A1F	TP2S26
Software Entrepreneurship and Business Planning	7.5	Product Development	G2F	TSEG16
Engineering of Socio-technical Systems	6		G1N	TUSG15

Elective courses

Course Name	Credits	Main field of study	Specialised in	Course Code
Cloud Computing and Data Analytics[1]	6	Informatics	A1N	TCCR26
User Experience Design[1]	6	Informatics	A1N	TUER26

Programme overview

Year 1

Semester 1		Semester 2	
Period 1	Period 2	Period 3	Period 4
Industrial Product Realization, Process - Methods - Leadership, 9 credits	Engineering of Socio-technical Systems, 6 credits	Mathematics for Software Engineers, 6 credits	Software Entrepreneurship and Business Planning, 7.5 credits
Software Engineering - a Product Perspective, 9 credits		Software Product Architectures, 7.5 credits	Software Product Quality Assurance, 6 credits
		Product Development in Cross-discipline Teams, 3 credits	

Year 2

Semester 3		Semester 4	
Period 1	Period 2	Period 3	Period 4
Industrial Placement Course in Product Development, 9 credits	Product Development in Cross-discipline Teams - 2, 9 credits	Final Project Work in Product Development, 30 credits	
Cloud Computing and Data Analytics [1], 6 credits	Product Specification and Requirements Management, 6 credits		
User Experience Design [1], 6 credits			

Teaching and examination

Academic year is divided into two semesters and normally read two courses in parallel. Examination forms and grades are given by each course plan, respectively. The programme overview shows the programme structure for both years and may be changed during the programme. For updated programme overview see http://www.jth.hj.se

Prerequisites

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 ECTS credits in computer engineering, electrical engineering (with relevant courses in computer engineering), or equivalent. The bachelor's degree should comprise a minimum of 15 ECTS credits in mathematics. Proof of English proficiency is required.

Continuation Requirements

In order to begin the second year, at least 30 credits from the programme's first year must be completed.

Qualification Requirements

To obtain a Degree of Master in Product Development, specialisation in Software Product Engineering, students must complete a minimum of 120 higher education 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

Management councils , Head of Programmes, teachers and students work together with the development of the programmes and courses. All students get the opportunity to do a course evaluation after each completed course and before graduation time. The results of the evaluation are presented to the Head of Programmes, Head of Departments, Course Coordinators and to the Director of Education for further development.
Head of Departments, or corresponding, and Head of Programmes raise questions regarding the programme development within the Council of Programmes.
Student representatives, Director of Education and Study Counselor meet four times per year to discuss the recent completed courses within the programmes.
The chairman of students Educational Committee is a regular member in Council of Education.

Other Information

Course included in the programme can be read as a separate course, subject to availability. Prerequisites are stated in the syllabus.
Non-EU/EEA/Switzerland citizens pay tuition fees at the current rate. For further information see http://www.hj.se, / / Tuition and Application Fee / /