JÖNKÖPING UNIVERSITY
School of Engineering

PROGRAMME SYLLABUS

Software Product Engineering (master), 120 credits

Programmestart: Autumn 2018

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PROGRAMME SYLLABUS

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Programme code:	TAPM7	**Programmestart:**	Autumn 2018
Confirmed by:	Dean 2018-03-01	**Education Cycle:**	Second-cycle level
Version:	2		

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 enable 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.

Objectives

Master Programme in Software Product Engineering aims to develop in students the knowledge, skills and experience required 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 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 covers more specialist areas such as: safety and security; the use of mathematics to enhance programming skills; and entrepreneurship. During the programme students engage in 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.

Research
This 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, underpinned by the Knowledge Intensive Product Realization research environment. Within the Department of Computer Science & Informatics there is a strong focus on research related to data analytics, machine learning, and the creation and enhancement of algorithms that strengthen application effectiveness and efficiency. The Department also encourages 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 by exploiting ontology technologies to enable the automated generation of test cases.

Educational concept at the School of Engineering
All degree programmes at the School of Engineering at Jönköping University (JTH) follow an education concept. The concept can be seen as consisting of a number of different aspects that have to be included in the degree programmes in order to guarantee their quality and appeal as well as their ability to produce professionally skilled, in-demand students. The concept places special emphasis on collaboration with industry and internationalisation as two essential tools in developing successful programmes attracting many applicants.

In the concept for the Master's programmes, there are common learning outcomes regarding the areas leadership, project management, internationalisation, and sustainable development. There is also an Industrial Placement Course (IPC) included in all programmes, whereby students put their theoretical knowledge into practice. IPC is a 9 credit course (5 weeks practise at a company), and it is also possible to complete the course abroad.

Internationalisation means that, for example, the opportunity is provided to practise languages and intercultural communication through student exchanges with foreign universities. JTH has around 70 partner universities around the world, and takes part in a number of international student exchange programmes. There is an opportunity to spend part of the study period abroad and to accredit studies abroad towards the degree. All Master's programmes at JTH are given completely in English.

Objectives
After the completion of the programme, students must meet the intended learning outcomes, as described in The Higher Education Ordinance by Degree of Master (1-9), and also the intended learning outcomes, as described by JTH:

Common learning outcomeserstanding
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
JTH. prove ability to apply acquired knowledge in practical work
JTH. prove ability to collaborate effectively in teams, especially in the presence of a strong multicultural dimension

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 understanding of future professional engineering roles, including a sound awareness of an engineer's ethical responsibilities towards society and the need for economic, social and ecological sustainable development
JTH. prove ability to embrace interdisciplinary approaches through the application of a system perspective

Programme-specific learning outcomes

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

Knowledge and Understanding

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

Competence and skills

13. demonstrate an ability to design a software architecture that satisfies the quality requirements of a software product.
14. demonstrate the skills required to be able to systematically generate and carry out development of software-intensive systems.
15. demonstrate an ability to generate the level of comprehensive documentation necessary to support software product development.
16. demonstrate the ability to work in cross-discipline teams during development of a product for the needs of specific users, organizations, or businesses

Judgement and Approach

17. demonstrate understanding of how to reconcile Agile development techniques with established software engineering principles,
18. demonstrate an ability to evaluate existing codebases to determine their reusability and scope for evolution,
19. demonstrate the ability to decide when to use models and to select appropriate models to

support software product development.

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.Similarly, Agile software delivery are used in practical work to deliver software products that satisfy customer goals and end-user needs.

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.

Programme 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 through the use of models and Agile techniques. 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 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 Management, 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; Mathematics for Software Engineers; Software Entrepreneurship and Business Planning; Cloud Computing and Data Analytics (Elective); and User Experience Design (Elective).

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 with Product Development in Cross-Discipline Teams - 1. 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 in Collaboration	6	Production Systems, Product Development	A1N	TIPR28
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	6	Product Development	A1N	TMUR26
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 – 1	9		A1F	TP1S28
Product Development in Cross-discipline Teams - 2	3		A1F	TP2S28
Software Entrepreneurship and Business Planning	7.5	Product Development	G2F	TSEG16
Safety and Security of Software Products	6		A1F	TSMS25
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[2]	6	Informatics	A1N	TUER26

[1] Elective block 1

[2] Elective block 2

Programme overview

Year 1

Semester 1		Semester 2	
Period 1	Period 2	Period 3	Period 4
Industrial Product Realization in Collaboration, 6 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, 6 credits	Safety and Security of Software Products, 6 credits	Software Product Architectures, 7.5 credits	Software Product Quality Assurance, 6 credits
	Product Development in Cross-discipline Teams – 1, 9 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, 3 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 [2], 6 credits			

[1] Elective block 1

[2] Elective block 2

Teaching and examination

Throughout the academic year, typically, two courses are taken in parallel. Examination forms and grades are given by each course module, respectively. The programme overview shows the programme structure for both years and may be changed during the programme. For updated programme overview visit http://www.ju.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 of Science (120 credits) with a major 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.
Representatives of students and programme managers gather continuously to discuss the recently completed programme courses..

Other Information

If formal competence is missing, the applicant's substantial competence is tested if the applicant has acquired equivalent knowledge in some other way. The aim is to assess the collective competence and if the applicant has the opportunity to meet selected training. Substantial competence can be about knowledge and experience from working life, long-term mobility or other courses.

Course included in the programme can be read as a separate course, subject to availability. Prerequisites are stated in the syllabus.
Admission is under "Admission arrangements for first and second level" at Jönköping University.

This syllabus is based on "Regulations and guidelines for education at undergraduate, postgraduate and doctoral studies at Jönköping"