

Professional Bachelor in Software Development study programme

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The curriculum was revised August 2015 in relation to the mandatory prerequisites for participation in KEA Week

Professional Bachelor in Software Development study programme – common part

1.0 Origin and framework

This common part of the study programme for the additional programme for PBA Software Development has been prepared jointly by the course providers and applies to all certified courses.

The Study Programme has been prepared within the framework contained in current legislation (the Examination Order, the Main Order and the Course Order) and applies to students commencing the PBA programme from 1 December 2010.

1.1 The purpose of the course

The purpose of the Professional Bachelor in Software Development programme is to qualify the graduate to be able to function independently as an IT specialist with focus on integration and architecture and to participate in professional collaboration on developing large, data-intensive distributed IT systems in IT firms, IT consultant firms or internal IT development departments. Finally, the programme will qualify graduates to continue in relevant studies at Master level.

1.2 The scope of the course

The course, which is full-time, is estimated at 1½ academic years. An academic year is a full-time student's work for one year. An academic year is the equivalent of 60 points in the European Credit Transfer System (ECTS points). Thus the course corresponds to a total of 90 ECTS.

1.3 Title

Students who have completed this course and passed the examination are entitled to use the Danish title **Professionsbachelor i softwareudvikling** (PBA Softwareudvikling). The title in English is **Bachelor of Software Development** (BSc Software Development.)

1.4 Access to the programme

The Professional Bachelor in Software Development programme is a top-up course to the Computer Science course, which therefore gives direct access.

Other applicants may be admitted on the basis of individual assessments of their actual qualifications; cf. the Ministerial Order no. 8 of 10 January 2008 on Individual Competency Assessments (Assessment of non-formal and informal learning) in Higher Adult Education programs (VVU) and in Diploma Education Programs.

2.0 The overall academic objectives of the course

2.1 Knowledge

The objective is to give the graduate knowledge of

- the strategic role of tests in system development,
- globalisation of software production,
- system architecture and understanding of its strategic importance for the company's business,
- knowledge of applied theory and method and widely-used technologies in the domain and
- the connections between applied theory, method and technology, and to enable the student to reflect on their suitability in different situations.

2.2 Skills

The objective is that the graduate will be able

- to integrate IT systems and develop systems that support future integration,
- to make use of contracts as a mechanism for control and management in the development process,
- to evaluate and select database systems, and design, re-design and optimise databases for performance,
- to plan and manage development processes with many geographically scattered participants, and
- to determine and apply a relevant degree of formalism in connection with internal communications and coordination in development projects.

2.3. Proficiencies

The objective is that students will be able

- to handle the planning and implementation of tests of large IT systems
- to participate in professional collaboration on developing large systems using widespread methods and technologies
- to familiarise themselves with new technologies and standards for handling integration between systems
- to develop their own profiles of expertise through practice from primarily being a back-end developer profile to taking on assignments as system architects and
- to handle determination and realisation of appropriate architecture from business and technological viewpoints for large systems

These overall objectives are put into practice through a number of part objectives for knowledge, skills and proficiencies, which are described in more detail under the individual modules of the programme.

3.0 The structure, core areas and mandatory elements of the programme

The PBS programme is built up of modules and consists of:

- Main modules
- Optional module
- Work experience (15 ECTS)
- Final Bachelor project (15 ECTS)

Modules

The line consists of a series of modules which together span the professional area and thereby give the student the relevant expertise.

These modules are closely interlinked, and therefore the individual modules acquire meaning through the whole programme which they are part of – the total number of modules.

It will be possible for the student to define his/her programme in different directions through a choice of modules.

Main modules

- Databases for developers
- Testing
- System integration
- Development of large systems

Examples of optional modules

- Project management
- Security
- Theory of science
- Mobile platforms

Other

- Work experience
- Final Bachelor Project

4.0 Learning objectives of elements of the programme

4.1 Main modules

4.1.1 Testing (10 ECTS)

Purpose

The objective of the module is to qualify the student for the work of planning and implementing tests. In addition, the student should be able to see the strategic role of the test in the total development process and take responsibility for the internal quality control of a project.

Objectives

Knowledge

The objective is to give the student knowledge of

- essential test strategies and models and their role in system development
- tests as an integrated element of a development project
- various forms of tests and their application

Skills

The objective is that the student will have acquired proficiencies in

- planning a test sequence based on a test model
- making use of both black-box and white-box test forms
- making use of techniques for both verification and validation
- ensuring traceability between system requirements and tests at all levels
- make use of tests as part of the quality assurance in project work
- designing tests that can be used for verification of compliance with contracts, including internal contracts between part-systems
- applying techniques and tools for automation of various forms of tests
- constructing systems to manage tests and fault correction in development projects

Proficiencies

The objective is that the student will have acquired proficiency in

- selecting and applying a test strategy, a test model and testing techniques that are suitable for the development model applied
- planning and managing the implementation of both internal and external tests of a system
- designing a test with a relevant degree of test coverage
- determining principles of system design that help make a system testable

4.1.2 System integration (10 ECTS)

Purpose

The objective of the module is to qualify the student to work with technical integration of systems. After completing the module the student should be able (1) to integrate existing systems, (2) to integrate existing systems in connection with developing new systems and (3) be able to develop new systems that support future integration.

Objectives

Knowledge

The objective is to give the student knowledge of

- the business considerations associated with system integration
- standards and standardisation organisations
- techniques used in data conversion and migration
- the service concept and an understanding of its connection with service-oriented architecture
- technologies that can be used to implement a service-oriented architecture

- similarities and differences between object-oriented and service-oriented architecture
- tools for integration

Skills

The objective is that the student will have acquired the ability to

- use an object-oriented system in service-oriented architecture
- design a system so that it is easy to integrate with other systems, and so that it makes use of already existing services
- transform or extend a system so that it can function in service-oriented architecture
- make use of patterns that support system integration
- develop supplementary modules for generic systems
- integrate generic and other systems

Proficiencies

The objective is that the student will have acquired proficiency in

- choosing between different methods of integration
- converting elements in a business strategy to specific requirements for systems integration
- adapting a development method in system development so that it supports system integration
- acquisition of knowledge about development in standards for integration

4.1.3 Developing large systems (10 ECTS)

Purpose

The objective of the module is to qualify the student to work in development of large systems, i.e. after completing the module the student should be able on the one hand to plan and manage development procedures with many project participants, and on the other hand be able to design and implement large systems that are divided into smaller sections and developed by independent development groups.

Objectives

Knowledge

The objective is to give the student knowledge of

- problematic issues associated with managing large projects
- techniques for managing large projects
- the roles involved in large development projects
- the challenges associated with distributed development of systems across organisations or national borders
- quality systems that are used to measure and ensure quality
- the various techniques that can be used in connection with rolling out large systems
- starting up a system in a technically distributed environment (moving from the development environment to the operational environment)

Skills

The objective is that the student will have acquired the ability to

- formulate requirements between part-systems
- ensure the quality of implementation of changes in requirements across part-systems, including traceability

- make use of patterns and frameworks in designing and implementing large systems at architect level
- divide a software system into smaller elements
- make use of and develop components with re-use in mind
- specify interaction between the parts at an abstract level
- make use of techniques for configuration management (version management, document management and release management)
- use a professional multi-user development environment
- apply techniques for internal quality assurance between development groups
- apply techniques to manage changed requirements between part-systems

Proficiencies

The objective is that the student will have acquired proficiency in

- assuming and performing a specific role
- adapting a development method to development of large systems
- participating in intercultural global development projects

4.1.4 Databases for developers (10 ECTS)

Objectives:

The objective of the module is to qualify the student to be able to select and utilise different types of database appropriately in relation to different domains of application. In addition, the student should be able to analyse and work with large databases, including redesigning and optimising their performance.

Objectives

Knowledge

The objective is to give the student knowledge of

- different types of databases and the underlying models
- the organisation of storage and processing of queries in a specific database system
- the possible ways of optimising a specific database – including advantages and disadvantages and possible trade-offs
- database-specific security problems and their solutions
- an administrative tool that is used to monitor and optimise a specific database
- the particular problems raised by many simultaneous transactions, including those in connection with the web and distributed databases
- relational algebra

Skills

The objective is that the student will have acquired the ability to

- transform logical data models to physical models in different types of database
- carry out optimisation of databases
- use the security system of a specific database
- use elements of the administrative tool for optimisation and tuning already existing databases
- use the tools of a specific database system to handle simultaneous transactions
- make use of the facilities and programming options made available by a modern DBMS
- use an object-relational mapping tool
- use relational algebra to understand possibilities for optimisation

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Proficiencies

The objective is that the student will have acquired proficiency in

- analysing the application domain in order to select the type of database

4.2 Examples of optional modules

These are examples only. There may be other optional modules.

4.2.1 Project management (10 ECTS)

Purpose

The purpose of the module is to qualify the student to be able to lead small and medium-sized development and maintenance projects and to take responsibility for management tasks in connection with larger projects.

Objectives

Knowledge

Project formulations and strategies (project models)

The objective is that the student

- will become familiar with a number of project models that set out from different development methods and philosophies

Management tasks of the project

The objective is that the student

- acknowledges that personnel management is also an element of project management
- knows various team-building techniques and can make use of them
- gains an understanding of conflict management

Interaction with other projects and the rest of the organisation

The objective is that the student

- gains an understanding of how the individual project is or can be part of a larger entity, and that adjustment and setting priorities may be necessary

Skills

Project identification

The objective is that the student

- will be able to identify the factors associated with an assignment which mean that it must or should be carried out as a project
- will be able to clarify and describe the framework in which the project is to be carried out

Project formulations and strategies (project models)

The objective is that the student

- will be able to draw up a formulation of the project, taking into account the conditions and framework for the project
- will be able to formulate a project strategy and organise the project in accordance with it

Project planning including estimates

The objective is that the student

- will be able to separate out a series of activities and organise them in suitable phases

- will be able to illustrate the mutual connections and dependencies between these activities
- will be able to make use of different estimation techniques for both resources and calendar time
- will be able to prepare operational project plans both for time and resources

Quality assurance and follow-up

The objective is that the student

- will be able to define quality requirements for the project deliveries
- will be able to make use of various quality assurance techniques
- will be able to set up a quality assurance plan for the project

Management tasks of the project

The objective is that the student

- can make use of different techniques for problem diagnosis and solutions
- can carry out a risk analysis and draw up a risk-management plan

Interaction with other projects and the rest of the organisation

The objective is that the student

- will be able to prepare and implement a procedural plan for the project and the individual participants

Proficiencies

The student should acquire proficiency in:

- acting as project manager in all phases of a project, and be able to make the necessary decisions independently with regard to the project.

4.2.2 Security (10 ECTS)

Purpose

The purpose is to enable the student to carry out a security analysis, prepare proposals for a solution and an action plan, take charge of implementation of the solution and take part in the regular administration.

Objectives

Knowledge

Operating system security

The objective is that the student will

- gain knowledge of the principles for controlling access to operating systems
- be able to explain how operating systems can be maintained with regard to updating and "disaster recovery"

Security techniques

The objective is that the student will

- be able to give an account of general principles of cryptography, including symmetrical and asymmetrical encryption and the difference between weak and strong encryption keys

- be able to give an account of other security techniques based more or less on cryptographic principles, including Digital Signatures, Certificates and Message Digests
- be informed about widespread cryptographic standards (e.g. AES and RSA)
- be able to explain the use of VPN
- have knowledge of widespread security systems used on the World Wide Web, including SSL and SSH

Wireless security

The objective is that the student will

- gain knowledge of the special threats and problems of wireless communications
- be able to give an account of the best way to secure wireless communications, including use of encryption, MAC address validation and authentication

Firewalls

The objective is that the student will

- be able to explain how different types of firewalls work, including filter routers and application firewalls
- have knowledge of IDS – Intrusion Detection Systems

Application security

The objective is that the student will

- know the ordinary general threats that must be taken into consideration in applications and be able to implement solutions to counter these threats

Skills

Security analysis

The objective is that the student will

- be able to describe and categorise essential threats to security and associated security techniques
- be able to work out plans for physical security, redundant systems, backup strategies and control mechanisms that will detect security breaches
- be able to work out a security policy
- be able to carry out a security analysis, including
 - o identifying the assets of the IT system and defining the requirements for their protection
 - o identifying the threats
 - o carrying out a risk analysis
 - o implementing parts of the security system
 - o preparing an action plan for what must be done if security is breached

Operating system security

The objective is that the student will

- be able to draw up guidelines for how to obtain good password protection
- be able to draw up guidelines for controlling access to files and resources

Application security

The objective is that the student will

- be able to identify where it is necessary to include application-specific security in programs

Proficiencies

The student should acquire proficiency in:

- following developments in the field of security with a view to identifying new threats and products and techniques to counter these and pre-existing threats
- implementing and advising on developing adequately secure applications

4.2.3 Theory of science (5 ECTS)

Purpose

The purpose of the module is to qualify the student to handle epistemological subjects and apply central scientific theoretical concepts and theories to the description of relations between humans, science and technology.

Objectives

Knowledge

Theory of science

The objective is that the student

- will acquire knowledge of central traditions and viewpoints in the theory of science, including empiricism, rationalism, hermeneutics and phenomenology
- will acquire knowledge of essential scientific problems of a philosophical, idea-historical, theoretical and scientific-methodological nature
- will acquire knowledge of scientific and technological-philosophical concepts of relations between humans, science and technology

5.0 The practical part of the course (15 ECTS)

5.1 Work experience

Work experience takes place in one or more companies, where the student must participate in and become familiar with relevant business functions. Work experience can be planned to be flexible and varied and must form the basis of the student's bachelor project.

The purpose of work experience is to give the student the opportunity to test the knowledge gained in the first two semesters in practice by working under job-like conditions in a relevant IT-related company and job function.

5.2 Learning objectives for work experience

- To gain an insight into a company's requirements and expectations of a software developer's knowledge
- skills and approach to the work involved
- To experience professional IT work under normal conditions over an extended period of time
- To work on practical development projects in line with the student's own learning objectives
- To test in practice the knowledge and skills that have been acquired on the PBA course
- To gain experience of other working methods and tools to complete specific projects

In addition, if applicable:

- To gather ideas for a bachelor project and a possible foundation for a bachelor project

Based on the set work experience learning objectives, the student and the Work Experience Coordinator together determine the learning objectives for the period of work experience. These objectives will form the basis for planning the student's work during his/her work experience.

At the end of the period of work experience the student will submit a written report describing what was learned from the work experience. The report must be approved by the Work Experience Coordinator before the student can register for the examination in the final project.

Work experience is comparable to a full-time job with the concomitant requirements for working hours, effort, commitment and flexibility that the graduate Professional Bachelor would expect to find in his/her first job.

The student is entitled to student grant support during the work experience period.

6.0 Final Bachelor project (15 ECTS)

For the bachelor project, the student is asked to document his/her ability to adapt a complex and practical problem related to a specific task in IT on an analytical and methodical basis. The bachelor project must include main course subjects.

6.1 Prerequisites

The student must have passed all previous examinations to be able to complete the bachelor project. The results of the work experience must also have been approved.

6.2. Content

The formulation of the question for the final bachelor project must be prepared by the student in partnership with a company. The formulation of the question must be approved by the educational institution.

In resolving the set problem it is important that students are able to apply important theories and methods.

The educational institution will prepare the detailed guidelines with the formal requirements for the project.

7.0 Timeline for the modules

Since there is no progression from one subject level to another in the modules of the course, no specific order has been defined for taking them.

8.0 Course examinations

8.1 Examinations in the individual modules

In order to document that the student has achieved the learning objectives set for each module in the course, an examination is held after each module.

A pass must be obtained for each module, and a student who does not pass may register to retake the examination; cf. the rules about this in the Examination Order.

During the first year of study, the student takes six modules. At least three modules must be examined externally. The institution will announce which modules will be examined externally. The remaining modules will be examined internally.

Rules for individual examinations:

It is a prerequisite for sitting the examination that the student has submitted the mandatory assignment(s) for the module and that they have been approved.

Basis for the test: The specific module

Form: Oral examination

Duration:

30 minutes' examination including discussion of the student's performance. The individual institution determines the details of how the examination is held, including whether students will draw questions, whether there is preparation time etc.

Marking: The 7-point grading scale.

8.2 Work experience examination

Assessment of work experience

The assessment is made at an internal examination at which the student and the Work Experience Coordinator together review the main conclusions of the report, and the report is assessed as "Approved" or "Not approved". The duration of the examination is 30 minutes including discussion of student's performance.

8.3 Final Bachelor project examination

The subject of the final bachelor project is formulated by the student in consultation with the college and as far as possible in consultation with a company. The college approves the problem formulation.

The examination of the final bachelor project is external, and consists of an assessment of the submitted documentation of the project and an oral defence.

If the student does not pass the final bachelor project, a supplement to the original project report may be submitted.

The final bachelor project must show documentation that the learning objectives and level required at the final examination of the course have been achieved.

The bachelor project may be carried out in groups of up to 3 students. The institution determines this in consultation with each student.

The documents for the bachelor project must be submitted to the institution in the form of a report and a product, if applicable, in three copies. Excluding attachments, the volume of the report must be a maximum of 40 standard pages and 20 pages per student. The product may for instance be a program. The report is assessed on an individual basis, which means that the report must clearly state who is responsible for each part. The oral part of the examination is based on the whole report.

Examination in the bachelor project takes the form of an individual oral defence lasting 30 minutes.

At the beginning of the examination the student gives / students give a joint presentation of the project, lasting a maximum of ten minutes per student.

An examination dialogue is then held with each student, lasting approx. 25 minutes. An

overall individual mark is given in the assessment of the report and the oral part of the examination.

9.0 Provisions for commencement

The study programme commences with effect for students beginning their studies on or after 1 December 2010.

10.0 Reference to current legislation

The legal basis for the study programme is in the following legislation and executive orders:

- The Danish Business Academy Act: Act no. 207 of 31 March 2008 on Academic Business and Professional Bachelor Degree Courses
- Executive Order on Academic Business Courses and Professional Bachelor Degree Courses: no. 636 of 29 June 2009
- Executive Order no. 975 of 19 October 2009 on the Bachelor's Degree Programme in Software Development
- Ministerial Order on Quality: Executive Order no. 635 of 30 June 2000 on Quality Development and Quality Control of Academic Business Courses
- Executive Order on Admissions: Executive Order no. 106 of 9 February 2009 on Access, Registration and Leave, etc. on Certain Further Education Courses
- Executive Order on Examinations: Executive order no. 766 of 26 June 2007 on Testing and Examinations for Vocational Courses
- Executive Order on Marking: Executive Order no. 262 of 20 March 2007 on Marking Scale and Other Assessment
- Open Educational Courses: Executive Order no. 956 of 28 November 2003, as last amended by S. 77 of Act no. 562 of 6 June 2007.
- This legislation and the regulations are available at www.uvm.dk.

11.0 Professional Bachelor in Software Development Study programme – institution section for Copenhagen Technical Academy

11.1. Optional course elements

The course includes two modules of 10 ECTS each, with varying content. These modules may deal with Mobile platforms, Contract-based development, Security, Project management or other subjects.

11.2 Arrangements for work experience

(Ref.section 5.0 The practical part of the course (15 ECTS))

It is the responsibility of Copenhagen Technical Academy to evaluate whether the work experience placement(s) are suitable. Before the start of the work experience period, a work experience contract must be drawn up between the company offering work experience, the student and Copenhagen Technical Academy. This contract includes formalities and practical arrangements. Copenhagen Technical Academy has a standard scheme to be used for drawing up the work experience contract. In addition, as part of the contract, the student, the Technical Academy and the company offering work experience must make a mutually binding plan for the period of work experience. This plan must ensure that the student learns and benefits, and as a minimum must include objectives for the work experience and a description of specific tasks and participation in activities and their timing.

At the beginning of the 2nd semester, in connection with the work experience, guidelines will be issued to the student with the relevant dates and factors that apply during the work experience period. The guidelines also include a description of the requirements and expectations for the student, Copenhagen Technical Academy and the company offering work experience.

At the end of the period of work experience the student will submit a report describing what was learned from the work experience. The report must be submitted in two copies to the Work Experience Coordinator. The report may consist of a maximum of 20 standard pages (see appendix 1 for the definition of a standard page and formal requirements for assignment formats).

The work experience may be completed abroad.

11.3 Internal/external examinations

(Ref. Section 8 Course examinations.)

11.4 Sections of the course that may be taken abroad

Since the course is built up in modules, and the modules may be taken in any order, it is normally possible for a student to take a semester or part of a semester abroad. Copenhagen Technical Academy must approve the educational establishment and the

content of the course applied for. Similarly, the work experience and the bachelor project may be completed abroad. However, the final examination will always be held at Copenhagen Technical Academy. Copenhagen Technical Academy must approve the company offering work experience abroad.

11.5. Foreign language requirements

Parts of the course may be conducted in English, and the greater part of the teaching materials are in English. A requirement for the course, therefore, is English at Level C or above.

11.6 Teaching and working forms

The teaching on the course is based on relevant industry experience and applied theory and is implemented as a combination of class teaching, work in study groups, self-study, individual assignments, exercises and project work. Various other activities are offered to help promote individual learning, including individual supervision and coaching. Guest lectures and visits to businesses will also be included as elements in the course.

In the teaching, emphasis is placed on the students' active participation.

11.7 Course attendance

Students are required to be active in their studies and participate actively in mandatory project work and tasks. The number of projects and requirements for approval are set out in the term plan for the individual subject.

11.8 Rules on merit transfer

The individual modules of the course can be transferred to other educational establishments offering the same course.

11.9 Existing merit agreements

Existing merit agreements can be viewed on the institution's website.

11.10 Teaching available as open educational courses

The course is offered as a Diploma Education Programme according to the Act on Open Education. For further details please refer to the appropriate Business Academy website.

11.11 Attendance requirements – KEA Week

Students at KEA are required to attend the annual KEA Week, which has an agenda relevant for all students at KEA.

Students that do not attend the entire program of KEA Week will be obliged to attend a learning activity followed by a quiz. The results of this quiz do not appear on the diploma, but attendance is mandatory.

The quiz will be administered within 2 weeks after KEA Week.

Students who do not attend KEA Week, and who does not participate in the learning activity and take the quiz, will not be allowed to take the next regular exam at his/her education

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before the learning activity and quiz are completed.

The rules above do not apply to students who are doing their internship, are writing their final project, are documented ill (requires a note from a doctor), or are on leave due to pregnancy.