



Curriculum Bachelor of Software Development

2010



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Part 1

1. Background and framework

The National Curriculum for the PBA Software development programme is prepared in co-operation by the providers of the education and effects all approved providers of the programme.

The curriculum has been developed within the framework of existing acts and ministerial orders (examination regulations, main order and programme order) and is valid for students starting the PBA programme from the 1st of February 2010.

1.1 Programme objectives

The programme aims at qualifying the graduate to work independently as an IT- specialist focusing on integration and architecture and to enter into a professional cooperation about the development of large data heavy distributed IT systems in IT firms, IT consultancies or internal IT development departments.

Finally, the training qualifies graduates to pursue relevant training at postgraduate level.

1.2 Scope of the programme

The programme, which is a full-time study, is rated as an FTE (full time effort) of 1½ years of study. A student's yearly FTE is a full-time student's work in 1 year.

A student's yearly FTE is equivalent to 60 ECTS points (European Credit Transfer System). The programme is rated for a total of 90 ECTS.

1.3 Title

Those who have completed and passed the programme are entitled to use the title **Bachelor of Software Development** (BSc Software Development).

1.4 Admission to the programme

Bachelor of Software Development is a top-up programme of the Computer Science diploma (AP Degree) programme, which gives direct admission to the programme.

Other applicants may be accepted based on a concrete assessment of their actual competencies, cf. "Bekendtgørelse nr. 8 af 10. januar 2008 om individual kompetencevurdering i videregående voksenuddannelse (VVU) og diplomuddannelse I videreuddannelsessystemet for voksne": an individual competency assessment in further education for adults, corresponding to an AP-degree, and diploma courses in further education for adults.



2.0 Overall Learning Objectives for the Programme

2.1 Knowledge

The objective is that the student gain knowledge about:

- The strategic role of tests in system development
- Globalisation of software production
- System architecture and the understanding of its strategic importance for the company's business
- Knowledge of applied theory and method as well as widespread technologies within the domain and the
- Relation among applied theory and method and technology and the ability to reflect upon their applicability in different situations

2.2 Skills

The objective is that the student has skills to:

- Integrate IT systems and develop systems that support future integration
- Apply contracts as a management and coordinating system in the development process
- Assess and select database systems, as well as design, redesign and optimize the operation of databases
- Plan and manage development with many geographically separated project participants and
- Lay down and use a relevant degree of formality in connection with communication and coordination internally in development projects.

2.3 Competencies

The objective is that the student has the competencies to

- manage the planning and implementation of tests of large IT systems
- co-operate professionally about the development of large systems by applying widespread methods and technologies.
- study new technologies and standards to handle integration between systems
- develop one's own competence profile from being primarily a backend developer profiler to manage tasks as a system architect and
- manage the laying down and realisation of a business relevant architecture as well as a technologically relevant one for large systems.

The overall objective is utilized into a series of targets for knowledge, skills and competencies described under the individual modules.



3.0 Structure of the Programme, Core and Mandatory Educational Elements

The Bachelor programme is modular and consists of

- Core modules
- Elective modul
- Internship (15 ECTS)
- Final bachelor project (15 ECTS)

Modules

The line consists of several modules which together spans the field and thus provides the student with the relevant skills.

These modules are closely linked, and each module becomes meaningful through the entirety it is a part of - the total number of modules.

The student may shape his/her education in different directions depending on the choice of modules.

Core modules

- Databases for developers
- Tests
- Systems integration
- Contract based development
- Development of large systems

Examples of elective Modules

- Project Management
- Security
- C#

Others

- Internship
- Final bachelor project

3.1 Scheduled Plan of the Modules

As there is no professional progression between the modules of the programme, a time sequence has therefore not been defined.

Core Modules	Semester	ECTS	Exam
Databases for developers	1.	10	Oral
Development of large systems	1. or. 2.	10	Oral
Contract based development	2.	10	Oral
System integration	1. or. 2.	10	Oral
Tests	2.	10	Oral
Elective modules			
Project Management	1. or. 2.	10	Oral
Security	1. or. 2.	10	Oral
C#	1. or. 2.	10	Oral

Internship	3.	15	Joint, intern, project assignment
Final Bachelor Project	3.	15	Joint, intern, project assignment and oral

4.0 Learning Objectives for Programme Elements

4.1 Test (10 ECTS)

Purpose

The purpose of this module is to qualify the student to work with the planning and implementation of test. Furthermore, the student should be able to see the strategic role of the test in the total development process, and be responsible for the internal quality control of a project.

Objectives

Knowledge

The objective is that student has knowledge about

- Important test strategies and test models as well as their role in the systems development
- Test as an integral part of a development project
- Different test types and their applicability

Skills

The objective is that student has acquired skills to

- Plan a test based on a test model
- Apply both black box and white box test forms
- Apply techniques for both verification and validation
- Ensure traceability between system demands and test at all levels
- Apply test as a part of quality control in the project work
- Make test which can be used to verify the performance of contracts, among others, internal contracts among part systems
- Apply techniques and tools for the automation of different test types
- Build systems to control test and the process of removing errors in development projects

Competencies

The objective is that the student has the competencies to

- analyse and apply a test strategy, a test model and test techniques adapted to the development model in question
- plan and control the implementation of an internal as well as an external test of a system
- design a test with a relevant test coverage
- lay down principles for systems design that contribute to making it possible to test the system

4.2 System Integration (10 ECTS)

Purpose

The purpose of this module is to enable the student to work with technical integration of systems. The student must be able to (1) integrate existing systems (2) integrate existing systems in



connection with the development of new systems, and (3) develop new systems that support future integration.

Objectives

Knowledge

The students has knowledge about

- commercial deliberations about system integration
- standards and standardisation organisation
- techniques used in connection with data conversion
- the service concept, and understand its connection with service oriented architecture
- similarities and differences between object oriented and service oriented architecture
- tools for integration

Skills

The student has acquired skills to:

- apply an object oriented system in a service oriented architecture
- design a system that is easy to integrate with other systems, so it uses existing services
- transform or expand a system in a way that it can function in a service oriented architecture
- apply patterns that support system integration
- develop additional patterns for generic systems
- can integrate generic and other systems

Competencies

The student has the competencies to

- choose among different methods for integration
- convert elements in a business strategy to concrete demands for the integration of systems
- adapt a systems development method to support system integration
- acquire knowledge about the development of standards for integration

4.3 Design By Contracts (10 ECTS)

Purpose

The purpose of the module is to enable the student to apply contracts at different abstraction levels and with different degrees of formalism in connection with the development of large systems.

Objectives

Knowledge

The student has knowledge about

- the importance of separating specification and implementation
- the connection between contracts and verification of performing contracts
- practical programming with contracts
- tools that support contract based programming and design
- fundamental mathematical structures (sets, multisets, functions and relations)
- mathematical proof techniques
- programme statements, validity and accuracy of programmes

Skills



The student has acquired skills to:

- work out functional specifications
- specify parts of a system, both sub systems and programme modules
- apply contracts at model level
- implement parts of a system based on contracts
- apply contracts to different levels of abstraction and formalisation and handle their connection and transformation
- work out contracts expressed in predicate logic
- apply contracts to the verification of programme elements
- apply contracts as an integral part of the development process
- apply contracts to the classification, coordination and integration of large systems
- assess the degree of formalism which is relevant in different contexts

Competencies

The student has the competencies to:

- apply contracts in cross-cultural global development projects
- participate in the implementation of the use of contracts in development projects
- acquire knowledge and skills within software development that require knowledge of mathematical concepts and structures

4.4 Development of Large Systems

Purpose

The purpose of the module is to enable the student to work with the development of large systems, i.e. the student must be able to partly plan and manage a development process with many project members and partly to design and implement large systems, which are divided into smaller parts and developed by independent development groups.

Objectives

Knowledge

The student has knowledge about

- problems connected to manage large projects
- techniques to manage large projects
- the roles that form part of large development projects
- challenges connected to the distributed development of systems that cut across organisations and country boundaries.
- quality systems used to measure and assure quality
- different techniques that can be used in connection with the deployment of large systems
- launch a system in a technical distributed environment (move it from a development to an operation environment)

Skills

The student has acquired skills to

- specify demands for interaction among sub systems
- assure the quality of the implementation of changed requirements across sub systems through documentation, among others, traceability
- apply patterns and frameworks in design and implement large systems at architect level
- split up a software system in smaller parts
- apply and develop components with a view to recycling



- specify the co-operation between the parts at an abstract level
- apply techniques for configuration management (version management, document management and release management)
- apply a professional multiple user development environment
- apply techniques for internal quality assurance between the development groups
- apply techniques to managing changes of demands between sub systems

Competencies

The student has the competencies to

- be a part of and fill a specific role
- adjust a development method to the development of large systems
- participate in cross-cultural global development projects

4.5 Databases for System Developers (10 ECTS)

Purpose

The purpose of the module is to qualify the student to be able to choose and apply different database types efficiently to different application domains. The student must also be capable of analysing and working with large databases, including redesign and operation optimisation.

Objectives

Knowledge

The student has knowledge about

- different database types and underlying models
- the storage organisation and execution of requests of a specific database system
- the optimisation options of a concrete database system – including advantages and disadvantages, and possible trade offs
- specific database security problems and their solutions
- an administrative tool for monitoring and the optimisation of a concrete database
- the specific problems which are caused by many simultaneous transactions, among others, in connection with web and distributed databases
- relational algebra

Skills

- transform logical data models for physical database types
- implement the optimisation of databases
- apply a concrete database security system
- apply parts of the administrative system for optimisation and improve performance of existing databases
- apply the tools of a concrete database system to handle simultaneous transactions
- apply the facilities and programme options which a modern DBMS
- apply and object relational mapping facility
- apply relational algebra to understand optimisation options

Competencies

The student has the competencies to

- analyse the application domain with a view to the choice of database type



5.0 Internship (15 ECTS)

Internship

The internship will take place in one or more companies where the student must participate in, and acquire knowledge of relevant business functions. The internship can be organised in a flexible and differentiated way, and should form the basis for the student's final bachelor project.

The purpose of the internship is to give the student the opportunity to test the first two semesters of learning in practice by performing in a job situation relevant to the profession and the job function.

During the internship, the student has an internship tutor respectively from the academy and the company.

Learning objectives for the internship

- To get insight into the requirements and expectations that companies have to software developers' knowledge
- To acquire skills and attitudes to work
- To experience a daily routine and tasks through a longer period within the profession
- To work with development tasks in practice in accordance with the student's own learning objectives
- To test the knowledge and skills in practice that have been achieved through the BACHELOR programme
- To get experience from other work methods and tools for solving specific tasks

In addition, maybe

- To get ideas for a final bachelor project and a possible basis for the bachelor project

Based on the learning objectives of the internship, the student and the two tutors together establish the objectives for the student's learning outcomes of the internship period. This is subsequently normative for the organisation of the student's work during the internship period.

On completion of the internship, the student delivers a written report addressing the learning outcomes of the internship. The report must be approved by the internship tutor to ensure that the student can sit for the final project examination.

The internship equates a full-time job with the requirements to working hours, effort, commitment and flexibility that the professional graduate is expected to meet in his/her first job.

The student can get the government grant (SU) during the internship, and the two parties, the student and the company, agree on the economic terms for the business internship.



6.0 Final Bachelor Project (15 ECTS)

In the final bachelor project, the student must demonstrate the ability, on an analytical and methodical basis, to process a complex and practice-related problem to a specific task in the IT field. The final bachelor project should include key topics of the programme.

Prerequisites

The student must have passed all previous tests to sit in for the final exam. Furthermore, the internship must have been approved.

Content

The research question for the final examination project will be prepared by the student in collaboration with a company. The research question must be approved by the academy.

In solving the identified problem, it is important that the student can apply key theories and methods.

The academy draws up detailed guidelines containing the formal requirements for the project.

7.0 Tests

7.1 Test of Each Module

To document that the student has achieved the learning objectives that have been laid down for each module of the programme, one test will be held after each module. The examination of each module is external.

Each module must be passed. The student can apply for a re-examination, if a test has not been passed, cf. "Eksamensbekendtgørelsen": the rules of the Examination Executive Order.

For each test, the following applies:

Attendance at each examination requires that the student has handed in the compulsory task(s) of the module and that it has / they have been approved.

Basis of the test: The specific module

Type: Oral external test

Scope: 30 min. examination incl. evaluation. Each institution lays down rules of how the test is held; should the student draw a question, have preparation time etc.



Evaluation: 7-point scale

7.3 Final Bachelor Project

The topic of the final bachelor project is formulated by the student in consultation with the institution, and to the extent possible in cooperation with a company. The institution approves the formulation.

The examination of the final bachelor project is external and involves an assessment of the project (product and documentation), and the oral defence. The student is awarded one grade. The oral defence is used primarily to ensure that the documentation has been made by the examinee, and secondarily for minor adjustments of the assessment of the examinee's level.

Firstly, the tutor and the external examiner together assess the project (product and documentation). Secondly, the student defends the project in the presence of the tutor and the external examiner.

If the final bachelor project is not approved, a revised version of the original project report may be handed in for the re-examination.

The final bachelor project must demonstrate that the learning objectives and the final level of the programme have been achieved.

The bachelor project can be undertaken in groups of usually up to 3 students. The institution lays down rules regarding this in consultation with each individual student.

The bachelor project, consisting of a report and perhaps a product for the institution, is handed in to the institution in 3 copies. The report excl. appendices must have a scope of a maximum of 40 standard pages **, and an additional 20 pages per student. The product may e.g. be a programme. The report is assessed individually, which means that it must clearly appear from the report, which student is responsible for his/her individual part. At the individual oral examination it is the entire report which forms the basis for the examination.

The individual oral defence of the bachelor project lasts 30 minutes.

At the oral examination of the project, the individual student starts out by presenting the problems and contents of the project for maximum 10 minutes. After that, an examination dialogue is conducted for approximately 20 min. Each individual student is awarded one grade based on the evaluation of the report and the oral examination.



Part 2

8.0 General conditions for examinations

All assessments are individual. If the test is based on a group project, the efforts of the student in this process will be included in the assessment.

8.1 Examination

To document that the student has achieved the learning objectives set for each module of the education, each module ends with an external or internal test.

Each module must be passed. In case the test is not passed the student will be recommended for a re-examination acc. to the regulations of the *Test and Examinations in Professionally Oriented Programmes*.

During the first year of study the student has 6 modules. *Minimum* 3 of the modules will be externally orally tested. By the end of each semester the Academy announces which modules will be externally tested. The modules not chosen for external testing will be tested internally.

For each external test applies:

Attendance at each exam requires that the student has handed in the module's compulsory tasks and that these have been approved.

Basis of test:	The specific module
Form:	Oral external test
Scope:	30 min. examination including deliberation. The exam can have either 30 minute preparation or a Synopsis, depending on the specific module.
Rating:	7-point scale

Internal test

For the modules which are not externally tested, the mandatory assignment is the basis of the internal test. For all modules a mandatory assignment must be handed in by the end of the semester. The assignment is evaluated by the lecturer and is marked "passed" or "not passed". When all mandatory assignments have been handed in and evaluated, the Academy will announce which modules will be examined externally.

8.1 Product Requirements



Product requirements for mandatory assignments, projects, Synopses, internship reporting, and the bachelor project will be given in separate guidelines annexed to the curriculum..

8.2 Re-examination

A student who has participated in the recently held examinations and acquired the grade 00 or less from the 7-point scale, alternatively given the assessment “not passed”, has the right to be re-examined.

Access to re-examination requires:

- that the test is not part of another test that the student has already passed all together
- that the student has not previously passed the part of the education in which the current test is placed.

8.3 Examination attempts

The student can register for the same examination a maximum of three times. The Business Academy may allow registration for a fourth attempt if unusual conditions substantiate this.

8.4 Mandatory assignments

In each module mandatory assignments can be given, eg. as a case and/or project which has to be approved in order to be recommended for examination in that module. The assignments will be assessed by the teacher solely.

A student who has not participated in and/or had his mandatory assignment approved, must retake that module.

Other rules regarding the mandatory homework assignments, including deadlines, is communicated through the educational institution.

8.5 Evaluation and Censorship

All tests are individual tests. In connection with written group-based projects etc. the contribution of the individual student must be unambiguously identifiable. Further guidelines appear from the Programme’s intranet.

In connection with oral tests where the student is tested on basis of a group-based product, the other members of the group must not be present in the examination room before they have been tested themselves.

The purpose of the tests is to evaluate if and to what extent the student’s professional qualifications are consistent with the requirements and objectives established for the Programme in the curriculum.



8.6 Examination Language

The language used for the teaching of a subject is also used for the examination. The Business Academy may grant an exemption in special cases.

8.7 Special examination conditions

The Business Academy can deviate from stipulated conditions for individual examinations with a view to allowing special conditions for students with physical or mental disabilities, for students with another native language than Danish and for students with similar difficulties when this is deemed necessary to give such students equal conditions in an examination situation.

8.8 Examination abroad

Under special circumstances permission to take the examination abroad can be given. The examination has to be taken at a Danish representation (eg. embassy, consulate or learning institution) after previous agreement with the representation.

8.9 Deadlines in connection with Examinations

The Business Academy's rules and deadlines concerning registration and de-registration to examinations, including make-up examinations, are available via the Programme's intranet.

8.10 Complaints of Evaluation

Complaints of evaluation, examinations, etc. must be submitted to the institution not later than 2 weeks after that the student has been notified of the evaluation. Instructions can be found at, e.g., www.kvu-censor.dk.

For further guidelines and rules regarding complaints, please contact the institution.

8.11 Diploma

A Diploma and a Diploma Supplement are issued in connection with the graduation when the student has passed all examinations in the Programme.

The diploma will show:

1. The result of the assessments of each examination
2. Weight of the grades – and their part of the total average
3. The achieved average rating for the studies as a whole
4. Note regarding the Internship

Students leaving the Programme without having graduated are entitled to receive documentation for tests passed. The documentation includes information of the type of test and the mark achieved.



9. Credit and other conditions

9.1 Credit Transfer

The Business Academy can approve that passed subjects or parts thereof, according to this curriculum, passed at another institution are equivalent to subjects or parts thereof in this curriculum. If the subject in question is assessed according to the 7-step scale at the institution where the examination has been held and corresponds to an entire subject in this curriculum, the mark is transferred. In all other cases the evaluation is transferred as "passed" and are not included in the calculation of the average grade.

The Business Academy can approve that passed subjects from another Danish or foreign programme substitute subjects included in this curriculum. On approval the subject is considered completed if it is passed according to the rules for the programme in question. The evaluation is transferred as "passed".

9.2 Credit student

The institution can approve that a student from other higher educations follows parts of the teaching and is examined in accordance with current rules. It is a condition that it is an accepted part of their own education.

9.3 Leave of Absence

A student may be granted leave of absence from the programme due to personal conditions. Further rules about absence of leave as well as rules applying to students on leave can be found in the Business Academy's guidelines.

9.4 Exemption from the Curriculum

When special conditions substantiate it, the Business Academy can grant an exemption from the rules in the curriculum which are not bound by the basis of the Executive Order.

9.5 Complaints

Complaints of decisions with reference to this curriculum are submitted to the Business Academy. The deadline for submitting of complaints is 2 weeks from the day the student has been notified of the decision.

The student can present the Business Academy's decisions according to this curriculum to the Ministry of Education when the complaint concerns legal questions. The deadline for presenting the complaint is 2 weeks from the day the student has been notified of the decision.

The complaint is addressed to the Ministry of Education, but is submitted to the institution. The institution gives a statement which the claimant has the opportunity to comment on – within the



time limit of one working week. Then the Business Academy forwards the complaint, the Academy's statement and the claimant's possible comment to the Ministry of Education.

10. Commencement

This curriculum becomes effective for students starting their studies as per February 2010.

11.0 Reference to the Rules of Law

The legal basis of the curriculum is the following laws and regulations:

- Erhvervsakademiloven: Lov nr. 207 af 31. marts 2008 om Lov om erhvervsakademiuddannelser og professionsbacheloruddannelser
- Bekendtgørelse om erhvervsakademiuddannelser og professionsbacheloruddannelser nr. 636 af 29. juni 2009
- Uddannelsesbekendtgørelsen: Bekendtgørelse om ny BACHELOR i Softwareudvikling. Endnu ikke udarbejdet
- Kvalitetsbekendtgørelsen: Bekendtgørelse nr. 635 af 30. juni 2000 om kvalitetsudvikling og kvalitetskontrol i erhvervsakademiuddannelserne.
- Adgangsbekendtgørelsen: Bekendtgørelse nr. 106 af 9. februar 2009 om adgang, indskrivning og orlov m.v. ved videregående uddannelser
- Eksamensbekendtgørelsen: Bekendtgørelse nr. 766 af 26. juni 2007 om prøver og eksamen i erhvervsrettede uddannelser
- Karakterbekendtgørelsen: Bekendtgørelse nr. 262 af 20. marts 2007 om karakterskala og anden bedømmelse.
- Åben Uddannelse: Lovbekendtgørelse nr. 956 af 28. november 2003, som ændret senest ved § 77 i lov nr. 562 af 6. juni 2007.

The laws and regulations are available on www.uvm.dk