

# **A CONCEPT FOR A BACHELOR PROGRAM IN ELECTRICAL ENGINEERING**

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## **ABSTRACT**

The main concept for the Bachelor of Science in Engineering (BScE) in electrical engineering at Technical University of Denmark (DTU) will be described in this paper.

A new curriculum was introduced from the start of the autumn semester in 2010. The curriculum was the result of more than one year of work with first description of competences followed by a more detailed description of the single main areas. Finally, the new study plan was implemented through a number of courses satisfying some general rules for bachelor study plans.

## **KEYWORDS**

Design of a new bachelor program, the design process, program implementation.

## **MOTIVATION**

The previous program for Bachelor of Science in Engineering (BScE) in electrical engineering at Technical University of Denmark (DTU) was developed 10 years ago. It was the result of dividing the original master program at 5 years into a bachelor program and a new master program. This was a consequence of the Bologna agreement in EU.

The first bachelor program in was mainly based on existing courses in electrical engineering at DTU. Only necessary changes have been done to satisfy a general paradigm for bachelor programs at DTU.

Based on the experience from the start of the bachelor program in electrical engineering, it was time to consider a new program in 2009. The process was started in the summer 2009 with a 24 hours meeting where general concept for a new bachelor program was discussed. The work with the new program was completed the year after and was introduced for the students from the autumn semester in 2010.

The process of developing a new bachelor program will be described. Further, also the results of the process will be described and discussed.

## **THE PROCESS**

The process of developing a new curriculum for a bachelor in electrical engineering at DTU will be described in details in the following. The process involved the following steps:

- A 24 hours starting up meeting – general discussing of the content of the new plan.
- Working groups looking into different subareas of the plan.
- A half day workshop discussing the results of the different working groups.
- The working groups complete their work based on the half day workshop.
- A draft to a new study plan is developed by the director for the study line in electrical engineering.
- The draft was presented for all interested, faculty members and students, in a two hour meeting.
- Suggestions and comments to the draft were received after the meeting.
- The draft version was updated based on the corrections, comments and suggestions.
- The new study plan was approved by the dean of education.

In the following, the single steps will be described. The main focus will be on the first steps, where the most interesting part of the process is.

### **The starting point**

The area of the electrical technology at DTU is quite large and is divided between a numbers of different departments. As a consequence of this, it will not be possible for every group to get its own introduction course as a part of the new study plan. This problem needs to be handled by preparing a very detailed description of the content of the new study plan. This includes a specification of the competences that the students will get when they have completed the bachelor program in electrical engineering. This was the starting point for the work on the new study plan.

Another issue in connection with developing a new study plan is the fact that it needs to satisfy the general structure specified by DTU. This structure specifies that the students must have 36 course units (of 5 ETCS points) taken from four different groups. These groups are:

- Basic courses in math, physic etc. (take 9 out of 12 course units).
- General electro technological courses (take 9 out of 12 course units).
- Projects and general courses (9 course units).
- Optional courses (9 course units)

### **The 24 hours meeting**

This meeting was central for the process to get the new study plan. All the basic elements were considered at this meeting. The participants were selected among the key persons in teaching from the related departments in the education. Also some key persons from the administration participated in the meeting.

The first point was the competence description for the study plan. The existing competence description was discussed followed by an update of these. This work was done as group work. The new set of competences includes both electro technological competences as well

as more general competences. Moreover, the students following the bachelor program will get the competence to continue the study at a master program in electrical engineering or a related program.

Based on a new set of competences for the study program, all participants developed a number of course descriptions (title, suggested semester, content) they found relevant for the new study plan. Based on these large number of course descriptions, a new group work is done. This time, the work has focus on creating a structure for the central (mandatory) part of the study plan based on these course descriptions. The result of this work was an identification of the central parts for a new study plan.

A number of central elements were identified. These elements were subjects for further investigation after the meeting. This work should end up in a detailed description of the content of the specific part, including which elements should be mandatory and which elements should be optional.

### **The working groups**

The working groups were organized by a chairman selected among the participants from the first meeting. The other members of the groups are selected by the chairman to get representative groups. The different groups are the following:

- Analogous electro technology
- Digital electro technology
- Signal analysis
- Electromagnetism
- Project work
- Programming
- Optional study lines
- External co-operations

The result of this work was presented at half day workshop two months after the first 24 hours meeting.

### **The half day workshop**

The results of the different groups were presented at this workshop. Everyone were invited to join this workshop, it was not restricted to the participants from the 24 hours meeting.

The results were shortly presented following by a discussion. The outcome of this workshop is a common agreement of which elements should be mandatory and which should be optional in the different subjects.

Special the works of two groups were interesting. The groups dealing with project work and optional study lines are central in the work of creating a study plan with connection. The students will have the first project work at first semester and again a larger project work at fourth semester. The project work at first semester should among other things be used to introduce the different directions/areas in electro technology. Further, the project work should also give the students a connection between the different courses at first semester, so they will be able to see the relevance of these courses. At last, it should also give the students competences in elementary lab work.

In the last part of the bachelor program, the students can select a number of courses freely among all courses at DTU. To give the students some guidelines for the selection of these courses, a number of optional study lines have been suggested. These suggested study lines goes into different directions in the area of electro technology. It is not the intension that the students should be specialist in a specific area through a given study line. A study line will give the student courses at the level over the mandatory courses in the area. Further, it will also prepare the student for the selection of a master program after the bachelor study.

As a result of the half day workshop, a number of the groups continue their work based on the many suggestions and comments from the other groups.

### **A new study plan**

Based on the above work, a draft for a new study plan was derived by the director for the Bachelor of Science in Engineering (BScE) in electrical engineering. The new study plan was based on the set of competences specified at the first 24 hours meeting. Together with the other results from this meeting together with the detailed results from the seven working groups, a new plan was derived. The study plan was a compromise between a large number of suggestions and possibilities.

The draft version of the study plan was send to all involved departments and all bachelor students. Further, the plan was presented at a two hour meeting for all interested people. As a result of this meeting, a number of comments and suggestions appear. A minor modification of the plan was derived based on these comments and suggestions from this meeting. This new study plan was then approved by the administration at DTU.

### **THE RESULT**

The result of the work was a new study plan for the BScE in electrical engineering. The new study plan is based on the following set of competences:

- Has an understanding for the electro technology area
- Be able to analyse analogous circuits and network with respect to both signals and effect purpose.
- Understand the principle behind digital system construction and digital circuits and be able to construct connected digital systems.
- Understand the principles for handling of signals in continuous-time and discrete-time, can analysis system functions and handle stochastic signals.
- Understand the general electromagnetic principles.
- Can analyse larger problems and come up with solutions on subsystems level.
- Can estimate if subsystems shall be realized in hardware or software.
- Can applied electro technology principles on at least one of the following areas: energy, sound and acoustic, wireless systems, embedded systems and programming, electronic and electromagnetic systems, automation and instrumentation in the final bachelor project.
- Is independent and can reflect over problems inside the electro technology area.
- Have competences in English to be able to understand teaching in English at master level courses.
- Have competences to be able to continue the study at master level in area of electro technology after the bachelor degree.

The study plan consists of a list of mandatory courses in:

- Basic courses in math, physic etc.
- General electro technology courses.
- Projects and general courses.

At first semester the course “Engineering practices – Electro technology” (two course unit) is the first course where the electro technology area is introduced. In the first part of the course, the different study lines are introduced through a number of small projects. These projects are related to the different optional study lines. A joint project is given in the last part of the course. This focus in this part is to give the students a connection between the different courses at first semester. The project will also give the student an introduction to laboratory work. They should all be able to work in an electro laboratory and be able to handle all the standard electro instruments.

At fourth semester, the course “Introductory project – Electro technology” (two course unit) is a follow up at the first project course. The main focus in this course is the project work. The students should be able to work systematic with projects. Further, the course will also connect the other courses in the study plan. It is the intension that as many as possible of the projects are in the area of “Green Combat” at DTU. This is a second yearly event at DTU where the focus is in the area of green technology.

The last part of the study plan consists of 6 optional study lines. These study lines are selected such that all major areas are included in at least one study line. These lines will give the students an overview of the different major directions that it is possible to follow both as bachelor student as well as in a following master student. Some of the suggested study lines are tin entrance to other master lines than in electrical engineering. The 6 optional study lines are:

- Energy
- Sound and acoustic
- Wireless systems
- Embedded systems and programming
- Electronic and electromagnetic systems
- Automation and instrumentation

All 6 study lines consist of a short description of the area together with two central key courses. These two courses will give a good introduction to the area. Based on these introduction courses, it is the intension that the student should be able to select other courses in relation to the area.

By including only two courses in each study line will give the student the possibility to select more than one study line. This is to avoid that the bachelor students gets specialists in a certain area. The specialization is taken place in the master programs.

To get in close contact both with teachers and students, some teams has been established. A semester team is set up for every semester including the teachers for the single semesters. It is here possible to coordinate and discuss the teaching and the single courses at every semester. This is important to get an optimal coordination of the different courses at the single semesters. In parallel with this, a student team is also established for every year. It is here possible to get in close contact with the students, get information and suggestions from them. Through a good contact with the student team, it is also possible to take care of problems before it gets into major problems.

At last, it is also the intension in the study plan that there should be a (small) number of subject teams related to different areas. The intension with these teams is that they should

take care of the coordination of a certain subject between the different semesters. This has not been established yet.

## **CLOSING REMARKS**

The result of the work over a year is a new bachelor study plan. It has been possible to involve a large number of people to take part of this work. As a consequence of this, the ownership of the plan is shared by many people at the involved departments.

In spite of everyone is not agree with the final study plan, everyone has been able to take part in the work with the new plan and in that way have influence on the final plan. In that way, the necessary compromises have also been more clearly for everyone.

## ***Biographical Information***

Dr. Henrik Niemann is connected to the Automation and Control group at the Department of Electrical Engineering. His current research focuses on robust control, fault diagnosis and fault tolerant control. Applications include energy systems, process systems, mobile systems, cooling systems etc.

Henrik Niemann is also director for the Bachelor of Science in Engineering (BScE) in electrical engineering at Technical University of Denmark.

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