Designing a master level course from scratch – where to start and how to proceed? Experience from course 31783

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Introduction

In March 2014, I had the possibility to take over the responsibility of the master course 31783: Integration of wind power in the power systems. The course is 5 ECTS module and it runs in the autumn semester. Due to poor planning in the previous edition, the course was not running in good shape and did need major revising. I had therefore the possibility, and the need, to redesign it from scratch.

When planning the course I asked myself the two questions:

- *What would I like to learn if I were to take this course (student perspective)?*
- *What can I, as an early stage teacher, offer to the students that are taking this course (teacher perspective)?*

The answer to the first question was pretty straightforward: as a student I would like to know more about wind power and what are the challenges in increasing the share in the system and, also, I would like to know how I can analyze this in some analytical ways, possibly using professional software which is popular and powerful so that I can spend the competence acquired during the course in my future working life.

For answering the second question I have been trying to list what are my strong points as teacher and as researcher. I have been trying to align the course objectives to my existing scientific knowledge and eventually filling in gaps by revising some subjects, which I was not use to deal with, in my daily working life.

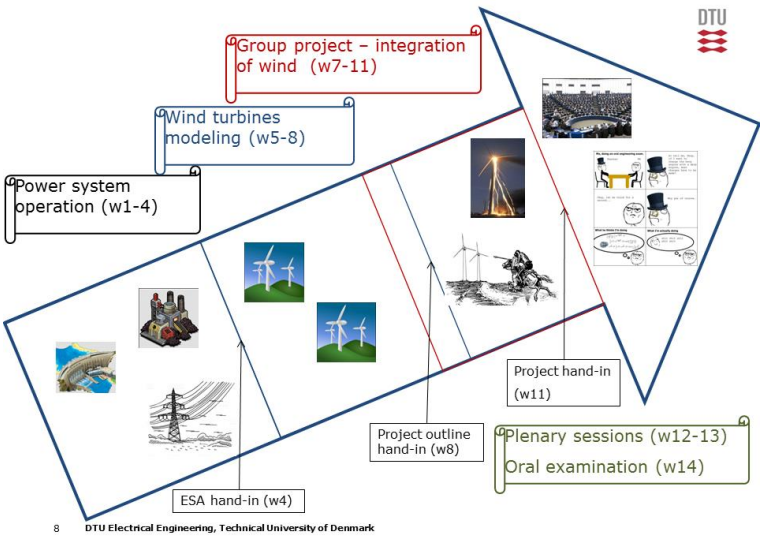
The first edition of the course (Fall 2014) was pretty positive as it can be seen from students' evaluations and final grading. Naturally there is room for improvement and the refining process is always in progress.

Course content description and students assessment

The course intends to give students knowledge about electro-technical, operational and economic integration of wind power in the electrical power grid. The course provides the students with an introduction of the relevant control issues of power systems. Analysis of the different electrical wind turbines technologies and the interaction with the grid both from the operational point of view and from the market perspective is performed. Modeling of wind turbines, load flows and influence on system frequency and voltages are investigated with the usage of the simulation software DIgSILENT – Powerfactory. The learning objective of the course can be roughly grouped in 3 areas (power systems, wind power and wind integration): for each area, 3 specific learning objectives are defined. Generic competences, such as capacity to define own research questions and ability to effectively communicate scientific results, are included as well.

The core elements of the course include a set of technical and relationship competences. I expect students to learn about the main physical laws behind operation of power system and wind turbines, apply this knowledge and verify it with the support of technical software.

An early stage assignment (ESA) is set at the end of the first month in order to individually verify the analytical knowledge of power system operation and the ability to effectively use the software. Part of the final assessment consists in presenting the results of a mini-project carried out in groups of 4-5 students. The presentation is given to the whole class (around 10-15 minutes plus 10 minutes of Q&A) and is graded, contributing to 1/3 of the final mark. The assessment is completed by an individual oral examination (around 20-25 minutes) which contributes to the remaining 2/3 of the grade. The oral examination is guided by giving the students a list of 10 possible topics which will be randomly chosen at the beginning of the oral exam. Once the topic is clearly addressed and explained, the examiner asks another question, typically complementing the first one: if the first question is power system related, the second one will be wind turbine related and vice-versa. A graphical sketch of the course content, millstones and assessment is reported in the figure.



Course design methods applied and further suggestions

Having clear learning objectives is the first and probably most important step when designing a course, as I have been constantly reminded during UDTU module 1 course, back in May 2014. Learning goals, however, are not enough: the course needs a red line that guides the students in the learning process and elevate them to the final objectives and competences. UDTU module 2 and 3 (taken in 2015) helped me to better frame the teaching methods applied in the first edition of the course. I am mostly using 2 methods: the classical frontal and dialog-based lecture, mainly adopted in the first half of the course, followed by the learning by project method in the remaining part. In the dialog-based, I present theoretical concepts and some examples supported by real cases. I try to fill in the lectures' material - and the way of presenting it - with several questions so that I can keep a tight contact with the students and avoid that their minds drift away. I try to have several questions during the presentation so that the students are "forced" to think and reply with reasonable answers. Two 1-hour clickers sessions at the end of each macro-area (power system and wind power) are used to assess the student learning. The correct answers are given immediately after, so that each student can check whether the answer given was correct or not; moreover I can use this tool for repeating important concepts.

The learning by project is the core part of the second half of the course. Following some examples where problems related to wind integration are presented, I invite the students to divide themselves in groups (4-5 persons) and focus their investigation on few focal points. I am basically defining a "state-space" where they are welcome to shape their own project, which is practically investigated by using the software mentioned before. Before the end of the course they have to come up with a short report (10 pages max) and a power point presentation. The presentation is given to the whole class and is part of the final assessment. This is probably one of the most important steps in the learning process, because, by getting on the stage and explaining the topic investigated to the class, they are confronted with the acquired knowledge.

Besides the UDTU course, it is possible to find online more material concerning course preparation, such as the guidelines made available by Stanford University (https://teachingcommons.stanford.edu/resources/course-preparation-resources). Under the section "course design", useful suggestions are given for designing a new course or improving an existing one. The main focus is always on making clear learning goals and defining skills that students are supposed to acquire. Subsequently recommendations on how to assemble the means needed for supporting the learning process, such as reading material, assignment and activities as well as indications for the content of the final assessment are given. Furthermore, it is mentioned the importance of creating an order in the topics dealt in the course, together with tips on how to design class activities.

Finally, I would like to refer also the supporting material available in the University of Copenhagen website (https://innovationenglish.sites.ku.dk/), which reports a series of methods for tackling innovation in course design. 48 different methods are listed and described.