

COURSE ANALYSIS, postgraduate course

Third cycle courses, EECS School, KTH , 2021

An asterix (*) denotes non-compulsory data.

Course data

Course name	Modulation of Power Electronic Converters
Course ID	EJ2311
Credits	6
Credits per module	
Time period for course	3
Teachers	Staffan Norrga (6 Lectures, Written exam, Course Responsible, Examiner),
Examiner	Hans-Peter Nee (2 lectures) Mehrddad Nahalparvari (Tutorials, Computer Exercises, Lab)
Classroom hours	18 (Lect), 6 (Computer Assignments), 12 (Tut), 4 (Lab)
Nr of registered students	15
Examination rate, in %	after first exam: 71%

Goals

Global course goals	The purpose of the course is to provide a solid working understanding of modern synthesis and analysis methods of modulation for voltage source converters.
How the course design helps fulfill these goals	Computer exercises and tutorials are designed to convey understanding of the topic. Written exam to follow up (no grading, only pass /fail).

Pedagogical development - I

Changes made since previous time course was given	The main developments this year have been related to adapting the course to pandemic conditions, i.e. all-digital teaching. Otherwise, incremental improvements of lecture and tutorial materials were the main development efforts.
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Course teacher's impressions from the evaluation

Comments	Overall positive feedback, especially given the fact that the course was given in pandemic conditions.
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Course teacher's summary

Overall view	Generally positive, despite pandemic conditions
Positive comments	Content, lectures, tutorials, exam
Negative comments	Too few lectures for the course content. Computer labs too repetitive and focused on Matlab programming.
View on pre-knowledge*	Mostly seems satisfactory
View on course design*	More lectures requested
View on course material	Good
View on examination	Good (improvement since previous evaluation)

Pedagogical development - II

Outcome of course changes made since last time course was given	The exam results have improved, possibly because of the earlier implemented changes.
Changes to be made before	Possibly more lectures to be added to allow for more in-

next time course is given

depth explanation of the course content.
Recorded lectures and tutorials should be provided, also post-COVID.
The laboratory exercise need to be updated and the equipment should be partly replaced.
Various details in computer exercises to be adjusted based on student comments below.

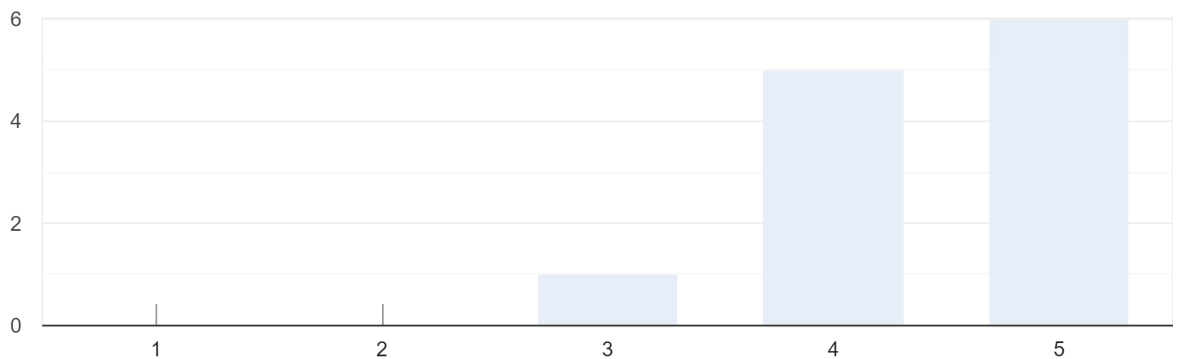
Course evaluation; comments from students

Based on the anonymous questionnaire.

Background knowledge

Background knowledge

12 svar



(Q: I had the necessary background knowledge before starting following the course.)

Additional comments regarding background knowledge:

3 svar

As recommended I had all the prerequisites i.e complete bachelors degree and proficiency in english

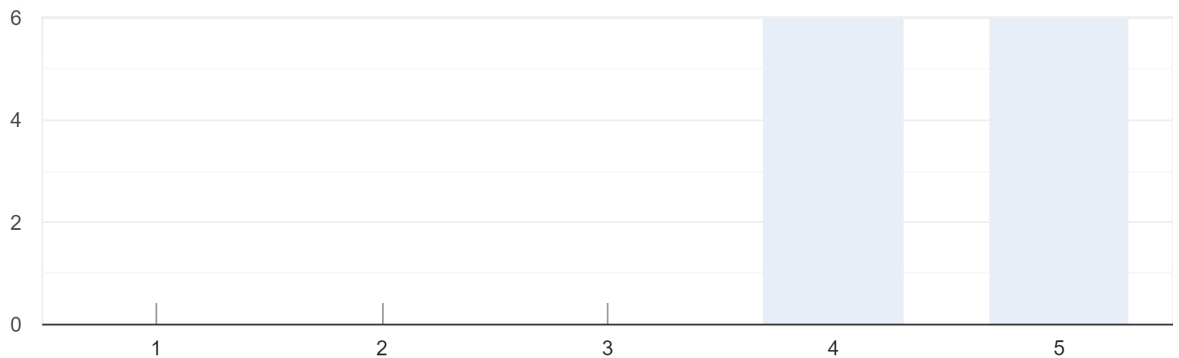
I think Hans-Peter Nee's course about power electronics is sufficient

I think my background knowledge was sufficient, both actual knowledge about electric power engineering but also experience in Matlab and Simulink

Lectures

Lectures

12 svar



(Q: How do you judge the quality of the lectures offered in the course?)

Additional comments regarding lectures

5 svar

The equality of lectures were good but the content quantity in a lecture was too much. In my opinion the number of lectures delivered during the course can be increased with smaller quantity of course content covered in each lecture.

I feel like the implications of the harmonics itself was not talked about enough. There was a lot on how the spectra look for the different modulation types but then there impact was not discussed much.

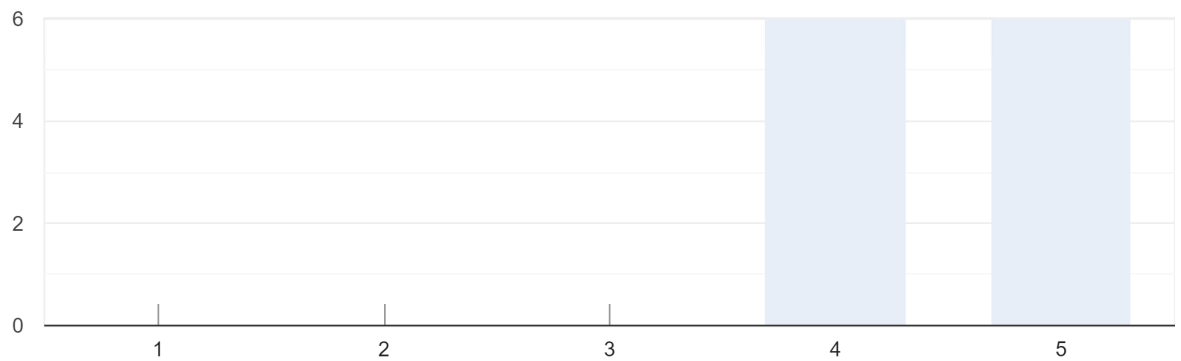
I think the lectures by Staffan were excellent. Really good pace and good explanations of interesting topics.

It was good that Staffan sneaked in some questions every now and then about key concepts in the lectures.

Hard to judge the quality when the main concerns wasn't because of the lecturer but instead due to technical difficulties.

Lecture handouts

12 svar



(Q: How do you judge the quality of the lecture handouts provided in the course?)

Additional comments regarding the lecture handouts

3 svar

They contain little information but I think they are well suited for the way the lectures were held. The information is in the book anyways so I think it's fine.

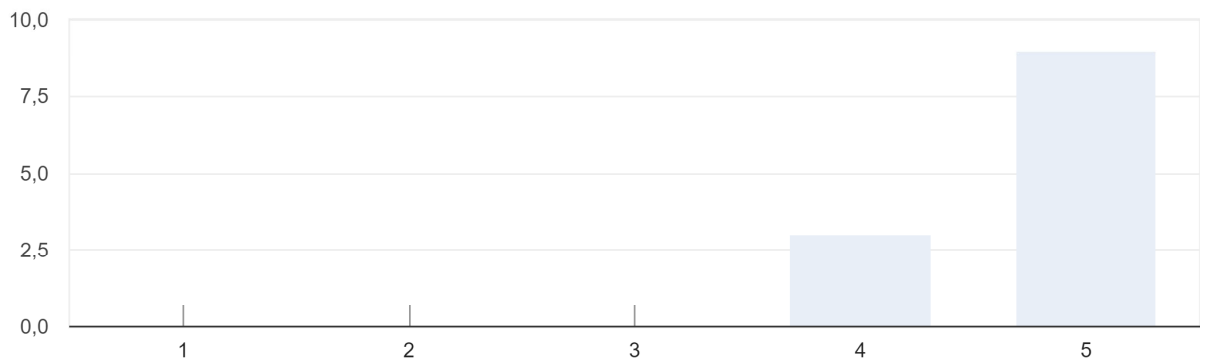
The lecture handout were perfect complements to the book. I liked that the book was very in-depth and the lectures summarized the most important parts and also included the relevant information needed to work with the assignments. I constantly went back to the lecture slides when working on the assignments and also read in the book when I wanted even more in-depth explanations. Very good handouts.

I could use the lecture material/notes to a large extent to understand all important concepts and solve the computer exercises.

Computer Assignments

Computer exercises

12 svar



(Q: How do you judge the value of the computer assignments for understanding the course content?)

Additional comments regarding the computer exercises

4 svar

The computer assignment are excellent and well designed and helps to understand the practical aspect of course content in depth.

Most of the work for the first one was matlab related and not modulation related. We just had to do the same code over and over again for slightly different modulation schemes. making it less about matlab in general would help.

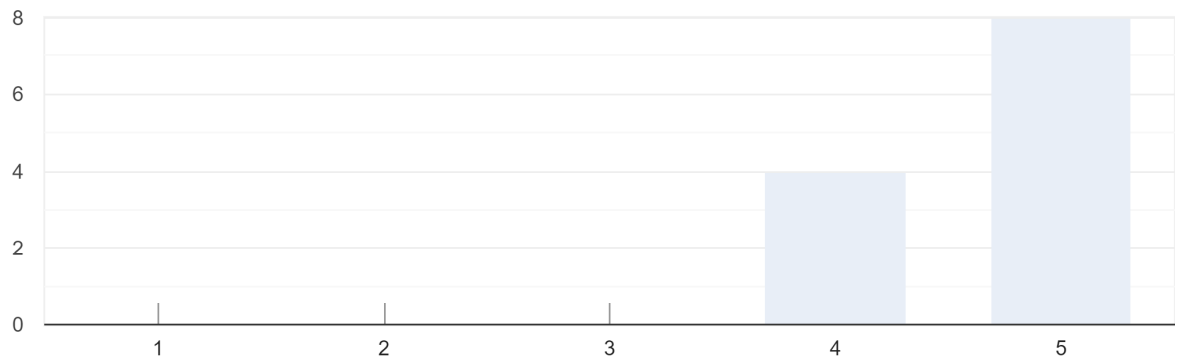
Exceptionally helpful

Really good computer exercises. Mehrdad did a great job as a teacher assistant by being really engaged. He supported me when I needed it and it made the assignments stimulating to work with and I felt I learned a lot.

Tutorials

Tutorials

12 svar



(Q: How do you judge the value of the tutorials for understanding the course content?)

Additional comments regarding the Tutorials

2 svar

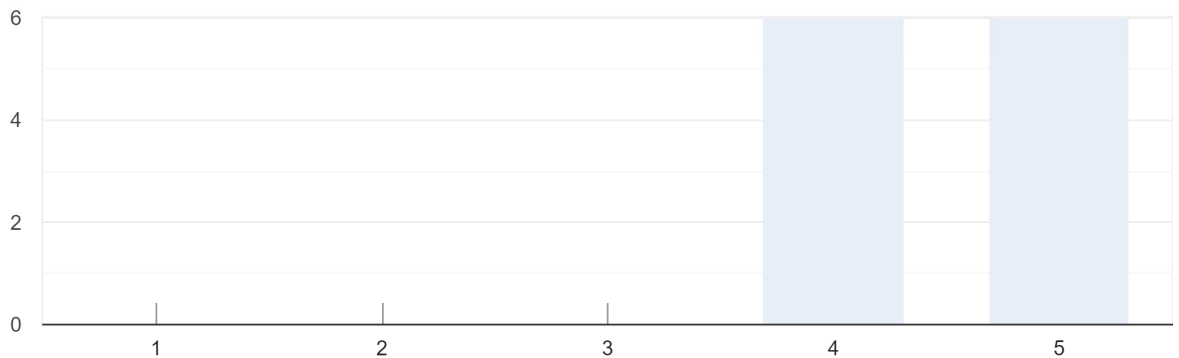
Mehrdad did a great job.

I think the tutorials were executed well by Mehrdad and the tasks he solved were also very relevant and helped my understanding

Laboratory Exercise

Laboratory exercise

12 svar



(Q: How do you judge the value of the laboratory exercise?)

Additional comments regarding the laboratory exercise 5 svar

was a good insight.

The lab is a little boring.

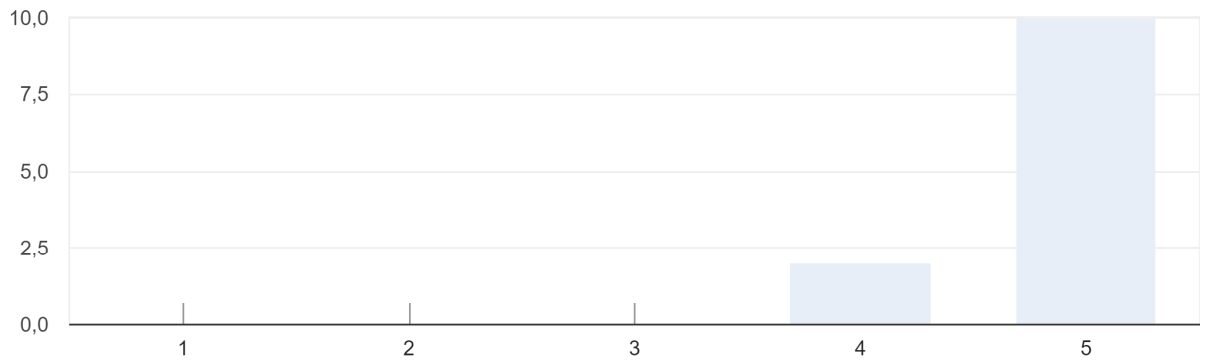
Really good and interesting lab where I got to learn a lot and familiarize myself with how a VSC + control system looks like and works in practice. The lab assignment afterwards was also really good and extremely interesting to see the real results on the oscilloscope. However, I'd like to point out that some extra information (tips) on how the sampling affected the real measured data would have been appreciated by me. I had to spend too much time in my opinion, trying to figure out how to do the FFT in Matlab of my waveforms. All harmonics were moved around and appearing at wrong orders if this was not taken care of. I think some tips in advance on how to manage that would have been very helpful.

Nice setup, and good for understanding both practical and theoretical aspects of modulation

It was difficult to process the data from the laboratory exercise, but I guess that was part of the exercise.

Written Examination

Exam
12 svar



(Q: How well do you think the written examination reflected the course contents?)

Additional comments regarding the examination

2 svar

The exam consisted of actually interesting problems. That is rare. I think the exam was reasonable as it covered the general content of the course. However, when I practiced on previous exams I noticed there was a certain part of the course that I had not fully understood and that was the different cascade multilevel converters and the voltage levels you could get out from different circuit topologies of them. Therefore I think some extra emphasis on that in the lectures and tutorials would have helped me (probably). I also think an extra half a bonus point for the lab report could be implemented. It's not a big deal but I think it could be nice considering it was pretty much like the assignments 1 & 2 in terms of time I spent on it and obtaining all results in Matlab.

Workload

Workload

12 svar



(Q: This course corresponds to 6 ECTS credits which should correspond to a total workload of approximately 4 40-hour working weeks. How much time do you think you will invest (totally) on this course?)

Additional comments regarding the workload

2 svar

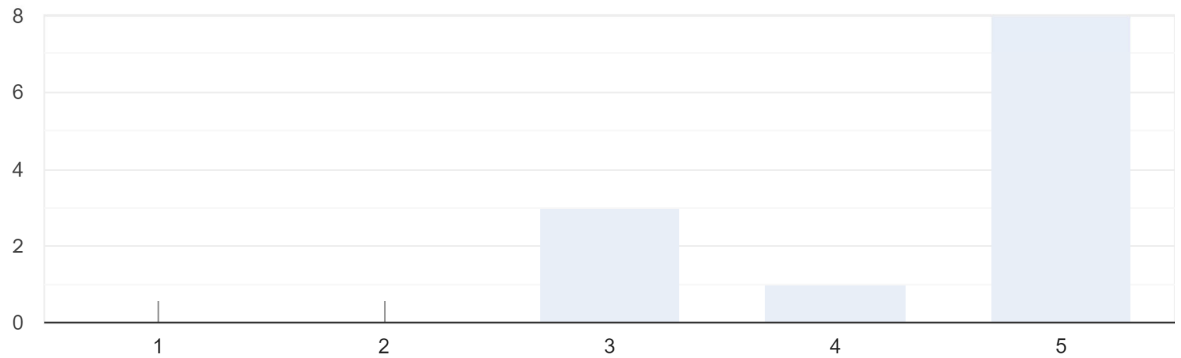
I think I spent somewhat more time than 6 credits. Although I practiced on all the available previous exams I think it was the projects that resulted in the majority of the time I spent on the course. However, the projects/assignments by themselves prepared me very well for the exam (task 1 to 3 especially). So I would not say any of the content in the projects should be changed, as I think it also varies between students' skills with Matlab and Simulink for how much time you must spend on the assignments. In the end I think the time I spent was very reasonable for how much I learned.

Like the computer exercises due to these giving an increased understanding but they also take quite a lot of time.

COVID-19 Adaptation of the Course

COVID-19 changes to the course

12 svar



(Q: The course was mostly given online due to the COVID-19 pandemic. The equipment and methods used were satisfactory.)

Additional comments regarding COVID-19 changes

4 svar

I think the way the course was adapted was good. Mehrdad helped us a lot whenever there were any questions.

Worked well with digital lectures, pre-recorded tutorials and digital computer exercises, although I prefer to be in a classroom.

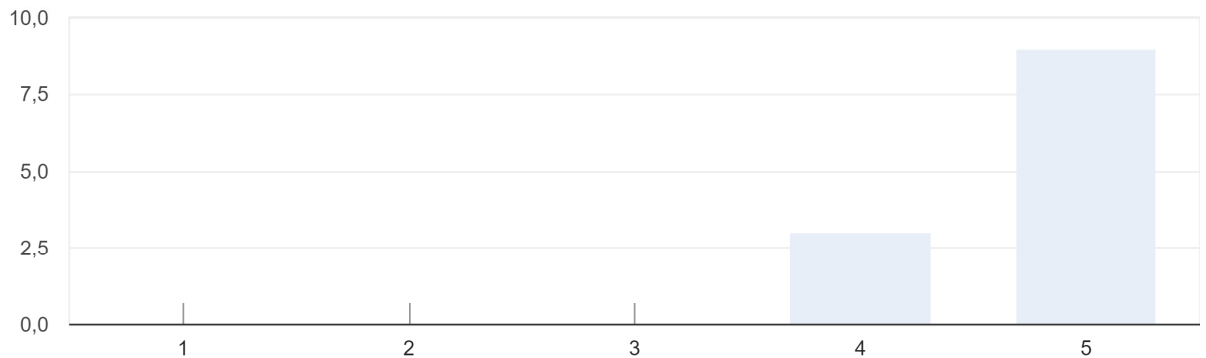
It would have been nice to have been taken through some of the derivations step-by-step on a white board

There were just one lecture that wasn't up to standard. I believe you know why and which one it was.

General Opinions and Suggestions

Expectations

12 svar



(Q: My expectations on the course were fulfilled.)

What was best with the course?

8 svar

I would really like to praise Mehrdad Nahalparvari as a teaching assistant. He was always there to help us and clear all the doubts during the course.

Course content and course organization

Actually expected the course to be harder. Was very interesting in the end.

Staffan and Mehrdad are really kind and patient.

The course was really appealing to me when I applied to take it and it delivered as a whole a good understanding of the subject and it was really interesting. Really good examiner and teaching assistant as well.

I've been eager to learn more about modulation strategies and the course taught some of the most prevalent ones in a very satisfactory way. I feel more prepared for working with power electronics and take sound decision on modulation strategies for inverter-fed loads. The computer exercise were very good for my understanding; in particular to reinforce the learning.

Tutorials helped a lot to understand the concepts

Learning the concepts behind modulation as this has been perceived as quite a hard concept to grasp in previous courses.

What was worst with the course?

4 svar

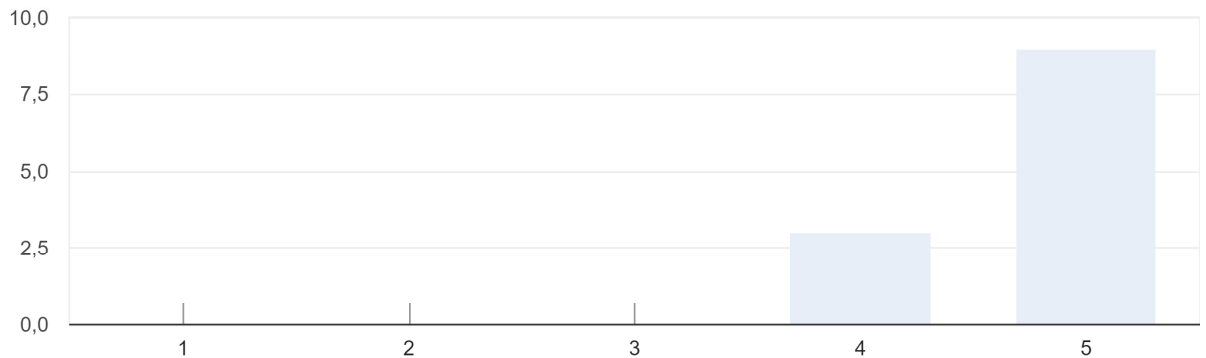
Number of lectures delivered were far too less

the second assignment and the lab reports were very close to each other. that made the end stressful.

The tutorials is not much useful for the exam.... but the old exams are helpful. That it had to be online unfortunately.

Overall opinion

12 svar



(Q: My overall opinion on the course is that the course is of high quality.)

This is my best suggestion regarding future improvements of the course

4 svar

Number of lectures should be increased from 8 to 12 at least as there is far too much content which is taught very rapidly in less lectures, prof. could teach them in an elaborate way taking few more lectures and that would be best for students then..especially lecture 6 and lecture 7 has too much of content it should be conducted in 4 lectures not 2

Please keep the recorded lectures for the future. If Covid had one positive impact it's recorded lectures. Nowadays the technology is there to make it the standard and it is just immensely help to be able to go back to a lecture and rewatch it when you get stuck in an assignment. Often there are small details that I don't understand and when I listen to the lecture I don't know what details I am missing yet. So when I start struggling because of those details I did not understand when I watched the lecture the first time I can just go back. It makes everything so much easier.

To summarize my personal suggestions that I wrote above: 1) Some extra tips/information on what to think about when performing FFT on the real waveforms from the lab 2) Perhaps some more emphasis on the cascade MMC topologies and voltage levels you can get from them 3) A possible 0.5 bonus point from the lab report. Perhaps also task 4 on our exam was a bit outside of the main content of the course in my opinion. It was mentioned once in a lecture and never again, so I did not quite understand level shifted PWM and put most of my study time on other things I thought were more relevant to the course.

I know it would be time consuming, but perhaps another lab session where we get to program parts of a code for some simple sinusoidal PWM (and perhaps PI-control?) ourselves. It would give a better idea about practicalities such as how many sensors are needed in an implementation.