Course analysis: SK2901 Quantum Materials and Devices, 7.5 hp, period 2, 2019

Course data

Registered students:	33	
Teachers:	Jan Linnros, course responsible, 10 lectures	
	Ilya Sychugov, 6 lectures	
	Sara Cavallaro, PhD student, tutorials	
	Adil Baitenov, quantum dot lab	
	Rinat Yapparov, quantized conductance lab	
Examination results:		
TEN1, 2019-01-13	16 passed, 8 failed	6.0 hp
TEN1, 2019-04-16	-	6.0 hp
LABs	31 passed	1.5 hp
Mini Project	7 participated (not compulsory, bonus for exam)	0 hp
Two control exams	23 participated (not compulsory, bonus for exam)	0 hp
Full course	15 passed	
Overall examination	45 % (after first exam)	

General about this year's course

Last year (2018) the course changed name (from Nanoelectronics) and was reduced to 7,5 hp to agree with other courses in the Nanotechnology program. Thus, the mini-project had to be taken away. As the mini-project was very appreciated previous years we decided to keep it as an optional project, however without report. This decreased the workload of teachers considerably. The presentation seminar could give up to 3 bonus points for exam (at max 32 points).

The number of students increased slightly this year to 33 (2018: 26). Students were mostly from Nanotechnology program but also from Engineering Physics and Materials Science.

Lectures followed previous years but this year Ilya Sychugov gave 6 lectures on the first 3 chapters of the book. Again, there was a guest lecture by Apurba Dev on biosensing.

Approximately ~20 students on average followed the 8 tutorials which included 2 control exams (yielding up to 5 credits for the exam). Seven tutorials (2 hours) consisted of the discussion/solution of 4 exercises taken from the course book with additional exercises given as homework. The last tutorial consisted of the solution of exercises from previous exams. The students were usually divided in workgroups of 3-4 students and their participation was active.

There were 2 labs: (i) Quantum dots and (ii) Quantized conductance. One AFM/STM lab has been taken away as students do an AFM lab in the "Analysis methods" course. Lab reports were corrected.

Student evaluation

A student evaluation using Canvas was performed. Only 7 students answered. Examples of responses are given here for each question:

- Main impression: "Good. Hard. It`s very useful for further study" "It was a good connection of the theoretical knowledge with modern applications. Personally, I couldn't manage the volume of information of the two last chapters"
- Text book and course material: "The book was very good. Pedagogical and easy to understand. Very critical to the course. The additional articles were also interesting and helpful" "The book was dense, took a lot of staring and prodding. But ultimately 99% of the information was in there or could be figured out by googling some of the terms"
- Lectures: "The level of the lectures was good. Writing equations and explanations on the blackboard was an effective way of teaching" "Lectures were good, in my opinion the lectures by Ilya were more structured and i believe that i learned more from them" "Good. But, it would help the students if there is some pictorial representations of the electron movements/tunneling for all the cases. Just saying that electrons go back or forth doesn't say anything and sometimes imagining that is very difficult as students come from different backgrounds. Just the aftermath plots won't help them understand the actual phenomenon"
- Tutorials: "The tutorials were good. The tutor always prepared and when she didn't know an answer tried to tell me the next tutorial" "Tutorials were useful. But all the tutorial solutions were already up on CANVAS, maybe solve some new questions whose solutions are not available beforehand" "Tutorials were OK, in the end it just solving questions. Not much to it. I don't really like the structure of these types of tutorials were the student is supposed to solve the problems on their own first and then the assistant solves it on the board. I would like the assistant to solve the problems directly. Otherwise i could have done the problems on my own"
- Labs: "I thought that the laborations were very good. Especially the QC lab. Very cool phenomena. PL was not as interesting but still OK. The best part about both of the labs is that the students get to conduct the whole laboration themselves and not just watch the lab assistant do experiments, which sadly is the case in a lot of courses" "PL was good. But QC not so much. It would be helpful if there is a whole lecture dedicated to explain the labs prior to their start. This can be done by the lab instructors coming and explaining the QC and PL principles and phenomenon and what exactly are the students are going to do in the lab" "Both the labs had 4 students each and during the lab sessions, they were split into two pairs. This is all good. But the problem arises when the students upload the documents. There will only be one slot to upload the report and whoever does it second will overwrite the first pair's report and they end up without getting the grade. So, it would be better to put two slots for the document uploading which would avoid all the confusions for the students and the lab instructors"
- Control exams: "Their level was good. It was a nice way to get a feedback about our study progress" "They were good. But, in the second control exam (question 2), most of the students knew how to do the problem, but there was no information about the InGaAs. In the solution it was assumed 50% InAs and 50% GaAs. But, this assumption is precisely what the question lacked"
- Exam: "Hard but can be solved" "Exam was difficult in my opinion, but then again this is a very difficult subject. I made some silly mistakes which is totally on me. The correction of the exams was fair. I like open book exams. Feels more like a real-life situation when you solve problems using the lecture books. You learn how to approach different problems and not to remember certain equations"
- Mini project useful: "Yes" "Did not participate"
- General evaluation – see statistics below
- Further comments: "I overall really enjoyed the course" "I felt that the Electrical and Magnetic part could use another lecture so as to explain where exactly are these used (Like in what devices and how)" "Feels like it is a one semester course (rather than one period). During the start of the course there are many lectures on the introduction part (~5). It would be better to skip the intro to crystallography and focus on the Quantum physics more because all the students completed solid state physics just before the start of this course. Since, students come from different backgrounds there is no guarantee that they are familiar with Quantum physics and this course mostly relies on the quantum. So, it would help the students not only in this course but in general if there is a 3 credit - Introduction to quantum physics course in the first period" "Thanks for improving my understanding of Semiconductors and Quantum devices. This was a very valuable course and so far the most challenging for me. I am glad to have been met with such insight and rigour"

Very good	3 respondenter	**43 %**
Good	4 respondenter	57 %
Medium		0 %
Poor		0 %
Very poor		0 %

Changes to next year

For next year (2020 period 2) Ilya Sychugov will take over the course giving majority of lectures. This will allow him to get an overall impression of the course such that he could maybe reform it during coming years.

The textbook ("The physics of low-dimensional semiconductors", by John A. Davies) has been the same now for the 15 years the course has been given (+1 in 2005 in a slightly different shape). Thus it would be time to shift to a more updated textbook since many topics are not considered in this book (e.g. quantum dots, nanowires, single electronics…). On the other hand, the book is very pedagogical building on Solid State Physics course books. The plan is to find a more suitable textbook and to reform the course in 2021.

Individual comments as stated above should be addressed.

Summary/Conclusion

This year the course had ~33 students. In general the course seems to be well appreciated but I have a feeling it is considered as hard. Anyway, grades are spreading over the whole scale.

In the near future, the course should be updated with maybe a new text book, one more lab and maybe more tutorials. Also a new lecturer could be good…..

Stockholm 2020-03-27

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