

## Course analysis: SK2901 Quantum Materials and Devices, 7.5 hp, period 3, 2023

### Course data

Registered students:	40 (34 first time)
Teachers:	Ilya Sychugov, course responsible, 14 lectures Ali Elshaari and Apurba Dev, 1 invited lecture each Juan Carlos Rivera Hernandez, PhD student, tutorials Frank Elson, quantum dot lab Fredrik Stridfeldt, quantized conductance lab

### Examination results:

TEN1, 2023-03-13	28 passed, 7 failed	6.0 hp
TEN1, 2023-06-09	5 passed, 1 upgrade, 4 failed	6.0 hp
LABs	35 passed, 3 failed	1.5 hp
Mini Project	24 participated (not compulsory, bonus for exam)	0 hp
Two control exams	30 and 32 participated (not compulsory, bonus for exam)	0 hp
Full course	33 passed	
Overall examination*	80 % (after first exam), 91% (after re-exam)	

*\*Number of first-time registered students, who passed the course until a given date, in relation to the total number of first-time registered students (values from Ladok)*

### General about this year's course

This year the course was based on the same book, and both teachers and tutorial assistant were the same as in 2022. One lab responsible changed to the QD lab (previously responsible PhD student graduated). Both lectures and tutorials were run on site only. The mini-projects and control exams were voluntary and could add up to 25% of the maximum exam score.

The number of students increased this year to 40 (2022: 28). Students were mostly from Nanotechnology program but also from exchange students.







There was a guest lecture by Apurba Dev on biosensing and by Ali El-Shaari on quantum photonics.

Approximately ~20-25 students on average followed lectures and tutorials. Two tutorials included 2 control exams (one hour each). Seven tutorials (2 hours) consisted of the discussion/solution of exercises taken from the course book and some consisted of the solution of previous exams.

There were 2 labs: (i) Quantum dots and (ii) Quantized conductance. Lab reports were corrected.

## Student evaluation

A student evaluation using Canvas was performed. Only seven students answered, and the general evaluation was positive:

Very good	2 respondents	29 %	
Good	1 respondent	14 %	
Medium	2 respondents	29 %	
Poor		0 %	
Very poor		0 %	
No Answer	2 respondents	29 %	

Examples of responses are given here for each question:

- Main impression. "Overall, I am really satisfied of the course. At the beginning I was concerned not having any wave mechanics background studies, but I think that an excellent job has been done: concepts and applications have been explained clearly, trying first to focus on the more intuitive side for understanding." "Good level, complicated problems explained in an understandable way, systematic work thanks to control exams". "Good. The professor is nice and would answer everything in class." "In overall, the course was on a good level". "It was difficult in a way that it contained a lot of information in a short time." "My performance is bad for this course, especially the understanding of the equations."
- Text book and course material: "The reference book is most of the time clear, even though in some parts it was difficult to understand. In combination with the lecture, the relevant parts are clear enough." The book itself was satisfactory, as well as other course materials." "Actually, the lecture handouts are more useful than the book." "Quite informative and useful. The notes cover most of the things mentioned in the lectures."
- Lectures: "Lectures and available material are excellent. Lectures were on a good level; any questions were answered right away." "A bit too fast for me. But the handwriting is pretty clear and recognizable, so I can still understand what the professor wants to say."
- Tutorials: "Good approach to the tutorials, well done. I would suggest trying to align the latest tutorials with the theoretical topics, since some exercises were beyond the scope of the course." Good, though tutorials problems were easier than exam problems." "Tutorials were also on a good level. The TA answered all of our questions thoroughly or directed us to sources or ideas that could help." "Good. The TA works hard and tries to answer our questions completely."
- Labs "The labs have been interesting. QC lab has been inherently repetitive, and the setup was not completely suitable (vibrations on the table were preventing us from getting meaningful results). PL lab has been really interesting, nothing to adjust." "The two lab were quite interesting. The lab manuals were well written and very detailed, regarding the expected content of the lab reports. It is a very good thing to know what exactly is expected and how to do it. Both TAs were very helpful, responsive and gave detailed feedback on our work." "QC lab is more interesting although it's hard to conduct. But the oscilloscope is quite old and needs update." "The report of PL lab is more tricky since we have to analyze lots of data."
- Control exams. "Control exams have been a great opportunity to test ourselves and to keep up with the lectures. Keep them for the upcoming years! Good and useful to check if we understand the lectures."
- Exam. "The exam was difficult, but ok." "A few of the questions were formulated in a way that was not too clear (e.g. the question about resonant states the hint was misleading) and the grading was not too clear either. I am not a fan of exams in general, especially if they require a book that is difficult to get (from a library) and needs to either be bought or printed (more in the last question) "Quite hard. Not sure if everything is covered in the lectures. Better if some words are clearly explained, such as the hint given in question five." "Not good, actually for the first part, we don't need to have that much understanding and memorize so many things."
- Mini project useful: "Yes (4)" "Did not participate (1)"
- Further comments: "It's been great seeing applications related to what we are studying. Guest lecturers were very passionate, kind and clear in the explanations." "Invited lecturers gave very interesting lectures." "It is very difficult to memorize all necessary formulas, so I appreciate the open-book exam. However, I would suggest using assignments as a form of assessing the progress on the course. The book is available online, so it would be accessible to everyone. It would also "force" us to work consistently throughout the entire course. I liked the mini-projects, because they required research and preparation, but in our own pace. I also liked that all exams were marked very fast." "No, but thanks for teaching this lecture. Learn a lot from it."

### *Changes to next year*

In response to previous year comments this year we have modified tutorials content and made corrections to the exam, clearly separating no-book theory from book-allowed calculation parts. No criticism about these points has been raised, so we will continue with the present practice. Also, the new lab assistant (Frank) was appreciated by the students.

The whole teaching crew will probably remain the same for the next year. The main change would be to work on clear exam problem formulations and its difficulty level alignment with tutorials.

### *Summary/Conclusion*

This year the course had many students (40), and not all even had the opportunity to run a mini-project (24 slots only available). Including re-exams, about a third of examined students got A/B grades, which is a good performance. In general, the course seems to be well appreciated but it is considered hard for students without a proper physics background. At the same time, for those with a strong background in solid state physics, quantum mechanics, etc. introductory lectures are not so interesting. So, it is not easy to keep the difficulty level balanced for the whole group.

In the near future, the course should be updated with maybe a new textbook, and some lab equipment needs to be upgraded.

Stockholm 2023-06-21

Ilya Sychugov