



## ETH Zurich, an Unforgettable Experience

In some of the passages I will be quite brief as to not unnecessarily repeat some of the excellent comments made in other exchange reports about ETH.

### Before departure

I applied to do exchange studies in part because I thought it would be a good challenge to study at ETH, in part to live in another country with a different culture, and in part since I wanted to get a broader idea of the opportunities that I have. When I applied during my second year of studies, I had to find a bachelor thesis supervisor at ETH around one year prior to the planned start date of my thesis. I sent requests via email to a few professors that I thought seemed interesting to write my thesis with. With the professor I ended up writing my thesis with, I had to find all the mathematical errors in an article to test my mathematical knowledge, before he finally accepted to supervise me.

### Upon arrival

I came three weeks before the start of the semester to attend an intensive German course, which I recommend. Bear in mind that the places for the course fill up very fast. The course was a great way to make friends.

### Accommodation

I got my accommodation by filling out a form on the university website, it was very convenient. Typical rents for students seemed to be 550-800 CHF.

### University and studies

The professors at ETH were all of very high standard. Compared to KTH I think that the courses at ETH are more theoretical and focus more on core/fundamental theories. I also found it quite challenging to get the high grades on the courses at ETH. In exercise classes and homework sheets at ETH I found that there was usually very few, but extremely hard, tasks. At ETH you really feel that both the other exchange students and the lecturers are extremely motivated and talented. For example, I attended a math course where the teacher had won the Fields Medal. To be well prepared for the mathematical rigour at ETH, I can highly recommend to attend the lecture Foundations of Analysis at KTH before the exchange.

### Courses

I will briefly describe the courses that I took during my exchange year at ETH Zurich.

Mathematical Foundations for Finance (difficulty 5+/5):

Warning! This is the hardest course I have ever taken. Very interesting, but you should (preferably) have a background in measure theoretic probability. It covers (among other

things) discrete time financial models, the Fundamental theorem of asset pricing, Brownian motion, stochastic integration, stochastic calculus, continuous time financial models. Very interesting!

10 Credit Project (difficulty: 4/5):

I wrote my bachelor thesis on a proof showing that the training loss of wide neural networks trained by gradient descent will converge to zero. I can recommend writing your thesis here, you will be challenged, and be prepared to spend a lot of time working with it.

Electrodynamics (difficulty 4/5) – transferred to KTH as Teoretisk elektroteknik.

This course was taught in German, with some exercises in English. I was struggling with this quite a lot since I didn't know any German before coming to Zurich.

On the upside, I think I learnt both very much about theoretical physics and German. It was quite cool to read Einstein's original article "Zur Elektrodynamik bewegter Körper" which has been seminal. The course is very theoretical, with a large focus on tensors fields and invariant formulations of Electrodynamics. It is a good introduction for anyone interested in general relativity or differential geometry. I can highly recommend any lecture with Renato Renner.

Entrepreneurial Risks: (difficulty 1/5) – transferred as the ethics module of the bachelor thesis

The most interesting course I took. Try to find any lecture with Peter Cauwels or Didier Sornette.

Geophysical Fluid Dynamics (difficulty 2/5) – transferred as Strömmingsmekanik.

A very easy course on fluid mechanics, applied to planetary cores. There was a large focus on rapidly rotating flows.

Probability Theory (difficulty 4/5): This course assumes knowledge of measure theory, however, only knowledge of the construction of the Lebesgue measure, the Radon Nikodym theorem, the Dominated Convergence theorem, and the Monotone convergence theorem is strictly necessary.

A key course for many of the advanced courses within applied math.

Programming Techniques for Scientific Simulations (difficulty 5/5) – transferred as Simulering och modellering

An advanced course in C++ programming. I didn't have a background in C++ so I had to work very hard. However, after this course, you will have very solid (theoretical) C++ skills.

Control Systems (difficulty 3/5) – transferred as Reglerteknik.

This was the six credit course given to electrical engineering students at ETH. It requires some familiarity with bode plots and other typical electrical engineering things before the course. This was a slight problem, as I did not have this background.

In conclusion, if you consider going to ETH in the third year of Engineering Physics at KTH, be aware that the workload will be a lot higher than during the first two years and you will have to take courses from many departments, some of which might be at least partly in German. As the programs at ETH are more specialised than at KTH I felt like I was a bit behind on each course from the beginning, as I had to take courses from quite a few areas, whereas the local students study one area more intensely. However, I want to stress that even though you don't have the prerequisites for a certain course, you can take it, but be ready to put in a lot of work.

### **City and country**

Zurich is a city with a living standard that is arguably better than that of Stockholm. It is cleaner, you feel safer, and people who work here enjoy (very) high salaries. Zurich is quite liberal when it comes to drinking alcohol, you will sometimes see people have a beer on the tram. However, it seems as if it is quite seldom that people get really drunk here. One thing I never got used to was the terrible opening hours of all stores. There is nothing open on Sundays.

### **Leisure and social activities**

The sports association at ETH is very impressive. They offer free membership to exchange students. With the membership you will be able to attend many different sports classes, don't miss out on this great opportunity. Hikes are never far away in Zurich, the surrounding nature is stunning.

### **Other recommendations and observations**

The exchange helped me to see my studies from a broader perspective, and to look for opportunities not only within Sweden but also abroad. You should try to take the opportunity to go to Italy or any of the other surrounding countries, as you will be able to get there by a short direct train from the Zurich main station.

Please reach out to me with any questions: [elliote@kth.se](mailto:elliote@kth.se)