



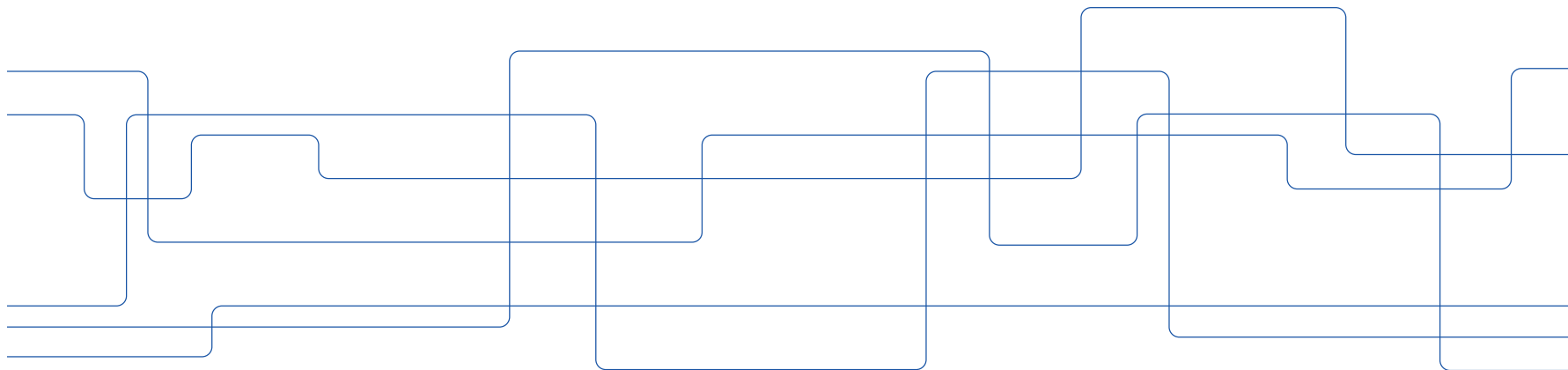
Welcome to Advanced Organic Chemistry!

Markus Kärkäs

Asst. Prof.

Div. of Organic Chemistry
Teknikringen 30, plan 6

karkas@kth.se





General course information

- All course information can be found in Canvas
- Including this information!

Canvas = web tool



Canvas

<https://kth.instructure.com/login/canvas>

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Welcome to Advanced Organic Chemistry!

Advanced course (7.5 credits) that builds on basic courses in organic chemistry (e.g., KTH courses [Organic Chemistry 1 \(KD1230\)](#) and [Organic Chemistry 2 \(KD1270\)](#), and is preparative for further studies in organic chemistry (e.g., KTH course [Selective Organic Synthesis \(KD2385, KD2390\)](#)).

The course takes off from the two undergraduate courses in organic chemistry and proceeds deeper and broader into organic chemistry and their reactions. In addition to providing a good understanding of how and why organic reactions occur, a range of new reaction types and concepts will be covered.

The course is comprised of:

- 16 lectures
- 6 exercises
- 1 project task including 1 project seminar
- 1 written examination

Course responsible, examiner:

Markus Kärkäs

E-mail: karkas@kth.se

☞

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Contact course administration for access!



Canvas

Overview in module mode

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+ Module

General information		✓	+	⋮
⋮	📄 Welcome to Advanced Organic Chemistry!	✓		⋮
⋮	📄 Link to course page	✓		⋮
⋮	📄 Course information	✓		⋮
⋮	📄 Link to Schedule	✓		⋮
⋮	📄 Teachers	✓		⋮
⋮	📄 KD2310: LEQ & Course specific evaluation Nov 1 3 pts	✓		⋮

Theory (6 credits)		✓	+	⋮
⋮	📄 Course literature and reading instructions	✓		⋮
⋮	📄 Lectures	✓		⋮
⋮	📄 Exercises	✓		⋮
⋮	📄 Exam	✓		⋮

Green Chemistry Projekt (1.5 credits)		✓	+	⋮
⋮	📄 Green Chemistry Project (1.5 credits)	✓		⋮



Canvas

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⋮

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Link to course page

This is a link to an external page which will be opened in a new window:

<http://www.kth.se/student/kurser/kurs/KD2310> ^e

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External KTH course page



KD2310 Advanced Organic Chemistry 7.5 credits

Organisk kemi, fortsättningskurs

About course

Administrate →

Course information

Course development and history



Advanced Organic Chemistry (KD2310, 7.5 credits) builds on basic courses in organic chemistry (e.g., KTH courses [Organic Chemistry 1 \(KD1230\)](#) and [Organic Chemistry 2 \(KD1270\)](#)), and is preparative for further studies in organic chemistry (e.g., KTH course [Selective Organic Synthesis \(KD2385, KD2390\)](#)).

The course uses [Canvas](#) as a Learning Management System and in order to access [Canvas](#) you have to register for the course. If you study the course for the first time, register on the web.

If you have read the course earlier and want to re-register on the course, please contact the course expedition and they will assist you. Teachers can NOT register students or give access to Canvas.

Markus Kärkäs (Course responsible, examiner)

Email: karkas@kth.se

Course information

* Retrieved from  [Course syllabus \(Autumn 2019 -\)](#)


Content and learning outcomes

Course contents *

Short course description:

- Focus on reactivity and synthesis in organic chemistry.
- Principles and factors governing reactions of organic compounds.
- Application of the concept of green chemistry in organic chemistry for sustainable development.

Show course information based on the chosen semester and course offering:

Autumn 2019 

Autumn 2019 Start date 26/08/2019 programme students

Offering and execution

Offering



Intended learning outcomes

After completing the course the student should be able to:

- Describe, explain, and compare the reactivity in organic chemistry and synthesis with for example reaction mechanisms and concepts in physical organic chemistry
- Analyze and evaluate processes in organic chemistry from a green and sustainable perspective



Course content

Detailed course description:

- Delineate mechanisms for reactions in organic chemistry
- Application of organic reactions in multi-step synthesis
- Principles regarding reaction energetics and reaction kinetics
- Application of molecular orbital theory on reactivity and stereochemistry
- Principles for the rationalization of regio- or enantioselective reaction outcomes
- Basic metal-organic chemistry
- Silicon, phosphorus, and sulfur in organic chemistry
- The process of drug discovery in the pharmaceutical industry
- Application of knowledge in organic chemistry on pharmaceutical and medicinal chemistry
- Principles concerning green- and sustainable chemistry



Course content

- **Theory (TEN2) 6 credits**

- Lectures
- Exercises

Written exam ← **Determines the final grade!**

Grade:	A	B	C	D	E	F _x	F
Points:	90–100	80–89	70–79	60–69	50–59	45–49	0–44

- **Project (PRO1) 1.5 credits**

- Green/sustainable organic chemistry

Seminar

↑
**Complementary
exam**



Theory (TEN2) 6 credits

- **16 Lectures**
 - 14 on general course material
 - 2 guest lectures
- **6 Exercises**
 - "learning-by-doing" **IMPORTANT!**
 - up to **6 bonus credits** from voluntary hand-in problems (added to final grade if you pass the exam)

Theory (TEN2) 6 credits



Markus



Peter



Helena



Anders



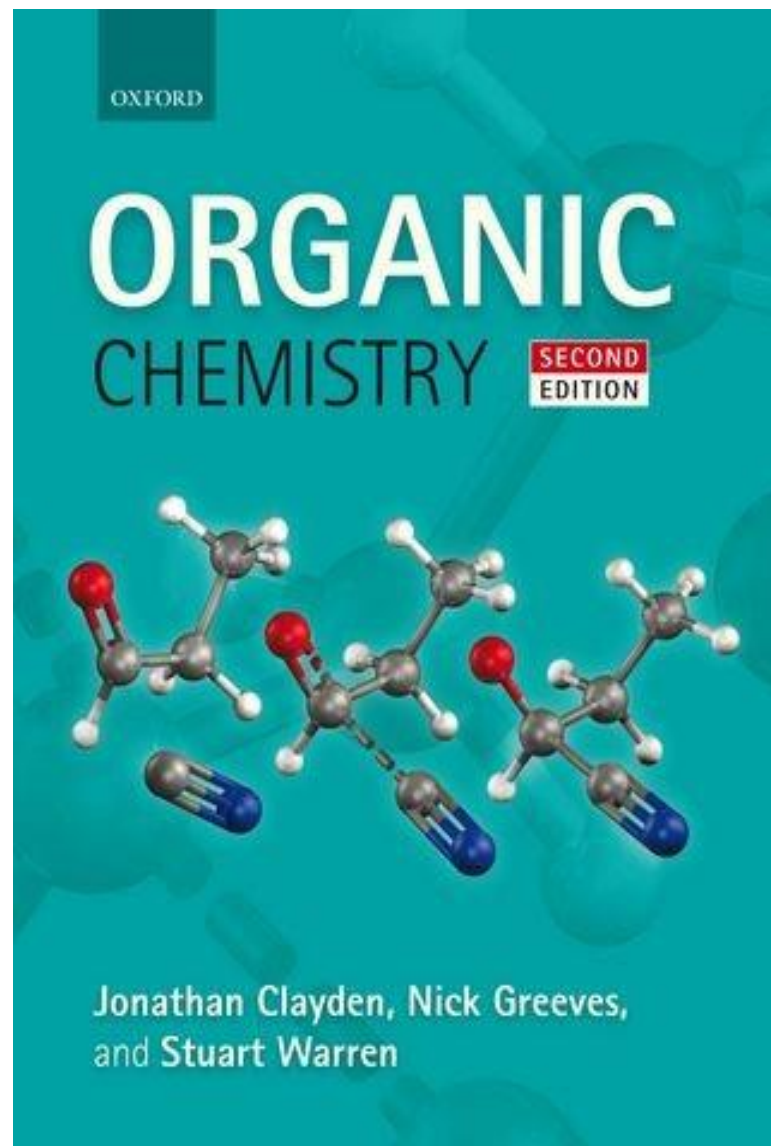
Daniel

Course coordination	Lectures	Exercises
Course responsible	Peter Dinér	Markus Kärkäs
Markus Kärkäs	Markus Kärkäs	Helena Lundberg
Examiner	Helena Lundberg	
Markus Kärkäs	External	
	Anders Bøgevig (Chemnotia) Daniel Pettersen (AstraZeneca)	



Literature 2019

Clayden, Greeves & Warren
Organic Chemistry
Oxford University Press, 2012
ISBN: 978-0-19-927029-3





Content

1. What is organic chemistry?
2. Organic structures
3. Determining organic structures
4. Structure of molecules
5. Organic reactions
6. Nucleophilic addition to the carbonyl group
7. Delocalization and conjugation
8. Acidity, basicity, and pK_a
9. Using organometallic reagents to make C-C bonds
10. Nucleophilic substitution at the carbonyl group
11. Nucleophilic substitution at C=O with loss of carbonyl oxygen
12. Equilibria, rates and mechanisms
13. ^1H NMR: Proton nuclear magnetic resonance
14. Stereochemistry
15. Nucleophilic substitution at saturated carbon
16. Conformational analysis
17. Elimination reactions
18. Review of spectroscopic methods
19. Electrophilic addition to alkenes
20. Formation and reactions of enols and enolates
21. Electrophilic aromatic substitution
22. Conjugate addition and nucleophilic aromatic substitution
23. Chemoselectivity and protecting groups
24. Regioselectivity
25. Alkylation of enolates
26. Reactions of enolates with carbonyl compounds: the aldol and Claisen reactions
27. Sulfur, silicon and phosphorus in organic chemistry
28. Retrosynthetic analysis
29. Aromatic heterocycles 1: structures and reactions
30. Aromatic heterocycles 2: synthesis
31. Saturated heterocycles and stereoelectronics
32. Stereoselectivity in cyclic molecules
33. Diastereoselectivity
34. Pericyclic reactions 1: cycloadditions
35. Pericyclic reactions 2: sigmatropic and electrocyclic reactions
36. Participation, rearrangement and fragmentation
37. Radical reactions
38. Synthesis and reactions of carbenes
39. Determining reaction mechanisms
40. Organometallic chemistry
41. Asymmetric synthesis
42. Organic chemistry of life
43. Organic chemistry today



Content

1. **What is organic chemistry?**
2. **Organic structures**
3. **Determining organic structures**
4. **Structure of molecules**
5. **Organic reactions**
6. **Nucleophilic addition to the carbonyl group**
7. **Delocalization and conjugation**
8. **Acidity, basicity, and pK_a**
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37. Radical reactions
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Previous knowledge



Content

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38. Synthesis and reactions of carbenes
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This course (AOC)



Content

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3. Determining organic structures
4. Structure of molecules
5. Organic reactions
6. Nucleophilic addition to the carbonyl group
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40. Organometallic chemistry
41. **Asymmetric synthesis**
42. Organic chemistry of life
43. Organic chemistry today

Complementary course (SOS)

Exercises

- **Only one exercise group!**
- Groups of 4–5 students



Markus



Helena

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Exercises

The exercises are **problem-oriented learning** - e.g. questions from previous exams - and demands a large amount of own work. Before each workshop, go through and try to solve the questions on your own. One question has been selected for **hand-in before the workshop**. Correctly solved hand-in generates 1 p/hand-in, which is added to the exam.

Observe! The exercises below can be replaced. Use the latest version before the exercise session.

Exercises

[Workshop 1: Thermodynamic and kinetic concepts](#) 📄

Prepare by reading chapter 12 + lecture notes.

[Table with BDEs](#) 📄

[Workshop 2: Transition metal catalysed organic reactions](#) 📄

Prepare by reading chapter 40 + lecture notes.



Project (PRO1) 1.5 credits

- Groups of ~5 students
- Choose 1 of the 4 projects/molecules
- Green organic chemistry problems
- Introductory lecture by Anders Bøgevig + own studies
- Presentation at one of the seminars – end of course



Project (PRO1) 1.5 credits

☰ KD2310HT191 > Pages > Green Chemistry Project (1.5 credits)

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Green Chemistry Project (1.5 credits)

Aim of Green Chemistry Project:

- Practice in how to design new, efficient, and environmentally benign organic chemistry processes.
- Based on a set of principles and tools to aid in the design and analysis of different routes.

An overview of these principles, tools, and guidelines will be presented partly by Anders Bøgevig in [Lecture 5](#).

Task:

- To use the green chemistry principles/tools to analyze the synthesis of a specific pharmaceutical drug (Active Pharmaceutical Ingredient, API)

Background review: R. A. Sheldon, [Chem. Soc. Rev., 2012,41, 1437-1451](#), (+ [supporting information](#)).

1. Sildenafil (Groups A:1 and B:1)

[Synthesis of Sildenafil](#)

Literature 1: xlink.rsc.org/?doi=10.1039/b312329d

Literature 2: pubs.acs.org/doi/abs/10.1021/op9900683

2. Ibuprofen (Groups A:2 and B:2)

[Synthesis of Ibuprofen](#)

Literature 1: www.sciencedirect.com/science/article/pii/S004040390500033X

Literature 2: onlinelibrary.wiley.com/doi/10.1002/anie.200903055/abstract

Literature extra: pubs.acs.org/doi/abs/10.1021/ed100892p

Patent document: [EP0284310B1.pdf](#), [US4981995.pdf](#), [WO9619431.pdf](#)

Note: Project 4 will be replaced



Project (PRO1) 1.5 credits

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A3 Project groups

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A4 Project groups

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B1 Project groups

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B2 Project groups

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B3 Project groups

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B4 Project groups

0 students



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☰ Theory (6 credits)

+

⋮

☰ Workshop 1 - Hand-in
1 pts

✓

⋮

☰ Workshop 2 - Hand-in
1 pts

✓

⋮

☰ Workshop 3 - Hand-in
1 pts

✓

⋮

☰ Workshop 4 - Hand-in
1 pts

✓

⋮

☰ Workshop 5 - Hand-in
1 pts

✓

⋮

☰ Workshop 6 - Hand-in
1 pts

✓

⋮

☰ Exam + bonus points (October)
100 pts

✓

⋮

☰ Re-exam (december)
100 pts

✓

⋮

☰ Complementary exam (November)
100 pts

✓

⋮

☰ Green Chemistry Project (1.5 credits)

+

⋮

☰ Green Chemistry Seminar
1.5 pts

✓

⋮



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Schedule week 35

w35	Monday 26/8	Tuesday 27/8	Wednesday 28/8	Thursday 29/8	Friday 30/8
8	08:00 Lecture KD2310 Helklass KD2310 U1 Peter Dinér				
9	TMMMM1 TMVTM1				
10			10:00 Lecture KD2310 Helklass KD2310 U1 Peter Dinér		
11			TMMMM1 TMVTM1		
12					
13				13:00 Lecture KD2310 Helklass KD2310 U1 Peter Dinér	
14				TMMMM1 TMVTM1	
15					
16					
17					






Schedule week 36

w36	Monday 2/9	Tuesday 3/9	Wednesday 4/9	Thursday 5/9	Friday 6/9
8	08:00 Lecture KD2310 Helklass KD2310 U1 Peter Dinér TMMMM1 TMVTM1				
9		Exercise 1			
10		10:00 Exercise KD2310 Helklass KD2310 M31 Peter Dinér TMMMM1 TMVTM1	10:00 Lecture KD2310 Helklass KD2310 K2 Peter Dinér TMMMM1 TMVTM1		
11					
12		 			
13				13:00 Exercise KD2310-grupp B KD2310 L34 Peter Dinér TMMMM1 TMVTM1	
14			Intro to project		
15			Anders Bøgevig <i>Green and safe synthesis, medchem, industrial processes</i>		
16					
17					






Schedule week 37

w37	Monday 9/9	Tuesday 10/9	Wednesday 11/9	Thursday 12/9	Friday 13/9
8	08:00 Lecture KD2310 Helklass KD2310 U1 Peter Dinér TMMMM1 TMVTM1				08:00 Lecture KD2310 Helklass KD2310 U1 Peter Dinér TMMMM1 TMVTM1
9					
10			10:00 Lecture KD2310 Helklass KD2310 U1 Peter Dinér TMMMM1 TMVTM1		
11					
12					
13				Exercise 2 Exercise KD2310 Helklass KD2310 V21 Peter Dinér TMMMM1 TMVTM1	Exercise KD2310 grupp B KD2310 936 (Gamla styrelserum) Peter Dinér TMMMM1 TMVTM1
14					
15				 	
16					
17					






Schedule week 38

w38	Monday 16/9	Tuesday 17/9	Wednesday 18/9	Thursday 19/9	Friday 20/9
8	08:00 Lecture KD2310 Helklass KD2310 V3 Peter Dinér TMMMM1 TMVTM1				
9					
10			10:00 Lecture KD2310 Helklass KD2310 V3 Peter Dinér TMMMM1 TMVTM1		
11					
12				12:00 Exercise 3	
13				Exercise KD2310 Helklass KD2310 V21 Peter Dinér TMMMM1 TMVTM1	
14					
15				 	15:00-15:00 Exercise KD2310 grupp B KD2310 B23 Peter Dinér TMMMM1 TMVTM1
16					
17					17:00




Schedule week 39

w39	Monday 23/9	Tuesday 24/9	Wednesday 25/9	Thursday 26/9	Friday 27/9
8					
9					
10					10:00 Lecture KD2310 Helklass KD2310 L1 Peter Dinér TMMMM1 TMVTM1
11	Medicinal chemistry lecture				
12	Daniel Pettersen AstraZeneca				12:00
13				 	13:00 Exercise KD2310-grupp B KD2310 B35 Peter Dinér TMMMM1 TMVTM1
14					
15		15:00 Lecture KD2310 Helklass KD2310 K2 Peter Dinér TMMMM1 TMVTM1	15:00 Lecture KD2310 Helklass KD2310 D3 Peter Dinér TMMMM1 TMVTM1	15:00 Exercise KD2310 Helklass KD2310 K51 Peter Dinér TMMMM1 TMVTM1	15:00
16					
17				Exercise 4	




Schedule week 40

w40	Monday 30/9	Tuesday 1/10	Wednesday 2/10	Thursday 3/10	Friday 4/10
8	08:00 Lecture KD2310 Helklass KD2310 K2 Peter Dinér TMMMM1 TMV/TM1				08:00 Lecture KD2310 Helklass KD2310 Q2 Peter Dinér TMMMM1 TMV/TM1
9					
10			10:00 Lecture KD2310 Helklass KD2310 V3 Peter Dinér TMMMM1 TMV/TM1		
11					
12					
13				Exercise 5 Exercise KD2310 Helklass KD2310 V21 Peter Dinér TMMMM1 TMV/TM1	
14					
15					
16					
17					

Schedule week 41

w41	Monday 7/10	Tuesday 8/10	Wednesday 9/10	Thursday 10/10	Friday 11/10
8					08:00 Exercise KD2310-grupp-A KD2310 Q26 Peter Dinér TMMMM1 TMVTM1 
9			Group A		
10			Seminar KD2310 grupp A KD2310 D36 (Gamla styrelserummet) Peter Dinér TMMMM1 TMVTM1		
11					
12				Group B	Exercise 6
13		<i>Project seminars</i>		Seminar KD2310 grupp B KD2310 D33 Peter Dinér TMMMM1 TMVTM1	Exercise KD2310 Helklass KD2310 K51 Peter Dinér TMMMM1 TMVTM1
14					
15					 
16					
17					

Schedule week 42

w42	Monday 14/10	Tuesday 15/10	Wednesday 16/10	Thursday 17/10	Friday 18/10
8					
9				<p>Workshop/ question session</p> <p>10:00</p> <p>Math help session KD2310 Helklass KD2310 K51 Peter Dinér TMMMM1 TMVTM1</p> <p>12:00</p>	
10					
11					
12				  	
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17					

EXAM STUDY!



Schedule week 43

w43	Monday 21/10	Tuesday 22/10	Wednesday 23/10	Thursday 24/10	Friday 25/10
8					
9					
10					
11					
12					
13					
14				EXAM	
15				14:00 Written Exam KD2310 Helklass KD2310 K51 K53 Peter Dinér TMMMM1 TMVTM1	
16					
17					



Schedule week 45

w45	Monday 4/11	Tuesday 5/11	Wednesday 6/11	Thursday 7/11	Friday 8/11
8				<p style="text-align: center;">Complementary Exam</p> <p style="text-align: center;">For exam results: 45–49 p (grade F_x)</p>	
9					
10					
11					
12		12:00 KTH-Global	12:00 KTH-Global	12:00 KTH-Global	
13					
14			14:00	14:00	14:00
15					
16					
17	17:00 Mastermässan				
					18:00



Re-exam (December 18, 2019)

w51	Monday 16/12	Tuesday 17/12	Wednesday 18/12	Thursday 19/12	Friday 20/12
8					
9					
10					
11					
12					
13					
14					
15					
16					
17					

RE-EXAM

14:00
Re-exam
KD2310
K53
Peter Dinér
TMMMM1
TMVTM1



Most difficult part of the course...

<https://www.kth.se/places>



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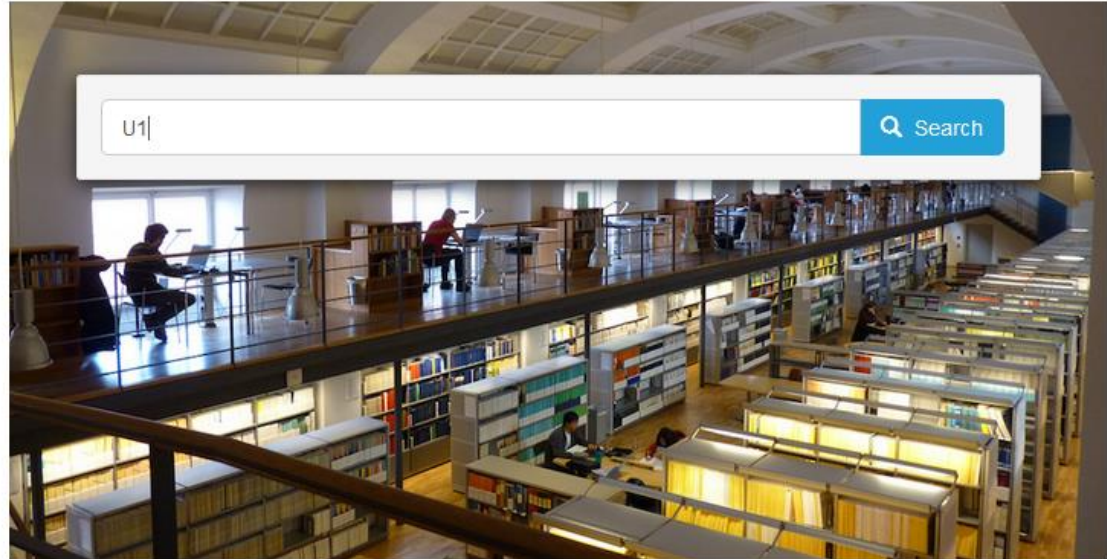
 

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- ▶ Course, programme and group webs
- ▶ Learning management system (Canvas)
- ▶ Webmail

KTH Royal Institute of Technology
 SE-100 44 Stockholm
 Sweden
 +46 8 790 60 00

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<https://www.kth.se/places>



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✕ Facilities

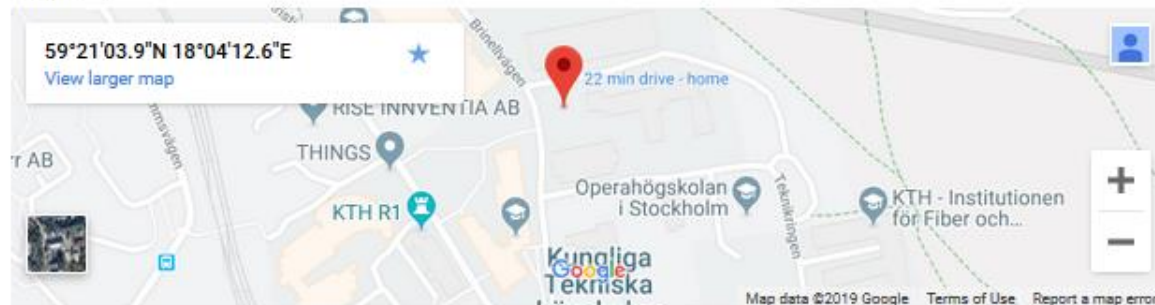
U1 Search

U1

PLACE <https://www.kth.se/places/room/id/a97c7287-81cb-470d-bd01-2db4da7ca98d>

Address: Brinellvägen 28A

Floor: 6



Your search in *Facilities* returned 1 result(s). Filter the results with options below.

Type

Places 1

How can we improve search?

Help us be better at search, share your ideas.



Some advice from previous students

“...ask as many questions as you can! The teachers are very approachable, and care about your learning, so take the opportunity when it's there!”

“Work hard before and during the workshops!”

“Prepare before the workshops”

“Work together to figure out mechanisms and solve problems continuously throughout the course. The workshop problems that are given are a good representation of what you will need to know on the exam, so use them! The book is also very helpful. Even though it is a big chunk of text associated with this course, the more you can prepare for lectures by reading ahead, the better!”

“Study consistently and do not hesitate to ask questions!”

...and don't forget to have fun!



Let's get this party started!