

FLUID MECHANICS/STRÖMNINGSMEKANIK

SG2214, 7.5 hp., 2019

KTH-web course registration August 22 – September 2

Course information

Course requirements

- **INL 1 (3 hp.)**
 - 3 sets of home work problems
 - Homework 1, due Sept. 9 (for max 3p. bonus on first exam)
 - Homework 2, due Oct. 7 (for max 5.5p. bonus on first exam)
 - Homework 3, due Oct. 14 (for max 3.5p. bonus on first exam)
 - 1 laboration, week 39
- **TEN1 (4.5 hp.) Oct. 21, 2019** (Re-exam Dec 16-19, 2019)
KTH-web registration for exam: See KTH web pages.
PhD-students register to: student@mech.kth.se
 - 1 written exam (max 50+12 p. including bonus from homework 1, 2 and 3)
 - The grade FX is given at 19 p. including homework problems. The grade FX can be supplemented to E within six weeks after the grading is ready. Grades are given according to the table, which may be slightly adjusted for each exam:

Exam result R	ECTS Grade
$40 \leq R$	A
$35 \leq R < 40$	B
$30 \leq R < 35$	C
$25 \leq R < 30$	D
$20 \leq R < 25$	E
$R = 19$	FX
$R < 19$	F

Literature:

Book: Kundu & Cohen & Dowling, Fluid Mechanics (6:th ed.), Elsevier AP

- useful also in SG2218 Turbulence, 7.5 hp.
- and in SG2221 Wave motions and hydrodynamic stability, 7.5 hp.
- **E-book (5:th edition) via:**

<http://www.sciencedirect.com/science/book/9780123821003>

Lecture notes via course home page

Recitation notes via course home page

Old exams via course home page

Laboration:

Experimental lab scheduled during course (week 39)

Self-similar boundary layer lab with a favourable pressure gradient (FPG).

Address: Fluid Physics lab, Teknikringen 8

Teachers:

Lectures: Anders Dahlkild, 790 9174, ad@mech.kth.se

Recitations: Luca Brandt, 790 7671, luca@mech.kth.se

Learning outcomes SG2214

The student should

1. be able to identify, apply and/or present derivations of mathematical models of fluid mechanical phenomena and make relevant approximations
2. for simplified cases be able to apply the derived models (numerically or theoretically) and be able to interpret the result
3. show an ability to relate obtained data, observed phenomena and processes in laboratory environment to the description of fluid mechanics

in order to get a fundamental preparation for working with fluid mechanical problems as an engineer.

Grade criteria SG2214

For learning outcomes 1 and 2

E By written presentations of solutions, possibly in cooperation with classmates, to at least one of the problems for each of the three homework assignments.
At a written exam show the ability to clearly formulate a model and present a solution to basic fluid mechanical phenomena and/or to present coherent derivations of fluid mechanics theory.

D-A By the requirements for E and showing larger width by solving more problems from the homework assignments and/or at the written exam deal satisfactory with more problems/derivations and/or show larger depth by solving and analysing homework assignments/exam problems with excellence and explain the results.

For learning outcome 3

E By preparing for and execute the experimental lab in the course and submitting a lab report.

Detailed course plan

Day	Time	Room	Teacher	Description
1. Introduction, tensors, kinematics				
Mon Aug 26	10-12	V34	Anders Dahlkild	Lecture 1: Introduction and motivation of Navier-Stokes eq. Kinematics: Lagrange/Euler coord., material derivative.
Tue Aug 27	15-17	V34	Luca Brandt	Recitation 1: Tensors.
Thu Aug 29	10-12	V34	AD	L2: Kinematics: relative motion.
Fri Aug 30	15-17	V32	LB	R2: Euler/Lagrange coordinates and relative motion.
Weekend 35				
2. Conservation laws				
Mon Sep 2	08-10	V34	AD	L3: Stress tensor, Reynolds transport theorem, Conservation of momentum and mass.
Tue Sep 3	15-18	V22	LB	R3: Stress tensor, application of conservation equations. Tutorial homework 1.
3. Laminar viscous flow				
Thu Sep 5	10-12	V34	AD	L4: Navier-Stokes equations, examples.
Fri Sep 6	15-17	V32	LB	R4: Exact solutions to Navier-Stokes equations
Weekend 36				
Mon Sep 9	8-10	U31	AD	L5: Rotating cylinders and Stokes' problem. Due Homework 1
Mon Sep 9	10-12	U31	LB	R5: Exact solutions to Navier-Stokes equations.
4. Conservation of energy				
Tue Sep 10	15-17	V32	AD	L6: Conservation of energy.
Fri Sep 13	15-18	V34	LB	R6: Exact solutions to the energy equation. Tutorial Homework 2.
Weekend 37				
5. Laminar boundary layers; LABORATION WEEK 39				
Mon Sep 16	08-10	U1	AD	L7: Boundary layer equations and Blasius flow.
Mon Sep 16	10-12	V32	LB	R7: Boundary layers: Similarity and wake flow.
Tue Sep 17	15-17	V3	AD	L8: Boundary layers with pressure gradient, separation of the boundary layer.

Weekend 38				
Mon Sep 23	09-12	U21	LB	R8: More boundary layers. Tutorial Homework 2, 3
Tue Sep 24 – Fri Sep 27	See lab group schedule		Fluid physics lab, Teknikringen 8	Self-similar boundary layer laboration - FPG -
6. Vorticity dynamics				
Tue Sep 24	15-17	V3	AD	L9: Vorticity dynamics, Kelvins circulation theorem.
Wed Sep 25	13-15	U41	LB	R9: Rankine vortex, Generation of vorticity in natural convection.
Thu Sep 26	10-12	V3	AD	L10: Flows at large Re, streamfunction, velocity potential, Bernoulli's equation.
Fri Sep 27	15-17	U21	LB	R10: Axisymmetric flows with vorticity, Hiemenz problem.
Weekend 39				
7. 2D irrotational flow				
Tue Oct 1	15-18	V3	AD	L11: 2D inviscid flow and the complex potential. Tutorial Homework 2, 3.
Wed Oct 2	13-15	V32	LB	R11: Bernoulli's equation, pressure in solid body rotation/irrotational vortex, stream function.
Fri Oct 4	08-10	V3	AD	L12: Flow past a circular cylinder with circulation, lift and drag.
Weekend 40				
Mon Oct 7	08-10	U21	LB	R12: Potential flow problems. Due Homework 2.
8. Introduction to turbulent flow				
Tue Oct 8	15-17	Q36	AD	L13: Averaged equations for turbulent flow, Reynolds stresses, turbulent kinetic energy.
Wed Oct 9	10-12	V32	LB	R13: Turbulent flows.
Thu Oct 9	13-15	V32	AD	L14: Turbulent channel flow. Summary.
Fri Oct 11	08-10	U21	LB	R14: Problems from old exams.
Weekend 41				
Mon Oct 14				Due Homework 3 (lab report)
Weekend 42				
Mon Oct 21	14:00-18:00	M23,M24,M36 ,M37		Written Exam
Weekend 50				
Dec 16-19	??:00-??:00	??		Written Re-exam

KTH för arkitektur och samhällsbyggnad/ School of Architecture and Built Environment
Drottning Kristinas väg 30

Bysggetskap
Osquars backe 5
Brinellvägen 1
Fastigheter och byggnad
Brinellvägen 1
Filosofi och teknikhistoria
Brinellvägen 32
Mark och vattenteknik
Teknikringen 72/78 B
Samhällsplanering och miljö
Drottning Kristinas väg 30
Transportvetenskap
Teknikringen 10A

Skolan för bioteknologi/School of Biotechnology
Roslagstullsbacken 21

Skolan för datavetenskap och kommunikation/ School of Computer Science and Communication
Lindstedtsvägen 3
Lindstedtsvägen 3
Teoretisk datalogi
Teknikringen 14
Beräkningsteori
Roslagstullsbacken 35
Medieteknik och interaktionsdesign
Lindstedtsvägen 3
Människa-datorinteraktion
Lindstedtsvägen 5
Tal, musik och hörsel
Lindstedtsvägen 24
Parallelllaboratoriet
Teknikringen 14

Skolan för elektro- och systemteknik/School of Electrical Engineering
Osquildas väg 10
Alfvénlaboratoriet
Teknikringen 31
Elektriska energisystem
Teknikringen 33
Elektroteknisk teori och konstruktion
Teknikringen 33
Fusionsplasmafysik
Teknikringen 31
Fusionsplasmateori och styrteknik
Teknikringen 31
Kommunikationsnät
Osquildas väg 10
Mikro- och nanosystem
Osquildas väg 10
Regelteknik
Osquildas väg 10
Rymd- och plasmafysik
Teknikringen 31

Skolan för industriell teknik och management/ School of Industrial Engineering and Management
Lindstedtsvägen 30

Skolan för kemivetenskap/School of Chemical Science and Engineering
Teknikringen 42
Kemiteknik
Teknikringen 36
Fiber och polymersteknologi
Teknikringen 42
Teknikringen 56

Skolan för teknikvetenskap/School of Engineering Sciences
Roslagstullsbacken 21

Fysik
Roslagstullsbacken 21

Matematik
Osquars backe 18

Mekaniik
Osquars backe 18

Farkost och flyg
Teknikringen 8

Hälfästetslära
Teknikringen 8

Skolan för teknikutbildning och lärande/ School of Education and Communication in Engineering Science
Osquars backe 31

KTH Education
Lindstedtsvägen 30

Språk och kommunikation
Lindstedtsvägen 24

Vetenskapshuset
Roslagstullsbacken 29

Academiskt resurscentrum
Osquars backe 31

KTH Biblioteket/ KTH Library
Osquars backe 31

KTH Universitetsförvaltning/KTH University Administration
Brinellvägen 8
Rektor/President
Brinellvägen 8
Miljö- och byggnadsavdelningen/Site Management
Brinellvägen 8
Lokalservice/Site Services
Drottning Kristinas väg 48
IT-avdelningen/IT Department
Drottning Kristinas väg 48

Kommunikation och internationella Relationer
Brinellvägen 8

KTH Post/Postal Services
Drottning Kristinas väg 48

Registratör/Registrar's Office
Brinellvägen 8

Central anläggning/KTH Admissions Office
Brinellvägen 8

Central studentvägledning/ Central Student Guidance
Drottning Kristinas väg 4

Avdelningen för student service DKV4
Drottning Kristinas väg 4

Examen/Degree Office
Brinellvägen 8

KTHs hörsalar och övningssalar/KTH lecture and exercise premises
A-salar A1-A7
Ostermalmsgatan 26
B-salar B1-B3, B21-B26
Brinellvägen 23
D-salar D1, D41, D43-63
Lindstedtsvägen 17
E-salar E1, E2, D31-D35, D42, D44-48
Lindstedtsvägen 3
F-salar F1, E2, E31-E36
Lindstedtsvägen 3
F-salar F1, E2, E31-E36
Osquars backe 14
F-salar F2, F3
Lindstedtsvägen 22
F-salar F1, F2, F3
Lindstedtsvägen 26
K-salar K1, K2, K3
Teknikringen 28
K-salar K1, K2, K3-53
Teknikringen 28
L-salar
Drottning Kristinas väg 30
M-salar
Drottning Kristinas väg 30
Q-salar Q1-Q36
Osquildas väg 4
V-salar V1-V2, V34-V35
Osquildas väg 6
V-salar V01, V11-V12, V21-V23, V32-V33

Kårhuset THS/Student Union House
Drottning Kristinas väg 15

AlbaNova
Roslagstullsbacken 21

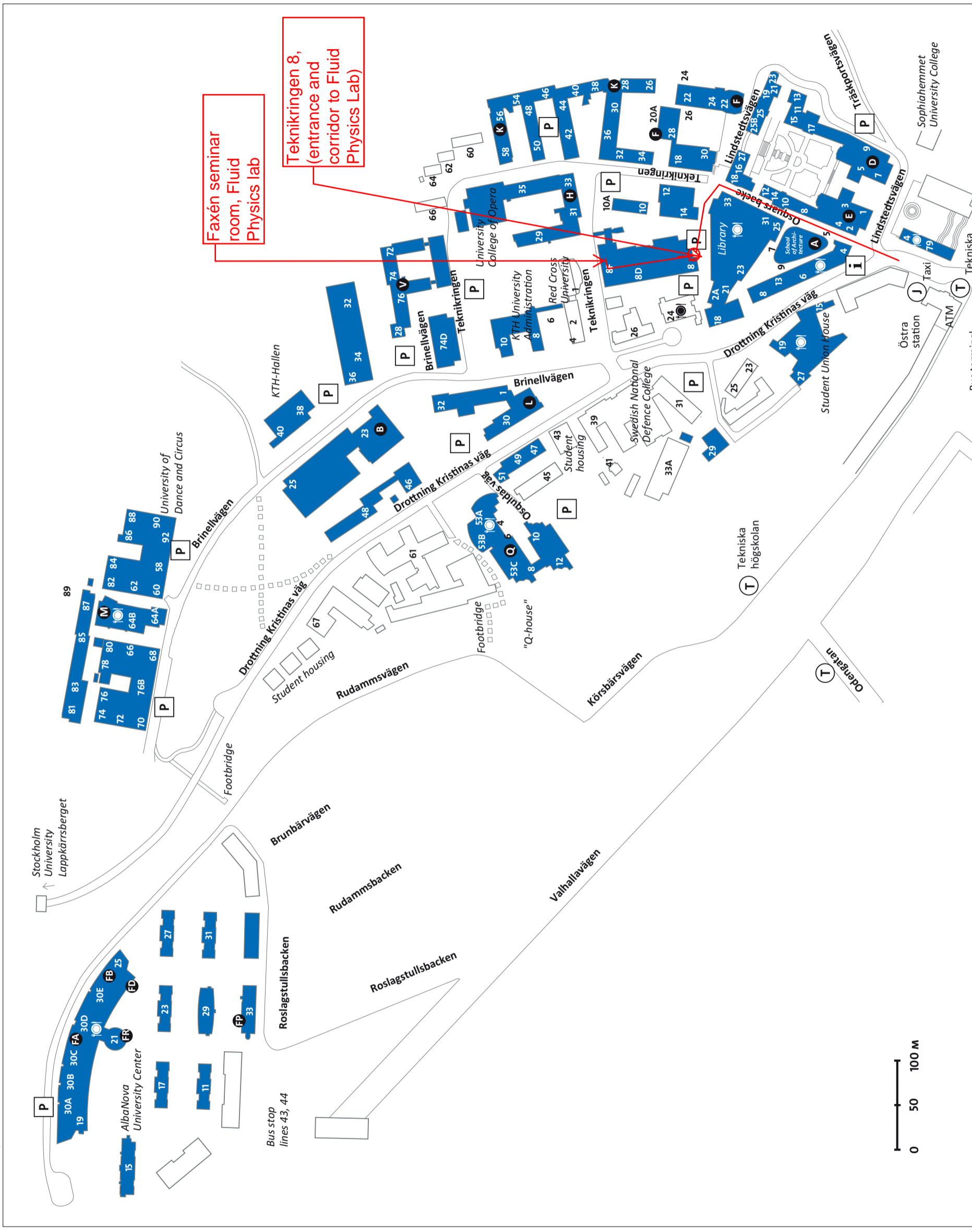
KTH Entré and IT Support
Drottning Kristinas väg 4

Övriga högskolor/Other Universities
Danishögskolan/University of Dance and Circus
Brinellvägen 58
Forsvarshögskolan/National Defence College
Drottning Kristinas väg 37
Gymnasiet och lärotröghögskolan GIH
Lidingövägen 1
Musik- och teaterhögskolan i Stockholm
Valhallavägen 1
Opera högskolan/University College of Opera
Teknikringen 35
Röda korsets högskola RKH/
The Red Cross University College
Sophiahemmet högskola/
Sophiahemmet University College
Lindstedtsvägen 8

Restauranger/Restaurants
Café Entré
Drottning Kristinas väg 4
KTH-Hallen
Brinellvägen 38
KTH Stories
Osquars Backe 31
Open café
Valhallavägen 79
Restaurang Brazilia
Brinellvägen 64
Restaurang Entré
Roslagstullsbacken 21
Restaurang Nymble
Drottning Kristinas väg 19
Restaurang Q
Osquildas väg 4

Övrigt på Campus
Academic Work AB
Lindstedtsvägen 24
Akademiska Hus AB
Drottning Kristinas väg 25
GIH-badet (Indoor pool)
Drottning Sofias väg 20
KTH-hallen (Fitness centre)
Brinellvägen 38
Kärbokhandel (Bookstore)
Drottning Kristinas väg 19
Studenthalsan (Health service)
Fiskarsvägen 15 A
US-AB University service (Printing office)
Drottning Kristinas väg 53 B
Valnögskola huset
Villegatan 19

KTH Campus



Faxén seminar room, Fluid Physics lab

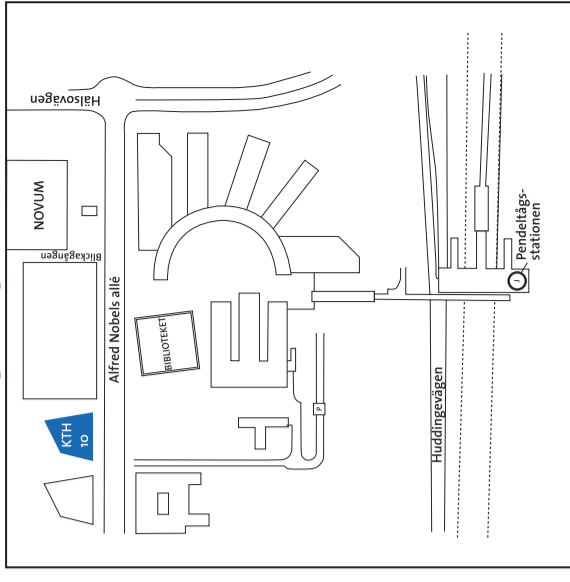
Teknikringen 8, (entrance and corridor to Fluid Physics Lab)



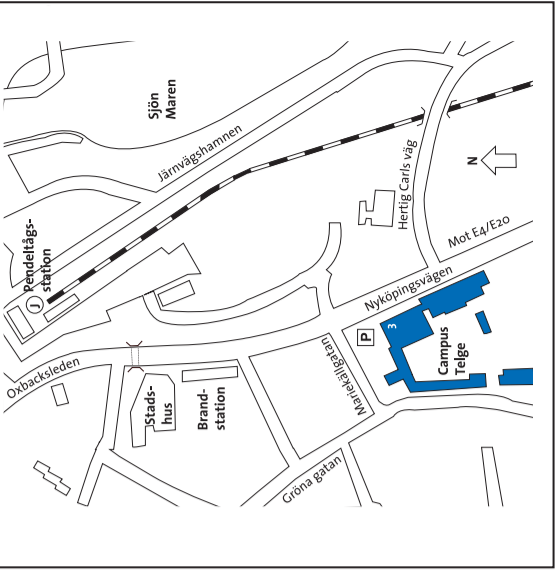
- LECTURE/EXERCISE PREMISES**
37
- STREET ADDRESS**
KTH ENTRÉ
- PARKING**
- LIGHT RAIL STATION**
- METRO STATION**
- RESTAURANT/CAFÉ**

- KTH ENTRÉ**
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 - HELP FINDING THE RIGHT PERSON OR YOUR WAY AT KTH AND MORE

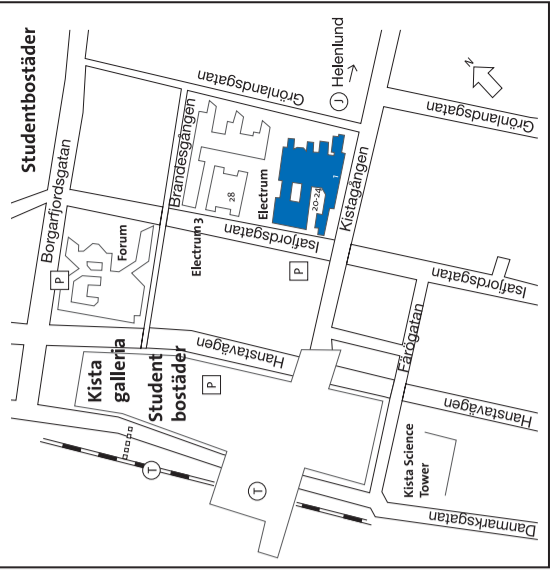
KTH Flemingsberg



KTH Södertälje



KTH Kista



KTH Haninge

