FLUID MECHANICS/STRÖMNINGSMEKANIK
SG2214, 7.5 hp., 2020

KTH-web course registration August 20 – 31

Course information

Course requirements

- **INL 1 (3 hp.)**
  - **3 sets of home work problems**
    - **Homework 1, due Sept. 7 (for max 3p. bonus on first exam)**
    - **Homework 2, due Oct. 5 (for max 5.5p. bonus on first exam)**
    - **Homework 3, due Oct. 9 (for max 3.5p. bonus on first exam)**
  - **1 laboration, week 39**

- **TEN1 (4.5 hp.)** **Oct. 15, 2020** (Re-exams 14-17 Dec, 2020)
  KTH-web registration for exam: September 15-29
  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 ≤ R	A
35 ≤R< 40	B
30 ≤R< 35	C
25 ≤R< 30	D
20 ≤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 fauvourable 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				
Wed Aug 26	10-12	**Room: See KTH-schedule. Zoom: See CANVAS.**	**Anders Dahlkild**	**Lecture 1:** Introduction and motivation of Navier-Stokes eq. Kinematics: Lagrange/Euler coord., material derivative.
Wed Aug 26	13-15		**Luca Brandt**	**Recitation 1:** Tensors.
Fri Aug 28	08-10		**AD**	**L2:** Kinematics: relative motion.
Fri Aug 38	15-17		**LB**	**R2:** Euler/Lagrange coordinates and relative motion.
Weekend 35				
2. Conservation laws				
Mon Aug 31	10-12		**AD**	**L3:** Stress tensor, Reynolds transport theorem, Conservation of momentum and mass.
Tue Sep 1	15-18		**LB**	**R3:** Stress tensor, application of conservation equations. **Tutorial homework 1.**
3. Laminar viscous flow				
Wed Sep 2	13-15		**AD**	**L4:** Navier-Stokes equations, examples.
Fri Sep 4	15-17		**LB**	**R4:** Exact solutions to Navier-Stokes equations
Weekend 36				
Mon Sep 7	8-10		**AD**	**L5:** Rotating cylinders and Stokes' problem. **Due Homework 1**
Mon Sep 7	10-12		**LB**	**R5:** Exact solutions to Navier-Stokes equations.
4. Conservation of energy				
Tue Sep 8	15-17		**AD**	**L6:** Conservation of energy.
Wed Sep 9	13-16		**LB**	**R6:** Exact solutions to the energy equation. **Tutorial Homework 2.**
Weekend 37				
5. Laminar boundary layers; LABORATION WEEK 39				
Thu Sep 17	13-15		**AD**	**L7:** Boundary layer equations and Blausius flow.
Thu Sep 17	15-17		**LB**	**R7:** Boundary layers: Similarity and wake flow.
Fri Sep 18	08-10		**AD**	**L8:** Boundary layers with pressure gradient, separation of the boundary layer.

Weekend 38				
Tue Sep 22	15-18		**LB**	**R8:** More boundary layers**.** **Tutorial Homework 2, 3**
Tue Sep 22 – Fri Sep 25	**See lab group schedule**		**Fluid physics lab, Teknikringen 8**	**Self-similar boundary layer laboration - FPG -**
6. Vorticity dynamics				
Wed Sep 23	13-15		**AD**	**L9:** Vorticity dynamics, Kelvins circulation theorem.
Fri Sep 25	08-10		**LB**	**R9:** Rankine vortex, Generation of vorticity in natural convection.
Fri Sep 25	15-17		**AD**	**L10:** Flows at large Re, streamfunction, velocity potential, Bernoulli's equation.
Weekend 39				
7. 2D irrotational flow				
Mon Sep 28	10-12		**LB**	**R10:** Axisymmetric flows with vorticity, Hiemenz problem.
Tue Sep 29	15-18		**AD**	**L11:** 2D inviscid flow and the complex potential. **Tutorial Homework 2, 3.**
Wed Sep 30	10-12		**LB**	**R11:** Bernoulli's equation, pressure in solid body rotation/irrotational vortex, stream function.
Fri Oct 2	08-10		**AD**	**L12:** Flow past a circular cylinder with circulation, lift and drag.
Weekend 40				
Mon Oct 5	08-10		**LB**	**R12:** Potential flow problems. **Due Homework 2.**
8. Introduction to turbulent flow				
Tue Oct 6	15-17		**AD**	**L13:** Averaged equations for turbulent flow, Reynolds stresses, turbulent kinetic energy.
Wed Oct 7	10-12		**LB**	**R13:** Turbulent flows.
Thu Oct 8	10-12		**AD**	**L14:** Turbulent channel flow. Summary.
Fri Oct 9	15-17		**LB**	**R14:** Problems from old exams.
Fri Oct 9				**Due Homework 3 (lab report)**
Weekend 41				
Thu Oct 15	**14:00-18:00**			**Written Exam**
Weekend 50				
Dec	**??:00-??:00**	**??**		**Written Re-exam**