

Computational Fluid Dynamics (SG2212/SG3114), 7.5 ECTS

Lecturers:

Philipp Schlatter (PS), pschlatt@mech.kth.se, Eng. Mechanics, tel. 790 7176
Office hours: Friday 14-15

Ardeshir Hanifi (AH), hanifi@kth.se, Eng. Mechanics, tel. 790 8482
Office hours: Friday 14-15

Assistants:

Marco Atzori (MA), atzori@mech.kth.se, Eng. Mechanics, tel. 790 7162
Office hours: Monday 14-17

Luca Guastoni (LG), guastoni@mech.kth.se, Eng. Mechanics, tel. 790 7570
Office hours: Monday 14-17

Homework corrections will be discussed in the office hours.

Literature:

Relevant books:

- *Computational Fluid Dynamics*, John D. Anderson, Jr., McGraw-Hill, 1995
- *Essential Computational Fluid Dynamics*, Oleg Zikanov, Wiley, 2019.

Lecture notes on the home page

Grading:

Exam total max 50p, homeworks + project 10p.

Total points >25 (E), >28 (D), >38 (C), >48 (B), >54 (A).

Exam open for registration: 6 Feb - 20 Feb 2020. All students need to register!

Re-exam open for registration: 30 Apr - 14 May 2020. All students need to register!

Web links:

<https://kth.instructure.com/courses/17594>

Homeworks: (max 3 points, 5 of 6 required for pass, about 75% for pass/points)

- Homework 1, due 23/1
- Homework 2, due 29/1
- Homework 3, due 5/2
- Homework 4, due 13/2
- Homework 5, due 19/2
- Homework 6, due 26/2

Please use Canvas for questions and submission of homeworks!

Project (max 7 points, at least 6 points total required for pass):

Project, due 27/3

Course plan

Week 3	Wed	15 Jan	10-12	U51	Fluid dynamics I: Introduction and outline of the course. Derivation of the governing equation.	AH
	Thu	16 Jan	10-12	V32	Fluid dynamics II Derivation of the governing equation, cont.	AH
	Fri	17 Jan	10-12	U31	Fluid dynamics III: Derivation of the governing equation, cont.	AH
Week 4	Mon	20 Jan	15-17	U51	Basic numerics I: Mathematical behavior of hyperbolic, parabolic and elliptic equation. Well-posedness.	PS
	Wed	22 Jan	10-12	U31	Basic numerics II: Discretization by finite differences. Analysis of discretized equation; order of accuracy, Convergence	PS
	Thu	23 Jan	15-17	U31	Basic numerics III: Analysis of discretized equation, cont.	PS
	Fri	24 Jan	10-12	U51	Analysis of discretized equations: Consistency, Convergence and Stability, CFL condition Homework session 1 and introduction to Matlab	PS LG, MA
Week 5	Mon	27 Jan	15-17	V22	Compressible flow I: Introduction to compressible flow, Euler equation, conservation laws, entropy	PS
	Tue	28 Jan	13-15	U31	Compressible flow II: Numerical methods for conservation laws, Stability, Dispersion, Diffusion	PS
	Thu	30 Jan	15-17	U31	Compressible flow III: Shock tube, boundary conditions, artificial viscosity Homework session 2	PS LG, MA
Week 6	Mon	3 Feb	15-17	U31	Compressible flow IV: Systems of conservation laws, Riemann Invariants	PS
	Tue	4 Feb	13-15	U31	Introduction to incompressible flow. Navier-Stokes in integral form. Finite volume and finite difference methods: Laplace equation on arbitrary grids, equivalence with finite-differences.	AH
	Thu	6 Feb	15-17	U31	Finite volume and finite difference methods: Cartesian grid and spurious solutions. Homework session 3	AH LG, MA

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Week 7	Mon	10 Feb	15-17	U51	Staggered grid/volume formulation + BC. Steady incompressible flows: Artificial compressibility	AH
	Tue	11 Feb	13-15	U31	Projection on divergence-free space, Unsteady incompressible flows: projection method, discrete Poisson pressure eq.	AH
	Thu	13 Feb	15-17	U31	linear systems: Iterative methods, Gauss-Seidel as smothers for multi-grid	AH
	Fri	14 Feb	10-12	U31	Complex geometries, Coordinate transformation. Homework session 4	AH LG, MA
Week 8	Mon	17 Feb	15-17	U21	Unstructured Node-Centered FV: consistency and accuracy.	AH
	Tue	18 Feb	13-15	U31	Upwind schemes, Flux splitting	AH
	Wed	19 Feb	10-12	U31	High-order compact finite differences.	AH
	Thu	20 Feb	15-17	U31	Introduction of project Homework session 5	PS LG, MA
Week 9	Mon	24 Feb	10-12	U21	Project lecture	PS
	Tue	25 Feb	13-15	U31	Open Foam demonstration	PS LG, MA
	Wed	26 Feb	10-12	U51	General Questions Demonstration of project	PS
	Thu	27 Feb	15-17	U31	Homework session 6	LG, MA
	Fri	13 Mar	14-18	U41, U51, U61	Examination	
	Fri	5 Jun	14-18	U21	Re-exam	