

Computational Fluid Dynamics (SG2212/SG3114), 7.5 ECTS

Lecturers:

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Homework corrections will be discussed in the office hours.

Literature:

Relevant books:

- *Computational Fluid Dynamics*, John D. Anderson, Jr., McGraw-Hill, 1995
- *Numerical Computation of Internal & External Flows*, Charles Hirsch, Butterworth-Heinemann, Second Edition, ISBN: 978-0-7506-6594-0.

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: 7 Feb - 21 Feb 2019. All students need to register!

Web links:

<https://kth.instructure.com/courses/8140>

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

- Homework 1, due 22/1
- Homework 2, due 29/1
- Homework 3, due 5/2
- Homework 4, due 12/2
- 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 31/3

Course plan

Week 3	Tue	15 Jan	15-17	U51	Fluid dynamics I: Introduction and outline of the course. Derivation of the governing equation.	AH
	Wed	16 Jan	13-15	U41	Fluid dynamics II Derivation of the governing equation, cont.	AH
	Thu	17 Jan	15-17	U21	Fluid dynamics III: Derivation of the governing equation, cont.	AH
Week 4	Mon	21 Jan	15-17	U41	Basic numerics I: Mathematical behavior of hyperbolic, parabolic and elliptic equation. Well-posedness.	PS
	Tue	22 Jan	10-12	U41	Basic numerics II: Discretization by finite differences. Analysis of discretized equation; order of accuracy, Convergence	PS
	Wed	23 Jan	8-10	U41	Basic numerics III: Analysis of discretized equation, cont.	PS
	Mon W5	28 Jan	15-17	U41	Analysis of discretized equations: Consistency, Convergence and Stability, CFL condition Homework session 1 and introduction to Matlab	PS AT, MA
Week 5	Tue	29 Jan	10-12	U41	Compressible flow I: Introduction to compressible flow, Euler equation, conservation laws, entropy	PS
	Wed	30 Jan	08-10	U51	Compressible flow II: Numerical methods for conservation laws, Stability, Dispersion, Diffusion	PS
	Mon W6	4 Feb	15-17	U41	Compressible flow III: Shock tube, boundary conditions, artificial viscosity Homework session 2	PS AT, MA
Week 6	Tue	5 Feb	10-12	U31	Compressible flow IV: Systems of conservation laws, Riemann Invariants	PS
	Wed	6 Feb	13-15	U51	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	7 Feb	15-17	U41	Finite volume and finite difference methods: Cartesian grid and spurious solutions. Homework session 3	AH AT, MA

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Week 7	Mon	11 Feb	15-17	U21	Staggered grid/volume formulation + BC. Steady incompressible flows: Artificial compressibility	AH
	Tue	12 Feb	10-12	U51	Projection on divergence-free space, Unsteady incompressible flows: projection method, discrete Poisson pressure eq.	AH
	Wed	13 Feb	13-15	U41	linear systems: Iterative methods, Gauss-Seidel as smothers for multi-grid	AH
	Thu	14 Feb	15-17	U21	Complex geometries, Coordinate transformation. Homework session 4	AH AT, MA
Week 8	Mon	18 Feb	15-17	U41	Unstructured Node-Centered FV: consistency and accuracy.	AH
	Tue	19 Feb	10-12	U31	Upwind schemes, Flux splitting	AH
	Thu	20 Feb	13-15	U41	High-order compact finite differences.	AH
	Thu	21 Feb	15-17	U41	Introduction of project Homework session 5	PS AT, MA
Week 9	Mon	25 Feb	15-17	U41	Project lecture	PS
	Tue	26 Feb	10-12	U51	Project supervision + extra topics	PS AT, MA
	Wed	27 Feb	13-15	U41	General Questions Demonstration of project	PS
	Thu	28 Feb	15-17	U41	Homework session 6	AT, MA
	Fri	15 Mar	14-18	D32- D35	Examination	
	Sat	8 Jun	9-13	U21	Re-exam	