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 Computational Fluid Dynamics (D. Henningson)
Introduction to Matlab (see homepage)

Grading:

Exam total max 50p, project (compulsory) 10p.

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

Exam open for registration 18-01-25 00:00 until 18-02-22 23:59

Web links:

https://kth.instructure.com/courses/4077

Homeworks: (5 of 6 are compulsory, approx. 75% correct in each HW to pass)

- 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 KTH Social for questions on homeworks!

Project (compulsory):

Project, due 23/3

Course plan

Week 3	Tue	16 Jan	13-15	U31	Fluid dynamics I: Introduction and outline of the course. Derivation of the governing equation.	AH
	Wed	17 Jan	15-17	U31	Fluid dynamics II Derivation of the governing equation, cont.	AH
	Thu	18 Jan	15-17	U31	Fluid dynamics III: Derivation of the governing equation, cont.	AH
Week 4	Mon	22 Jan	15-17	U21	Basic numerics I: Mathematical behavior of hyperbolic, parabolic and elliptic equation. Well-posedness.	PS
	Tue	23 Jan	13-15	U31	Basic numerics II: Discretization by finite differences. Analysis of discretized equation; order of accuracy, Convergence	PS
	Wed	24 Jan	15-17	U31	Basic numerics III: Analysis of discretized equation, cont.	PS
	Thu	25 Jan	15-17	U41	Analysis of discretized equations: Consistency, Convergence and Stability, CFL condition **Homework session and introduction to Matlab**	PS AT, MA
Week 5	Mon	29 Jan	15-17	U21	Compressible flow I: Introduction to compressible flow, Euler equation, conservation laws, entropy	PS
	Tue	30 Jan	13-15	U31	Compressible flow II: Numerical methods for conservation laws, Stability, Dispersion, Diffusion	PS
	Fri	2 Feb	13-15	U51	Compressible flow III: Shock tube, boundary conditions, artificial viscosity **Homework session**	PS AT, MA
Week 6	Mon	5 Feb	15-17	U41	Compressible flow IV: Systems of conservation laws, Riemann Invariants	PS
	Tue	6 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
	Wed	7 Feb	13-15	U31	Finite volume and finite difference methods: Cartesian grid and spurious solutions. **Homework session**	AH AT, MA

Week 7	Mon	12 Feb	15-17	U31	Staggered grid/volume formulation + BC. Steady incompressible flows: Artificial compressibility	AH
	Tue	13 Feb	13-15	U31	Projection on divergence-free space, Unsteady incompressible flows: projection method, discrete Poisson pressure eq.	AH
	Wed	14 Feb	13-15	U31	linear systems: Iterative methods, Gauss-Seidel as smothers for multi-grid	AH
	Thu	15 Feb	15-17	U31	Complex geometries, Coordinate transformation. **Homework session**	AH AT, MA
Week 8	Mon	19 Feb	15-17	U31	Unstructured Node-Centered FV: consistency and accuracy.	AH
	Tue	20 Feb	13-15	U31	Upwind schemes, Flux splitting	AH
	Wed	21 Feb	13-15	U31	High-order compact finite differences.	AH
	Thu	22 Feb	15-17	U41	Introduction of project **Homework session**	PS AT, MA
Week 9	Mon	26 Feb	15-17	U21	Project lecture	PS
	Tue	27 Feb	13-15	U31	Project supervision + extra topics	PS AT, MA
	Wed	28 Feb	13-15	U31	General Questions **Demonstration of project**	PS
	Thu	1 Mar	15-17	U41	**Homework session**	AT, MA
	Thu	15 Mar	8-12	Q34 Q33	**Examination**	
	Fri	8 Jun	8-12	E32	**Re-exam**	