Computational Fluid Dynamics (SG2212/SG3114), 7.5 ECTS

Lecturers:

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Erik Boström (EB), *erikbos@mech.kth.se*, KTH Mechanics, tel 790 7162

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

- *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 17-01-29 00:00 until 17-02-26 23:59

Web links:

https://www.kth.se/social/course/SG2212/

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

- Homework 1, due 24/1
- Homework 2, due 31/1
- Homework 3, due 7/2
- Homework 4, due 14/2
- Homework 5, due 21/2
- Homework 6, due 28/2

Please use KTH Social for questions on homeworks!

Project (compulsory):

Project, due 23/3

Course plan

Week 3	Tue	17 Jan	13-15	L52	Fluid dynamics I: Introduction and outline of the course. Derivation of the governing equation.	AH
	Wed	18 Jan	13-15	Q33	Fluid dynamics II Derivation of the governing equation , cont.	AH
	Thu	19 Jan	08-10	Q34	Fluid dynamics III: Derivation of the governing equation , cont.	AH
Week 4	Mon	23 Jan	08-10	L51	Basic numerics I: Mathematical behavior of hyperbolic, parabolic and elliptic equation. Well-posedness.	PS
	Wed	25 Jan	13-15	L52	Basic numerics II: Discretization by finite differences. Analysis of discretized equation; order of accuracy, Convergence	PS
	Thu	26 Jan	08-10	Q36	Basic numerics III: Analysis of discretized equation, cont.	PS
	Fri	27 Jan	08-10	Q31	Analysis of discretized equations: Consistency, Convergence and Stability, CFL condition **Homework session and introduction to Matlab**	PS EB, JC
Week 5	Mon	30 Jan	08-10	L52	Compressible flow I: Introduction to compressible flow, Euler equation, conservation laws, entropy	PS
	Wed	1 Feb	13-15	Q34	Compressible flow II: Numerical methods for conservation laws, Stability, Dispersion, Diffusion	PS
	Thu	2 Feb	08-10	V22	Compressible flow III: Shock tube, boundary conditions, artificial viscosity **Homework session**	PS EB, JC
Week 6	Mon	6 Feb	08-10	E2	Compressible flow IV: Systems of conservation laws, Riemann Invariants	PS
	Wed	8 Feb	13-15	Q31	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

Week 6	Thu	9 Feb	15-17		L52	Finite volume and finite difference methods: Cartesian grid and spurious solutions. Staggered grid/volume formulation + BC.	AH
	Fri	10 Feb	13-15		Q31	Steady incompressible flows: Artificial compressibility **Homework session**	AH EB, JC
Week 7	Mon	13 Feb	08-10		L52	Projection on divergence-free space, Unsteady incompressible flows: projection method, discrete Poisson pressure eq.	AH
	Wed	15 Feb	13-15		L52	linear systems: Iterative methods, Gauss-Seidel as smothers for multi-grid	AH
	Thu	16 Feb	08-10		Q36	Complex geometries, Coordinate transformation.	AH
	Fri	17 Feb	08-10		Q33	Unstructured Node-Centered FV: consistency and accuracy. **Homework session**	AH EB, JC
Week 8	Mon	20 Feb	08-10		L51	Upwind schemes, Flux splitting	AH
	Wed	22 Feb	13-15		V32	High-order compact finite differences.	AH
	Thu	23 Feb	15-17		Q31	Introduction of project **Homework session**	PS EB, JC
Week 9	Mon	27 Feb	08-10		E3	Project lecture	PS
	Wed	1 Mar	13-15		Q36	Project supervision + extra topics	EB, JC PS
	Thu	2 Mar	10-12		M33	General Questions **Demonstration of project**	PS
	Fri	3 Mar	08-10		V3	**Homework session**	EB, JC
	Sat	18 Mar	14-18		L51 L52	**Examination**	
	Thu	8 Jun	08-12		M23 M24	**Re-exam**	