Computational Fluid Dynamics (SG2212/SG3114), 7.5 ECTS

Lecturers:

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Assistants:

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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
- *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: 8 Feb - 22 Feb 2023. All students need to register!

Re-exam open for registration: 8 May - 22 May 2023. All students need to register!

Web links:

Canvas: https://canvas.kth.se/courses/37882

All lectures and exercises online via Zoom: https://kth-se.zoom.us/j/69100960780

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

- Homework 1, due 25/1
- Homework 2, due 1/2
- Homework 3, due 8/2
- Homework 4, due 15/2
- Homework 5, due 22/2
- Homework 6, due 1/3

Please use Canvas for questions and submission of homeworks!

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

Project, due 24/3 **This is the final date for any submission for SG2212/SG3114!**

Course plan

Week 3	Tue	17 Jan	15-17	Q21	1 Fluid dynamics I: Introduction and outline of the course. Derivation of the governing equation.	AH
	Thu	19 Jan	15-17	Q21	2 Fluid dynamics II Derivation of the governing equation, cont.	AH
	Fri	20 Jan	10-12	Q21	3 Fluid dynamics III: Derivation of the governing equation, cont.	AH
Week 4	Mon	23 Jan	15-17	Zoom	4 Basic numerics I: Mathematical behavior of hyperbolic, parabolic and elliptic equation. Well-posedness.	PS
	Tue	24 Jan	15-17	Zoom	5 Basic numerics II: Analysis of discretized equation; order of accuracy, Convergence	PS
	Thu	26 Jan	15-17	Zoom	6 Basic numerics III: Discretization by finite differences and modified wavenumber	PS
	Fri	27 Jan	10-12	Zoom U51	7 Basic numerics IV: Analysis of discretized equations: Consistency **Homework session 1 and introduction to Matlab**	PS AP, FM
Week 5	Mon	30 Jan	15-17	Zoom	8 Basic numeric V: Analysis of discretized equation, cont. Convergence and Stability, CFL condition	PS
	Thu	2 Feb	15-17	V23	9 Introduction to incompressible flow. Navier-Stokes in integral form. Finite volume and finite difference methods: Discretization of equations with first and second derivatives on arbitrary grids, equivalence with finite-differences.	AH
	Fri	3 Feb	10-12	Q21	10 Finite volume and finite difference methods: Cartesian grid and spurious solutions. Staggered grid/volume formulation + BC. **Homework session 2**	AH AP, FM
Week 6	Tue	6 Feb	15-17	Q21	11 Methods for incompressible flows: Stream function-Vorticity formulation, Artificial compressibility, projection method	AH
	Thu	9 Feb	15-17	V23	12 Linear systems: Iterative methods, Multi-grid	AH
	Fri	10 Feb	10-12	V23	13 Complex geometries: Coordinate transformation **Homework session 3**	AH AP, FM

Week 7	Tue	13 Feb	15-17	Q21	14 Unstructured Node-Centered FV: consistency and accuracy.	AH
	Tue	14 Feb	15-17	V23	15 Upwind schemes, Flux splitting High-order compact finite differences.	AH
	Thu	16 Feb	15-17	Zoom	16 Compressible flow I: Introduction to compressible flow, Euler equation, conservation laws, entropy	PS
	Fri	17 Feb	10-12	Zoom Q21	17 Compressible flow II: Numerical methods for conservation laws, Stability, Dispersion, Diffusion **Homework session 4**	PS AP, FM
Week 8	Mon	20 Feb	15-17	Zoom	18 Compressible flow III: Shock tube, boundary conditions, artificial viscosity	PS
	Tue	21 Feb	15-17	Zoom	19 Compressible flow IV: wave-like solutions, analysis in Fourier space	PS
	Thu	23 Feb	15-17	Zoom	20 Compressible flow V: Systems of conservation laws, Riemann Invariants	PS
	Fri	24 Feb	10-12	Zoom Q21	21 Introduction of project **Homework session 5**	PS AP, FM
Week 9	Wed	1 Mar	10-12	Zoom	22 Project lecture	PS
	Thu	2 Mar	15-17	V23	23 Open Foam demonstration	PS AP, FM
	Fri	3 Mar	10-12	Zoom	24 General Questions/additional topics **Demonstration of project**	PS
Week 10	Mon	6 Mar	15-17	V33	25 **Homework session 6**	AP, FM
Week 11			TBA	Oral	**Examination (TBA)**	PS, AH
Week 23			TBA	Oral	**Re-exam (TBA)**	PS, AH

Zoom link: https://kth-se.zoom.us/j/69100960780