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Lappeenranta University of Technology

Course	**Computational Fluid Dynamics, 3 ECTS credits**
Year and period	M. Sc.1-2, 31.7-4.8.2017
Teacher(s)	Professor Jari Hämäläinen, LUT Research associate Steffen Basting, TU Dortmund University Adjunct Professor Jari Järvinen, Silicom Ltd
Person(s) in Charge	Professor Jari Hämäläinen, LUT
Aims	*Panta rhei – everything flows*. But, how to model fluid flows and to solve them on a computer? The Computational Fluid Dynamics (CFD) course introduces the basic equations of fluid dynamics, and concentrates on numerical methods to solve those equations by finite element methods and practical implementations software. Our approach aims at being practical, without giving too many mathematical details. A major part of the course is based on exercises with CFD software. Also, industrial examples are given. After having passed this course the student is able to: - formulate the basic equations of fluid dynamics - select correct equations and parameters for different flow configurations including coupled problems - select numerical methods which work for the relevant type of equations - solve CFD problems in practice with open-source ELMER software
Content	During the course the student will become familiar with: - Conservation laws and general fluid dynamics equations. - Specific flow models valid for different flow configurations. - Basics of finite element methods. - Advanced numerical methods for CFD. - ELMER software (students can download and use it freely). The course is suitable also for doctoral studies.
Modes of Study	- Introductory lectures and exercises 24 hours - Team work and a limited project work 20 hours - Presentations of the results of the team work/ project work 8 hours - Independent work needed 26 hours Total workload 78 hours

Evaluation	Final grade 0 – 5. Evaluation: - project work 70 % - presentation 30 %
Study Materials	Lecture notes (provided in advance) and the book by Kuzmin, Hämäläinen: “Finite Element Methods for Computational Fluid Dynamics: A Practical Guide”, SIAM, (2014)
Prerequisites	Previous studies in mathematical modeling (based on partial differential equations) or numerical methods are recommended.