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COURSE: Fluid Mechanics for Internal Combustion Engines and Turbomachinery

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INSTRUCTOR: Annarita Viggiano

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e-mail: [annarita.viggiano@unibas.it](mailto:annarita.viggiano@unibas.it)

website: <http://oldwww.unibas.it/utenti/viggiano/viggiano.htm>

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Language: Italian

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ECTS: 9

n. of hours: 81

Academic year: 2014/2015

Campus: Potenza

Spring Semester

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#### TOPICS

Mathematical models for the study of turbulent reacting flows in fluid machinery.

Numerical schemes for computational fluid dynamics.

Applications to design and analysis of fluid machinery.

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#### TEACHING METHODS

x Theoretical lessons

x Tutorials in classroom

x Tutorials in laboratory

Project works

Technical visits

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#### TEXTBOOKS

1. D.C. Wilcox, Turbulence Modeling for CFD, Dcw Industries, 2006.

2. J.C. Tannehill, D. A. Anderson, R. H. Pletcher, Computational Fluid Mechanics and Heat Transfer, Taylor & Francis, 1997.

3. J.D. Anderson, Modern Compressible Flow: with Historical Perspective, McGraw-Hill, New York, 2002.

4. J.B. Heywood, Internal Combustion Engine Fundamentals, McGraw-Hill, New York, 1988.

5. Instructor's notes.

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#### ON-LINE EDUCATIONAL MATERIAL

web address: <http://oldwww.unibas.it/utenti/viggiano/viggiano.htm>

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#### LEARNING OUTCOMES

The purpose of this course is to provide the fundamentals of fluid dynamics, as applied to fluid machinery, and of Computational Fluid Dynamics (CFD) and to introduce students to the use of CFD for fluid machinery design and analysis.

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#### REQUIREMENTS

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#### EVALUATION METHODS

Intermediate verifications

Written examination

x Discussion of a project work

Practical test

x Oral examination

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#### DETAILED CONTENT

Fundamentals of fluid dynamics: conservation equations. Compressible and incompressible flows. Multicomponent mixtures flows. Introduction to turbulence. Energy cascade and dissipation at small scales. Kolmogorov's universal equilibrium theory. Kolmogorov scales. Direct numerical simulation of turbulence. Reynolds averaged Navier-Stokes equations. Turbulence models: algebraic models, one-equation models, two-equation models. Favre averaged equations. Introduction to LES and DES.

Computational fluid dynamics. Classification of PDE. Equilibrium problems and marching problems. Finite differences. Accuracy, consistency and stability of a numerical scheme. von Neumann analysis. Amplification factor. Modified equation: dissipation, dispersion and diffusion errors. Definition of convergence: Lax's equivalence theorem. Application of numerical schemes to the model equations. Finite volume methods. Computational grids. Initial and boundary conditions.

Applications of CFD to the design and analysis of internal combustion engines by using open source software.

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Università degli Studi della Basilicata  
**Scuola di Ingegneria**

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TENTATIVE EXAM SCHEDULE

04/02/2016; 24/03/2016; 05/05/2016; 09/06/2016; 21/07/2016; 29/09/2016; 27/10/2016; 01/12/2016

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SEMINARS BY EXTERNAL EXPERTS    YES     NO

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FURTHER INFORMATION

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