Freie Universität Bozen
Libera Università di Bolzano
Università Liedia de Bulsan

Syllabus
Course description

Course title	Advanced applications of fluid mechanics
Course code	46023
Scientific sector	ICAR/01
Degree	PhD in Sustainable Energy and Technologies
Semester	2
Year	1
Academic year	2019/2020
Credits	3
Modular	NO

Total lecturing hours	19
Total exercise hours	11
Attendance	Not compulsory
Prerequisites	Fundamentals of fluid mechanics
Course page	Reserve collection

Specific educational objectives	The students will have the opportunity to improve their knowledge on some specific topics that are generally not treated in depth in basic courses of fluid mechanics, such as turbulence and non-Newtonian fluids, with a special focus on energy engineering applications. A significant part of the course will be devoted to the explanation and utilization of advanced measuring methods used for fluid mechanics applications in laboratory and on field. In this way the candidates will acquire the competences necessary in order to design and carry out experimental measures on fluids within their research activity.

Lecturer	Giuseppe Pisaturo, Maurizio Righetti, Michele Larcher
Scientific sector of the lecturer	ICAR/01 (08/A1)
Teaching language	English
Office hours	Whole week, on appointment
Teaching assistant *(if any)*	
Office hours	
List of topics covered	The course will cover the following topics: • Turbulence insights - Description of turbulence, - Kinematics of fluid motion, - Reynolds averaged Navier-Stokes (RANS) equations, - Scaling of turbulent flows (free shear layers and boundary layers),

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	- Turbulence Modeling: Hierarchy of turbulence closures • Non-Newtonian fluids - General features - Granular systems - Fluidized beds - Granular segregation - Applications to gasification, combustion, industrial production, drying, cooling • Advanced measuring techniques in fluid mechanics - Experimental methods, e.g. Particle Image Velocimetry (PIV), Particle Tracking Velocimetry (PTV), Laser Doppler Anemometry (LDA), Ultrasonic Doppler Velocimetry (UDV)… - Experimental instruments - Experimental applications
Teaching format	Lectures and tutorials in class; experiments in the laboratory.

Learning outcomes	By the end of the course, students are supposed to be able to: - *Knowledge and understanding:* explain the main principles relevant to the topics addressed in the course; develop an intuitive comprehension. - *Applying knowledge and understanding:* give examples of real applications and practical problems to underline how the topics treated in the course are used within scientific and engineering activity. - *Making judgements:* show the ability to make autonomous judgements in the choice and comparison of the suitable methods and tools for the solution of scientific and engineering problems involving the mechanics of fluids. - *Communication skills:* communication skills to correctly and properly present the concepts acquired in the course and the analysis of experimental results. - *Learning skills:* Ability to autonomously extend the knowledge acquired during the study course by reading and understanding scientific and technical documentation.
Assessment	The assessment is based on a discussion on the topics covered within the course and on the presentation of the analysis of the results of the experimental activity.
Assessment language	English
Evaluation criteria and criteria for awarding marks	Students will be evaluated on the base of the oral discussion. Evaluation is based on a 30 points scale. At the examination, knowledge and understanding of the topic (25%), the attitude at applying knowledge and understanding (20%) and at making judgments (20%), the communication skills (20%) and the learning skills (15%) will be assessed.

Required readings	The topics will be sampled out of different books and scientific publications. Attending regularly the classes is highly recommended. Some material will be made available in the reserve collection.
Supplementary readings	C. Bailly & G. Comte-Bellot, Turbulence, Springer, 2015 S.B. Pope, Turbulent flows: Cambridge University Press, 2000. H. Tennekes & J.L. Lumley, A First Course in Turbulence. MIT Press, Cambridge 1972 J.O. Hinze, Turbulence, McGraw-Hill International Book Company, New York, 1975 Y.A. Çengel, & J.M. Cimbala, Fluid Mechanics – Fundamentals and Applications, 2006, McGraw-Hill F. Irgens, Rheology and Non-Newtonian Fluids, Springer, 2014 B. Andreotti, Y. Forterre & O. Pouliquen, Granular Media: Between Fluid and Solid, Cambridge University Press, 2013