Syllabus

Course Description

Course Title	Computational Thermo-Fluid Dynamics (CTFD)
Course Code	47562
Course Title Additional	
Scientific-Disciplinary Sector	IIND-07/A
Language	English
Degree Course	Master in Industrial Mechanical Engineering
Other Degree Courses (Loaned)	
Lecturers	Prof. Francesco Patuzzi, Francesco.Patuzzi@unibz.it https://www.unibz.it/en/faculties/engineering/academic-staff/person/30127
Teaching Assistant	
Semester	First semester
Course Year/s	1
CP	5
Teaching Hours	28
Lab Hours	18
Individual Study Hours	79
Planned Office Hours	15
Contents Summary	The course introduces the fundamentals of computational thermal-fluid-dynamic, by presenting and discussing the governing equations of fluid flow motion and heat transfer. Proper terms and definitions will be introduced, as well as the appropriate conservation principles needed to analyze a complete fluid-flow system. Particular emphasis will be given to the study of practical applications in industrial engineering, such as heat exchangers and cooling fins. Combustion principles and flame dynamics will be also discussed. During the course, both a bottom-up approach (starting from

	fundamental equations) and a top-down approach (starting from the system level) will be used. The concepts of computational fluid dynamic (CFD) will be presented by means of the application of numerical techniques to the solution of some practical fluid flow and heat transfer problems. A commercial CFD software will be presented and applied to illustrative fluid flow and heat transfer problems. Exercises proposed during the course consist in solving practical design problems with the aim of giving the students a deeper comprehension and understanding of the topics.
Course Topics	• Fundamental equations of fluid mechanics in differential and integral form and common approximations • Review of turbulence models • Review on modes of heat transfer • Computational thermo fluid dynamics and application to practical examples. • Heat exchangers: types, design principles, performance evaluation, numerical simulation • Cooling fins: fins performance parameters, parametric design, numerical simulation, effects of flow conditions • Combustion principles and introduction to flame dynamics.
Keywords	Simulation, Fluid Dynamics, Heat transfer
Recommended Prerequisites	The course integrates and complements topics of thermodynamics, heat transfer and fluid mechanics introduced in previous elective courses.
Propaedeutic Courses	
Teaching Format	The course consists of lectures in which the topics are presented by the professor. There are also classes (exercises) that will give practical examples of the application of the theoretical topics and the utilization of commercial software for computational fluid dynamic. Course topics will be presented at the blackboard and using electronic slides. Teaching material and additional materials will be provided by the Professor during the semester.
Mandatory Attendance	Not mandatory, but strongly recommended.
Specific Educational Objectives and Learning Outcomes	Learning outcomes (ILO): Through the study and the application of the topics presented during the lessons, students should acquire: 1. the knowledge and understanding of the fundamentals of

	thermo-fluid-dynamic 2. the ability to apply knowledge and understanding of the theoretical principles to the analysis of thermal-fluid systems 3. the ability to make autonomous judgements in the assessment of numerical solution of thermal-fluid systems 4. communication skills to correctly and properly present the concepts acquired in the course and to solve simple application problems regarding thermal-fluid systems 5. lifelong learning skills through the possession of the tools for the acquisition of technical information on the thermal-fluid systems and to update knowledge.
Specific Educational Objectives and Learning Outcomes (additional info.)	
Assessment	Examination of the course is carried out by means of an oral exam. The oral examination includes questions to assess the knowledge and understanding of the course topics and questions designed to assess the ability to transfer these skills to case studies and practical applications. Questions on practical applications also assess the ability of the student to apply the knowledge and understanding of the course topics, the ability to make judgments and finally, the student communication skills.
Evaluation Criteria	Students regularly enrolled at the 2nd year of the Master of Industrial and Mechanical Engineering are eligible for the attendance of the lessons and the exam. Other exceptional cases have to be discussed with the Professors. The student is asked to attend an oral exam. It is relevant for the oral exam to: master the specific language (also with respect to teaching language); prove the understanding of the topics and learning skills; evaluate and establish relationships between topics; grow specific skills in critical thinking. Regarding the practical applications, it is relevant to clearly describe suitable technical solutions and be able to make critical judgments and apply the theoretical concepts. The exam mark will be assessed as follows: oral exam.

Required Readings	• Notes taken during lecture • Notes written by the teacher during the lessons, that will be available in the online repository • M. Moran, H. Shapiro, B. Munson, D. DeWitt, Introduction to Thermal Systems Engineering: Thermodynamics, Fluid Mechanics, and Heat Transfer, Wiley • F. Incropera, D. DeWitt, Fundamentals of Heat and Mass Transfer, Wiley • G.F.C. Rogers, Yon Mayhew. Engineering Thermodynamics: Work and Heat Transfer, Pearson Education
Supplementary Readings	
Further Information	
Sustainable Development Goals (SDGs)	Affordable and clean energy, Quality education