Freie Universität Bozen
Libera Università di Bolzano
Università Liedia de Bulsan

Syllabus
Course description

Course title	Advanced Materials for Energy Engineering
Course code	
Scientific sector	ING-IND/22
Degree	Master in Energy Engineering
Semester	1
Year	*//*
Academic year	2017/2018
Credits	6
Modular	*No*

Total lecturing hours	30
Total lab hours	24
Total exercise hours	6
Attendance	No
Prerequisites	Students should be familiar with basic elements of general chemistry, physics and solid mechanics. Before attending the course, students should review their background on materials science, e.g. by reading some textbook (see basic bibliography) or any other equivalent source.
Course page	https://www.unibz.it/en/faculties/sciencetechnology/master-energy-engineering/

Specific educational objectives	The course is intended to give the student a broad scope preparation in *selecting* and *using* materials for applications in energy engineering. In more detail, besides theory and general knowledge, learning Ashby approach to materials selection is an objective. Students are trained in laboratory practices, with hands-on activities related to the topics discussed in the classroom teaching; therefore, further objectives are learning basics principles and how to use instruments, including: testing materials durability (e.g., microhardness, mechanical fatigue), modifying materials (e.g., by shot-peening), characterizing materials properties (e.g., residual stress by XRD and Hole Drilling methods); electrical and electrochemical testing of solar cells, batteries, fuel cells, hydrogen production, wind energy generation.

Lecturer	*Prof. Paolo Scardi, DICAM University of Trento, via Mesiano 77, Trento. Paolo.Scardi@unitn.it, 0461-282417*
Scientific sector of the lecturer	ING-IND/22

Teaching language	English
Office hours	When not lecturing
Teaching assistant *(if any)*	*Dr Elisa Cappelletto, Dr Eng Mirco D'Incau, same address,*
Office hours	When not lecturing
List of topics covered	Elements of materials science: classification and basic properties. Selection of materials based on their use and cost – Ashby diagrams and approach to materials selection based on specific applications. Production of energy. High-temperature materials (heat engines, e.g. turbines). Materials for direct generation (e.g. solar cells, fuel cells, wind power). Storage (batteries, supercapacitors, hydrogen carrier) and transport of energy (conductors, superconductors, insulators). Energy saving: influence of the choice of materials (thermal insulation). Aging, damage and failure of materials in exercise (e.g. creep, mechanical fatigue, cavitation, wear and corrosion).
Teaching format	*Frontal lectures, exercises and related laboratory practice. Each student is required to produce a report, individually or as a group activity, on each laboratory practice. Reports contribute to the assessment, see below.*

Learning outcomes	*Knowledge and understanding* • Learn materials by properties and application-based selection, with special attentions to applications in energy engineering *Applying knowledge and understanding* • Use concepts discussed and learned in the classroom lectures for the laboratory practice • Solve simple exercises and computations dealing with materials performance in selected energy-related applications *Making judgements* • Be able to select materials for specific applications • Use Ashby diagrams for materials selection *Communication skills* • Be able to produce a report on laboratory activity • Make and present a powerpoint projection on a specific topic of the course and/or a laboratory activity *Learning skills* • Be able to autonomously extend the knowledge acquired during the study course by reading and understanding scientific and technical documentation. • Carry out assigned jobs in the laboratory practice, independently and as part of a small team.

Assessment	The assessment of the course consists of two parts: • Preparation of a report on the laboratory activity. This can be done individually or as part of a team (groups of no more than 4 students) (50%): assessed with the correction and evaluation of the report; • Presentation of the laboratory activity and an assigned topic among the main ones presented in the study course (50%): assessed through a powerpoint presentation, followed by questions. Both parts must be positive to pass the exam. The final grade is the weighted average between the two parts. A positive evaluation of the report is a pre-requisite to access the oral exam (powerpoint presentation).
Assessment language	*English*
Evaluation criteria and criteria for awarding marks	A positive evaluation of the report on the laboratory activity is a pre-requisite to sit for the oral exam, which is given as a powerpoint presentation followed by discussion (questions/answers to specific topics regarding the presentation and main themes of the lectures given during the study course). The final grade is the weighted average of the report (50%) and the oral exam (50%). Both parts must be positive. • Criteria for the evaluation of the report: appropriate execution of the laboratory activity and correct description of results; methods and technologies used in the laboratory experience. • Criteria for the evaluation of the oral exam: quality of and correctness of the presentation. Ability to answer questions.

Required readings	There is no single textbook that covers the entire course. The course material is collected from various textbooks and research paper; lecture notes will be made available in advance (before each corresponding lecture). Useful textbooks include the following ones. For general reference: M. F. Ashby, Materials Selection in Mechanical Design, Butterworth-Heinemann, 2010. W. D. Callister, D. G. Rethwisch, Fundamentals of Materials Science and Engineering: An Integrated Approach, Wiley, 2012. Additional sources will be announced during the course.
Supplementary readings	Further sources – deeper insight: D. W. Bruce, D. O'Hare, R. I. Walton, Energy Materialas, Wiley, 2011. Additional sources will be announced during the course.