Freie Universität Bozen
Libera Università di Bolzano
Università Liedia de Bulsan

Syllabus
Course description

Course title	Energetics
Course code	42158
Scientific sector	ING-IND/10
Degree	Industrial and Mechanical Engineering
Semester	II
Year	///
Academic year	2019/20
Credits	8
Modular	*No*

Total lecturing hours	50
Total lab hours	-
Total exercise hours	30
Attendance	Strongly recomended
Prerequisites	Technical Physics
Course page	https://www.unibz.it/it/faculties/sciencetechnology/bachelor-industrial-mechanical-engineering/course-offering/?academicYear=2018

Specific educational objectives	The present course is a core teaching in the context of the Bachelor in Industrial and Mechanical Engineering (curriculum Energetics), in the specific area of Energy and Mechanical Engineering (Area delle Attivitá Formative Caratterizzanti, Thermal Engineering and Industrial Energy Systems, ING-IND/10). It specifically deals with the fundamental concepts of energetics, integrates and complements topics of thermodynamics and heat transfer introduced in previous elective courses and supplies some tools useful for energy auditing and for the design of energy systems. The course consists of 48 hours of frontal lectures and 32 hours of exercises. The lectures introduce the fundamentals of Energetics, by presenting and discussing main issues on the energy resources. Proper terms and definitions will be introduced. Comparative analysis of alternatives paths of energy generation and recovery will be presented Exergy concept and fundamentals will be also discussed in order to assess irreversibility losses in energy systems and provide an efficient tool for exergy efficiency assessment of plants. Thermodynamics of inverse cycles will be recalled with an

	in-depth presentation of refrigeration machines, heat pumps and their working fluids. Both vapor-compression and absorption technologies will be presented The knowledge on thermodynamics of gas mixture and psychrometry - already acquired by the students in previous elective courses - will be supplemented with advanced concepts in order to describe and discuss air conditioning cycles. Compressed air generation and distribution systems will be also presented. The layout of compressed air systems will be discussed along with the characteristics and energy performance of their components. 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.

Lecturer	Marco Baratieri, K0.03, marco.baratieri @unibz.it, 0471-017201 Francesco Patuzzi, francesco.patuzzi@unibz.it, 0471-017601
Scientific sector of the lecturer	ING-IND/10
Teaching language	English
Office hours	Mondays to Thursday, by appointment
Teaching assistant *(if any)*	-
Office hours	-
List of topics covered	The course will cover the following topics: • Energy resources and final uses. Energy vectors and users of an energy system. Comparative analysis of alternatives paths of energy generation and recovery. • Energy processes and applied thermodynamics. Exergy. General equations for energy and exergy balances. Irreversibility losses. Exergy efficiency assessment of energy plants. • Inverse cycles. Refrigeration machines and heat pumps. Working fluids. Vapor-compression and absorption systems. • Thermodynamics of gas mixtures. Psychrometry. Processes of moist air. Air conditioning cycles. Cooling Towers. • Compressed air generation and distribution systems. Layout of plants and characteristics of components.
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. 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.

Learning outcomes (ILOs)	The learning outcomes need to refer to the Dublin Descriptors: <u>Knowledge and understanding</u> 1. Knowledge and understanding of the fundamentals of energetics, the working principles and technical solutions regarding some significant energy engineering systems <u>Applying knowledge and understanding</u> 2. Applying knowledge and understanding to the solution of energy balances and for problem solving and design of significant engineering systems. <u>Making judgements</u> 3. Ability to make autonomous judgements in the assessment of suitable energy scenarios, in particular regarding energy plants design and operation <u>Communication skills</u> 4. Communication skills to correctly and properly present the concepts acquired in the course and to solve simple numerical application regarding energy systems <u>Ability to learn</u> 5. lifelong learning skills through the possession of the tools for the acquisition of technical information on the energy generation plants and to update knowledge.

Assessment	**Formative assessment** **Form** | **Length /duration** | **ILOs assessed** In class exercises and discussion | 32 hours (average duration 30-45 minutes/exercise) | 1, 2, 3, 4, 5

Summative 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.

Form	%	Length /duration	ILOs assessed
Written exam – exercises	33 %	60 minutes	1, 2, 3
Oral exam – theory	67 %	30 minutes	1, 2, 3, 4, 5

Assessment language

English

Evaluation criteria and criteria for awarding marks

Students regularly enrolled at the 3rd year of the Bachelor of Industrial and Mechanical Engineering (curriculum in Energetics) 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 a written and 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: 33% written exam, 67% oral exam.

Required readings

- Didactic materials will be provided by the professor during the course.
- G.F.C. Rogers, Yon Mayhew. Engineering Thermodynamics: Work and Heat Transfer, Pearson Education

	- K. Wark, Applied Thermodynamics for Engineers, McGraw-Hill - F. Incropera, D. DeWitt, Fundamentals of Heat and Mass Transfer, Wiley
Supplementary readings	-