Fakultät für Ingenieurwesen
Facoltà di Ingegneria
Faculty of Engineering

COURSE DESCRIPTION – ACADEMIC YEAR 2023/2024

Course title	**Engineering Thermodynamics and Heat Transfer**
Course code	42173
Scientific sector	ING-IND/11
Degree	Bachelor in Industrial and Mechanical Engineering
Semester	2
Year	2
Credits	10
Modular	

Total lecturing hours	64
Total lab/exercise hours	30
Attendance	Not compulsory
Prerequisites	
Course page	Microsoft Teams: https://teams.microsoft.com/l/team/19%3A_iPqPSQ_isBYgpoeYc-ZL3ukZsIf0hG15BdGNsH92ts1%40thread.tacv2/conversations?groupId=ff3269b6-9d29-471e-84a1-8182b256950e&tenantId=92513267-03e3-401a-80d4-c58ed6674e3b

Specific educational objectives	The course belongs to the type "caratterizzanti ". The aim of the course is to provide the students with a suitable knowledge of the general scientific contents, of the methods and of some specific professional skills. The course deals with the fundamentals of engineering thermodynamics, which are needed to understand the conventional and innovative energy conversion systems. The study of prime movers based on direct cycles (steam and gas cycles) and inverse cycle systems is presented. Fundamentals of heat transfer and heat exchanger design and operation and thermodynamics of moist air complete the course program. The students will learn theoretical concepts as well as acquire the ability to apply these concepts to some reference system calculations.

Lecturer	Andrea Gasparella, https://www.unibz.it/en/faculties/sciencetechnology/academic-staff/person/30619-andrea-gasparella Marco Baratieri, https://www.unibz.it/en/faculties/sciencetechnology/academic-staff/person/27442-marco-baratieri
Contact	Andrea Gasparella, K0.08, andrea.gasparella@unibz.it

	0471 017200 Marco Baratieri, K0.03, marco.baratieri@unibz.it 0471 017201
Scientific sector of lecturer	Andrea Gasparella (ING-IND/11) Marco Baratieri (ING-IND/10)
Teaching language	English
Office hours	Monday to Wednesday by appointment
Lecturing Assistant (if any)	-
Contact LA	-
Office hours LA	-

List of topics	• Introduction to measurement theory
	  • Measurement and units
	  • Uncertainty
	  • Systems of measurement units
	• Fundamentals of thermodynamics
	  • Thermodynamic systems/processes (non-flow/flow) and quantities (state and path functions)
	  • Work, heat, 0^{th} law
	  • First law and applications
	  • Second law and applications
	• Operating fluids
	  • Ideal gas
	    • Properties and processes
	    • reciprocating compressors
	  • Phase change fluids
	    • Properties, processes, state diagrams (p-v-t, T-s, h-s)
	• Reference direct cycles
	  • Vapour cycles (Carnot, Rankine cycles)
	  • Gas cycles (Otto, Diesel, Brayton-Joule)
	• Reference reversed cycles
	  • Vapour cycles
	  • (Gas cycles)
	• Heat transfer
	  • Conduction
	  • Convection
	  • Radiation
	• Global heat transfer
	  • Mechanisms
	  • Extended surfaces
	  • Heat exchangers
	• (Thermodynamics of moist air)
	  • (Gas and vapour mixtures and thermodynamic properties)
	  • (Reference processes)
	  • (Winter and summer air conditioning cycles)

Teaching format	The course consists of classroom lectures introducing theoretical concepts and exercise classes providing numerical examples of technical application. Lectures format includes blackboard, slides, videos, etc. Integrative teaching material (handhouts) will be available for the students through the teams file repository.

Learning outcomes	The learning outcomes need to refer to the Dublin Descriptors: Knowledge and understanding 1. Knowledge and understanding of the fundamentals topics dealing with technical systems' energy balance, heat transfer mechanisms and thermodynamic processes. Applying knowledge and understanding 2. Applying knowledge and understanding to the solution of energy balance analysis and to the quantification of energy fluxes within and among physical systems Making judgements 3. Making judgments through the acquisition of the basics of the thermodynamic analysis of complex systems and the analysis approach based on simplification and de-structuration. Communication skills 4. Communication skills dealing with the correct use of highly specific terms and definitions, including the correct use and conversion of the units of measurement Ability to learn 5. Lifelong learning skills through the comparison of different sources, and engineering methods and the acquisition of a critical sense

Assessment

Formative assessment

Form	Length /duration	ILOs assessed
In class exercises and discussion	30 hours (average duration 30 minutes/exercise)	1, 2, 3, 4, 5

Summative assessment

The exam consists of two written parts.

The first deals with the solution of a well-structured numerical exercise related to the calculation of energy balance and exchanges of the technical systems considered in the course. This way we can assess the ability of the student of applying the knowledge and understanding of the analysis and solution techniques, and of making judgment and to correctly use the units of measurement.

	The second one consists of some open questions dealing with theoretical aspects of each main topic of the course (engineering thermodynamics, heat transfer, thermodynamics of moist air). This way the knowledge and understanding of the fundamental topics, the written communication skills are assessed

Form	%	Length /duration	ILOs assessed
Written exam – numerical exercise	33%	1 exercises (1 hour)	1, 2, 3
Written exam – theory	67%	3 open-ended questions (1.5 hours)	1, 2, 3, 4, 5

Assessment language	English
Assessment Typology	Examination committee
Evaluation criteria and criteria for awarding marks	To the admission to the second part the first one has to be successfully passed. The first part (numerical exercise) consists of six numerical questions. The answer is correct when the number provided is within a given tolerance with respect to the reference value. Each student works on the same problem but with personal starting data. The evaluation is based on the accuracy of the numerical result of each question. The starting mark is assigned considering 3 points per each correct answer (starting from 12). The score of this part contributes for 1/3 to the final mark. In the second part, each question – out of the proposed 3 – concerns a different section of the program (applied thermodynamics, heat transfer, thermodynamics of moist air). It equally contributes to the mark, with the exception of one of the 3, which is 4/3 of the others- and requires some steps to prove a proposition. The evaluation is based on the completeness of the answer in terms of 1) definition of the subject 2) analytical description 3) graphical and mathematical representations 4) proof (if required) The score of this second part contributes for 2/3 of the final mark.

Required readings	Teacher's handouts and booklets (available in the reserve collection)
Supplementary readings	• G.F.C. Rogers, Yon Mayhew. Engineering Thermodynamics: Work and Heat Transfer (4th Edition/or later) Pearson Education (1996) • F. Incropera, D. DeWitt, Fundamentals of Heat and Mass Transfer (5th Edition/or later) Wiley (2002)
Software used	