Freie Universität Bozen
Libera Università di Bolzano
Università Liedia de Bulsan

Syllabus
Course description

Course title	Engineering Thermodynamics, Heat and Mass Transfer
Course code	45505
Scientific sector	ING-IND/10 "Thermal Engineering and Industrial Energy Systems"
Degree	Master Energy Engineering
Semester	1
Year	1
Academic year	2021/2022
Credits	6
Modular	No

Total lecturing hours	36
Total lab and exercise hours	24
Attendance	Not mandatory
Recommended preliminary knowledge	None
Connections with other courses	The course builds up on basic knowledge on Thermodynamics on Bachelor degree level and sets the basis for the courses Building HVAC Systems, Power Production, CHP and District Heating Systems as well as Advanced Applications of Building Physics
Course page	

Specific educational objectives	This course covers the topics related to the fundamentals of thermodynamics (Zeroth and First Laws of Thermodynamics, Ideal gases), the Second law of Thermodynamics, Heat Transfer, Real Working Fluids, Mixtures and Moist Air, Thermodynamic Cycles without and with Phase Change, Heat Exchanger, Heat Pumps, Heat and Mass Transfer. Emphasis is laid on the deeper technical understanding of thermodynamic problems including the apparatus and the application of dedicated software.

Lecturer	Fabian Ochs
Scientific sector of the lecturer	ING-IND/10
Teaching language	English
Office hours	Appointment by email
Teaching assistant *(if any)*	-
Office hours	-
List of topics covered	Repetition of basic thermodynamics concepts, Introduction EES/Matlab, Second Law, thermodynamic cycles, Heat Pump (basic thermodynamics), Psychrometrics, Introduction to Matlab/CoolProp, Mixtures.

	Heat transfer (conduction, convection, radiation), Heat exchanger, Combustion, heat pumps (applied thermodynamics, how components realize technically the thermodynamic process) Mass Transfer (Introduction to diffusive mass transfer, convective mass transfer)
Professional applications of the covered topics	The basic knowledge provided by the course can be applied in planning companies, HVAC industry as well as for energy related software developing.
Teaching format	Oral presentation and excercises

Learning outcomes	**(1) Knowledge and understanding** Knowledge of basics of thermodynamics and heat and mass transfer, with/without phase change. Knowledge of key factors for different thermal devices and systems, in particular, heat exchangers and heat pumps. **(2) Applying Knowledge and understanding** Analyzing the technical approach to thermodynamic problems of different appliances (space heating surfaces, heat pumps …). The exercise part provides instruction on the calculation methods for thermodynamic problems as well as the calculation of various explicit examples on the white board and with computers (energy modelling). **(3) Making judgements** Autonomous judgement will be enhanced by means of the knowledge of basic concepts and analytical approaches applied to thermodynamic systems. **(4) Communication skills** The student will be able to discuss the learned knowledge with vocabulary and technical terms of the discipline. **(5) Ability to learn** Capability of autonomous study of heat and mass transfer phenomena and mechanisms applied in thermal devices and systems.
Assessment	**Group project work** Students develop in groups (2 to max 4 students) an energy related project and apply the theoretic knowledge to engineer and model a thermodynamic component (e.g. heat pump) for a typical application (e.g. house heating).

Formative assessment

Form	Length /duration	ILOs assessed
Development of the group project work	During the course	(2), (3), (5)

Summative assessment

Form	%	Length /duration	ILOs assessed
Presentation of the group project work	100	About 1 hour	All except (5).

Assessment language

English

Evaluation criteria and criteria for awarding marks

The knowledge and the ability of applying knowledge will be assessed through the developed project, aimed also at checking the ability to use the correct technical vocabulary and analyze thermodynamic and heat and mass transfer problems.

The evaluation is based on the developed model (including documentation) and the final presentation, which includes
- Introduction to the problem
- Description of the Model
- Implementation
- Case Study
- Sensitivity analysis
- Discussion of the results
- Summary and Conclusions

Table: Evaluation Key

1	Complexity of Topic	10
2	Relevance of Topic	5
3	Description of Problem and Approach	20
4	Model with Comments	25
5	Presentation of Results	15
6	Sensitivity Analysis	10
7	Presentation	15
	Sum	100

Required readings	Lecture book
Supplementary readings	• Müller, I., Müller, W. 2009, Fundamentals of Thermodynamics and Applications: With Historical Annotations and Many Citations from Avogadro to Zermelo, Springer Verlag • VDI Wärmeatlas, Springer Verlag • Nellis, G., Klein, S., Heat Transfer, 2008 Cambridge University Press • Baehr, H.D., Kabelac, St. 2005, Thermodynamik, Springer Verlag • P.K. Nag, 2005, Engineering Thermodynamics, Tata McGraw-Hill Education