Syllabus

Kursbeschreibung

Titel der Lehrveranstaltung	Power Production, CHP and District Heating Systems
Code der Lehrveranstaltung	45510
Zusätzlicher Titel der Lehrveranstaltung	
Wissenschaftlich-disziplinärer Bereich	NN
Sprache	Englisch
Studiengang	Master in Energie-Ingenieurwissenschaften
Andere Studiengänge (gem. Lehrveranstaltung)	
Dozenten/Dozentinnen	Prof. Marco Baratieri, Marco.Baratieri@unibz.it https://www.unibz.it/en/faculties/engineering/academic-staff/person/27442 Prof. Massimiliano Renzi, Massimiliano.Renzi@unibz.it https://www.unibz.it/en/faculties/engineering/academic-staff/person/32541
Wissensch. Mitarbeiter/Mitarbeiterin	
Semester	Erstes Semester
Studienjahr/e	2
KP	12
Vorlesungsstunden	72
Laboratoriumsstunden	48
Stunden für individuelles Studium	214
Vorgesehene Sprechzeiten	
Inhaltsangabe	The courses "Engineering Thermodynamics, Heat and Mass Transfer" and "Fluid Machines Engineering", offered in the first semester, supply the main concepts of Engineering

	Thermodynamics and Fluid Machines. These topics are deepened in the Power Production, CHP and District Heating Systems course and specific and practical applications of power conversion systems are presented. The know-how acquired in the present course will be useful to follow the curricular courses "District Heating System Design" and "Bioenergy" and the elective course "Electric and hybrid mobility".
Themen der Lehrveranstaltung	The Power Production, CHP and District Heating Systems course is a core teaching in the context of the Master in Energy Engineering and, specifically, it deals with the industrial plants used for electric and thermal power production both for small scale and community scale appliances. The course consists of two modules. The first module starts with the description of the main energy resources with a particular focus on renewable sources. Then, fundamentals of energy conversion are presented, along with the working principles and the main operational aspects of the most used cogeneration plants both for large scale and for small scale distributed generation. Thermochemical processes are analyzed by means of thermodynamic and kinetic approaches, as well as direct conversion technologies. Technical aspects of power generation systems and solutions to improve their energy and environmental performance are presented, dealing also with constructive aspects, plant operation and management issues and heat distribution networks. The second module introduces the fundamental concepts of cogeneration and presents the most used cogeneration solutions for civil and industrial applications. The working principles of the core devices of power production plants are presented. The main mechanical, fluid-dynamic and energy conservation principles and equations will be described and applied to the presented components of the power production plant. In particular, the following educational objectives will be addressed: constructive aspects, behavior of the fluid machines employed in power production plants, components, thermo-fluid-dynamic laws, evaluation of the plant performance in design and off-design operating conditions.
Stichwörter	Power Production; Cogeneration; Thermochemical processes;

	Energy conversion; Heat distribution networks
Empfohlene Voraussetzungen	Engineering Thermodynamics, Heat and Mass Transfer Fluid Machine Engineering
Propädeutische Lehrveranstaltungen	
Unterrichtsform	Module A - "Thermal Engines" This is a lecture course in which topics are presented by the Professor. Practical parts are explained by the Professor and the Teaching Assistants (if present). Power Point presentations will be given to the students in pdf format before each single lecture. Additional material will be provided by the Professor. Module B - "Thermal Power Production and Distribution" 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 theoretical topics. Course topics will be presented on the blackboard and using electronic slides. Teaching material and additional materials will be provided by the Professor during the semester.
Anwesenheitspflicht	Attendance not mandatory
Spezifische Bildungsziele und erwartete Lernergebnisse	Intended Learning Outcomes (ILO) Knowledge and understanding Students should acquire the knowledge and the understanding of: 1. the most important separate-generation and co-generation plant configurations for centralized or small and community scale power production, considering their energy and environmental performance 2. the fundamental plant components used in power production plants and their operative function 3. the fundamental design principles of the core components, their integration in a complex plant and the use of power plants in industrial and civil applications Applying knowledge and understanding 4. the ability to apply basic thermodynamic, kinetic and fluid-dynamic laws to the design of the components of power production plants

	5. the ability to apply the studied power production plants to industrial and civil users Making judgements 6. to be able to make autonomous judgements in the choice of the design solutions, of the suitable machines and of the plant solutions in relation to their applications Communication skills 7. the ability to correctly and properly present the concepts acquired in the course both in written and oral form 8. the ability to use the proper technical terms to describe the design solutions of the power production plants. Ability to learn 9. the ability to acquire lifelong learning skills in the field of power production plants and cogeneration by applying the methods and the concepts acquired in the course
Spezifisches Bildungsziel und erwartete Lernergebnisse (zusätzliche Informationen)	
Art der Prüfung	The student is asked to produce a project work on the design of an energy system (also integrating the topics of the other module of the course); this part of the assessment evaluates the ability of the student to apply the topics of the course in practical applications, the comprehension of the theoretical concepts and the ability to make judgments. The student is also asked to carry out an oral exam for each module of the course. 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 of energy plants and thermal and electric energy production devices. Formative assessment Form Length /duration ILOs assessed In class exercises 24 X 60 minutes 3,4,5

	Summative assessment Form % Length /duration ILOs assessed Oral exam – theory 70% 2 or 3 open-end questions per each module (1 hour) 1,2,3,4,5,7,8 Project work presentation 30% Presentation and discussion (30 minutes) 4,5,6,7,8,9
Bewertungskriterien	Assessment language: English Students regularly enrolled in the 2nd year of the Master in Energy Engineering are eligible for the attendance of the lessons and the exam. Other exceptional cases have to be discussed with the Professor. Oral exam – theory (open-end questions): The oral exam on the theory assesses the knowledge and understanding of the course topics, the knowledge of the fundamentals of conversion technologies, of the operating principle and the design choices of energy production plants for community scale and small-scale cogeneration, as well as the ability to transfer these skills to case studies and to make judgment. The following criteria will be considered: - Correctness of the design choices - Correctness of the dimensioning procedure - Correctness of the numerical solution - Appropriate use of measurement units - Theoretical knowledge - Ability to provide examples/applications of the theoretical concepts Project work presentation: The following criteria will be taken into account: - Theoretical knowledge - Ability to provide examples/applications of the theoretical concepts - Communication skills and master of the technical language The final mark will be weighted as follows: oral exam (70%,

	equally weighted for each module), project work presentation (30%). It will not be possible to pass the exam if the oral exam of both the modules has not been positively evaluated.
Pflichtliteratur	Slides of the courses
Weiterführende Literatur	• G. Rogers, Y. Mayhew. Engineering Thermodynamics: Work and Heat Transfer. LongmaN Scientific. • F. P. Incropera, D.P. DeWitt, T. L. Bergman, A. S. Lavine. Fundamentals of Heat and Mass Transfer. John Wiley & Sons. • J.M. Smith, H. C. Van Ness, M. Abbott. Introduction to Chemical Engineering Thermodynamics. McGraw-Hill Series in Civil and Environmental Engineering. • J. Warnatz, U. Maas, R. W. Dibble. Combustion: Physical and Chemical Fundamentals, Modeling and Simulation, Experiments, Pollutant Formation. Springer. • H. Spliethoff, Power generation from solid fuels. Springer. • R. Kehlhofer, F. Hannemann, F. Stirnimann, B. Rukes, Combined cycle Gas and Steam Turbine Power Plants, PennWell, 2009. • J. Heywood, Internal Combustion Engine Fundamentals, Mcgraw Hill, 1988. • G. Negri di Montenegro, M. Bianchi, A. Peretto, Sistemi energetici e loro componenti. Considerazioni teoriche e valutazioni numeriche, Pitagora Editrice, Bologna, 2003. • S. Sandrolini, G. Naldi, Macchine. Vol. 3: Gli impianti motori termici e i loro componenti, Pitagora Editrice, Bologna, 2003.
Weitere Informationen	Connections with other courses: The courses "Applied Energetics" and "Fluid Machines Engineering", offered in the first semester, supply the main concepts of Engineering Thermodynamics and Fluid Machines. These topics are deepened in the Power Production, CHP and District Heating Systems course and specific and practical applications of power conversion systems are presented. The know-how acquired in the present course will be useful to follow the curricular courses "District Heating System Design" and "Bioenergy" and the elective course "Electric and hybrid mobility". Professional applications of the covered topics: The knowledge acquired through the first module (Thermal Power

	Production and Distribution) can be applied in the design and management of thermal plants and industrial energy systems. The related professional tasks are relevant to traditional and innovative technologies for thermal power generation, e.g. combustion, gasification and pyrolysis. The competences can be deployed in private engineering companies, in public agencies, in utilities companies, as well as in the industry. The contents of the second module (Thermal engines) will be useful for all the professional tasks, in the industry or in the public sector, related to the use of power plants and fluid machines in the energy conversion process. Typical jobs can be related to the design of cogeneration systems, boilers, fluid machines for power conversion (steam and gas turbines, combustion engines), management and control of power plants. These competences are necessary in the companies designing, managing and maintaining power plants, in utilities' companies and in the industries designing components and solutions for the power conversion.
Ziele für nachhaltige Entwicklung (SDGs)	Bezahlbare und saubere Energie, Industrie, Innovation und Infrastruktur, Maßnahmen zum Klimaschutz, Nachhaltiger Konsum und Produktion, Nachhaltige Städte und Gemeinden

Kursmodul

Titel des Bestandteils der Lehrveranstaltung	Thermal Engines
Code der Lehrveranstaltung	45510A
Wissenschaftlich-disziplinärer Bereich	ING-IND/08
Sprache	Englisch
Dozenten/Dozentinnen	Prof. Massimiliano Renzi, Massimiliano.Renzi@unibz.it https://www.unibz.it/en/faculties/engineering/academic-staff/person/32541
Wissensch. Mitarbeiter/Mitarbeiterin	
Semester	
KP	6
Verantwortliche/r Dozent/in	

Vorlesungsstunden	36
Laboratoriumsstunden	24
Stunden für individuelles Studium	90
Vorgesehene Sprechzeiten	
Inhaltsangabe	The Thermal Engine module is intended to give the students the design solutions for both large scale plants and small micro-cogeneration units for the local and distributed generation. The traditional fossil fuel feeding and the alternative or renewable energy feeding of the generation devices will be presented.
Themen der Lehrveranstaltung	The course will cover the following topics: • Energy auditing and cogeneration indexes • Gas turbine plants design and microturbines • Internal combustion engine co-generators • Traditional and low temperature steam cycles • Combined cycles • External combustion thermal engine co-generators The contents of this module will be useful for all the professional tasks, in the industry or in the public sector, related to the use of power plants and fluid machines in the energy conversion process. Typical jobs can be related to the design of cogeneration systems, boilers, fluid machines for power conversion (steam and gas turbines, combustion engines), management and control of power plants. These competences are necessary in the companies designing, managing and maintaining power plants, in utilities' companies and in the industries designing components and solutions for the power conversion.
Unterrichtsform	This is a lecture course in which topics are presented by the Professor. Practical parts are explained by the Professor and the Teaching Assistants (if present). Power Point presentations will be given to the students in pdf format before each single lecture. Additional material will be provided by the Professor.
Pflichtliteratur	Slides of the courses
Weiterführende Literatur	

Kursmodul

Titel des Bestandteils der Lehrveranstaltung	Thermal Power Production and Distribution
Code der Lehrveranstaltung	45510B
Wissenschaftlich-disziplinärer Bereich	ING-IND/10
Sprache	Englisch
Dozenten/Dozentinnen	Prof. Marco Baratieri, Marco.Baratieri@unibz.it https://www.unibz.it/en/faculties/engineering/academic-staff/person/27442
Wissensch. Mitarbeiter/Mitarbeiterin	
Semester	
KP	6
Verantwortliche/r Dozent/in	
Vorlesungsstunden	36
Laboratoriumsstunden	24
Stunden für individuelles Studium	90
Vorgesehene Sprechzeiten	18
Inhaltsangabe	The Thermal Power Production and Distribution module is intended to give the students the fundamentals of energy conversion processes from fossil or renewable sources to thermal power in centralized and distributed generation systems.
Themen der Lehrveranstaltung	The course will cover the following topics: • Fuels and energy vectors • Fundamentals of thermochemical conversion • Fundamentals of direct conversion • Cogeneration and polygeneration systems • Thermal energy distribution The knowledge acquired through this module can be applied in the design and management of thermal plants and industrial energy systems. The related professional tasks are relevant to traditional

	and innovative technologies for thermal power generation, e.g. combustion, gasification and pyrolysis. The competences can be deployed in private engineering companies, in public agencies, in utilities companies, as well as in the industry.
Unterrichtsform	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 theoretical topics. Course topics will be presented on the blackboard and using electronic slides. Teaching material and additional materials will be provided by the Professor during the semester.
Pflichtliteratur	Slides of the courses
Weiterführende Literatur	