Syllabus

Descrizione corso

Titolo insegnamento	Applied Mechanics and Technologies for Energy Efficiency
Codice insegnamento	45531
Titolo aggiuntivo	
Settore Scientifico-Disciplinare	
Lingua	Inglese
Corso di Studio	Corso di laurea magistrale in Ingegneria energetica
Altri Corsi di Studio (mutuati)	
Docenti	prof. dr. Erwin Rauch, Erwin.Rauch@unibz.it https://www.unibz.it/en/faculties/engineering/academic-staff/person/17786 dott. Roberto Belotti, Roberto.Belotti@unibz.it https://www.unibz.it/en/faculties/engineering/academic-staff/person/38331 dott. Davide Don, Davide.Don@unibz.it https://www.unibz.it/en/faculties/engineering/academic-staff/person/49990
Assistente	
Semestre	Primo semestre
Anno/i di corso	2
CFU	12
Ore didattica frontale	68
Ore di laboratorio	48
Ore di studio individuale	0
Ore di ricevimento previste	
Sintesi contenuti	Module 1 - Basic knowledge about the main features of power generation, storage, and distribution plants.

	Module 2 - The course aims to give guidelines for the functional design of automatic machines, in particular taking into account mechanical efficiency. Criteria and methods to analyze and choose mechanical devices, design motion laws and evaluate the best system to minimize energy dissipation in electromechanical systems will be addressed.
Argomenti dell'insegnamento	Module 1: Basic knowledge about the main features of power generation, storage, and distribution plants. Examination of the production processes (both conventional and advanced) used to yield components and assemblies in the energy engineering field, including: a) gas power generation plants. b) solar power plants. c) eolic plants. d) tanks and pressure containers for energy storage. e) tube and piping for energy distribution. f) electric energy distribution. Module 2: • Introduction: Introduction to functional design, classification of the mechanisms and motion systems. • Basic concepts and definitions. Mechanical efficiency, performance, energy efficiency and energy savings in automatic machines. Direct/reverse energy flow and motor–load systems. • Mechanical components for transferring and transforming energy. Classification is based on function, working principle as well as performance and efficiency. • Optimization is aimed at improving the quality of motion and efficiency. • Energy storage systems and energy recovery. Classification (working principle and scope of use). • Classification of motion laws implemented in automatic machines. An analysis of the main requirements in the design of motion law and its optimization.
Parole chiave	Mechanical elements of energy plants; tanks; tubes and piping; mechanical functional design; automatic machines
Prerequisiti	Module 1: students should be familiar with the basic knowledge of

	mathematical analysis. Module 2: Some knowledge of electrical machines is preferred, e.g. the content of the course "Electric Power Conversion Equipment".
Insegnamenti propedeutici	
Modalità di insegnamento	The course is based on hours of frontal lectures and hours dedicated to classroom and/or laboratory activities. The topics of the course are reported in the lecture notes provided by the professor, as well as in the textbooks of the bibliography. After each lecture, the corresponding pdf presentation will be posted in the Reserve Collection database. The professor can also provide additional material (e.g., research papers). The professor can be contacted by students for questions and clarifications by appointment.
Obbligo di frequenza	Strongly recommended.
Obiettivi formativi specifici e risultati di apprendimento attesi	- Module 1: Knowledge and understanding: Students will 1. acquire a knowledge about some important production processes used for the fabrication of the main mechanical assemblies and components in the energy industry. 2. be able to identify the advantages and limitations of these industrial production processes. 3. acquire a basic knowledge of the production process Applying Knowledge and understanding: 4. Students will be able to select some manufacturing processes to be used in the energy industry. 5. Students will have the ability to apply their knowledge to identify which are the main systems and issues of a production process. 6. The exercises in the classroom, progress tests, conversations with the teacher, and the performance of specific tasks would allow us to assess and evaluate the student's ability to apply his knowledge and understanding of the topics covered during the course. Making judgments: Students will acquire an autonomy of judgment that will allow him 7. to select proper manufacturing processes for the fabrication of

	some mechanical assemblies and components in the energy engineering field. 8. to examine objectively the results obtained from analytical processing, numerical simulations or experimental laboratory tests. 9. to make use of technical and scientific literature. Communication skills: 10. Students will have the ability to structure and prepare scientific and technical documentation inherent to the selection of some manufacturing processes used in the energy engineering field. 11. students will have the ability to present, communicate, discuss and argue the topics covered in the course. Learning skills: 12. The students will develop learning skills through the individual study of the topics dealt with in the lecturing and exercise hours. In addition, the analysis of different problems related to the fabrication of mechanical components for the energy engineering field will also be addressed by group discussions. 13. The students will have the opportunity to extend the knowledge of the topics of the course by consulting scientific literature, specialized texts, technical standards and international standards that the professor will provide during the course. - Module 2: The course aims to give guidelines for the functional design of automatic machines, in particular taking into account mechanical efficiency. Criteria and methods to analyze and choose mechanical devices, design motion laws and evaluate the best system to minimize energy dissipation in electromechanical systems will be addressed. 1. Knowledge and Understanding • Identify the main components of transmission systems and sources of inefficiency • Understand the basic principles of energy storage, recovery and redistribution systems. 2. Applying knowledge and understanding • Evaluate and select the proper transmission system considering

	mechanical and energy efficiency. 3. Making judgments • Select and design an effective motion law under different working conditions and targets. • Choose a suitable combination of mechanical and electric components for energy transformation and transfer 4. Communication skills • Ability to structure and prepare scientific and technical documentation 5. Learning skills • Ability to independently build upon the knowledge acquired during the study course by reading and understanding scientific and technical documentation.
Obiettivi formativi specifici e risultati di apprendimento attesi (ulteriori info.)	
Modalità di esame	- Module 1: - Formative assessment In class discussion about the topics covered during the course (ILOS assessed 1,2,3,6,12). - Summative assessment The assessment of the course is: • Oral exam (ILOS assessed 4,5,7,8,11) The oral exam consists of 2 or 3 open-end questions to assess the knowledge and understanding of the topics of the course and the ability of the student to present, communicate, discuss and argue the basics of industrial plant systems and of some industrial processes used in the energy industry. Moreover, the student will should reflect on the characteristics of a production process and its limitations in terms of product quality, cost and so forth. - Module 2: - Formative assessment In-class exercises: continuosly in exercise courses; ILOs assessed: 1, 2, 3, 4, 5. - Summative assessment Written exam: 3 h; ILOs assessed: 1, 2, 3, 4, 5.
Criteri di valutazione	- Module 1:

	The evaluation criterion of the oral exam is based on the knowledge of the topics of the course, the clarity of the response and the properties of language of the student (in relation to the language of the course), the pertinence and the relevance of the response, and the autonomy of judgment. - Module 2: The written examination will include both theoretical questions and numerical exercises to show the ability to solve problems handled on this course. Written examination: Theoretical knowledge (35%) Correctness of methods (30%) Correctness in solution (30%) Appropriate use of units (5%)
Bibliografia obbligatoria	Module 1: There is no single textbook that covers the entire course. A collection of suggested readings from various sources will be announced during the course. Module 2: Slides provided to the students after each lecture and notes taken by students during lecture
Bibliografia facoltativa	Module 1: Additional textbooks, lecture notes, research papers and readings may be provided by the professor. Module 2: A collection of suggested readings from various sources will be announced during the course. Such sources will be papers, manuals, technical notes, and excerpts from textbooks, including · Biagiotti, Luigi, and Claudio Melchiorri. Trajectory planning for automatic machines and robots. Springer Science & Business Media, 2008. · Norton, Robert L. Kinematics and dynamics of machinery. McGraw Hill Higher Education, 2009. · Filizadeh, S. Electric Machines and Drives: Principles, control, modelling and simulation. CRC Press, 2013.
Altre informazioni	
Obiettivi di Sviluppo	Energia rinnovabile e accessibile, Lotta contro il cambiamento

Sostenibile (SDGs)	climatico, Utilizzo responsabile delle risorse, Innovazione e infrastrutture

Modulo del corso

Titolo della parte costituente del corso	Technologies and Production Processes for Energy Engineering
Codice insegnamento	45531A
Settore Scientifico-Disciplinare	ING-IND/16
Lingua	Inglese
Docenti	prof. dr. Erwin Rauch, Erwin.Rauch@unibz.it https://www.unibz.it/en/faculties/engineering/academic-staff/person/17786 dott. Davide Don, Davide.Don@unibz.it https://www.unibz.it/en/faculties/engineering/academic-staff/person/49990
Assistente	
Semestre	
CFU	6
Docente responsabile	
Ore didattica frontale	36
Ore di laboratorio	24
Ore di studio individuale	90
Ore di ricevimento previste	
Sintesi contenuti	
Argomenti dell'insegnamento	Basic knowledge about the main features of power generation, storage, and distribution plants. Examination of the production processes (both conventional and advanced) used to yield components and assemblies in the energy engineering field, including: a) gas power generation plants. b) solar power plants. c) eolic plants. d) tanks and pressure containers for energy storage.

	e) tube and piping for energy distribution. f) electric energy distribution.
Modalità di insegnamento	The course is based on hours of frontal lectures and hours dedicated to classroom and/or laboratory activities. The topics of the course are reported in the lecture notes provided by the professor, as well as in the textbooks of the bibliography. After each lecture, the corresponding pdf presentation will be posted in the Reserve Collection database. The professor can also provide additional material (e.g., research papers). The professor can be contacted by students for questions and clarifications by appointment.
Bibliografia obbligatoria	There is no single textbook that covers the entire course. A collection of suggested readings from various sources will be announced during the course.
Bibliografia facoltativa	Additional textbooks, lecture notes, research papers and readings may be provided by the professor.

Modulo del corso

Titolo della parte costituente del corso	Functional Mechanical Design for Energy Efficiency
Codice insegnamento	45531B
Settore Scientifico-Disciplinare	ING-IND/13
Lingua	Inglese
Docenti	dott. Roberto Belotti, Roberto.Belotti@unibz.it https://www.unibz.it/en/faculties/engineering/academic-staff/person/38331
Assistente	
Semestre	
CFU	6
Docente responsabile	
Ore didattica frontale	32

Ore di laboratorio	24
Ore di studio individuale	94
Ore di ricevimento previste	
Sintesi contenuti	The course aims to give guidelines for the functional design of automatic machines, in particular taking into account mechanical efficiency. Criteria and methods to analyze and choose mechanical devices, design motion laws and evaluate the best system to minimize energy dissipation in electromechanical systems will be addressed.
Argomenti dell'insegnamento	• Introduction: Introduction to functional design, classification of the mechanisms and motion systems. • Basic concepts and definitions. Mechanical efficiency, performance, energy efficiency and energy savings in automatic machines. Direct/reverse energy flow and motor–load systems. • Mechanical components for transferring and transforming energy. Classification is based on function, working principle as well as performance and efficiency. • Optimization is aimed at improving the quality of motion and efficiency. • Energy storage systems and energy recovery. Classification (working principle and scope of use). • Classification of motion laws implemented in automatic machines. An analysis of the main requirements in the design of motion law and its optimization.
Modalità di insegnamento	Frontal lectures, hand-calculation exercises, computer-assisted exercises.
Bibliografia obbligatoria	Slides provided to the students after each lecture and notes taken by students during lecture.
Bibliografia facoltativa	A collection of suggested readings from various sources will be announced during the course. Such sources will be papers, manuals, technical notes, and excerpts from textbooks, including • Biagiotti, Luigi, and Claudio Melchiorri. *Trajectory planning for automatic machines and robots*. Springer Science & Business Media, 2008. • Norton, Robert L. *Kinematics and dynamics of machinery*. McGraw Hill Higher Education, 2009. • Filizadeh, S. *Electric Machines and Drives: Principles,*

	control, modelling and simulation. CRC Press, 2013.