

Syllabus

Course description

Course title	Electric Power Conversion Equipment
Course code	45511/47558 (for LM-33)
Scientific sector	ING-IND/32 "Power Electronic Converters, Electrical Machines and Drives"
Degree	Master Energy Engineering
Semester	2
Year	1
Academic year	2023/2024
Credits	6
Modular	no

Total lecturing hours	36
Total lab and exercise hours	24
Attendance	Not mandatory
Recommended preliminary knowledge	Electrotechnics
Connections with other courses	
Course page	Course Offering / Free University of Bozen-Bolzano (unibz.it)

Specific educational objectives	The course discusses the theoretical basis and the practical applications of electrical energy conversion (electrical-to-electrical and electro-mechanical), with a special focus on electrical machines and their control. The main conversion topologies are introduced and studied. Practical aspects and applications will be considered, highlighting the advantages achievable with state-of-the-art technologies.
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Lecturers	Prof. Stefano Nuzzo Dr. Giampaolo Devito
Scientific sector of the lecturer	ING-IND/32
Teaching language	English
Office hours	On appointment
Teaching assistant (if any)	-
Office hours	-
List of topics covered	The course covers the following topics: <ul style="list-style-type: none"> • Recalling electrical engineering, including electric and magnetic circuits, principles and main laws. • Introduction to motion control, motor-load dynamic, motion trajectories, overview of components of an

	<p>electric drive.</p> <ul style="list-style-type: none"> • Electro-mechanical conversion, actuators, rotating electrical machines, main terminology and industrial standards • DC motor: operating principles, main features and construction, mechanical characteristics, exercises. • DC motor control: recalling control theory, including Laplace transforms, block schemes, nested loops, current and speed loops, choice of PI parameters, exercises • Static conversion using power electronics: generalities, H bridge, 2- and 3- levels modulation, current ripple. • Matlab-Simulink: implementation of DC motor control block scheme • Brushless synchronous motors: operating principles, main features, DC vs. AC brushless motors • AC brushless motor control: α-β and d-q transforms (Park and Clark transforms), operating limits, maximum-torque-per-ampere (MTPA) and maximum-torque-per-voltage (MTPV) strategies.
Professional applications of the covered topics	
Teaching format	Frontal lectures, exercises in lab
Learning outcomes	<p>(1) Knowledge and understanding: Master the most important concepts about electro-mechanical energy conversion, static conversion, and electrical machines and drives for different applications.</p> <p>(2) Applying knowledge and understanding: Verification of the requirements of an electric drive and understanding of real-world operations of electric drives in different application fields.</p> <p>(3) Making judgments: Ability to select the more adequate electric drive (and its components) for a certain application.</p> <p>(4) Communication skills: Acquisition of the field-related technical terminology. Ability to describe the state-of-the-art of the technology adopted in energy conversion systems. Ability to present the acquired knowledge and competences with a proper language</p> <p>(5) Learning skills: Improvement in the ability to autonomously extend the knowledge acquired during the study course, by reading and understanding scientific and technical documentation.</p>
Assessment	<p>Formative assessment In class with written exercises and using Simulink (assessment of ILOs 1, 2, 5).</p>

	<p>Summative assessment</p> <p>The assessment of the course consists of two parts:</p> <ul style="list-style-type: none"> • Written examination on basic electric circuits, La Place transforms, DC motor, AC brushless motors. • Eventual oral examination: assessed through questions relative to theoretical aspects. <p>All ILOs except the number 5 are assessed in the summative assessment.</p>
Assessment language	English
Evaluation criteria and criteria for awarding marks	<p>The final grade will take into account both the marks obtained in the two parts of the overall assessment.</p> <p>The following aspects will be considering in the evaluation:</p> <ul style="list-style-type: none"> • Written examination: clarity and correctness of answers, ability to summarize and evaluate results, presentation quality • Oral examination: clarity and correctness of answers with proper language, ability to summarize and evaluate results, presentation quality, problem solving ability, skills in critical thinking.
Required readings	<p>Lecture notes and documents for exercise will be available on Teams and the reserve collections.</p> <p>There is no single textbook covering the entire course content. The material is collected from various sources.</p>
Supplementary readings	<ol style="list-style-type: none"> 1. Shaahin Filizadeh. Electric Machines and Drives: Principles, control, modelling and simulation. CRC Press. 2. E.Bassi, A.Bossi "Macchine e Azionamenti Elettrici" UTET, Milano ISBN: 88-7933-184-1 3. W. Bolton, "Mechatronics - electronic control systems in mechanical and electrical engineering", 4th ed., Pearson Educational, ISBN 978-0-13- 240763-2. 4. M. Rashid, "Power electronics", 3rd ed., Prentice-Hall, ISBN 0-13-122815- 3