Freie Universität Bozen
Libera Università di Bolzano
Università Liedia de Bulsan

Syllabus
Course description

Course title	Electric Power Conversion Equipment
Course code	45511
Scientific sector	ING-IND/32 "Power Electronic Converters, Electrical Machines and Drives"
Degree	Master Energy Engineering
Semester	2
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	Electrotechnics
Connections with other courses	
Course page	

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. Practical work through laboratory exercises will be organized during the course.

Lecturer	Dr. Stefano Nuzzo Second Lecturer to be assigned
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: • 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

	electric drive. • 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	**(1) Knowledge and understanding:** Master the most important concepts about electro-mechanical energy conversion, static conversion, and electrical machines and drives for different applications. **(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. **(3) Making judgments:** Ability to select the more adequate electric drive (and its components) for a certain application. **(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 **(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.
Assessment	**Formative assessment** In class with written exercises and using Simulink, as well as laboratory activities, if possible (assessment of ILOs 1, 2, 5).

	Summative assessment The assessment of the course consists of two parts: • Preliminary written examination based on preliminary concepts, possibly including Simulink exercises • Oral examination: assessed through questions relative to theoretical aspects and practical exercises. The first part is mandatory to pass the overall exam and to access the second part. All ILOs except the number 5 are assessed in the summative assessment.
Assessment language	English
Evaluation criteria and criteria for awarding marks	The final grade will take into account both the marks obtained in the two parts of the overall assessment. The following aspects will be considering in the evaluation: • Preliminary 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	Lecture notes and documents for exercise will be available on the reserve collections. There is no single textbook covering the entire course content. The material is collected from various sources.
Supplementary readings	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