# Syllabus

## *Course Description*

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| **Course Title** | Electric Drives and Machines |
| **Course Code** | 47558 |
| **Course Title Additional** | |
| **Scientific-Disciplinary Sector** | IIND-08/A |
| **Language** | English |
| **Degree Course** | Master in Industrial Mechanical Engineering |
| **Other Degree Courses (Loaned)** | |
| **Lecturers** | Dott. Ing. Stefano Nuzzo,<br>Stefano.Nuzzo@unibz.it<br>https://www.unibz.it/en/faculties/engineering/academic-staff/person/43989 |
| **Teaching Assistant** | |
| **Semester** | Second semester |
| **Course Year/s** | 1 |
| **CP** | 5 |
| **Teaching Hours** | 36 |
| **Lab Hours** | 24 |
| **Individual Study Hours** | 65 |
| **Planned Office Hours** | |
| **Contents Summary** | 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. |
| **Course Topics** | 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 |

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| | machines and their control.<br>The course covers the following topics:<br>• Recalling electrical engineering, including electric and magnetic circuits, principles and main laws.<br>• Introduction to motion control, motor-load dynamic, motion trajectories, overview of components of an electric drive.<br>• Electro-mechanical conversion, actuators, rotating electrical machines, main terminology and industrial standards<br>• DC motor: operating principles, main features and construction, mechanical characteristics, exercises.<br>• DC motor control: recalling control theory, including Laplace transforms, block schemes, nested loops, current and speed loops, choice of PI parameters, exercises<br>• Matlab-Simulink: implementation of DC motor control block scheme<br>• Brushless synchronous motors: operating principles, main features, DC vs. AC brushless motors<br>• AC brushless motor control: a-ß and d-q transforms (Park and Clark transforms), operating limits, maximum-torque-per-ampere (MTPA) and maximum-torque-per-voltage (MTPV) strategies. |
| **Keywords** | Machines, Drives, Control, Synchronous, Modelling |
| **Recommended Prerequisites** | Electrotechnics |
| **Propaedeutic Courses** | |
| **Teaching Format** | The lectures will be in person, focusing for about 40 hours on theoretical aspects and for about 20 hours on practical exercises |
| **Mandatory Attendance** | Not mandatory. |
| **Specific Educational Objectives and Learning Outcomes** | (1) Knowledge and understanding:<br>Master the most important concepts about electro-mechanical energy conversion, static conversion, and electrical machines and drives for different applications.<br><br>(2) Applying knowledge and understanding:<br>Verification of the requirements of an electric drive and understanding of real world operations of electric drives in different application fields.<br><br>(3) Making judgments:<br>Ability to select the more adequate electric drive (and its |

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| | components) for a certain application.<br><br>(4) Communication skills:<br>Acquisition of the field related technical terminology.<br>Ability to describe the state of the art of the technology adopted in energy conversion systems.<br>Ability to present the acquired knowledge and competences with a proper language<br><br>(5) Learning skills:<br>Improvement in the ability to autonomously extend the knowledge acquired during the study course, by reading and understanding scientific and technical documentation. |
| **Specific Educational Objectives and Learning Outcomes (additional info.)** | |
| **Assessment** | Formative assessment<br>In class with written exercises and using Simulink (assessment of ILOs 1, 2, 5).<br>Summative assessment<br>The assessment of the course consists of two parts:<br>• Written examination on basic electric circuits, La Place transforms, DC motor, AC brushless motors.<br>• Eventual oral examination: assessed through questions relative to theoretical aspects.<br>All ILOs except the number 5 are assessed in the summative assessment. |
| **Evaluation Criteria** | The final grade will take into account both the marks obtained in the two parts of the overall assessment.<br>The following aspects will be considering in the evaluation:<br>• Written examination: clarity and correctness of answers, ability to summarize and evaluate results, presentation quality<br>• 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 Teams.<br><br>There is no single textbook covering the entire course content. The |

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| | material is collected from various sources. |
| **Supplementary Readings** | 1. Shaahin Filizadeh. Electric Machines and Drives: Principles, control, modelling and simulation. CRC Press.<br><br>2. E.Bassi, A.Bossi “Macchine e Azionamenti Elettrici” UTET, Milano ISBN: 88-7933-184-1<br><br>3. W. Bolton, "Mechatronics - electronic control systems in mechanical and electrical engineering", 4th ed., Pearson Educational, ISBN 978-0-13- 240763-2.<br><br>4. M. Rashid, "Power electronics", 3rd ed., Prentice-Hall, ISBN 0-13-122815- 3. |
| **Further Information** | |
| **Sustainable Development Goals (SDGs)** | Affordable and clean energy |