Freie Universität Bozen
Libera Università di Bolzano
Università Liedia de Bulsan

Syllabus
Course description

Course title	Electrical Systems Engineering
Course code	45500
Scientific sector	ING-IND/33 "Electrical Power Systems"
Degree	Master Energy Engineering
Semester	1
Year	1
Academic Year	2025/2026
Credits	6
Modular	No

Total lecturing hours	60
Total lab and exercise hours	2 (exercise)
Attendance	Not mandatory
Recommended preliminary knowledge	Mathematical analysis, Physics 2, Electrotechnics
Connections with other courses	• Hydropower and wind power Systems (45532) on hydro and wind power generation and their role in modern low-carbon power systems • Electrochemical energy storage and conversion (45534) on the role of energy storage in power residential and bulk power systems • Dispacciamento dell'energia (45525) the continuation of the topics presented in the Electrical Systems Engineering
Course page	https://www.unibz.it/en/faculties/engineering/master-energy-engineering/

Specific educational objectives	• Obtain working knowledge in electrical systems • Understand the current and future electricity scenarios • Learn how to make comparisons among different technologies and solutions based on multiple aspects • Master the main theoretical background in power systems design

Lecturer	Prof. Vincenzo Trovato
Scientific sector of the lecturer	ING-IND/33
Teaching language	English
Office hours	every Tuesday Morning 9:00-11 (no appointment needed). Other days/hours appointment by email
Teaching assistant (if any)	-
Office hours	-
List of topics covered	List of topics: 1. Definitions and generality

	2. Sinusoidal quantities 3. Three-phase systems 4. Networks structure 5. Sizing of continuous and alternating power lines 6. Transformers 7. Non-symmetrical electrical networks 8. Fault analysis 9. Electrical safety Initially the course refers to elements of general electrotechnics. Then the symbolic notation is introduced for the study of sinusoidal networks: complex operators; behaviour of the bipoles in sinusoidal and three-phase systems. The emphasis is put on electrical installations (structure of the Italian electricity system; structure of electrical networks; generation, transmission, distribution and final use of electricity). Furthermore, the criteria for the design of DC power lines is examined (cantilevered power lines; sizing of lines with constant section or constant current density). The main constructive characteristics of single-phase and three-phase transformers are also examined (magnetic cores and electric coils; real transformer; losses due to the Joule effect and iron losses due to hysteresis and eddy currents). The theory of symmetrical components for the understanding and analysis of non-symmetrical three-phase electrical faults is addressed. Finally, the effects of electricity on the human body are examined, the components of a grounding system and protection against indirect electrical contacts.
Professional applications of the covered topics	An Energy Engineer with solid knowledge in power system could join companies such as: • Enel, Terna, Eni, Edison etc. to carry out techno-economic analysis of power systems focusing on different sectors of the electricity systems. • Arera, ACER, Enel etc. to carry out activities in the context of energy policy • RSE, EURAC etc. to carry out techno-scientific research activities in the wide context of smart grids • Several consultancy firms which are being expanding their energy practices • Power system professional design offices to design the specifications of MV/LV power systems for domestic and industrial applications • Any university to continue education path with a PhD focused on smart grids etc.

Teaching format	Class lectures

Learning outcomes (ILOs)	The learning outcomes need to refer to the Dublin Descriptors: <u>Knowledge and understanding</u> 1. Knowledge of the basics related to the transmission and distribution of electricity and the main criteria to design electric lines, basics on transformers, line faults and electric safety. <u>Applying knowledge and understanding</u> 2. Students will be able to approach the design of direct current and alternating current lines, with a basic understanding on how to select the proper circuit protection. Recognize the different voltage level associated with electricity transmission and evaluate the main issues related to the distribution of electricity. A basic knowledge of CEI regulations is also provided. <u>Making judgements</u> 3. Students will be able to interpret design choices on existing systems, and to identify and investigate critical aspects related with them. <u>Communication skills</u> 4. Students will learn the main technical terms related to the topic. <u>Ability to learn</u> 5. The variety of topics of the course allow the students to have basic knowledge of many subjects, giving them the opportunity to easily deepen specific topics.

Assessment

Formative assessment

Form	Length /duration	ILOs assessed
-	-	-

Summative assessment

Oral examination with two or three general questions

Form	%	Length /duration	ILOs assessed
Oral examination, two or three questions	100	About ½ hour	all

Assessment language	English

Evaluation criteria and criteria for awarding marks	A single final mark will be calculated averaging the marks of two/three questions. All marks must be at least 18. Evaluation based on knowledge of the subject and ability to do connections between the various course topics

Required readings	Lessons and slides of the course
Supplementary readings	**Italian books** • R. Benato, L. Fellin – Impianti Elettrici – Wolters Kluwer (2014) • N. Falettim P. Chizzolini – Trasmissione e Distribuzione dell'Energia Elettrica Vol. I e II – Patron Editore (2004) • G. Conte – Manuale di Impianti Elettrici – biblioteca tecnica Hoepli (2014) • M. Fauri – Fondamenti di Elettrotecnica – Esculapio (2020) • V. Cataliotti – Impianti Elettrici – Dario Flaccovio Editore (2004) • V. Carrescia – Fondamenti di Sicurezza Elettrica – TNE (2008) **English books** • R. Dorf, J. Svoboda – Introduction to electric circuits – Wiley (2018) • W. Grainger, J. Stevenson – Power System Analysis – McGraw-Hill (1994) • J. Glover, T. Overbye, M. Sarma – Power System Analysis and Design – Cengage Learning (2016)