

Course Unit	Power Generation, Transmission and Distribution		Field of study	Energy	
Master in	Industrial Engineering - Electrical Engineering		School	School of Technology and Management	
Academic Year	2022/2023	Year of study	2	Level	2-2
Type	Semestral	Semester	1	ECTS credits	6.0
			Code	9572-355-2103-00-22	
Workload (hours)	162	Contact hours	T 30	TP -	PL 30
			TC -	S -	E -
			OT -	O -	

T - Lectures; TP - Lectures and problem-solving; PL - Problem-solving, project or laboratory; TC - Fieldwork; S - Seminar; E - Placement; OT - Tutorial; O - Other

Name(s) of lecturer(s) Luís Manuel Montenegro de Araújo Pizarro, Orlando Manuel de Castro Ferreira Soares

### Learning outcomes and competences

At the end of the course unit the learner is expected to be able to:

1. know the several types of production of energy and microproduction.
2. acquire basic concepts to project high voltage electrical transmission lines.
3. know technical aspects related to operation and control of electrical power systems.
4. know and identify the potentialities and consequences of using power electronics in different types of production of energy and in electrical distribution networks.
5. evaluate the security of electrical distribution networks which integrates a significant amount of electrical distributed power production.
6. project and to evaluate the reliability and quality of service of electrical distribution networks.
7. accomplish economic studies to electrical distribution networks.

### Prerequisites

Before the course unit the learner is expected to be able to:

1. know electrical machines and power electronics;
2. know basic concepts of electrical installations;
3. know the per-unit (pu) quantities;
4. know power flow methods.

### Course contents

Electrical power plants; High voltage Electrical Transmission lines and distribution networks; Frequency and voltage Control; Integration of electrical distributed power production.

### Course contents (extended version)

1. Portuguese Electrical Power System
  - Portuguese energetic services regulation entity (ERSE);
  - Portuguese concessionaire transmission network entity (RNT);
  - Portuguese plan for renewable energies.
2. Power plants
  - Conventional power plants: hydroelectric, wave power, thermoelectric, geothermal and nuclear power;
  - Distributed power plants: cogeneration, biomass, solar, wind power and micro-hydroelectric;
  - Microgrids: fuel cells and micro-turbines.
3. High voltage Transmission lines and distribution networks
  - Electrical transmission and distribution power systems structures;
  - Electrical substations;
  - High voltage electrical transmission lines;
  - Electrical distribution networks.
4. Frequency and voltage Control
  - Frequency – active power control;
  - Voltage – reactive power control.
5. Integration of the distributed power production
  - Integration of the distributed power production in the planning of electrical distribution networks;
  - Prevision of electrical distributed power plants;
  - Prevision of electrical distributed power plants quality impact (flickers and harmonics);
  - Protection and coordination of electrical distributed power plants.

### Recommended reading

1. J. J. Grainger, W. D. Stevenson Jr. , "Power System Analysis", McGraw-Hill, 1994
2. J. P. Sucena Paiva, "Redes de Energia Eléctrica, uma Análise Sistemática", IST Press, Abril, 2005
3. G. G. Karady, K. E. Holbert, "Electrical Energy conversion and Transport: an iterative Computer-Based Approach", Wiley IEEE Press, Novembro 2004
4. N. Jenkins, R. Allan, P. Crossley, D. Kirschen, G. Strbac, "Embedded generation", The Institute of Electrical Engineers, IEE Power and Energy Series, 31, London, 2000
5. P. Kundur, "Power System Stability and Control", Electric Power Research Institute, Power System Engineering Series, McGraw-Hill, 1993

### Teaching and learning methods

Presentation of the different modules/subjects concepts followed by the resolution of exercises, using practical examples. Exploration of the topics by means of application exercises and worksheets. Study visits guided to specific real installations of the area. Sessions techniques carried through in partnership with companies and specialists invited of the area.

### Assessment methods

1. Alternative 1 - (Regular, Student Worker) (Final, Supplementary, Special)
  - Final Written Exam - 100%
2. Alternative 2 - (Regular, Student Worker) (Final, Supplementary)
  - Projects - 100%
3. Alternative 3 - (Regular, Student Worker) (Final, Supplementary)
  - Projects - 70%
  - Final Written Exam - 30%

**Language of instruction**

Portuguese, with additional English support for foreign students.

**Electronic validation**

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10-10-2022	16-10-2022	17-10-2022	24-10-2022