INSTITUTO POLITÉCNICO DE BRAGANÇA

Course Unit	Electric Circuits			Field of study	Physics/Chemistry		
Bachelor in	Renewable Energy Engineering			School	School of Technology and Management		
Academic Year	2022/2023	Year of study	1	Level	1-1	ECTS credits	6.0
Type	Semestral	Semester	1	Code	9910-743-1101-00-22		

Workload (hours)	162	Contact hours	T	TP	PL	TC	S	E	OT	O
			30	30	-	-	-	-	-	-

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): Fernando Jorge Coutinho Monteiro, Fernando Jorge Teiga Teixeira

Learning outcomes and competences

At the end of the course unit the learner is expected to be able to:
1. Know the main concepts and laws of electrical circuits;
2. Understand theorems for electrical and electronics circuits' analysis;
3. Select methods to analyze complex electrical circuits;
4. Characterize temporal behaviour of circuits based on capacitors and inductors;
5. Analyze AC power circuits.

Prerequisites

Before the course unit the learner is expected to be able to:
1. Know trigonometry and complex numbers.
2. Know how to solve linear equations systems.
3. Know differential and integral calculus.

Course contents

Basic methods of analysis of electrical circuits; Voltage and currente sources; General methods of analysis of electrical circuits; Analysis of circuits with energy storage elements; analysis of a. c. power circuits; Introduction to the three-phase systems.

Course contents (extended version)

1. Basic methods of Analysis
   - Introduction to the Electric Current conduction phenomenon; Electrical units; Joule's law.
   - Electric Circuits' Laws: Ohm's Law; Voltage and Current Kirchhoff's Laws.
   - Association of Resistances in Series and parallel; Y-D Transformation.
   - Voltage and Current Dividers.
2. Voltage and Current Sources
   - Ideal and real voltage and current sources.
   - Equivalence among real voltage and current sources.
3. General methods of Analysis of electric circuits
   - Method of the Current in Branches; Method of the Independent Mesh; Method of the Analysis of Nodes.
   - Superposition theorem, Thevenin and Norton theorems; Dualities.
4. Analysis of Circuits with Energy Storage Elements
   - Energy Storage Elements: Capacitors and Inductors. Energy stored in capacitors and Inductors.
   - Association of capacitors and Inductors; Real Capacitors and Inductors.
   - Transient analysis of Circuits: 1st Order (RL and RC) and 2nd Order (RLC).
5. Analysis of a. c. circuits
   - Sinusoidal alternating units; Steinmetz's Transformation.
   - Impedance; Ohm's Law and Kirchhoff's Laws.
   - Method of the Current in Branches; Method of the Independent Mesh; Method of the Analysis of Nodes.
   - Superposition theorem, Thevenin and Norton theorems.
   - A. C. Powers: Active and Reactive Power; Physical meaning; Complex power; Power factor correction.

Recommended reading

1. J. W. Nilsson, S. A. Riedel, "Circuitos Eléctricos", 5ª Ed. , LTC, 1999
2. R. L. Boylestad, "Introductory Circuit Analysis", Prentice Hall Internacional Editions, 9th Edition, 2000
3. L. Bessonov, "Electricidade Aplicada para Engenheiros", 2ª Edição, Lopes da Silva Editora, 1977
4. W. H. Hayt, J. Kemmerly, "Engineering Circuit Analysis", McGraw-Hill International Editions, 5th Ed. , 1993
5. V. Meireles, "Circuitos Eléctricos", 3ª Edição Revista, Edições LIDEL, 2005

Teaching and learning methods

Theoretical classes: presentation of the course contents supported on illustrative examples. Practical classes: Problem-solving and execution of laboratorial works.

Assessment methods

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

Language of instruction

Portuguese, with additional English support for foreign students.

Electronic validation

Fernando Jorge Coutinho Monteiro	José Luís Sousa de Magalhaes Lima	Ana Maria Alves Queiroz da Silva	Paulo Alexandre Vara Alves
09-10-2022	16-10-2022	18-10-2022	03-11-2022