INSTITUTO POLITÉCNICO DE BRAGANÇA

Course Unit	Circuits and Electric Machines			Field of study	Physics										
Bachelor in	Mechanical 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	2	Code	9123-759-1204-00-22										
Workload (hours)	162	Contact hours	T -	TP 60	PL -	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): Fernando Jorge Teiga Teixeira, Ângela Paula Barbosa da Silva Ferreira, Ines Cristina Vinhas de Seixas, Victoria Clarissa de Abreu Melo

Learning outcomes and competences

At the end of the course unit the learner is expected to be able to:
1. Apply the proper concepts and fundamental laws related to Electrostatics and Electromagnetism.
2. Model and dimensioning Electrostatics and Magnetostatics systems.
3. Understand the fundamental concepts and laws of direct current and alternating current and properly apply the fundamental techniques used in their analysis.
4. Understand the operation and apply the mathematical models of electric machines, in particular motors and transformers.
5. Discuss practical applications of some basic components and systems used in the field of Electrical Engineering.

Prerequisites

Before the course unit the learner is expected to be able to:
Know the basic mathematical formalisms.

Course contents

Mathematical revisions. Electrostatics. The energy. Direct current. Alternate current. Electromagnetism. Electric machines.

Course contents (extended version)

1. Electrostatics
   - General concepts and electric charge.
   - Force, potential and electric field.
   - Work and potential energy.
2. Direct current
   - Ohm's and Joule´s laws.
   - Electric resistance and resistances association.
   - Electric power.
   - Real and ideals tension and current sources.
   - Association and equivalence of sources.
   - Kirchhoff's laws. Matrix methods for complex circuits resolution.
   - Superposition theorem, Thévenin and Norton theorems.
   - Duality and equivalence.
   - Transient and forced response.
3. Alternating current
   - Steinmetz transform.
   - Ohm's law, induction and charge laws.
   - Impedance, admittance and power factor.
   - Series and parallel RLC circuits.
   - Kirchhoff's Laws and matrix methods for complex circuits resolution.
   - Superposition theorem and Thévenin and Norton theorems.
   - Active, reactive and apparent power.
   - Series and parallel resonance.
   - Power factor correction.
4. Electromagnetism
   - Magnetic field and magnetic flux.
   - Magnetic and electromagnetic circuits.
   - Laplace´s, Faraday´s and Lenz´s laws.
   - Electromagnetic induction.
   - Eddy currents.
   - Self-induction and mutual induction, ferromagnetism and hysteresis.
   - Maxwell's equations.
5. Electric machines
   - General concepts and practical examples.
   - Functional characteristics of existing equipment in a laboratory.
   - Mathematical models and their applicability in the behavioral study of electric machines.

Recommended reading

1. O'Malley, John, "Análise de Circuitos", McGraw- Hill, 1983
2. Gussow, Milton, "Electricidade Básica", McGraw-Hill, 1985
3. Villate, Jaime E. , "Electromagnetismo", Mc Graw-Hill, 1999.
4. Crummett, William P. ; Western Arthur B. , "University Physics – Models and Applications", Wm. C. Brown, 1994
5. Monteiro, Fernando, Sebenta de Eletrotecnia, ESTiG - IPB, 2019.

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% (Laboratory works and/or Simulation works)

Assessment methods

2. Alternative 2 - (Student Worker) (Special)
   - Final Written Exam - 100%

Language of instruction

Portuguese, with additional English support for foreign students.

Electronic validation

Ângela Paula Barbosa da Silva Ferreira, Fernando Jorge Teiga Teixeira	José Luís Sousa de Magalhaes Lima	João da Rocha e Silva	José Carlos Rufino Amaro
01-03-2023	11-03-2023	12-03-2023	17-03-2023