Magnetic circuits and transformers

Academic Year: (2023 / 2024) **Review date: 28/03/2023 13:32:03**

Department assigned to the subject: Electrical Engineering Department

Coordinating teacher: GARCIA DE BURGOS, MARIA BELEN

Type: Electives ECTS Credits : 6.0

Year : 4 Semester : 1

REQUIREMENTS (SUBJECTS THAT ARE ASSUMED TO BE KNOWN)

Physics II
Electrical Power Engineering Fundamentals

LEARNING OUTCOMES

CB1. Students have demonstrated possession and understanding of knowledge in an area of study that builds on the foundation of general secondary education, and is usually at a level that, while relying on advanced textbooks, also includes some aspects that involve knowledge from the cutting edge of their field of study
CB2. Students are able to apply their knowledge to their work or vocation in a professional manner and possess the competences usually demonstrated through the development and defence of arguments and problem solving within their field of study.
CB3. Students have the ability to gather and interpret relevant data (usually within their field of study) in order to make judgements which include reflection on relevant social, scientific or ethical issues.
CB5. Students will have developed the learning skills necessary to undertake further study with a high degree of autonomy.
CG1. Ability to solve problems with initiative, decision-making, creativity, critical reasoning and to communicate and transmit knowledge, skills and abilities in the field of Industrial Engineering.
CG3. Ability to design a system, component or process in the field of Industrial Technologies to meet the required specifications
CG4. Knowledge and ability to apply current legislation as well as the specifications, regulations and mandatory standards in the field of Industrial Engineering.
CG5. Adequate knowledge of the concept of company, institutional and legal framework of the company. Organisation and management of companies.
CG6. Applied knowledge of company organisation.
CG8. Knowledge and ability to apply quality principles and methods.
CG9. Knowledge and ability to apply computational and experimental tools for the analysis and quantification of Industrial Engineering problems.
RA1. Knowledge and understanding: Have basic knowledge and understanding of science, mathematics and engineering within the industrial field, as well as knowledge and understanding of Mechanics, Solid and Structural Mechanics, Thermal Engineering, Fluid Mechanics, Production Systems, Electronics and Automation, Industrial Organisation and Electrical Engineering.
RA2. Engineering Analysis: To be able to identify engineering problems within the industrial field, recognise specifications, establish different resolution methods and select the most appropriate one for their solution
RA3. Engineering Design: To be able to design industrial products that comply with the required specifications, collaborating with professionals in related technologies within multidisciplinary teams.
RA4. Research and Innovation: To be able to use appropriate methods to carry out research and make innovative contributions in the field of Industrial Engineering.
RA5. Engineering Applications: To be able to apply their knowledge and understanding to solve problems and design devices or processes in the field of industrial engineering in accordance with criteria of cost, quality, safety, efficiency and respect for the environment.
RA6. Transversal Skills: To have the necessary skills for the practice of engineering in today's society.

OBJECTIVES

Design capability of electromagnetic components. Ability to analyze the operation of a transformer in different practical circumstances. Capability of carrying out tests to determine parameters. Basic knowledge of national and international regulations. Determination of the interactions of the transformer with the rest of the electrical system. Ability to choose a transformer for a specific application.
All of the above can be summarized in the following Learning Outcome:
Explain and justify the operation of single-phase, three-phase and measuring power transformers and their role in electrical transmission networks of energy

DESCRIPTION OF CONTENTS: PROGRAMME

Topic 1: REVIEWING BASIC CONCEPTS ON ELECTRICITY AND MAGNETISM. Maxwell equations. Core losses. Dielectric losses. Magnetic circuits. Self and mutual inductances.
Topic 2: CONSTITUTION OF POWER TRANSFORMERS. Magnetic core, windings, insulation system. Transformer refrigeration. Basic concepts on maintenance.
Topic 3: 1-PHASE TRANSFORMERS. No load performance. On-load performance. Overloads. Equivalent circuit. Efficiency. Voltage drop. Parallel operation. Short circuit currents. Inrush current.
Topic 4: 3-PHASE TRANSFORMERS. Types of transformers. Phasor groups. No-load performance. Transformer performance under balanced and un-balanced loads. Zero-sequence impedance. Tertiary windings. Interconnected star windings. Three winding transformers. Autotransformers. Tap changers. Application of the different transformer types and phasor groups.

LEARNING ACTIVITIES AND METHODOLOGY

The learning methodology includes:
- Lectures covering the main topics described within the course outline.
- Case study and problem solving lectures, where some issues are addressed from a practical point of view.
- Laboratory sessions

ASSESSMENT SYSTEM

% end-of-term-examination/test:	60
% of continuous assessment (assigments, laboratory, practicals…):	40

One writting exercise for each topic of the subject. With a score upper than 5.0 the exercise is passed.
Those students with one or various failed exercised must perform a final exam of those failed exercises.

BASIC BIBLIOGRAPHY

- Kulkarni, S.V.; Khaparde S.A. Transformer engineering. Design and Practice, Marcel Dekker, 2012

BASIC ELECTRONIC RESOURCES

- Juan Carlos Burgos . OCW Circuitos Magnéticos y Transformadores: http://ocw.uc3m.es/ingenieria-electrica/circuitos-magneticos-y-transformadores