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A MULTIPURPOSE USE POWER ELECTRONICS LABORATORY

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Abstract: *This work presents a power electronics laboratory for multipurpose use spanning the undergraduate and graduate programs and resources activities. The power electronics curriculum develops the basic concepts of the field and applies them to modern industrial challenges to solve practical problems. The laboratory is designed to support three fundamental disciplines: frequency line converters, high frequency switching converters and motor control and drives. The methodology adopted is a cooperative experiential learning activity to develop student's design skills. The design experience is based on a problem-based learning approach that motivates student learning and develops skills required by the student in a future professional capacity. Some equipment, computer and software provides the students modern tools necessary to analyze, design and build the circuitry. This laboratory significantly impacts many students who will take positions with organizations in the electrical/electronics industry, where the skills gained from laboratory experiences will be greatly valued.*

Palavras-chaves: power electronics laboratory, multipurpose use, cooperative experiential learning activity, problem-based learning approach.

1. INTRODUCTION

The power electronics laboratory is a multiuse state-of-the-art undergraduate and graduate teaching facility designed to be both flexible and powerful. The equipment facilities allow students an opportunity to apply and integrate classroom knowledge in analysis, simulating, design and experiment topologies in the field of power electronics and related topics. Students are exposed to software and modern tools necessary to analyze, design and build systems.

The laboratory is designed to support three fundamental disciplines: frequency line converters, high frequency switching converters and motor control and drives. The methodology adopted is a cooperative experiential learning activity to develop student's design skills. Essential elements of a well-structured formal cooperative learning group are considered along with the professor's role in structuring a problem-based cooperative learning group.

After an experiment, a primary simulation step is done by the student, so that most mistakes, improper measurement settings, etc., are detected and immediately fed back. This environment reinforces student motivation and a better comprehension of the systems analyzed.

With this methodology, students improving their skills in dealing with complex projects, linking theory to real world applications, and improving their problem-solving performance.

2. GENERAL ACTIVITIES

The power electronics laboratory is used as an educational "workbench" and in practical operational use. It is designed like a pedagogical tool, a research environment, and a fully operational data analysis system, i.e., it is used not only in undergraduate engineering courses, but in graduate study and general research. The tools allow the students to perform practical programming of standard topologies experimentation or to provide a new design which novel topologies or theories can be analyzed and implemented. This approach has eased many experimental setups, eliminating some manual tedious data collection routines and allowing more time for efficient analysis of results, proposing new models for the assimilation of fundamental concepts, and offering modern resources for the elaboration of reports.

Pspice is used as an instructional tool for an introductory-level power electronics course increasing student's abilities to comprehend the behavior of several power electronics circuits. Probe's capability of doing numerical computations reduces the effort needed to determine power-related quantities in nonlinear circuits. Fourier analysis capabilities of PSpice enable harmonics to be investigated.

Experimental examples using digital oscilloscopes having print/plot capability and dedicated softwares are used to compare with PSpice simulations. A design project is used to integrate the materials taught in the lectures with experience gained in the laboratory sessions. In general, students feel they learn more effectively in a practice-oriented course. The professional instruments and computational tools used in the laboratory have increased student's interest in the disciplines. Team work and creative learning are also objectives of the new methodology.

3. FINAL DISCUSSIONS

Students learn, verify, and reinforce lecture concepts by performing switching power converter experiments in the laboratory sessions. PSpice simulations are used extensively to verify concepts and to enhance student's comprehension. Design projects are used to integrate the materials taught in the lectures with experience gained in the laboratory sessions. In general, students feel they learn more effectively in a practice-oriented course. Furthermore, the design experience is based on a problem-based learning approach that motivates student learning and develops skills required by the student in a future professional capacity. The response was positive, which will encourage the extension of the approach to other subjects. In the final version of the paper the authors intend to present in details the laboratory configuration, equipment and softwares.

4. REFERENCES

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