

# EXPERIMENTAL SUPPORT OF THEORETICAL ELECTRICAL ENGINEERING EDUCATION

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**Abstract:** In the year 2007 has been proposed a new approach to teaching theoretical subjects at the Faculty of Electrical Engineering at University of West Bohemia in Pilsen. For achieving this target the specific grant from Higher Education Development Fund was acquired. Due to this grant it was possible to develop a new laboratory for experimental support of theoretical electrical engineering education. This paper deals with concept of experimental supported education, specific laboratory equipment and our first experiences with this kind of education.

**Key words:** Education, laboratory, experimental support

## INTRODUCTION

Three years ago started process of changing studying programs at the Faculty of electrical engineering. It was accepted two-steps model of university education. In context of this change the studying plans, especially in the first years of study, has changed significantly. Generally the number of students on courses has increased and it was necessary to reduce complexity of theoretical subjects guaranteed by the Department of theory of electrical engineering. According to new conditions the subject's contents were modified but it was also important to search new efficient methods of teaching and the way for time utilization. On the basis of analysis of present conditions we decided for a new approach to teaching theoretical subjects supported by experimental work.

## 1 PROBLEM FORMULATION

The Department of theory of electrical engineering provides education in both main steps of university education: bachelor and master courses. Also this department takes a part in combined form of university education.

The main goals of the solution of tabled problem can be summarized into several points:

- To increase motivation level of students.
- To improve the independency and creativity of students.

- To create ability to evaluate problems and limits of used methods.
- To teach students to verify theoretical ideas by experiment.

## 2 PROBLEM SOLUTION

Thank to specific grant from Higher Education Development Fund the new laboratory was built up. This laboratory consists of twelve laboratory workplaces.

The eight laboratory workplaces are determined primarily for bachelor courses students. These workplaces are equipped by a system RC Didactic (Fig 1.), which is a special tool for experiments in electric circuit area.

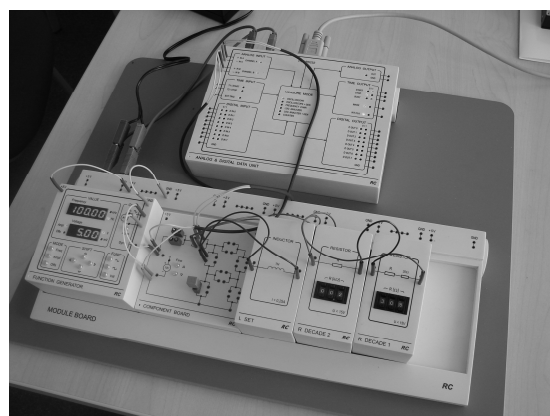


Fig. 1 Workplace with RC Didactic system

This system enables students to familiarize with the main tools used for electrical circuit analysis. The system consists of basic parts (resistors, capacitors, inductors etc.), common measurement equipment (AC and DC voltmeters) and it is possible to use this system in connection with PC as a simple oscilloscope, spectral analyzer, logic analyzer and V-A characteristics meter.

For each important section of the electric circuit theory a special task was prepared. Each task consists of three parts: analytical solution of given problem, numerical simulation and experimental verification.

There are several reasons for this kind of model:

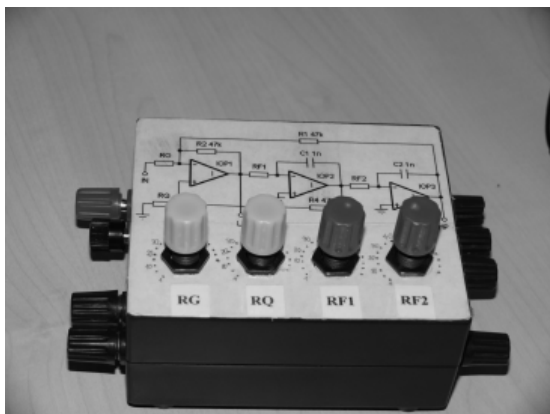
- This model makes students to compare results obtained from different sources and think about differences.
- Students learn to check their own work (calculations) by any independent way (simulations).
- Students are encouraged to use simulations and experiments for better understanding of fundamentals of problems.

For students in master courses were created four laboratory workplaces which contain professional laboratory measurement equipment: digital oscilloscopes, signal generators, voltage sources, spectral analyzer etc.

The philosophy of education in these courses is slightly different from the model used in bachelor courses. The part of master courses at the Department of theoretical electrical engineering concerns to the synthesis of electric circuits.

The objective to experimental education is to allow students independently try on the whole process of electric device design. Students obtain specific conditions on electric circuit, which they should design (for example filter). On the base of theoretical knowledge they design a structure of electric circuit. Then they use simulation software for determining of parameters and realize a prototype of circuit. If it is possible they can use RC Didactic system for realization, but this system is determined mainly for education and has a number of restrictions (voltage ranges, frequency ranges, etc.). The last step in electric circuit design is verifying of the prototype. Students have to verify that their circuit satisfies to the requested requirements. For verifying students can use professional laboratory equipment.

An example of student's work shows Fig. 2.



*Fig. 2 The example of student's work:  
The tunable active state variable filter*

The Department of theory of electrical engineering also ensures the advance course in theory of electromagnetic fields. In framework of this course were prepared experiments for demonstrating wave propagation.

### 3 CONCLUSION

The mentioned approaches to education of theory of electrical engineering were firstly used in academic year 2006/2007. In terms of bachelor studies were prepared and realized laboratory experiments in courses: Introduction to Electrical Engineering, Theory of Electrical Engineering and Electrical Engineering. During these courses more than one thousand students used the new laboratory.

In terms of master studies used laboratory about two hundred students in courses: Application of the Theory of El. Eng. and Theory of El. Eng. - Selected Parts.

A disinterested evaluation of influence of a new approach to theoretical electrical engineering education has not been provided yet. And it will be difficult to provide it in future due to very different level of students in each academic year.

On the other hand from the student evaluation of education process quality it follows that the students are mostly satisfied with inclusion of experimental work into courses.

Actually in the evaluation forms appeared several requirements for increasing of number of laboratory exercises.

### ACKNOWLEDGMENTS

This project has been sponsored by the Czech Higher Education Development Fund in the framework of the project "The development of the experimental laboratory for theoretical electrical engineering education support" FRVS 310/2007.

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