

ELECTRONIC TEXTS FOR DISTANCE EDUCATION OF „MODELING AND SIMULATION“

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Abstract: A concept of elaborating the electronic texts (ETs) for distance education on the Faculty of EE and Communication (FEEC), Brno University of Technology (BUT), is explained. As an example, the ETs for the subject “modeling and simulation in Microelectronics” are described. For the conventional form of education, the important part of education is practiced on computer classrooms. That is why it does not comport well with the concept of fully individual study in the frame of distance education.

Keywords: Distance education, electronic learning texts, modeling, simulation, mikroelectronics.

1 INTRODUCTION

Accreditation of the corresponding branches of study also in the distance form is a necessary condition of the realization of distance education. Most Czech Universities hold the accreditation of a number of branches of study only in the present or so-called combined form. Before the accreditation being initiated, it is necessary to account for the appropriate aids, supporting the distance education (DiE), particularly the textbooks (TBs) in the printed or electronic form. The TBs have to conform to specific criteria [1]. These criteria are based on the fact that the student – in contrast to the conventional education forms – works with the TBs quite individually [2], [3].

The basic question, where one can obtain such TBs, has two important aspects: **1.** Who will create the TBs? **2.** How to ensure the TBs elaboration within a relatively short time interval and in the desired quality for a wide spectrum of the subjects of the branch of study?

Note that it is rather problematic to use the existing TBs from other Universities for a distance education of concrete subject in concrete branch of study. That is why the answer to the question No. 1 is the following: Elaboration of the TBs will be provided by the guarantees of the individual subjects. The question No. 2 is about the ability of the educational institution to motivate the TBs authors. As regards the quality of TBs, it cannot be substantially influenced by any administrative measure. The quality is determined by a current experience of the author and by his ability to challenge the exacting and newly-made demands on the TBs for individual study.

2 SPECIFICS OF DISTANCE LEARNING AT TECHNICAL UNIVERSITIES

A strict demand for the individual study in the frame of distance education at technical Universities is in a partial conflict with the needs of practical training, which should be exercised directly at the faculty. The point is about the laboratory and computer exercises. One cannot assume that exacting measuring devices, laboratory aids, or a special software will be available to students in their home conditions. The system of DiE allows for such cases, enabling some short term attachments at the faculty in the form of so-called tutorials or summer schools. Then the main purpose of TBs is to prepare optimally the students to these contact forms of education.

It results from the above that the requirements for the TBs will be related to the character of a concrete subject, particularly to the teaching form that will be implemented [1].

3 REQUIREMENTS FOR THE STs FOR DISTANCE LEARNING AT FEEC BUT

In 2005, FEEC BUT passed the accreditation of a new Bachelor's EECC branch of study (Electrical Engineering, Electronics, Communication and Control) in the distant form. An extensive setup of TBs has been performed. It was concluded that the optimal form of TBs is electronic text. In the following, such TBs will be specified by the abbreviation ETs.

Several preliminary stages have been accomplished. All of them were covered by externally financed development projects. In 2002, the project „Development of the Bachelor's branches of study in context of the Bologna declaration“ has been solved [4]. In the frame of this project, 121 ETs were created with the total pages of 12893. At the end of this stage, 94 subjects from 141 subjects of the EECC branch of study were covered by the ETs. These ETs **were not** created with a special emphasis on the specifics of the distance study.

The project prosecuted in 2003 in order to extend the ETs by the features of distance learning. In these days, almost all the subjects are supplied by the corresponding ETs. Most of them fulfill the exacting requisitions of distance learning [5], [6]. This aim has been also reached owing to a strong material motivation of the authors, whose extraordinary author's fees were covered by the financial support of the above projects.

As a result, each subject of the EECC branch of study is supplied by at most three kinds of ETs: **for individual study (ETS)**, **for laboratory instructions (ETL)**, and **for computer exercises (ETP)**. The claims on these ETs are summarized in Table 1 [1], [7], [8].

No.	Claims	Valid for ET
1	ET is written into a template. Templates for Word and LaTeX are available on the faculty server.	ETS, ETL, ETP
2	The Contents is at the beginning of ET (arranged by the template).	ETS, ETL, ETP
3	The List of Figures is at the beginning of ET (arranged by the template).	ETS, ETL, ETP
4	The List of Tables is at the beginning of ET (arranged by the template).	ETS, ETL, ETP
5	The List of References is at the end of ET (arranged by the template).	ETS, ETL, ETP
6	ET contains hypertext cross references to Chapters, Sub-Chapters, Figures, Tables, Equations, Examples, Tests, etc. (arranged by the template).	ETS, ETL, ETP
7	The test of initial knowledge is at the beginning of ET.	ETS, ETL, ETP
8	The Chapter (Sub-chapter, laboratory exercise, etc.) aim is given at the beginning of this Chapter (Sub-Chapter, laboratory exercise, etc.).	ETS, ETL, ETP
9	A brief summary is given at the end of each Chapter (Sub-Chapter, laboratory exercise, etc.).	ETS, ETL, ETP
10	Solved examples , illustrating the Chapter (Sub-Chapter, ..) are at the end of each Chapter (Sub-Chapter..).	ETS
11	Checking questions are at the end of each Chapter (Sub-Chapter). Answers to these questions are at the end of ET.	ETS
12	Unsolved problems are at the end of each Chapter (Sub-Chapter), examining the understanding a Chapter (Sub-Chapter). Results are at the end of ET.	ETS
13	Answers to the checking questions are at the end of ET.	ETS
14	Results of the unsolved problems are at the end of ET.	ETS

Table 1. Claims to the ETs of ETS, ETL, and ETP types at FEEC BUT [1].

In the Table, the individual rows are colored accordingly to the recommended color scheme of the ET pages with the appropriate themes. If the subject has nonzero number of hours of lectures (L) or numerical exercises (NE), then one text of ETS-type is needed. Nonzero number of laboratory exercises (LE) leads to one ETL-type text, and nonzero hours of computer exercises (CE) one ETP-type text.

When the subject does not match the complete L+NE+LE+CE scheme, it is possible to combine the ETS, ETL, and ETP into a single ET for individual study, in which the interpretation of the theoretical parts will be properly interleaved by illustrative examples, results of computer simulations, etc.

ETs are available on the www pages of the faculty [9] in the PDF format. Their download is conditioned by the user's login. On the date of April 19, 2007, the total number of ETs on the server has been 321.

4 ET FOR THE SUBJECT “MODELING AND SIMULATION IN MICROELECTRONICS”

It is an obligatory subject for the 1st-year students of the “magister's” EECC branch of study. For the purposes of the distance learning, one ET for the individual study has been made up [10]. It is also utilized for the students of the present and “combined” forms of study.

The individual Chapters contain the theoretical and practical parts. The basics of computer modeling, analysis and simulation of electronic systems are explained in the theoretical parts. The practical part demonstrates the concrete software procedures by means of solved examples in PSPICE. Student can test his current knowledge by solving a number of examples in the ET.

The recommended style of the student's work with the ET is as follows:

1. The starting point is represented by the printed version of the circuit schematic, together with the analysis aims.
2. Making up the input circuit file is the first goal of the student's activity.
3. During the utilization of a new command, function, etc., student should keep these techniques as patterns of possible solutions of other concrete problems of computer simulation. He need not know the syntax rules, but he must know, where to search for them. He should find other versions of solution in the manuals. The recommended source of the information is the pspref.pdf file as a part of OrCADPSpice installation (in the doc/pspcref directory). Other documents are available on the www pages of the subject [11].
4. The preferred method of working with SPICE is a trial and error method in an input file-simulation loop, which should gradually converge to error-free results. It is important point for the student to come to the solution alone. The retro-effect of understanding the circuits which are simulated is also appreciated. The teacher in the conventional - contact form of education should respect two principles: Offering the instructive guidelines to students as well as a lot of time for individual solution, then demonstrating correct procedures, and discussing the simulation results from the point of view of “electrician” at the conclusion. Students were encouraged to work with suitable surveys of SPICE syntax and with their lecture notes, and to be able to do effective records of their computer experiments into the exercise books. Also the individual solution of examples on personal PCs beyond the organized classwork has been important. In the distance form of study, some of the above principles cannot be applied. The absence of a direct contact with the teacher seems to be serious student's handicap. This handicap can be partially reduced by the “added value” of high-quality ETs for distance education.

The subject is oriented to the OrCADPSpice simulating software. However, the general principles of computer modeling, analysis and simulation are useful for working with an arbitrary SPICE-Family program. The reading is based on the simulation on the level of input files. That is why it is not necessary for students to use OrCADPSpice. It is only recommended. The demo version is freely downloadable from the web pages of the subject [11].

The graduate student would be able to solve independently various problems, associated with the SPICE modeling and simulation.

5 CONCLUSIONS

The experience from FEEC BUT demonstrates the necessity of a well-considered **faculty** conception of elaborating the textbooks (TBs) for distance education. From the practical point of view (easy availability of TBs, their distribution with no expense, their links to other information sources), it is preferred the electronic form of these texts (ETs). It is useful to frame ETs in such a way to utilize them also for the conventional forms of education.

Compilation of the ETs for distance education is an exacting creative activity and a source of potential problems even for experienced teachers. The faculty should help them at least in the form of a well-operating template or other directions how the ET should look like. No less important thing is to find such form of teacher's motivation in order to create ETs and turn them in the scheduled deadlines.

According to the author's opinion, discussions should be led about the suggested contents of ET and about its concrete form (PDF with hypertext cross references). The HTML documents seem to be more preferable. However, their processing can be a serious problem, particularly for authors, which have no experience with the web presentations.

From the present point of view, the above conception of ETs for distance education can serve as an eventual part of more complex e-learning activities.

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