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MULTIMEDIA MANUAL FOR DISTANCE LEARNING IN TECHNICAL UNIVERSITY

Описано проблеми навчання технічних дисциплін через мережу Internet. Наведено практичний приклад приготування матеріалів для дистанційного викладання курсу мікроелектроніки.

In this paper the problems concerning technical education via Internet are described. Practical example of materials preparation for distance learning in microelectronics is given.

1. Introduction

Open and Distance Learning is known since the beginning of 20th century. For a long time, it was devoted to education in the areas of economics, law, languages, etc. Recently, this notion is also applied to technical subjects. However, education of engineers is more challenging since the students should acquire not only theoretical knowledge but also practical skills. The crucial question is how to substitute hands-on exercises in distance learning without loss of education quality. New information technology is necessary.

Many schools and companies in Europe offer short-term technical courses using long distance techniques as a cheaper alternative to stationary ones. These courses (on programming and telecommunications) are the form of continuos learning and they are rarely included into the curricula at the university. Warsaw University of Technology (WUT) went further trying to adjust the educational offer to economic conditions and especially to the expected job market needs. WUT started the distance curricula leading up to Eng. (B.Sc.) degree in engineering. The main reasons were the intention to overcome nontechnical trends in preferences of candidates as well as economic barriers, and to come at greater number of potential students (also from small provincial places). The long distance study at WUT reduces the formal requirements for the students so that it is the form opened for all candidates, in that number working, disable, living abroad or even foreign students.

2. Distance Learning in WUT

On-distance courses are offered by the Centre for Distance Learning [1] – the unit of WUT. The study initiative is called SPrINT (Study in Polytechnic realised by INTernet). SPrINT joins the efforts of three faculties: electronics and information technology, electrical engineering and mechatronics. This academic year more than 240 students were admitted to 4-year programme on computer engineering, multimedia techniques, mechatronics and industrial informatics.

The nominal time of the study is 4 year but the system of study is flexible and the time can be extended at the most twice. The students choose individually the progress rate of studying according to his or her capabilities as long as he or she satisfies the minimum performance requirements. SPrINT uses the European Counting System for the requirements checking. The academic year is divided into 4 quarters (the quarter is a half of one semester - it lasted 8 weeks).

During each quarter, the student is suggested to attend two courses – the big one (8 ECS pts) and the small one (5 ECS pts). All the courses are finished with the written exams carried out in the traditional way (at the classroom with the supervision of the tutor). It is necessary to avoid the problems of students authorisation. The structure of the programme requirements is summarised in Table 1.

Each academic year begins with the laboratory meeting at the University, lasting one week. Even using the modern information technology in teaching, there are still some exercises, which need the personal contact with the real device during the laboratory. In order to fulfil the requirements of the diploma in engineering, such laboratories were organised at the university.

The programme is divided into three thematic groups of courses: basic courses, directional courses and the study for the specialisation. Basic courses are aimed at the fundamental knowledge and they consist of the courses on Mathematics, Physics and Informatics. The same basic courses are delivered for all faculties within SPrINT. This approach lowers the cost of the study meaningfully. The directional courses contain the knowledge specific for the faculty. In this group, the course offer differs between faculties slightly. The study for the specialisation leads up to the diploma in the specific field. It contains not only obligatory, but some elective courses too.

Table 1

Programme requirements for Eng. diploma

	Course type	Number of courses	Score for each	Total score
1.	Big courses	15	8	120
2.	Small technical courses	11	5	55
3.	Small economic and social courses	4	5	20
4.	Meetings - Labs	5	5	25
5.	English	3	5	15
6.	Diploma seminar	1	5	5
7.	Diploma thesis	1	8	8
Total				248

The authors of the SPrINT courses have to face some difficulties. The questions considered as important there are as follow:

- handbooks for the on-distance student,
- communication between teacher and student,
- software and tools required for engineers teaching.

SPrINT takes the advantage of LOTUS LearningSpace. LearningSpace platform is designed for e-learning. It enables the on-line contacts with students and on-line sessions: it contains the database, the tools for course materials preparation and the build-in interactivity, which makes many methods the students testing possible. The lessons with LearningSpace take place in the virtual classroom, that is at the computer with the access to LAN network or Internet. Internet can help to solve many problems dealing with distance education. It is used for fast communication between teacher and student, knowledge exchange between students, on-line and off-line knowledge testing. But it is obvious that even using the interactive Internet techniques the distance

learning remains the method of self-learning and needs special educational assistance and equipment.

3. Example of materials preparation

For distance study at WUT, it was decided the textbooks would have form of multimedia manuals distributed on CD-ROMs. There are still many students in Poland without the access to Internet. Therefor the materials on CDs seemed to be the best solution. The preparation of such materials is difficult, very time consuming and needs the great efforts of the authors. The way of knowledge presentation differs from the standard textbook. The cost of manuals is the biggest part of total cost of distance study preparation.

As an example, we present a basic, obligatory course *Fundamentals of Electronics*. The course is dedicated to elements of integrated circuits and to fundamentals of the analogue and digital circuit realisation. It presents principles of action, basic technologies, computational models, basic functional blocks and logic cells, selected applications, parasitic elements. Special emphasis is placed on use of circuit simulator (SPICE) called directly from manual in order to observe devices characteristics, to analyse of simple circuits, and to extract selected parameters.

Fundamentals of Electronics is an introduction to advanced courses presenting the implementation of the more complex electronic circuits and systems, processes of design of VLSI structures and the CAD tools, including *virtual prototyping*.

The handbook for the course is prepared according to the template, accepted as a standard for every handbook for distance study programme at WUT. It is written in html format and can be processed by any kind of the browser accepting this format (for example Internet Explorer or Netscape). Together with the course contents, CDROM received by the student contains the installation versions of Netscape and PSPICE software.

The main page of the handbook (see fig. 1) contains the title and the list of the authors. From there the page containing the main table of contents can be opened (see fig. 2). The parts of the handbook are as follows:
- from authors,
- what your computer should be,
- how to work with this handbook,
- what do you have to know to understand,
- table of the course contents,
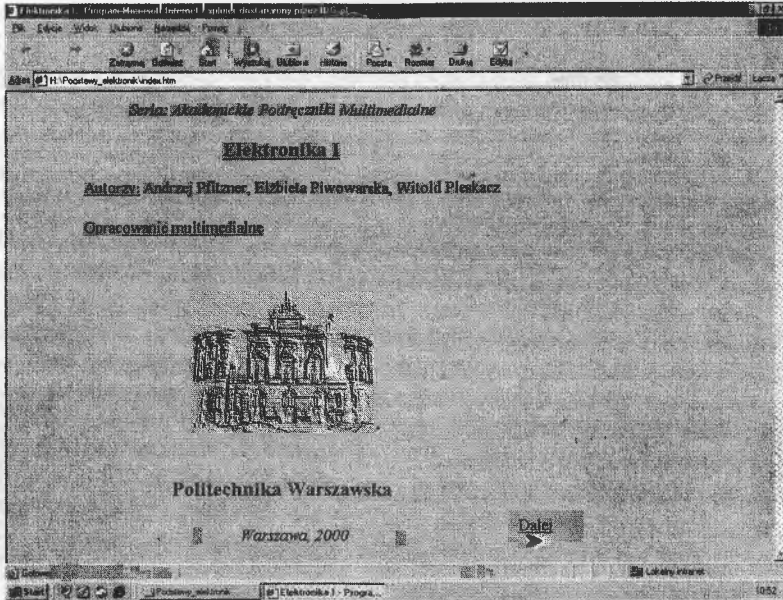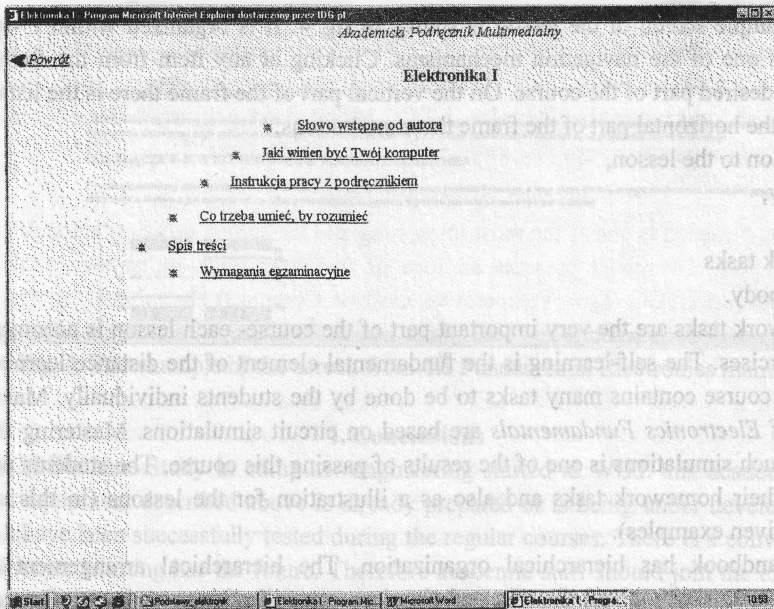- exam requirements.

Fig. 1. Main page

Fig. 2. Manual contents

After clicking the line *table of the course contents* the user enters the page containg the list of the course chapters (see fig. 3). The course recorded on CD is divided into chapters which consist of lessons. *Electronics Fundamentals* is divided into 15 lessons, each lesson includes a few segments, and each segment includes a few screens. 15 is the recommended number of lessons for each course. To enter the lesson it is enough to click into the line with the lesson's title.
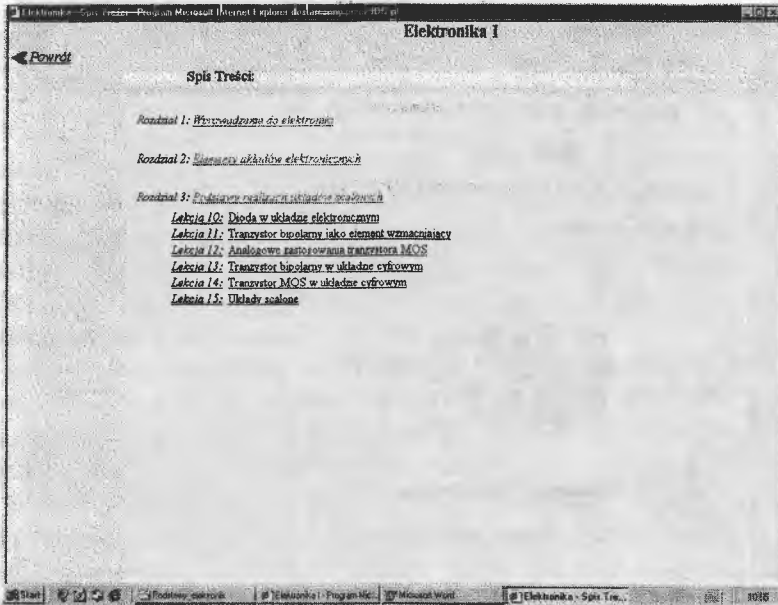
Fig. 3. Course contents

The example screen of the lesson is shown in fig. 4. It is organized within □-type frame. This frame is one of the navigation mechanisms. Clicking at any item from the frame the user moves to the desired part of the course. On the vertical part of the frame there is the list of lesson's sections. On the horizontal part of the frame there are buttons:

- introduction to the lesson,
- dictionary,
- literature,
- homework tasks
- lesson's body.

Homework tasks are the very important part of the course- each lesson is accompanied by a series of exercises. The self-learning is the fundamental element of the distance learning process. So that each course contains many tasks to be done by the students individually. Many tasks for the course of *Electronics Fundamentals* are based on circuit simulations. Mastering the skills in the field of such simulations is one of the results of passing this course. The students use PSPICE to simulate their homework tasks and also as a illustration for the lessons (in this case he/she follows the given examples).

The handbook has hierarchical organization. The hierarchical arrangement of content enables the easy moving about the text and simultaneous call of many screens. On the top level there is the most important information. For some parts of the text the user can open the additional windows with the additional information.

The use of the Internet does not solve the another important problem – the access to special software needed during engineer education. The current license and NDA conditions exclude the remote access to commercial software and technological information obtained for educational purposes. Moreover, most students will use relatively slow modem connections what makes impractical on-line use of such tools on remote system. Therefore, the solution is to base distance

learning on freeware software installed on students' computers. There are several such tools available; but for special purposes, they have to be prepared by academic staff itself. One of them is IMiOCAD developed at the WUT [2]. The system is aimed at full-custom design teaching. It consists of the following programs: layout editor, circuit extractor, logic extractor, process and device simulator with the statistical postprocessor. Together with the circuit simulator (e.g. PSPICE) IMiOCAD allows forming whole design flow in full-custom design. They offer professional level functionality and industry standard output formats (CIF, GDSII). The designs can be manufactured in industrial silicon foundries.
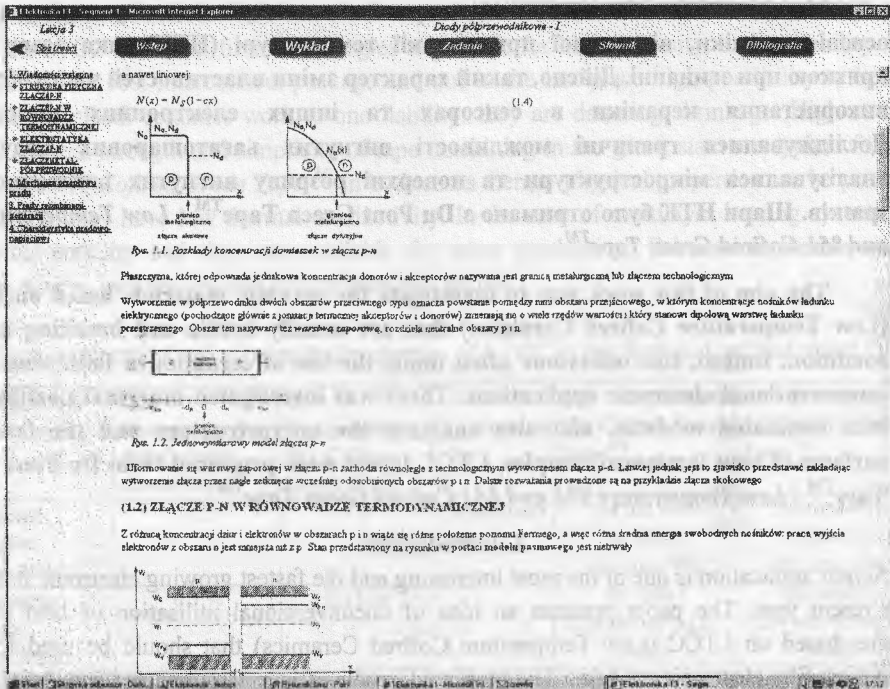

Fig. 4. The example of the screen from the Fundamental Electronics manual

4. Conclusions

The On-Distance-Study in computer engineering started at WUT this academic year. The educational equipment described above is already prepared or is being under development. Some of the tools have been successfully tested during the regular courses. There is a convincement that the long distance learning has the future. Therefore academic staff should join the efforts to work out the proper methods for engineering on-distance education. The cost of technical courses is much higher in compare to the theoretical courses that not needing practical support. The only solution to overcome above problem is creating the network of programs. Such a network of faculties was launched within the WUT. There is a plan to form the network with other technical universities in Poland in the near future.

1. http://www.okno.pw.edu.pl – the portal of Centre for Distance Learning (in Polish).
2. http://www.imio.pw.edu.pl/wwwvlsi/imiocad. 3. http://www.lotus.com/home.nsf/tabs/learnspace