Collaborative Technologies for a Microelectronic Course using Moodle

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Abstract: - This paper presents an introduction of a Microelectronics Circuits Course, where we have emphasized the collaborative technologies as educative methods. The main objectives are achieved using e-learning methodologies that include a different itinerary lessons and a sequential program of exercises offered by means of Moodle internet tools. The course has been adapted to the criteria established by the new European Higher Education Area (EHEA).

Key-Words: - Microelectronics Distance Course, On-Line learning

1…Introduction

The main objective in the Microelectronic Circuits Courses, taught in the major Electrical and Computing Engineering syllabus, is to provide the students the ability to analyze and design electronic circuits. While the application of the integrated circuits is covered, emphasis is placed on MOS transistor circuit design.

Nevertheless although we still analyze, design, and think about MOS transistors in more or less in the same way that we did several years ago, we start to consider new devices and design methodologies in a process of revision as silicon nanoelectronics start to become an approaching reality.

The teaching of these subjects in the Microelectronic Circuits course, within the syllabus of Telecommunications and Industrial Engineering in the University of Cantabria, needs special attention, and pay the way to incorporate new e_learning methodologies to prepare not only the actual knowledge’s transmission but also the introduction of new devices and circuits design methodologies.

The possibility that offer e-learning tools like Moodle (1), following the principles of learning based on the active participation of the students, allows to afford these objectives with the adapted tools.

In this paper we present the use of interactive methods, starting from the use of transmission technologies with the material necessary for the development of the subject available for all students each week.

During the course progress we intend to reach collaborative technologies using a self_evaluation program and mobilizing the forum communications between the student themselves and between the student and the professor, Fig 1.

So, one of the aspects developed for this course is a sequential exercise program, in an interactive way through Moodle [2], with an average of ten exercises per topic, as part of the continuous work that the student must do to progress in the subject. These exercises are evaluated in real time using the facilities of these internet tools.

The automatic assessment of the student progress carried out by Moodle in each topic’s exercises allows the control of timing in the subject program, to fulfill the aims of the course. Furthermore, this enables a personalized assignment of the simulation tasks of the different electronic circuits, which precede the practical work to be carried out with measurements in the traditional laboratory or in the distance access laboratory offered as well.

The paper is organized as follows: Section 2 describe the course contents and its organization using...
the Moodle facilities to offer the subjects of the course material to the student with an ordered and structured distribution by weeks. Section 3 presents the exercise program and its influence in the progress towards to the circuit simulation and the preparation of the practical work. Section 4 presents some examples of the web pages that the students have available in the so-called virtual classroom and in the Section 5 we present the main conclusions and results.

All these tasks are included in the adaptation program of the University of Cantabria to the criteria of the European Higher Education Area established by the Sorbonne Declaration (1998), and the Bologna Agreements (1999), affecting Engineering Curricula.

2 Teaching Content Development

The subjects of a Microelectronics Course, as a basic course in the Electrical and Electronic Engineering program in our University, have the aim of introducing the student to the basic concepts of electronic circuit design, such as the principal silicon device characteristics and modeling and the principles of amplification, and generation and processing of signals.

The student accesses the theoretical contents of the classes and all the problems dealt with in class, as well as the outlines of the practical exercises in the web page of the subject. This material can be consulted as like an electronic book using Moodle facilities [4] that is being offered as much as the progress of the course.

Figure 2 shows the home page constructed with Moodle for this course, which shows in the central part the access to the theoretical content topics and the set of problems that will be resolved in the classroom associate to each topic.

In this central part of the Moodle home page is shown as well a set of exercises selected for every week, from a collection of exercises data base.

All these activities have a weekly periodicity to schedule the student progress during the course. The current week is highlighted, so you have the theoretical contents, forums, and self-evaluation exercises for each week.

![Figure 2. Microelectronic Circuit Course Home Page.](image-url)
In this figure 2 is also possible to observe in the upper left side the course name, and a navigation bar below that fills with the hyperlinked names of the pages as you navigate from one page to another.

Below on the left there are four columns blocks with the participants in the course, professor and students, the activities which is possible to achieve, the administration of the course and the names of all the other courses that you have developed in Moodle.

In the right part there are three columns block as well, where the first block is a calendar with the activity dates highlighted the second block is the latest news list with the latest items added to the Forum News and the last block include the ability to add new column blocks.

3... Sequential Exercices Program

Within the teaching material have as an important role the incorporation of an exercises program to be sequentially solved by the students.

The exercises that the students have to do are divided into the same topics than the theoretical ones, so the students can progress topic by topic continuously until the end of the course [5].

The set of exercises of each topic covers its theoretical contents and enables the observation of the progress in the different topics as they are explained in the classes, so the exercise program operate in this way like a self_evaluation program.

There are different question types like multiple choice, true short answer, calculate answer, matching answer, etc. In our program most of the quizzes are multiple choice questions.

In the figure 4 we show some quizzes of multiple choice of a selected topic.

4... Virtual Classroom

One of the first effects obtained in this Microelectronic Circuits Course when using the Moodle's tools has been to improve the student’s access to information that actuate like an equivalent to an electronic book.

So this electronic book in this first stage is intended for re-enforcing the knowledge acquired in the classroom, in such a way that the student can access, from home or from the computer room, to the transparencies explained in class, additional exercises
and any other material which helps in the preparation of the course subjects.

Figure 5, shows the organization of the material in the files dedicated in Moodles to this course of Microelectronic Circuits.

The figure include the access to the course general presentation, the course program, lessons, exercises program and course contents with all the transparencies used in the classroom, sometime linked to new web pages.

Figure 5: Course Organization Material

Nevertheless as the use of Moodle tools continue it progress from an efficient method to transfer knowledge toward a more efficient and interactive method to access the knowledge.

As an example the figure 6 shows the material dedicated to the help in the laboratory work, including the practical work outline for each laboratory session and the simulation activities to prepare the measurements in the real laboratory.

This page also includes the manuals of the most common instruments used in the laboratory work

Figure 6: Course Practical Work

In the simulation software page it is included not only the reference manuals but also direct links to free student versions of IS-Spice and PSpice simulators, as shown in figure 7.

For a more friendly use of Spice simulation different automatic tutorials haves also been included, in which there is no interaction between the application and the user and the learning is achieved by mere observation of the computer screens.

Figure 7: Simulation Tools Access

Returning to the theoretical contents the Figure 8 shows the slides used during the course. This material appear in the central part of the home pages sequenced by weeks.

So, this page link to Adobe_Acrobat pdf format files, which that shows the transparencies used during the theoretical classes.

In this way the student can download this material at the beginning of the week dedicated to the each topic and to use it before the explanation in class in order to know previously the main difficulty of each item.

Figure Fig. 8: Topic Material Contents

After the class this material can help to resolve the most difficulties using exercises as a self_evaluation work to finalize the understanding of the successive items.

5 Conclusions

... In recent last years we have introduced Internet-related features, through useful tools such as Moodle, or the extensive use of Web pages, as a system to help the students to learn the subjects of Microelectronic Circuits in the Electronic Engineering Syllabus.

The sequencing of the student’s study of these subjects achieved through a program of automatically corrected exercises and the interactive use of the results interactively during the course, along with the increase in the ease of accessing the laboratories, has led to a considerable improvement in the results obtained by the students of these subjects.

The pass rate of the students of the subjects where we have applied these methodologies has gone up from 38.2% in the 02/03 course to 63.1% and higher currently.

In the last year the introduction of a Forum Activity have improve collaboration between the students themselves and the collaboration between the students and the professor.
A complementary practical work is achieved using real measurements with an online remote access to the electronics laboratory where the preparation of this work has also improved through the interactive methodologies.

References:

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