

WEB-BASED BUILDING COURSE ON ANALOG ELECTRONICS¹

(one teacher's story)

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The web-based building course on analog electronics (english and bulgarian versions) described in this paper is designed as a supplementary means to the classical analog electronics courses. It is implemented during the spring term of 2004 in the exercises with the students from the Faculty of Computer Systems and Faculty of Communication Technology.

The course proposed consists of seven parts: Contents, Class descriptions, Library, Student lists, Resources, Feedback.

The goals of the course are posed in the Introduction. Here, in order to illustrate the building approach to the students, a few interactive flash movies are included.

***Contents** reveals the structure of the course in a form of hierarchical classification. In this exposition, the electronic circuits are not presented as ready-made circuit solutions. Instead, they are built systematically according to the building approach - every new circuit based on the previous ones.*

*The implementation of all the 11 class exercises is described in the **Class descriptions** by means of problems, provoking questions, small projects, forms etc.*

*The circuit building blocks "invented" are gathered into a **Library** with the purpose of their future use in the next classes. The collection is hierarchically organized according to the contents.*

***Student lists** contain a personal information about the students: names, e-mails, sites, ICQ, phones etc. They also include an additional information about the classes (chronicle) including fun stories, photos etc.*

*A special part on the site - **Resources** - is allocated to related web resources: similar basic electronics courses, tutorials, web sites.*

*All the comments coming from colleagues, students, web readers etc. are placed in the **Feedback** page. Also, a lot of e-mail buttons with subjects prepared, forms, counters etc. are intended in order to give a feedback.*

1. INTRODUCTION

In the spring term of 2004 I was teaching two electronics courses together at the Technical University of Sofia: Analog electronics (class exercises with the students from the Faculty of Computer Systems) and Digital electronics (lab exercises with the students from the Faculty of Communication Technology). It was a great pleasure

¹ In order to know more about this web experiment, visit the web addresses as follows:

http://www.circuit-fantasia.com/my_work/conferences/et_2004/course_paper.htm - a html version,

http://circuit-fantasia.com/my_work/conferences/et_2004/course_paper.pdf - a pdf version,

<http://circuit-fantasia.com/my-students/ske2004/intro/intro-ske.htm> - a web based building course.

to me to teach analog and digital electronics together as I was able to expose to the students the universal relationship between the phenomena in electronic circuits.

At the time, I have already accumulated a lot of educational resources (tutorials, interactive movies, pictures, circuit phenomena and paradoxes etc.) about electronic circuits located on my site of *www.circuit-fantasia.com*. So, an idea flashed through my mind - to rearrange all the materials in a form most suitable for my students. Thus I decided to begin creating a supplementary course on the web, in order to support both the classes on Analog electronics and the labs on Digital electronics. Well, here is the story of this my new initiative on the web.

2. STRUCTURE

In the beginning, I had to build the hierarchical structure of the course. So, I decided to organize the materials into seven parts as follows.

2.1. Introduction

First, in order to motivate and to inspire the students, I wrote an emotional introduction. Here I posed the goals of the course introducing the building approach [1] to the students. As an example, I included a few flash movies illustrating how to build some of the most popular electronic circuits: *voltage-to-current converter*, *current-to-voltage converter*, *resistive voltage summer*, *op-amp inverting summer* etc. In the intro I outlined the site structure including a set of internal and external links to the various resources. I decided to code the links with a different color (for example, I specified a fuchsia color to the links pointing interactive multimedia flash movies such as op-amp circuit builder); for this purpose, I placed a color key in the intro. Also, as I used a lot of unusual interactive means (potential bars and diagrams, current loops, superimposed I-V curves etc.) in order to visualize and even sound the invisible electrical attributes of the circuits, I placed a small flash demo with legends about colors and sounds used on the front page.

2.2. Contents

Then I wrote a detailed contents of the subject where I structured the course in a form of 11 logically connected classes. In this exposition the electronic circuits were not presented as ready-made circuit solutions. Instead, according to the building approach, they were built systematically, every one new circuit based on the previous ones. Following the circuit evolution in analog electronics, I took a decision to divide the contents of the subject into six main parts.

2.3. Class descriptions.

Besides the contents of the class exercises, every week I were releasing also current class descriptions. In these 11 units, using a lot of provoking questions, problems, small projects, forms etc., I tried to reveal in a funny way the phenomena behind circuits as follows.

At the beginning, I and my students were deriving from the basic electrical circuits the most elementary passive resistive analog devices with current (unit 1) and voltage (unit 2) output. Then, following the building idea, we used them to build

more complicated compound resistive circuits with voltage input/output (unit 3) and also some classic time dependant circuits containing reactive elements (unit 4).

After, we added electronic components to the passive circuits thus getting basic diode (unit 5) and transistor (unit 6) circuits [2]. Next, we applied the powerful negative feedback principle to the transistor circuits [3] thus getting classic transistor amplifying circuits (unit 7). Similarly, applying a feedback to the op-amp amplifying circuits [4], we got basic op-amp amplifiers with negative feedback (unit 8); then (unit 9) we converted the imperfect passive circuits from part A into almost ideal op-amp circuits [5, 6].

A special part (unit 10) was separated for the basic circuits with positive feedback. Finally, the course finished with mixed (analog and digital) circuits (unit 11).

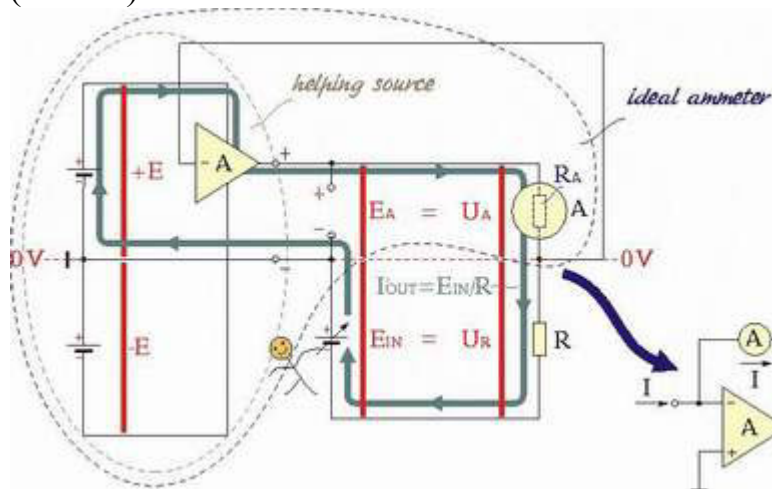


Figure 1. Here is an example derived from class exercise 9 where we have discussed how to make an almost ideal current source.

2.4. Library

On every class I and my students were "inventing" a couple of circuit building blocks. With the purpose of their future use in the next classes, we were gathering the new circuits "invented" into a

library of circuit building blocks. Thus the collection was continuously growing and growing through the semester.

2.5. Student lists

In this part of the site I were keeping a personal information about the students in form of groupe lists containing the student names, e-mails, sites, ICQ, phones etc. (see for example the BG-versions of the groupes 61, 63 and 64). Besides this staff-work, a were placing an additional information about the classes (chronicle) including fun stories, photos etc. In these groupe pages I were noting the student progress through the semester. Also, I were used the e-mail addresses to communicate with the students (e.g. to examine the students in the end of the semester).

2.6. Resources

I divided a special part on the site where I placed links pointing to related web resources: Physics 123 electronics course taught by Tom Hayes at Harvard University; Lessons In Electric Circuits maintained by Tony Kuphaldt (Bellingham Technical College, Washington); the more practical basic electronics course of Basic Car Audio Electronics maintained by Perry Babin etc. In order to stimulate my students, I got in touch with these authors. They wrote kind words about the building electronics course which I placed in the feedback page (see below).

2.7. Feedback

For the first time I was implementing such a web initiative with students; so, I needed a feedback in order to correct and improve the site. With this purpose I located a lot of e-mail buttons with subjects prepared, forms, counters etc. I even started a feedback part where I intended to place all the comments coming from colleagues, students, web readers etc. As almost all the subject of analog electronics is based on the feedback principle, I divided the feedback page into 4 parts: positive, negative, mixed and even ... missing. See these pages to know what the people thought about the course. If you want, you might also give me a feedback!

3. CONCLUSION

During the spring term of 2004 I managed to put the building approach into practice using all the materials I have created during the last years on the web. My students rapturously accepted the web-based building electronics course described. Now, I am inspired to improve the analog electronics course and to implement a new web experiment next year again.

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