TEXTBOOK WRITING OF THE FUNDAMENTALS OF CIRCUIT ANALYSIS UNDER CDIO

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ABSTRACT

Under CDIO engineering education innovation, how to write textbook named Fundamentals of Circuit Analysis is discussed in this paper. It was focused on the writing idea, the basic construction as well as the key features. The textbook combines basic principle and typical project application instance. It provides plenty of practical circuits and examples based on theory, which can enhance and promote the reader's practical idea and ability to integrate theory with practice, and expand their professional view. In May 2012, the textbook is published officially. In 2014, it is honored to be selected as "12th Five Year" national planning textbook in China.

KEYWORDS

Textbook writing;CDIO;Fundamentals of Circuit Analysis;Standards: 1,3,10

INTRODUCTION

Faced with the gap between scientific and practical engineering demands, the educators took up the challenge to reform engineering education. The result of the endeavor is the worldwide CDIO Initiative. The CDIO Initiative is an innovative educational framework which provides students with an education stressing engineering fundamentals set in the context of Conceiving-Designing-Implementing- Operating (CDIO) real-world systems and products.

In 2008, CUIT (Chengdu University of Information Technology), as one of first pilot universities in China, began to learn advanced idea of CDIO and implement innovation accordingly, such as building new professional teaching plan, modifying curriculum syllabus, and so on. However, one of the problem need to solve firstly is there is not a set of textbooks at all which are best suit for CDIO program.

Fundamentals of Circuit Analysis is one of core professional course among electronic engineering disciplines in China, which plays an important role in constructing circuit theory, basic circuit design and circuit making skills and so forth. In 2009, according to CDIO innovation program, the textbook writing of Fundamentals of Circuit Analysis was launched as the first teaching material construction directing towards CDIO.

Initially, after a thorough and extensive investigation into existing Circuit Analysis textbooks, several significant problems were exposed, that was content duplication, without distinctive features, could not afford to CDIO innovation etc. For these situation, the first task was to establish the textbook writing concept located as engineering education textbook.

CONCEPT

The criteria to weigh the pros and cons of a textbook is to see if it match the talent fostering, training mode and training programs. Regarding the product lifecycle as educational background, taking the engineering practice as a carrier, the main objective of CDIO mode is to cultivate students master the basic engineering and technical knowledge, improve their practical ability, and bear the social responsibility of engineering talents.

However, Fundamentals of Circuit Analysis is a basic course, it is a focus and difficulty to characterize the engineering education mode just by writing. To meet the CDIO mode, after repeatedly discussion, the writing concept was defined finally as: with the engineering background, guided as capacity-building, the combination of basic theory and practical application is highlighted, and the organic integration between knowledge initiating and capacity-building is strengthened, the aim is to develop student to be good at thinking, understanding and solving problems, broad their professional horizons, improve their practical application abilities and dynamic and keen insights to new knowledge.

CONSTRUCTION

In a textbook, the readers should be told clearly the teaching purposes and objectives, as well as what readers could get. For this reason, "the goal of the chapter" is presented firstly in every chapter beginning, including knowledge goal and ability goal; next, before theoretical statement, an typical example closely related with this chapter as "cited cases" is provided deliberately in order to mobilize the readers' interest and curiosity; the following is theoretical knowledge explained; then, corresponding previous "cited cases", "technical practice" section is given to explain the phenomenon appeared in cited cases by circuit theory, some similar useful circuits are expanded subsequently; later, "chapter summary" summarizes the knowledge points and related important conclusions; finally, exercises, composed of four parts, is to induce readers to ponder, discuss and test. The following table1 is the difference in construction between the traditional circuit textbook and our CDIO circuit textbook.

Table 1. The Construction Comparison

Traditional Circuit Textbook	Our CDIO Circuit Textbook
Theoretical statement	The goal of the chapter Cited case Theoretical statement Objective assessment Technical practice
Chapter summary	Chapter summary
Exercise	Theory foundation and raise part Project application Simulation part English Glossary

MAIN CONTENT

The content system is divided into two parts: one is basic theory, the other is application and extension toward practice field. Overcome some shortcomings appeared in other general circuit textbooks, just like too broad content, too deep theory and less focus, the traditional content in this textbook is reconstructed to delete obsolete and complexity parts, and featured those basis practical and easy to expand parts. The "General resistance circuit analysis," "Equivalent circuit", "First-order time-domain circuit analysis" and "Sinusoidal steady circuit analysis" etc are focused on. "Step response and impulse response", "Second-order time-domain circuit analysis" and so on are appended properly.

Additionally, it is a obvious trend in today's world that mutual penetration and integration among different fields. On the basis of knowledge inheritance, textbook should not only elaborate it's own contents, but also induct some basic concepts of follow-up courses in advance. For instance, establishing the connection with subsequent course "Analog electronic circuits" through the "Coupling inductance and ideal transformers", "Circuit frequency response" and "Two port network"; associating "The step response and impulse response" with the "Signal and system" course; setting up the basic concept of forceful electric power by the "Three phase circuit". Simultaneously, a large number of physical pictures are interspersed, such as CREE zoom flashlight, DIMUK amplifier and TCL telephone, all of these pictures provide readers with visual stimulation, embodying the combination between basic theory and the latest products.

The "Cited cases" located in the beginning, while the "Technical practice" lied in the last part of each chapter. "Cited cases" throws out questions; "Technology practice" answers and expands the questions according to the chapter's content. For example, in "Time domain analysis of first-order circuit", camera flash circuit is imported firstly, the original text as follows: "The flash is needed in daily life frequently. Generally, the camera flash circuit needs to be recharged after longer exposure. On other occasions, flash is used as a warning signal, for instance, antenna tower, building sites and so on." The questions is "what a flash circuit consists of? how does it works? how to determine the parameters of its elements?" Directing toward such problems, readers would study deeply and purposefully. In "Technical practice", analogous first-order circuits, such as "delay circuit", "relay circuit" and "automobile ignition circuit" are listed to expand knowledge.

SIMULATION

It is inevitably to encounter some complex analysis and calculation during circuit study, which will take lots of time and energy. Computer technology can reduce the repeated work and run rapidly and accurately. For this reason, " Computer aided analysis " is designed in every chapter necessarily.

So far, PSpicesr, Electronic Workbench (EWB) and MATLAB are the 3 main software used in circuit analysis. PSpicesr can not reflect the circuit analysis course because it obtains numerical rather than analytic results; EWB has the advantage of intuitive interface, convenient operation and so on, and could help readers quickly familiar with the measure methods of the common electronic instrument and master circuit performance; MATLAB code is short and powerful with drawing function and visualization simulation environment. It is a powerful auxiliary tool used in circuit analysis.

According to the investigation results, Multisim 9 (version EWB) and MATLAB 6.5 are used as aided software tools in this textbook to help students to learn how to apply advanced software into circuit analysis.

EXERCISE

The traditional circuit textbook is often focusing on theoretical concepts and despising the relation of theory and exercise. The knowledge that students acquire from books is indirect and abstract, students can understand but cannot solve problems, resulting in that the learning enthusiasm of the students is not high. It is our ultimate goal to use the theory to solve practical problems in the engineering, so it is a fundamental way to test the students' basic skills.

In our CDIO textbook, the selected exercises have certain practical value and are suited to be the practical engineering application. It can make students understand the importance of the learning content. By this way students can really pay attention to their learning courses. Soon afterwards it can improve their ability of solving the practical engineering problems. There are 4 parts in exercise design: "Objective assessment", "foundation and raise part" "project application" and "simulation part" . The different parts help students solve problems from easy to complex step by step, making the theory easier to be accepted and avoids students' resistance for the course.

TEACHING METHOD

For this course, the traditional teaching model is that the teacher systematically lectures. Those teachers overly focus on the systematicness and completeness of basic knowledge and pay more attention to the concepts and theories; therefore, most of students are in a passive status. This traditional teaching mode limits students to improve their ability to solve practical problems, and it is bad for the cultivation of innovative talents. With the further teaching, students get bored and lose interest in this course.

Hence, it is necessary to reform this old teaching mode and improve teaching quality. CDIO which is a kind of teaching mode of "learning from doing" can improve the student enthusiasm and initiative. This CDIO circuit textbook which combines abstract knowledge with the real case can prevent teachers from dropping into boring and cockamamie theoretical sermon. At the same time, the CDIO circuit textbook conforms to the cognitive rules of human beings, so it can make students easily obtain new knowledge.Focusing on the seriously selected cases, students explore the new knowledge and obtain the methods and techniques which can be used to solve the practical problem.

ANALYSIS OF TEACHING EFFECT

To test the teaching effect of using CDIO circuit textbook, the contrast experiments are researched. Test objects are graduate students of 2011 grade and 2012 grade. Common circuit textbook is applied to graduate students of 2011 grade, CDIO circuit textbook is applied to graduate students of 2012 grade respectively. After study the course content, textbook rating done properly the results are analyzed. Figure 1 show how much they like the circuit book. It can be seen from figure 1 that the like rate of 2011 grade graduate students 67% and that of 2012 grade graduate students 97%.
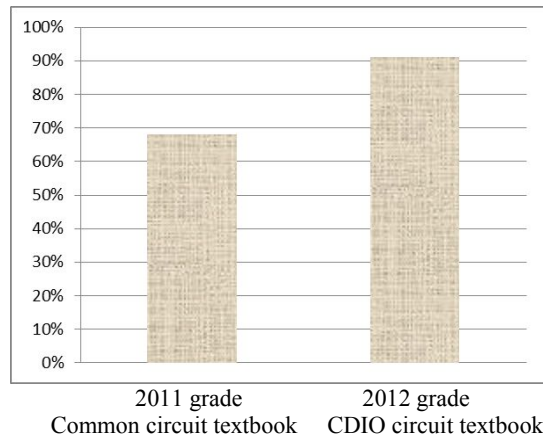
Figure 1: How much they like the circuit textbook

Analysis results show that the CDIO circuit textbook is welcomed in students. It is fully mobilizing the enthusiasm and initiative of students. By this way, students can achieve the knowledge and improve the ability of solving problem.

PERORATION

Before official publication, the book was used as textbook for two terms students for extensive comments collection and better details modification. In May 2012, the textbook was published officially as first engineering education series book by the Higher Education Press, ISBN number: 978-704-034-5858. In 2014, this textbook is honored to be selected as "12th Five Year" national planning textbook.

Teaching materials building should be based on educational innovation and educational research. A high-quality teaching material should satisfy the actual need of educational innovation. The essence of CDIO engineering education model is to serve for the real short-term and long-term real needs of students' future professional positions. However, it is impossible to separated the teaching material building from the whole educational environment to obtain the ideal effect of teaching.

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BIOGRAPHICAL INFORMATION

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