

Innovation and Exploration on Full English Course of "Power Electronics" for Chinese Students

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Abstract—As a necessary bridge for informationization, intelligence and automation into reality, "Power Electronics" plays a decisive role in the training of professionals in intelligent information technology. With the rapid development of global informationization and intelligent industries, it is very important to carry out the construction of the full English course of "Power Electronics" for Chinese students. In order to improve the teaching level, integrate international advanced education and cultivate professionals with a globalized vision. This paper illustrates the importance and urgency of the construction of full English course of "Power Electronics" from the aspects of the goal of curriculum construction, content architecture, teaching conditions and environment, teaching methods and means.

Index Terms—power electronics, full English teaching, curriculum construction, global informationization

I. INTRODUCTION

As early as the beginning of this century, the Ministry of Education in its *Opinions on Strengthening Undergraduate Teaching Work in Higher Education and Improving Teaching Quality* required that in order to better meet the needs of economic, technological and educational development after China had joined the WTO, undergraduate education should introduce the original foreign language teaching materials and use English as the foreign language to carry out public courses and specialized courses, especially the high-tech fields of information technology, biotechnology and other professional, and strive to three years, foreign language teaching courses to achieve the open curriculum 5% - 10%, training High-quality composite talents to achieve the sustainable development of China's higher education.

In the Fifth Plenary Session of the 18th Communist Party of China (CPC) Central Committee, it also clearly pointed out: "With informationization, industrialization drives modernization, gives play to advantages of backwardness and realizes the leapfrog development of social productive forces."

With China's accession to the WTO, foreign information products have flooded into the country, the international competition in the market and information

industry is very fierce. The success of competition ultimately depends on the number of talents and their abilities. "Power Electronics" is a compulsory subject of automation and related electrical information specialty. It takes optimization of power as its own responsibility, does well in energy and material saving, and aims at automation, intelligence, information and mechatronics services.

With the increase of foreign companies in China and overseas subsidiaries of Chinese companies, both working adults and students have strong motivation to improve their English and professional competence [1]. The construction of full English course for "Power Electronics" meets the development requirements of the strategy of state power. This will not only develop students' abilities to grasp the modern professional knowledge, but also put great emphasis on improving their English competence.

II. COURSE BUILDING GOALS

A. Create a Professional English Learning Environment and Strengthen the Connection between Technological Knowledge Globalization and Education Modernization

In the process of teaching, teachers should consciously create a professional English environment, guide students to focus on learning professional English, strengthen their ability to directly acquire advanced foreign expertise, and train them to become international professionals who understand English and use English.

B. Student Centered and Professional Oriented, with the Help of English Version of Matlab Software to Stimulate Students' Interest in Learning

Learning through the English Matlab software simulation circuits, on the one hand can help students verify the theoretical conclusion is correct; the other hand can help students to relieve their energy from theoretical study, pay more attention to the mastery and application of knowledge.

C. Development of Multi-media Courseware for "full English Teaching", Construction of Online Courses Such as MOOC, MC

Research and find the best combination of multimedia teaching and traditional teaching methods, searching for

the best teaching methods. Set up a digital Massive Open Online Courses (MOOC) and Micro Courses (MC) learning resources package, in which set the situation, interest and visualization as a whole. Thus, the students in an internet environment could easily go on a targeted learning at any time any place [2]

III. TEACHING CONTENT ARCHITECTURE SYSTEM

Describe the characteristics and engineering background of various circuits based on modern power electronics technology, update and integrate the content of the curriculum and strengthen the knowledge connection between the courses. Introduce the principle of the four categories of circuits, and at the same time track the application of new international technologies to broaden students' horizons and ideas, laying a solid foundation for students to apply their knowledge in the future under the background of globalization.

A. Organization and Arrangement of Teaching Content

The main contents of this course are as follows:

1) Power electronic devices

Mainly introduces the basic working principle and working characteristics of various types of power electronic devices [3]. Due to that most of the students are first time contact with the course, the course content is blurred to them, so in teaching of power electronic devices, the most common and the simplest diode is used as a specific example to introduce related concepts. Guide students to master the concept and essence of all kinds of devices through semiconductor device characteristics systems, and make full use of Matlab software simulation to describe the internal structure and working mechanism of various types of power electronic devices.

2) Four kinds of transform circuit

This part is the core of the whole course, introduces the rectifier circuit, the DC chopper circuit, inverter circuit, AC voltage and frequency conversion circuit with a strong theoretical [4]. As the circuits analysis is not easy to grasp, it is necessary to focus on guiding students to master the characteristics of various circuits, working principle and application areas. With the combination of circuit experiment and MATLAB software simulation, the students can straightly understand and master the core technology mechanism of modern power electronics.

3) Specific application and training case

Starting from the actual common application examples, through the design and simulation of switching power supply and SPWM inverter by Matlab, combined with the actual use of their own experience to further deepen the understanding of modern power electronics theory. Discover problems and solve problems in practical applications to enhance the digestion and absorption of the learned theoretical knowledge.

B. Practical Teaching Design

As "Power Electronics" is a highly technical and practical course, the students should not only have solid theoretical foundation, but also the capability of

engineering practice. This course has two in-class operation experiments, namely:

(1) Single-junction transistor triggering circuit and single-phase half-wave controllable rectifier circuit experiment

(2) Single-phase bridge half-controlled rectifier circuit experiment.

Guide students through the experiments to really feel the working mechanism of the rectifier circuit to complete the theoretical knowledge and practice of seamless technology convergence [5].

C. Experimental Adjustments

Half-wave and half-controlled rectifier circuits are the most basic type of circuits. According to the development of technology, more and more three phase circuits have been applied in practice. So we will gradually adjusted to one experiment for single phase circuit and the other one for three phase circuit in future teaching process.

According to the actual situation of the existing equipment, taking the form of a set of every two students, and the teacher conduct proper guidance to complete the experiments that combined with practical application of technology, so as to improve the students' ability to grasp the actual circuit of the engineering application.

IV. TEACHING CONDITIONS AND TEACHING ENVIRONMENT CONSTRUCTION

A. Teaching Team Building

A qualified full English professional course teacher should have a good command of English skills as well as a solid knowledge of professional courses. Our existing team of 5 teachers, all with a doctorate, 4 with the experience of overseas exchanges in English-speaking countries. We now plan to further improve the team's level of English teaching from following two perspectives.

(1) Vigorously introduce compound teachers with high level of English and professional knowledge.

(2) Strongly support teachers go out of the campus (go abroad) to further enhance their professional knowledge and English skills.

The construction of a highly qualified and qualified teaching staff and the dual development of teaching and professional competence will help to provide a solid foundation for the sound development of full English course construction.

B. Use and Construction of Teaching Materials

Selected *Power electronics (Second Edition)* edited by M. D. Singh and K. B. Khanchandani and *Fundamentals of Power Electronics* edited by R. W. Erickson and D. Maksimovic, these two classic textbooks are chosen by Massachusetts Institute of Technology MIT and other high-level universities in the field of power electronics. The textbooks systemly introduced the basic knowledge of power electronics and practical application of technology.

Taking into account the learning habits of students and their ability to understand English professional knowledge, this course will be complemented by *Modern*

Power Electronics Technology in Chinese, edited by teaching team members, to help students understand the various types of electricity. The book describes the various types of modern power electronics power electronics and various types of actual circuit in Chinese. Through the simulation analysis, from the shallow to the comprehensive explanation, to inspire students to further complete English learning.

C. Practice Teaching Plan

Since this course is a closely integrated course of theory and practice, practical teaching is particularly important. How to rationally design the practical teaching link is also an important factor which affecting the teaching effect of this course [6].

Therefore, one of the main goal of this course is to improve the construction of practical teaching. Combining traditional experiments and computer simulation [7], combining the confirmatory experiments and design experiments, with flexible and diverse forms and rich content, to achieve better results.

The experimental guidance book is revised on the basis of the original one. It mainly hopes to introduce three phase circuit experiments, and constantly adjust and update the simulation and experiment related contents according to the actual use and feedback from students [8].

D. Network Teaching Environment

The network teaching environment has not yet been provided. One of the objectives of the course construction is to create a teaching column in the College website, which is mainly about the teaching of *Power Electronics* (Full English) in the website, or a teaching dedicated server. The website/server provides some service contents such as course introduction, syllabus, multimedia courseware, references, homework exercises, experimental instruction, electronic lesson plans, teaching videos and other services for students to download and use.

At the same time, building an online exchange platform for students to interact with each other, so as to solve the difficulties encountered in learning timely. Help to promote students to learn at a spare time and effectively improve learning efficiency.

V. TEACHING METHOD AND TEACHING MEANS

A. Teaching Method

1) Use "Task-Driven Teaching" approach

Teachers organize teaching around the content of teaching materials in classroom teaching, set specific teaching tasks based on the professional content of the courses, pay attention to the information difference between teaching contents and students' cognitive structure, and highlight the actual professional knowledge and the cultivation of English communicative competence.

The more common use of "Task-Driven Teaching" is the "Problem-Solving" approach [9]. Enable students to

truly feel the relationship between classroom learning and practical use [10]. From the angle of language internationalization, it can complete the combination of professional technology and professional content and inspire students' enthusiasm for professional study. Help students develop effective learning strategies and guide students to develop professional working and research ability in English.

2) Design "student-centered" class activities

According to the actual career orientation and follow-up professional training needs, we design targeted curriculum exchange and learning activities in the form of "learning by doing" to improve students' ability of practical application, self-learning and cooperation[11]. Starting from the application of practical skills, focusing on mobilizing students' enthusiasm of learning English, and combining students' mastery of professional knowledge with English proficiency, design multi-form teaching activities in line with the actual situation. Focus on the cultivation of students' ability of independent thinking, interactive discussion and hands-on practice. Guide students to develop a good habit of learning, analyzing, finding and solving problems in practice.

3) Based on "learning needs" to achieve a targeted education

According to the needs of the actual industry, we analyze the "learning needs" of current students' future employment. Targeted understanding of the students' lack in knowledge and skills, combing the structure of the content that should be learned and further to understand the students' transaction accepted learning methods. Highlighting the teaching difficulties in the process of teaching, facing industry applications, we use heuristic teaching methods to guide students a solid grasp of the content.

For example, after a basic concept explanation, students can define the various characteristics of the devices conceptually by understanding all kinds of power electronic devices in Matlab simulation. After the completion of the theoretical explanation of the four kinds of transformation circuits, simulating the actual rectifier, inverter or chopper circuit, so that the students could have a clearer understanding of the practical application.

B. Teaching Means

1) The combination of blackboard and multimedia courseware

Selecting English original textbook, starting from the content architecture system, making the courseware in a form of pictures and essay, so as to display professional knowledge in a specific way, and at the same time, strive to be more vivid from the perspective of students to receive knowledge.

For the basic principles and technical parameters in "Power Electronics", adopting the method of blackboard derivation to let students clearly understand the mathematical and physical properties contained therein. By using the method of interaction between the blackboard and the multimedia [12], the students are fully

motivated to learn, as well as overcome many shortcomings of the traditional teaching mode, such as the slow pace, and the limit in depth, breadth and means.

2) Online MOOC/MC teaching and interaction

Making full use of the modern mobile communication environment, using micro-visual (audio) frequency as an interactive medium supplemented by supportive and scalable resources such as multimedia courseware, references, homework exercises and experimental guidance to establish a Digital Learning Resource Kit[13].

Make use of MOOC and MC to solve the problem of disengagement between teachers and students. Promote students to use their spare time for online learning and teacher-student interaction, and inject new vitality into the distance education technology. The distance between students and teachers can also be shortened from both the online and the offline perspectives so as to make students' professional learning more convenient and make the exchange between teachers and students ease and timely[14].

3) The introduction of simulation software

Fully consider the development of information technology to industrialization, with the help of the English version of Matlab simulation software analysis, combined with industry practical examples, students are enabled to clearly understand the working mechanism of components, the system parameters changes caused by changes in the actual circuit [15]. Through visual effects, students can understand what they learned intuitively and it's easy to complement each other with the contents of practical teaching. This is good for students to master the theory and guide the practical application of a heuristic and help to complete the knowledge and the actual industry docking. Teachers may also revise and improve the teaching content according to the actual reaction of students.

VI. CONCLUSION

Electrical and Computer Engineering Institute of Shanghai Engineering Technology Science University is committed to the training of electrical and information excellence engineers, comprehensively targeting the forefront of international engineering and technology, docking the national development strategy and service industry needs, based on the training of high-end personnel, continuing to convey to the community with an international perspective, solid theory, skillful manager and engineers. The teaching of full English course for "Power Electronics" meets the needs of the rapid development of international power electronics technology. With the research of actual industry demand, constructing reasonable teaching content, creating advanced teaching environment, integrating modern teaching methods, and build professional special courses combining theory with practice and practice with technology. The design concept of the course demonstrates the college's running characteristics and lays a solid foundation for training high-quality and high-skills international professionals.

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