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Research on the Curriculum Reform of Power Electronics Technology in Independent Colleges Based on Engineering Education Accreditation

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***Abstract*—This paper analyzes the current situation and existing problems of the teaching of power electronics technology in independent college, aiming at the target and positioning characteristics of the independent college. In view of the specific requirements of engineering education accreditation, the reform of teaching methods of power electronics technology in independent colleges is discussed, including the reform of theoretical teaching and the reform of practice teaching. The reform of the teaching method of this course can meet the requirements of engineering education certification, innovate the practical teaching of electric power electronic technology course, deepen the engineering teaching reform of electric power electronic technology course, cultivate the students' creative practice spirit, improve the students' practical ability in engineering, and cultivate the high-level applied engineering talents.**

Keywords—Engineering education accreditation, power electronics technology, teaching reform

I. INTRODUCTION

In recent years, with the invention of high-power semiconductor switching devices and the progress and development of converter circuits, power electronics technology, which uses high-power semiconductor switching devices and circuits to realize power conversion and control technology, arises at the historic moment. The technology is one of the foundations of modern electronic technology, which straddles three fields [1]: strong power, weak electricity and control. Power electronics technology can improve the efficiency of electric energy conversion and improve the quality of electricity use. At the same time, it is also a technology that must be mastered to realize green electricity usage and seek new clean energy.

Power electronics technology is a new branch of electric power technology, electronic technology and modern control technology. It is the most active branch of electrical engineering. This course is a professional basic course of automation, electrical engineering and automation undergraduate course. It is a close and practical course combining theory with practice. It not only lays a solid theoretical foundation for the students of electrical engineering and its automation, automation, mechanical and electrical integration and other related majors, but also provides important basic knowledge of modern high technology for engineers and technicians engaged in electrical energy transformation, electrical transmission, automation, power system and other related fields. It occupies an important position in the training of talents in this field [2].

At present, there are some problems in the course of "power electronics technology" in our school: (1) teaching content is relatively old. (2) students' basic education is poor. (3) traditional teaching mode is rather boring. This course contains a lot of circuits and waveforms. Most of these circuits and waveforms are quite abstract. How to let students understand and master these waves and circuits deeply, we need to reform the current teaching mode to improve students' perceptual knowledge of this course and then better understand and learn this course [3].

As an application-oriented university for the construction of a high-level applied university with regional characteristics, we should closely link the training goal of "high level application", so as to clarify the reform ideas and set up correct reform goals. How to determine appropriate teaching content, teaching plan, appropriate teaching methods and means to improve students' interest in learning and achieve ideal teaching results are a problem worthy of further exploration and practice.

II. ENGINEERING EDUCATION CERTIFICATION

The accreditation of engineering education is an international quality guarantee system for engineering education [4]. It is also an important basis for the international mutual recognition of engineering education and the international mutual recognition of engineers. The core of the engineering education professional certification is to confirm the established quality standard requirements for the engineering professional graduates to meet the industry approval. It is a qualified evaluation based on the training goal and the requirements of the graduation export. The professional accreditation of engineering education requires the establishment of the professional curriculum system, the staffing of the teachers and the configuration of the conditions for running a school, which are all around the core task of the

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students' Graduation ability and emphasizes the establishment of a professional continuous improvement mechanism and culture to ensure the quality of professional education and the vitality of the professional education.

The general standard of engineering education certification standard (revised in November 2017) issued by the Chinese Engineering Education Professional Certification Association (China Association for Engineering Education) has been formulated from seven aspects: students, training objectives, graduation requirements, continuous improvement, curriculum system, teachers and support conditions. In the professional supplementary standard, the detailed regulations are made from three aspects: the curriculum system, the teaching staff and the support conditions. In the course of the curriculum, the "power electronic technology" course is the core content of the two professional basic knowledge fields for the two major professional basic knowledge fields of automation and electrical engineering and automation. In order to make the core course of power electronics technology meet the specific requirements of engineering certification, we set out from the requirements of the "engineering education certification standard", and set up the teaching objectives of this course in combination with the characteristics of the power electronics technology course. The corresponding relationship between graduation requirements and Course Object (CO) is shown in Table I.

TABLE I. GRADUATION REQUIREMENTS AND COURSE OBJECTIVES (CO)

No	*Graduation Requirements*	*Course Objectives*
1	Engineering and professional knowledge can be used in design and improvement of complex engineering problems in automation field	CO1: The relevant models of power electronic system can be constructed by using the basic principles of power transformation and the design and control methods of power electronic transformation devices.
2	The process design, system parameters and equipment indexes can be calculated through model building.	CO2: The power electronic system can be calculated by using the circuit structure, basic principle, control method and design calculation method of the power electronic conversion device.
3	The process design of automatic production, equipment process and system management can be completed through the process of integrated unit, and the optimization of the process design scheme is carried out to embody the consciousness of innovation.	CO3: The design scheme of power electronics can be optimized by using the knowledge of circuit structure, basic principle, control method and design calculation of power electronic converter.
4	Based on professional theory, we can choose the research route according to the characteristics of objects and design feasible experimental plans.	CO4: The basic principle of electric energy conversion and the design and control method of power electronic transformation device, and the circuit structure, basic principle, control method and design calculation method of power electronic conversion device are applied to the feasibility design of the related schemes.

Around these curriculum objectives, we will explore the existing teaching reform of the power electronics technology course, including the reform of theory teaching and the reform of practice teaching. The reform of the teaching method of this course can meet the requirements of engineering education certification, innovate the practical teaching of electric power electronic technology course, deepen the engineering teaching reform of electric power electronic technology course, cultivate the students' creative practice spirit, improve the students' practical ability in engineering, and cultivate the high level applied engineering talents.

III. MEASURES OF CURRICULUM REFORM

In order to highlight the characteristics of "application-oriented" in the course reform of power electronics technology and meet the requirements of engineering education certification and the curriculum objectives in Table 1, we have applied teaching methods such as example teaching to help students lay a solid theoretical foundation, design practical teaching links such as experiments and training that are suitable for practical application, and enhance students' abilities. The application ability raises the student independent study ability, guarantees student's knowledge, the ability and the quality obtains the due enhancement. The reform of power electronics technology is mainly carried out in the following aspects:

A. Optimization of teaching content

The latest development and application of modern power electronics technology requires objective adjustment and optimization of conventional teaching contents. As a very practical course, we should pay attention to both theoretical deduction and practical application in the practical teaching of power electronics technology and according to the requirements of engineering education certification, the content we teach should be in accordance with our curriculum objectives. As regarding of the design of teaching contents [5], four basic kinds of basic transformation circuits of AC-DC, DC-DC, DC-AC and AC-AC are introduced, including the important pulse width modulation technology, the multiplicity and multilevel of the rectifying and inverting circuits, and the new voltage space vector pulse width modulation, the PWM rectifying circuit and matrix AC-AC converter. Taking the converting technology as the core and aiming at the engineering application, the teaching content is designed by modularization, and the teaching content and class time of the corresponding modules are adjusted appropriately according to the development of industrial production. In particular, it will increase the application of electric power technology in electrical engineering, especially to increase the application of green energy, such as variable speed constant frequency power generation technology and so on, to improve the practical concept of engineering.

B. Deepening the reform of teaching methods

In the course of teaching, the theoretical analysis and formula deduction of the complex circuit in the teaching material are weakened, and the analysis of the application and design of the actual circuit is highlighted. The teaching mode is mainly classroom teaching, supplemented by other ways such

as discussion teaching, etc. The discussion class is divided into the following forms: 1) self-study seminar 2) report discussion class 3) exercise discussion class. Through the discussion class, students' learning initiative is better, and the teaching effect is good. Through the breadth and depth of students 'questions in the discussion class, it shows that students are put forward on the basis of in-depth study and thinking about what they have learned. At the same time, it is also a challenge to teachers. Teachers are required to be fully prepared for the relevant content, have a wide range of knowledge, and have a wealth of relevant scientific research experience. At the same time, teachers can use the students 'questions to analyze the key content and difficult content, rather than simply indoctrinate teaching. In addition, we can also introduce engineering cases and teachers' scientific research projects into classroom teaching. Firstly, some typical engineering cases are introduced into the course teaching according to the key contents learned. From the engineer's point of view, the students are taught the project background, design requirements, detailed plans, technical lines, on-site debugging process, acceptance criteria and management methods of the whole project, so as to enable them to understand the actual project, let students have a comprehensive understanding of the actual project engineering, and increase students' interest in learning. Secondly, teachers' scientific research results are introduced into classroom teaching as engineering cases. In the whole teaching process, through the guidance of scientific research projects, the chapters learned in the whole course of "Power Electronics Technology" are connected in series, and the knowledge points learned are applied through the project, so as to achieve the learning purpose and improve the students' engineering ability.

C. Strengthen the practical teaching segment

To meet the relevant requirements of engineering education accreditation, we have added some comprehensive and innovative experiments in the experimental teaching of power electronics technology. At present, in order to meet the students' various experimental requirements, our school and Zhejiang Qiushi science and Education Equipment Co., Ltd. jointly developed a comprehensive teaching experimental platform for power electronics and electrical transmission, As shown in Fig.1. The main characteristic of the teaching experiment platform is modularization, as shown in Fig.2. On this comprehensive teaching experiment platform, students can carry out many basic, comprehensive and innovative experiments through simple and easy operation. This teaching experimental platform is a new experimental device with complete configuration, complete functions, compact structure, convenient use, wide adaptability and expanding ability. The device can complete all the teaching experiments of power electronics technology and motor control course, and can set up more than 20 teaching experiments of power electronics technology and power electronics speed regulation course. In order to meet the needs of the rapid development of power electronics and motor control technology, the research on new devices such as GTR, MOSFET, IGBT, drive and protection circuit, SPWM variable frequency speed regulation system, phase-shifted full-bridge zero voltage switching PWM converter, etc. has been expanded in recent years. Around the practical teaching links and graduation design contents of power electronics courses, some experimental boxes or test benches which can build power electronics components independently are built. Students can build their own circuits and debug these experimental boxes to complete the course design and graduation design of power electronics technology and power transmission. Through practical teaching contents such as electronic design competition of college students, we can train students' practical hands-on ability and circuit analysis ability to develop student's potent.

Fig. 1. Comprehensive teaching experiment platform for power electronics and electric drive.

D. Improve the assessment method

At present, students' examination results are composed of the usual performance, test results and final examination results. In order to better meet the requirements of engineering education accreditation, we adopted a separate experimental examination for the course of power electronics technology.

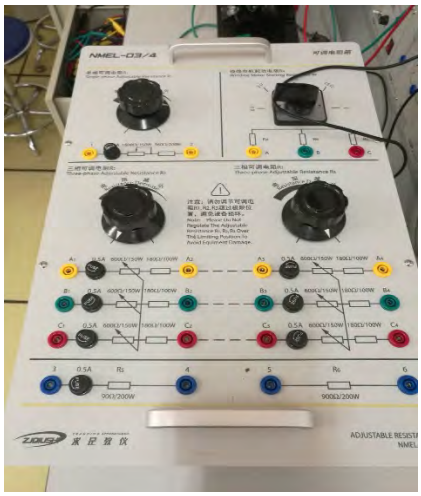

Fig. 2. Adjustable resistance box module

The composition of the improved examination results are as follows: final examination: 60%, experimental examination: 20% (one group per person), normal experiment: 10%, regular homework: 10%, writing small papers, classroom discussion (writing in accordance with the required papers, or actively participating in the appropriate points for the discussion of the discussion). At the end of the term, students can take a summary of the course prepared in advance, which accounts

for 10% of the final exam. This will help students to make a better summary.

E. Set up the teaching team of the course

The newly formed team members include one professor, three Ph. D., and one laboratory technician. Professor Pan has long been engaged in the teaching of "power electronics technology". Professor Pan's rich teaching experience and advanced teaching concepts will provide strong support and guarantee for the smooth implementation of the curriculum teaching reform.

IV. SUMMARY

This paper analyzes the current situation and existing problems of the teaching of electric power electronic technology in Independent College in view of the goals and positioning characteristics of the independent college. In view of the specific requirements of engineering education accreditation, the reform of teaching methods of power electronics technology in independent colleges is discussed. It mainly includes theoretical teaching reform, practical teaching reform, reform of teaching assessment methods and establishment of teaching team. It is hoped that through the comprehensive reform of the course teaching, we can meet the requirements of engineering education certification, innovate the practical teaching of electric power electronic technology course, deepen the engineering teaching reform of the electric power electronic technology course, train the students' creative practice spirit, improve the students' practical ability in the course of work and cultivate high level applied engineering talents.

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