

Training mode of Electrical engineering and automation based on Professional certification of Engineering education

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Abstract

This paper introduces the construction and practice of training mode of electrical engineering and automation of Yangtze University based on professional certification of Engineering Education, and explains the training objectives, graduation requirements, curriculum structure and practical teaching. The professional certification of engineering education improves students' comprehensive quality and ability, and ensures that the engineering and technical talents meets international standards.

Key words

Professional certification, Engineering education, Training mode, electrical engineering and automation

I. Introduction

Professional certification of engineering education has been implemented in many countries, it confirms the effects in promoting the development of engineering education. Establishing the professional certification system of higher engineering education is of great significance to improve the international competitiveness of China's higher engineering education and ensure the quality of engineering education. In the 1990s, China began to carry out professional certification of Engineering Education from architecture. In 1994, "Interim Provisions on education evaluation of construction majors in Colleges and universities" were promulgated and implemented, and the professional certification of engineering education has become a scientific, legal, standardized and institutionalized work [1, 2].

The core of engineering education professional certification is to confirm that engineering graduates

meet the established quality standards recognized by the industry, it is a qualification evaluation oriented by training objectives and graduation requirements[3]. China's engineering education certification standard consists of general standards and professional supplementary standards. The general standard includes seven elements: students, training objectives, graduation requirements, continuous improvement, curriculum system, teaching staff and support conditions[4, 5]. "Students" are the center, guided by "training objectives" and "graduation requirements", and realize the training objectives and graduation requirements through "curriculum system", "teaching staff" and "support conditions". The core value of certification is to promote "continuous improvement" through internal / external evaluation feedback. The supplementary standards for each professional field are formulated according to the special requirements of the discipline in the seven elements, which are the supplementary or specific contents not covered by some indicators of each discipline in the general standards[5, 6].

In 2006, with the approval of the Higher Education Department of the Ministry of education, "pilot working group for professional certification of electronic information and electrical engineering" was established to carry out the certification of electrical engineering and automation, electronic information engineering, electronic science and technology, communication engineering, photoelectric information engineering, automation. In 2020, electrical engineering and automation of Yangtze University was approved to enter the professional certification of engineering education organized by the Ministry of education. According to the Chinese engineering education certification standard, we have established the training mode of electrical engineering and automation of Yangtze University, and carried out the professional construction of electrical engineering and automation at the same time.

II. Significance of construction and practice of training mode based on professional certification

Constructing and practicing the training mode of engineering and technical based on the certification standards of engineering education has a very important role and practical significance for improving the training level of engineering and technical talents and gaining international recognition.

Based on the professional certification of engineering education, the construction and practice of the training mode of engineering and technical will help the engineering and technical talents to be recognized internationally and exported to the international market smoothly. The training scale of engineering professionals in China's higher undergraduate education has leapt to the first in the world. In addition to meeting China's social and economic construction and development, a large number of engineering and technical talents will become a new force in the demand for talents all over the world[6]. Training engineering and technical talents according to the professional certification standards of engineering education is bound to meet the needs of the international market and promote the integration of China's higher education with the world.

Constructing and practicing the training mode of engineering and technical based on the certification standard is helpful to formulate a clear training goal of engineering and technical. The clarity of training objectives is of guiding significance for talent training. It is an important basis for engineering and technical training that clarifying the graduation requirements of talent training in order to meet the standards of employment needs of the industry. The professional certification standard of engineering education can help colleges and universities formulate clear and reasonable training objectives.

Constructing and practicing the training mode of engineering and technical under the certification standard system is helpful to introduce the third-party evaluation mechanism and promote the sustainable development of talent training[7, 8]. The certification standard of engineering education puts forward a series of requirements for graduates trained in the school, and also puts forward certain requirements for students' professional achievements about five years after graduation. This requires the introduction of a third-party evaluation mechanism to track and evaluate the work of graduates for a long time through enterprises, employers or industry organizations, and feed back to colleges and universities, and establish a long-term evaluation and

feedback mechanism, which is conducive to the sustainable development of talent training.

The construction and practice of engineering technology training mode under the certification standard system is helpful to improve the curriculum system. The certification standard of engineering education clearly puts forward the basic qualities and requirements that graduates should have, involving multiple indicators such as specialty, natural science, society, security, law and culture. It provides a very important basis for colleges and universities to consider the comprehensive index and improve the curriculum system.

The construction and practice of engineering technology training mode under professional certification standards is conducive to the construction of teaching staff. The professional certification of engineering education has high requirements for the engineering practice ability of teachers, and puts forward very clear requirements for the number, structure, industry background, time and energy of teachers. Therefore, the engineering education certification standard is conducive to the establishment of a teaching team with stronger professional quality and ability in Colleges and universities.

Constructing and practicing the training mode of engineering technology under the professional certification standard is helpful to strengthen the reserve of teaching resources. Professional certification standards have strict requirements on the supporting conditions of talent training, such as practice and training base, engineering practice platform, teaching resources, teaching funds, infrastructure and management norms. According to this standard, colleges and universities can speed up the construction of teaching resources and improve the reserve of teaching resources.

III. Training mode of electrical engineering and automation base on professional certification

Electrical engineering and automation of Yangtze University was established in 2005, which is to train electrical information technology talents for the petroleum industry. This major was established as "The outstanding engineer program of Jingchu " in Hubei Province in 2016, and won the first-class discipline master authorization point of "Electrical Engineering" of the Ministry of education in 2020; Relying on "National electrical and electronic experiment demonstration center of Yangtze University", 13 specialized Laboratories of electrical engineering have been built. "Yangtze University-Rockwell Automation Technology Center" and "Research Center for intelligent control and safe operation of distribution network " have been built. It

has gradually formed four research directions: power electronics and electric drive, electrical control engineering, power system automation and electrical engineering information technology.

3.1 Training objectives

The training objectives of electrical engineering and automation of Yangtze University are as follows: This major cultivates qualified socialist builders and reliable successors who develop morally, intellectually, physically, aesthetically and laboriously in an all-round way and meet the needs of social and economic development, have reliable basic mathematical knowledge and specialized knowledge of electrical engineering and automation, have excellent humanistic and professional quality and reliable engineering practice ability, be able to engage in the design, development, production, operation, maintenance and management of various electrical equipment and power systems in the field of electrical engineering. For bottom enterprises in the field of electrical engineering, cultivate high-quality applied engineering and technical talents with strong sense of social responsibility, hard-working, certain sense of engineering innovation, team spirit and international vision. Five years after graduation, students have the ability:

1. Be able to engage in the design, development, production, operation, maintenance and management of various electrical equipment and power systems.

2. Be able to engage in system design, scientific and technological development, application research and operation management of power electronics and electric drive, and have excellent theoretical literacy and engineering practice ability in petroleum and petrochemical production and automatic measurement and control technology of large equipment.

3. Be able to continuously and independently study through continuing education or other ways, update knowledge, improve ability, have innovative spirit and entrepreneurial ability, and adapt to the sustainable development of social economy and electrical engineering industry.

4. Be able to effectively communicate and exchange with domestic and foreign cooperation teams, industry peers and the public in the context of internationalization, abide by the code of engineering professional ethics, and be willing and able to serve the society.

3.2 Graduation requirements

Students of this major are required to learn the specialized basic theoretical knowledge of circuit, electronic technology, computer technology, signal analysis and processing, electrical machinery, automatic control and electrical engineering, and

constantly improve their own specialized literacy and specialized skills. Students of this major receive basic training in electrician, electronics, information, control and computer technology, and have the basic ability to solve equipment design and manufacturing, system analysis and operation and control problems in the field of electrical engineering. Graduates should have the following knowledge and abilities:

1. Engineering knowledge: Have the mathematics, physics, engineering foundation, specialized foundation and specialized knowledge required for engineering and technical work in the field of electrical engineering, and be able to use these knowledge to solve complex engineering problems such as product design, development, production, application and maintenance in the field of electrical engineering.

2. Problem analysis: Be able to apply the basic theories of mathematics, physics and engineering technology to identify, describe and analyze the solutions to complex engineering problems in the field of electrical engineering through literature research, engineering reasoning, mathematical modeling and other methods, in order to obtain effective conclusions such as mathematical model and optimal electrical parameters of complex engineering problems in the field of electrical engineering.

3. Design / develop solutions: Be able to design solutions to complex engineering problems in the field of electrical engineering, and design electrical equipment and power system to meet the specific needs of users, can reflect the sense of innovation in the design process, and consider factors such as cost, safety and environmental protection.

4. Research: Be able to study complex engineering problems in electrical equipment and power system with basic theories and specialized knowledge of Applied Mathematics, natural science and electrical engineering. It includes modeling and simulation, designing experiments, analyzing and interpreting data, and obtaining reasonable and effective conclusions through information synthesis.

5. Using modern tools: Be able to select and use various electronic instruments and equipment, drawing and simulation software, various software and hardware development tools to simulate and predict complex engineering problems in the field of electrical engineering, and understand the limitations of current technologies and tools.

6. Engineering and society: Understand relevant industrial policies, domestic and foreign technical standards and specifications, laws and regulations in the field of electrical engineering, Be able to use the knowledge of electrical engineering to understand and evaluate the impact of electrical engineering practice on society, health, safety, law and culture,

and understand the responsibilities and obligations to be undertaken.

Table1 General education courses

Course nature	Course name
Required course	Ideological and moral cultivation and legal basis
	College English A
	Advanced English
	Advanced mathematics A
	Sports
	Outline of modern Chinese history
	Introduction to Mao Zedong Thought and the theoretical system of socialism with Chinese characteristics
	Basic Principle of Marxism
	Situation and policy
	Military theory
Restricted elective	Humanistic Quality Education
	Career development planning
	Mental health education
	Foundation of College Students' Entrepreneurship
	College Art
	Employment guidance

Table2 Discipline basic courses

Course nature	Course name
Required course	Introduction to electrical specialty
	Circuit theory
	Linear algebra
	College Physics B
	Circuit experiment
	C language programming
	Complex function and integral transformation
	Analog Electronic Technology
	Analog electronic technology experiment
	College Physics Experiment B
	Probability theory and mathematical statistics
	Digital electronic technology
	Digital electronic technology experiment
	Fundamentals of engineering drawing
	Principle and application of single chip microcomputer
	Engineering electromagnetic field
	Signal and system

7. Environment and sustainable development: Understand the guidelines, policies, laws and regulations related to environmental protection and sustainable development in the field of electrical engineering, and be able to understand and evaluate the impact of engineering practice for complex

engineering problems of electrical engineering on environmental and social sustainable development.

8. Professional norms: Have humanistic and social science literacy, sense of social responsibility, correct outlook on life and values. Be able to understand and abide by engineering professional ethics and norms in engineering practice, perform responsibilities.

Table3 Specialized courses

Course nature	Course name
Required course	Electrical Machinery
	Automatic control principle
	Power electronic technology
	Electric drive control system
	Power system analysis
	Comprehensive experiment of power system
Restricted elective	Electrical part of power plant
	Sensing technology
	Principle and application of PLC
	High voltage technology
	Power system automation
	Relay protection of power system
Elective courses	Power system planning and reliability
	Electrical safety
	Computer control technology
	Modern control theory
	Micro special motor and system
	Robotics - modeling, planning and control
	AC speed regulation technology
	New energy power generation converter technology
	Power electronic devices and systems
	Artificial intelligence and electrical application
	Smart grid technology
	Photovoltaic power generation technology and its application
	High level language design of single chip microcomputer
	Process control system and device
	Computer network
	Object oriented programming
	Hardware system design based on SOPC
	MATLAB and control system simulation
	DSP technology and application (control)
	Electrical engineering modeling and simulation
	Arm and embedded system
	Fundamentals of electronic design
	STM32 program development and Practice
	FPGA program development and Practice
	Integrated design and application of electronic system engineering

9. Individuals and teams: Be able to assume the role of individual, team member and person in charge in the engineering practice of design, development, production, application and

maintenance of electrical related products under the multi-disciplinary background, have good teamwork spirit.

10. Communication: Be able to effectively communicate with peers in the industry and the public on complex engineering problems of electrical engineering, including writing reports, designing manuscripts, making statements, expressing clearly or responding to instructions, and have a certain international vision and be able to communicate and exchange in a cross-cultural context.

11. Project management: Understand and master engineering management principles and economic decision-making methods in engineering practice such as design, development, production, application and maintenance of electrical related products, and be able to use engineering management and economic decision-making methods in the process of designing and developing solutions for electrical related products in a multidisciplinary environment.

12. Lifelong learning: Have the awareness of independent learning and lifelong learning, have the ability to continuously learn and adapt to the development of electrical engineering technology.

3.3 Curriculum system

Table4 Practical teaching courses

Course nature	Course name
Required course	Military theory and military training
	Social practice
	Electronic process practice
	Programming training
	Course design of electronic technology
	Engineering training 2
	Course design of intelligent control system
	Production practice
	Course design of Electrical Engineering Graduation project

The curriculum system of electrical engineering and automation is constructed with the training goal as the guidance and supporting the graduation requirements. The curriculum system is divided into four parts: general education courses(listed in Table 1), discipline basic courses(listed in Table 2), specialized courses(listed in Table 3) and practical teaching courses(listed in Table 4). It has formed two professional directions of power system, power electronics and electric drive. Optimize the contribution of various courses and teaching links to the achievement of graduation requirements, and clarify the promoting role of various courses and teaching links in cultivating students' knowledge, ability and quality, as well as the level to be achieved. Two practical teaching bases have been built: Hubei Zidian Electrical Equipment Co., Ltd. and Songzi

Weishui hydropower station. It has set up cognition practice and graduation practice with the characteristics of the power industry. The curriculum system highlights the professional characteristics of "power system".

3.4 Practical teaching system

According to the training objectives and graduation requirements, the major of electrical engineering and automation has built a perfect practical teaching system, two practical teaching bases of Hubei Zidian Electrical Equipment Co., Ltd. and Songzi Weishui hydropower station have been built. It has set up cognition practice and graduation practice with the characteristics of the power industry.

The experimental teaching of electrical engineering and automation consists of public basic experiments, specialized basic experiments and specialized experiments. Among them, public basic experiments include computer and program design experiments, college physics experiments, which are completed by the laboratory of the college and department; The experimental practice links such as engineering cognitive practice and machining training are completed by the engineering training center; The basic specialized and specialized experimental teaching is completed by the electrical specialized laboratory under National electrical and electronic experiment demonstration center of Yangtze University(shown in Figure 1). The experimental center is built according to relevant specifications and standards, including safety warning signs, professional fire emergency equipment, etc. Each laboratory adopts an access control management system, which can be managed remotely and has electrical safety protection measures.

The electrical and electronic experiment demonstration center has more than 20 laboratories, including electrical and electronic basic laboratory, electrical and automation specialized laboratory, power system comprehensive laboratory, power electronic technology laboratory, motor control laboratory, distribution operation simulation laboratory, computer control laboratory, microgrid laboratory, electrical and electronic practice base, college student innovation base and so on. The laboratories and experimental instruments and equipment affiliated to the demonstration center shall be subject to centralized overall management to ensure resource sharing, and students' experiments shall be subject to online reservation.

The practice course of electrical engineering and automation specialty includes three parts: in class experiment, in school independent practice course and out of school practice course. Students can further understand and master specialized

theoretical knowledge and train basic practical ability through practical teaching activities in class. Through a complete set of practical teaching in the school, students can be further trained in hands-on operation, engineering consciousness and innovation ability. Students' basic engineering ability, comprehensive practical ability and innovative ability have been cultivated in an all-round way. Off

campus practice courses include cognition practice, graduation practice, graduation design, etc. In the real production environment, students systematically complete relevant practical training according to job requirements, technical standards, objectives and tasks, comprehensively deepen the understanding of theory, improve practical ability and professional quality.

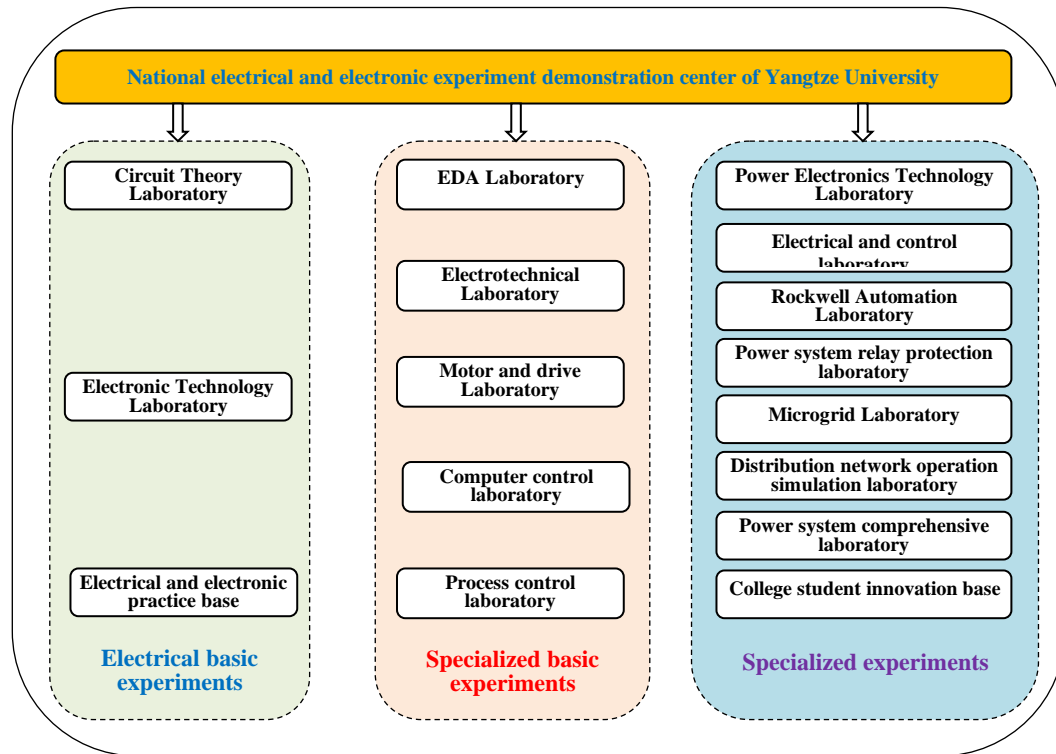


Figure1 National electrical and electronic experiment demonstration center of Yangtze University

IV. Conclusion

On the basis of understanding the importance of engineering education professional certification, aiming at the shortage of engineering and technical personnel training in higher education, combined with the characteristics of electrical engineering and automation major of Yangtze University, this paper constructs and practices the professional training mode, make the teaching quality monitoring and feedback mechanism operate effectively, teachers' teaching level and engineering practice ability are continuously improved. The continuous improvement of students' comprehensive quality and professional ability ensures that the training of engineering and technical talents meets international standards. In recent years, students of this major have won more than 30 national awards and nearly 100 provincial awards in scientific and technological activities such as college students' innovation and

entrepreneurship training program, smart car competition and industrial automation challenge; The quality of students ranks first among the undergraduate majors in Yangtze University, and is one of the most popular majors in this field in similar universities in the province; The employment rate of graduates is more than 95%, and the quality of graduates is generally recognized by employers.

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