

## Practice of case-based teaching reform of "Classic Control Theory" in colleges and universities under the background of new engineering

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**Abstract:** Focusing on students' growth and success, this paper introduces the overall design of the course " Classic Control Theory " from the aspects of teaching content organization, teaching resources construction, teaching means selection, examination method design and teacher-student relationship construction, etc. Based on the concept of engineering education, combined with the teaching requirements of application-oriented private universities, the teaching mode of "case penetration, integration of theory and practice, mixed inquiry" is the center. We should adapt to the new situation of scientific and technological revolution and industrial reform, and cultivate high-quality compound new engineering talents with strong practical ability and strong innovation ability. Enhance students' understanding of knowledge, more vividly understand the application of knowledge in engineering practice, strengthen the cultivation of application ability, and lay a good theoretical and practical foundation for students to participate in the registered engineer examination after graduation. This paper makes a case study of "classical control theory" in Colleges and Universities under the background of new engineering.

### 1. Introduction

Since the Ministry of Education launched the construction of new engineering disciplines, various universities, experts and scholars in the field of engineering education have gathered a broad consensus. The new concept, new standard, new model, new method, new technology and new culture of Engineering Science and technology personnel training are accelerating to form, which has fired the first shot in the battle to comprehensively revitalize China's basic education [1]. The role of control courses is difficult to locate, because the control-related courses are relatively systematic, and there are many kinds of courses, which are developing rapidly. How to choose and arrange relevant contents needs to be considered from the perspective of personnel training and positioning [2]. Build specialty and new structure of engineering specialty according to industrial demand; Update the knowledge system of engineering talents according to the content of technological development and reform; Let students' interests change methods and innovate engineering education methods and means; Integrate internal and external resources and strive to enhance the international competitiveness of engineering education. For traditional engineering talents, under the new engineering teaching mode, high-quality compound new engineering talents with strong practical ability, strong innovation ability and international competitiveness are cultivated [3].

"Classical Control Principle" is a professional core course for electrical engineering and its automation undergraduate major in Wuchang Shouyi University. It mainly teaches the basic knowledge of control theory, trains students' basic ability to analyze and solve control engineering problems, and forms a systematic view and thinking habit with feedback and optimization as the core [4]. Most control courses rely too much on knowledge inheritance, pay attention to the teaching process of "teaching" and ignore the cognitive process of "learning". There is a chain breaking phenomenon with the cutting-edge technology and industrial comprehensive application of manufacturing industry. It is still insufficient to cultivate students' independent learning, independent inquiry ability and learning ability of knowledge change. The main reform measures include: introducing engineering problems into the classroom; Simulation laboratory to strengthen students' practical ability; There is a research link in curriculum research to improve students'

practical ability; Let students directly participate in relevant competitions, and improve students' acceptance and innovation ability [5]. In this way, the construction of new engineering can cultivate excellent engineering and scientific talents for the future industry and industry development in time or in advance. It not only pays attention to professional knowledge, but also emphasizes the solution of practical problems, which is helpful for students to establish intuitive understanding, but also conducive to students' understanding and application of specialty.

## **2. Problems in the teaching of "Classical Control Theory" at this stage and their solutions**

### **2.1. Teaching problem**

Under the background of new engineering, the curriculum is required to adapt to the development of the times, but there are still many problems in the teaching of classical control theory. The survey found that the control courses set up by colleges and universities with this major in China are different [6]. Most colleges and universities generally pay attention to principle derivation and system analysis. The teaching forms of theoretical explanation and examination are contrary to the engineering attributes of automatic control, so it is difficult to apply what they have learned. Some colleges and universities have tried case teaching and engineering education mode to change the present situation, and are committed to cultivating applied talents with engineers' thinking. However, our teachers basically use blackboard writing and PPT to teach, but they still haven't got rid of the previous model of deducing formulas, explaining examples, and then practicing exercises. The complexity of the process makes it difficult for our students to master the teaching content in a short time [7].

Classical control theory itself is a theoretical, practical and comprehensive course with many contents, abstract concepts and a wide range of subjects. It not only requires our students to have a solid foundation, but also have strong computing ability. This kind of control theory in all kinds of colleges and universities is very mature, so many textbook examples are very old, too simple examples are not enough to attract our students' attention. Moreover, in our teaching team, some young teachers are rich in theoretical knowledge, but lack enough practical experience in engineering, so they can't apply these control theories to the actual engineering system, and the theory and practice can't be well combined, which leads to the disconnection between teaching and practice [8]. It is necessary to design and plan some teaching materials, increase experimental teaching and improve students' practical ability.

### **2.2. Solution**

In recent years, with the adjustment of the talent training program of the school, the class hours are constantly reducing, and the teaching content also needs to be adjusted with the times. With the development of new control theory and technology, some new control theory concepts should be integrated. Update the existing teaching content with modern teaching tools. Take the actual application demand as the driving carrier, run through and cover the whole teaching content, and change the organization mode of the content, which is not only classified and organized according to the analysis and design method, but oriented to the case solution process, so that the module content is gradually progressive and linked [9]. Let students have a certain understanding of current computer technology, so as to train students' engineering practice ability and cultivate their control engineering professional quality. Better know the existence of these technologies, which can be used at any time in future jobs. The overall design of the classic control theory course is shown in Figure 1.

The second is to build a qualified teaching staff. "Classical Control Theory" is a course combining theory and practice. It can be taught by senior teachers with deep theoretical reserves. In the practical application link, it can be taught by some enterprise engineers with rich practical experience. Combined with some practical problems they usually encounter, the system can be corrected by taking measures such as series correction, feedback correction, feedforward correction and interference compensation. This can not only make up for teachers' lack of practical experience,

but also make students understand knowledge more thoroughly and cultivate students' ability to solve complex engineering problems [10]. Recognizing the universality and objectivity of contradictions, scientifically grasping the relationship between learning from others' strengths and making up for oneself's weaknesses, and being good at finding shortcomings, analyzing shortcomings and making up shortcomings, can individuals and society have better development.

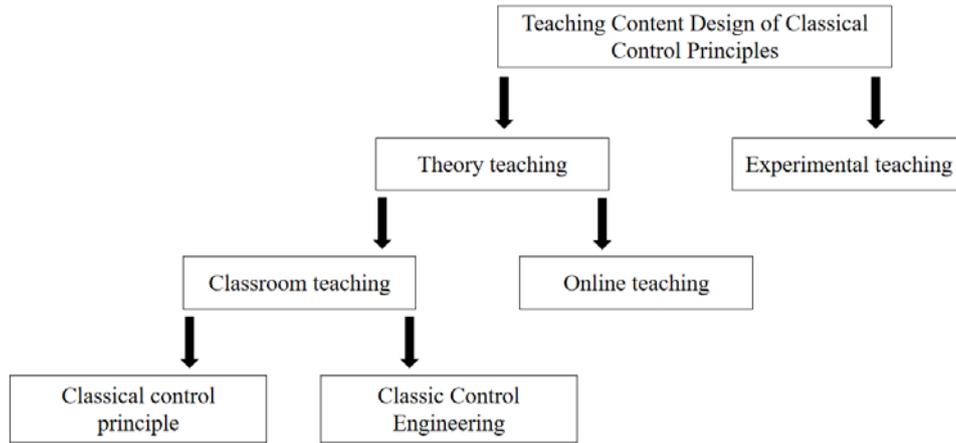


Figure 1 The overall curriculum design of classic control theory

### 3. Penetrating teaching case of "Classic Control Theory" course

At present, with the development of economy and science and technology, advanced application scenarios such as robots and intelligent factories have become a research hotspot in industry and academia. For example, the single-stage inverted pendulum system is used as a demonstration case for classroom teaching. The demonstration case runs through every teaching progress of the whole teaching content and through all teaching links of theoretical analysis and software and hardware simulation. This system aims at cultivating students' ability to solve complex electrical engineering problems, and extracts simple teaching cases from complex application scenarios such as robots, smart factories or power systems. In order to achieve the effect that the cases always run through and fully cover, we carefully designed, revised and improved repeatedly in the process of teaching practice, and made every effort to make the two demonstration cases have different typicality and representativeness in different aspects such as difficulty. In this way, the two cases cooperate with each other, cross and parallel, so as to better realize the overall coverage of the cases and better drive the natural promotion of the teaching content. The way and steps through teaching are shown in Figure 2.

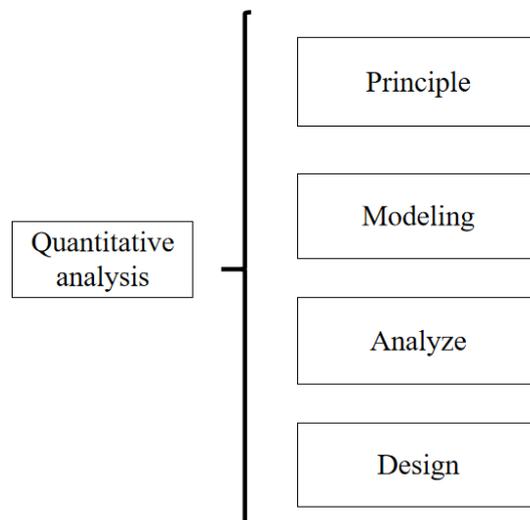


Figure 2 Teaching steps

Focusing on the above-mentioned teaching design ideas, we should pay attention to adopting inquiry teaching mode and project-based teaching mode in the teaching process, so as to cultivate students' ability to solve complex engineering problems. At the same time, it can free students' hands and make them concentrate on participating in classroom interaction. We distribute notes online before each class, and identify the important and difficult contents of each class, which improves students' classroom learning efficiency. The content of the teaching part can be changed at any time and emphasized, so as to better keep pace with the times in teaching. Introduce its most classic application, so that students can have the greatest perceptual knowledge of this course.

Teaching method is an old-fashioned problem that must be seriously faced. Enable students to understand people, their values and demand with an aim to put the results of product innovation to serve people. Combined with the characteristics of the current classical control theory course, this paper puts forward an employment oriented hierarchical teaching mode. Through the way of "certain, two choices and three designs", it creates a diversified classroom for students to choose from. It is committed to building a theoretical and practical classroom, conducting a fixed point test, and then the evaluation index comprehensively measures the effect of teaching reform. By analyzing the development status of control field, stimulate students' motivation and courage to learn; Introduce typical links, analyze the spirit of division of labor and cooperation in system engineering, educate students on professional ethics, understand the spirit of artisans, and convey the professional spirit of dedication, fairness and dedication to society. By analyzing the stability margin of the control system, it is analyzed that there should be room for doing things, and students should be reminded to have a humble attitude towards study and life. These are the qualities of excellent engineers advocated by the connotation of new engineering construction, and students should have more valuable than knowledge, Cultivate students' thinking. For example, when learning the basic idea of PID control, guide students to start from life experience, analyze the use of past, present and prediction information in decision-making, and inspire students to realize the importance of feedback and deviation information.

Through the above main line exploration, students are guided to take the initiative in the process of thinking; Cultivate students' engineering thinking mode through integration and infiltration; Improve students' innovative and practical ability through the integration of theory and practice. Compared with the past, the assessment of software simulation and Learning Pass preview is added to ensure the implementation effect of teaching method reform, and these usual assessment contents can be completed automatically through the platform, which is more scientific, convenient and effective.

#### **4. Conclusions**

In this paper, a penetrating discussion case is designed for the teaching of the control course for electrical professionals, and exploratory and project-based teaching methods are proposed to improve the teaching quality. Cases run through all teaching contents and links, making students' exploration of cases always continuous. Renew the teaching concept, build a flip classroom, organically integrate electrical engineering application cases and practical teaching links, and carry out reforms from the aspects of theoretical teaching, practice teaching and curriculum assessment to enhance students' practical innovation ability. Let students strengthen the relationship between basic theory courses, main courses and practice courses, increase the cultivation of students' innovation ability and exploration ability, and strengthen and amplify the improvement of students' comprehensive quality. Online relying on learning pass to realize the efficient mixed-sharing classrooms; Offline relying on the laboratory, we can realize the integration of theory and practice of teaching and learning, so that students' theory and practice are never divorced. Build the course of classical control theory into a vivid and interesting practical course. Strengthen the cognition of practical engineering problems and strengthen the cultivation of application ability, which has laid a good theoretical and practical foundation for students.

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