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Study and Exploration on the Featured Teaching of Automation Control Theory during the Information Age

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Abstract

To solve the problems in conventional teaching of automation control theory, we provide several featured teaching methods corresponding to its difficult learning and understanding. These featured teaching methods include macroscopic concept teaching, special background teaching of petroleum process control, enlightening teaching, recreation and interest teaching, review-connection-permutation teaching and so on, which have been developed into a special teaching system and idealism. The real practice teaches in recent five years show that the featured teaching methods have greatly motivated the students and improved the teaching effect.

Keywords: Automation control theory, Featured teaching, Teaching effect.

1. Featured teaching method Theory of automatic control theory

Aiming at the problems existing in the teaching process, we center on the engineering characteristic background of oil chemical control process and take the teaching methods of macroscopic type teaching, the light into the depths, interesting heuristic, associated with infiltration of teaching method to improve the students' interest in learning abstract control theory and learning effect.

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1.1. Macroscopic concept teaching has the characteristic of "All mountains in a single glance"

"Automatic Control Theory" has strong abstractness, which results to the fact that the majority of students can hardly understand and learn and the teaching effect is poorer. The main reason is that students do not know the consecution of learned content and what to learn in the future clearly. Therefore, it is necessary to first give students a clear understanding of the overall profile. In the teaching process, at the beginning of the first chapter and the end of chapter VIII of analysis of nonlinear systems, we should not only summary and analyze the key and difficult points, but also demonstrate and analyze knowledge to students at the end of each chapter structure as shown in Figure 1. Let the students have a sense of "All mountains in a single glance", which is easy to grasp the overall knowledge for the students. Through this way of teaching, students will easily understand the system of theory learning: On the basis of the establishment of the control system on the mathematical model of chapter II, throughout the Chapter III to Chapter VIII of the learning process from beginning to end mission is to "analyze the performance of the control system." Method of control system of task analysis including the three parallel analysis method form the chapter III to the chapter V, time domain analysis of linear systems, root locus analysis methods and frequency characteristics analysis. If the control performance of the control system cannot meet the requirements, we will learn knowledge of the control system design control system calibration in Chapter VI, in other word, to improve the controller. Behind the seventh, eighth two chapters are to analyze the discrete computer control system and nonlinear control system. The macro teaching mode can help students understand the relationship between different theories systems in the learning process, which can make students know better and grasp the macro knowledge system.

![Diagram](image)

Figure 1 macro learning architecture of automation control theory

1.2. With oil chemical control process engineering background characteristics of case teaching

In order to strengthen petroleum and petrochemical engineering background application of the school, first according to watching the petrochemical field automatic control video and automatic level control system control process of demonstration, students will establish clearer perceptions of the automatic control system, and then we explain the basic concepts and principles of automatic control composition theory, combined with typical cases
reanalysis. Then, according to the theory of module learning system modeling, system analysis and system design, such as content, the concrete is shown in figure 2. But after each module being finished, we are using a typical petroleum and petrochemical engineering case to carry on the corresponding analysis, this will enhance the students’ ability to integrate theory with practice, to promote learning concept or theory, and to improve teaching effectiveness. Thus in accordance with the principle of gradual and orderly progress from basic concepts, system modeling, system analysis (including time-domain analysis, root locus analysis, frequency domain analysis) and system design, to the discrete control systems and nonlinear systems, the typical background of petroleum and petrochemical control objects as examples of the integrated analysis, it will develop awareness of students in the learning process of the abstract theory and practical control engineering links.

1.3. *Light out into the deep* heuristic teaching

Most theories of automatic control theory are abstract, so it is difficult for students to accept, for which we use teaching methods "light out into the deep" heuristic shown in Figure 3 in the teaching process. We start with demonstrate of the corresponding control system simulation examples, let the student observe phenomenon, guide students to find problems, consciously guide the students to think and analysis, and gradually lead to the new theory which needs to be explained. As in learning control system stability analysis when it comes to the level control system as a simulation example, gradually increase the proportion of the gain or integral gain, so that students observe the gain coefficient from zero gradually change to large numerical (until the emergence of divergence) step response change process combined with the high-end systems learned to guide students to think step response characteristics of the liquid level control system in the cause of divergence, so that students think about how to determine the stability of a known control systems. This way can let students are more likely to accept the abstract control theory, and can contact the combination with the engineering practice. After completion of study and analysis of the new theory, and through examples and exercises to consolidate, the students finally have a comprehensive analysis of engineering examples.
1.4. Fun relaxed style esoteric theories of teaching methods

According to the characteristics of the control theory which is very abstract and difficult to comprehend, we try to choose some automatic control principle of animation or joke or living examples which in the process of lecture are both funny and containing some of the theory of automatic control principle, let students to appreciate the profound control theory in entertainment and deepen their memory. Such as in the control system stability concept, we let students see the scene as shown in figure 4 and 5, Cartoon Tom and Jerry. Tom held high plate and so hard to keep in a balance that the dishes fell on the ground, Tom casts a bowling ball out, but in the end, along the "S" type curve rolled back to the original place. We associate the concept of stability and instability of system with animation that students really like it, which can make the students learn and understand more deeply. Another example in the study of nonlinear systems is describing function analysis, in order to learn the previous "frequency characteristic analysis" linking theory, we firstly watch Zhao Benshan, and Song Dandan's "part-time" skit about the tiger and snake wearing a vest and taking off the vest story, so that students can feel in the course of a laugh and smooth acceptance of the nonlinear theory. Teaching Practice has proved that the students really enjoy the fun teaching methods, which greatly stimulated the interest in learning and positivity.

1.5. Establish research and refresher combined with the advance infiltration of teaching methods

According to the characteristics that students' learning "automatic control principle" theory is easy to forget, we pay attention to timely contact the old knowledge points in explaining the new theory, which is called “gain new knowledge by reviewing old” . And when students learn new theory, we will make students understand this theory...
with the actual control system or use. In order to allow students to accept new knowledge more easily in the future, we continue to turn a simple idea or concept related to the future of new knowledge presented in the actual lecture process, paving the way to achieve early penetration and laying the foundation for the science behind the new knowledge, specifically as shown in Figure 6. As in learning Routh criterion, again to obtain the transfer function of zero poles and the transfer function of the inverse Laplace transform is the system unit impulse response properties linked etc. After the completion of the Rolls stability criterion, we proposed the basic concept of simple root locus in advance, which is the value of closed-loop poles from a single system to determine system stability problems extend to the case of closed-loop poles as a control parameter varies continuously changing. When started to explain to draw root locus, we not only contact the root locus with performance indicators of Chapter III, but also review the intersection problem of the root locus and the imaginary axis and Routh criterion theory. When we talked about the root locus and system performance changes, we will in advance contact the system calibration of Chapter VI. By adopting this method of teaching, so that students in the process of learning new knowledge constantly review to old knowledge, in the process of learning new knowledge constantly puts new knowledge related to the future of pre infiltration, so as to improve the effect of learning and teaching.

![Figure 6 the teaching method of infiltration](image)

**2. The practice and effect of features teaching**

Since 2008, we have implemented the comprehensive characteristic teaching methods in our school in automation, electrical automation and thermal energy and power engineering and other professional five automatic control principle, the students' feedback effect is positive, and teaching effectiveness has gradually improved. Take an example, the "automatic control principle" pass rate of the students that major in electrical engineering automation has fell from 6.1% in 2008 to 2.1% in 2011, excellence rate rose from 5.1% in 2008 to 11.1% in 2011.(Every year the difficulty of the thesis is the same.) In addition, “Automatic control theory of the three-dimensional teaching method reform and practice” which has the characteristics of teaching methods around this article gained the education reform project funding in 2008 and in 2011, and won China Petroleum University 2012 Outstanding Teaching Achievement Award.

**3. Conclusion**

In this paper, according to the current the problems existing in the teaching process of "automatic control theory", and combined with the particularity of the course itself, from years of teaching experience in teaching automatic control theory we propose and implement innovative macro-concept teaching, case teaching background characteristics, specific teaching methods heuristic teaching, teaching and fun to ponder pedagogy and other related penetration. After nearly five years of actual teaching practice, it has proved that the characteristic teaching methods have played an important role in improving the students' learning interest and the teaching effect, and it also has the very good practical reference value in each university "automatic control theory" teaching.
References

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