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Teaching Exploration of Ideological and Political Construction of Control Theory for Mechanical EngineeringCourse Based on Feedback Control

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Abstract: *The ideological and political construction of curriculum is a new requirement for the ideological and political work in colleges and universities in the current reform plan of higher education in China. The ideological and political teaching reform of professional courses is an important way to cultivate students' national feelings. This paper discusses the necessity of the ideological and political construction of the course through the teaching exploration of integrating the ideological and political key points into the course of control theory. Based on the basic knowledge of the course Mechanical Control Theory, this paper deals with the ideological and political points as the "interference" factors of the traditional closed-loop teaching mode, and proposes the feed-forward and feedback teaching mode. This teaching mode makes the ideological and political courses with disciplinary characteristics and provides new ideas for solving the practical problems of ideological and political courses; At the same time, the ideological and political elements contained in the knowledge points of mechanical control theory are deeply excavated to explore a feasible ideological and political teaching path of the course "Construction of Control Theory for Mechanical Engineering" based on the principle of feedforward and feedback control.*

Keywords: *Construction of Control Theory for Mechanical Engineering, Ideological construction, feedforward-feedback teaching mode, morality education*

1. Introduction

Traditional ideological and political courses mainly focus on theoretical teaching, so the teaching mode and teaching content are unavoidably single and boring. More importantly, they cannot guide students to understand the expectations and requirements of the new generation of youth from the perspective of different disciplines deeply, nor can they solve the timeliness problem faced by the ideological and political construction of colleges and universities. At the National Conference on Ideological and Political Work in Colleges and Universities, General Secretary Xi Jinping put forward the construction direction of "Three Integrity Education" to colleges and universities, requiring all kinds of courses to be integrated with ideological and political theories, and solving the fundamental problems of what people to train, how to train people and for whom. [1-2]Therefore, from the perspective of training mechanical control professionals in line with the requirements of the new era, it is of profound significance to dig the ideological and political elements in professional courses deeply to strengthen the connection between ideological and political courses and professional courses.

2. Course Introduction

Mechanical control theory is a science that studies the application of "cybernetics" in "mechanical engineering". It is a specialized basic course for mechanical majors such as machinery manufacturing and automation. North China University of Water Resources and Electric Power has offered the course of "Construction of Control Theory for Mechanical Engineering" for several decades. With the joint efforts of several generations, the course system is becoming more and more perfect. The teaching content and teaching methods keep up with the changes of the times, and it has been awarded the honorary title of "Excellent Course in Henan Province". This course mainly introduces the basic

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concepts of control engineering, the establishment of mathematical model, the time and frequency domain analysis of control system, stability analysis, and the design and correction of the system. The teaching is guided by the socialist core values and focuses on case analysis to help students understand obscure knowledge points, so as to lay a solid professional foundation for students' subsequent study of other control-related courses [3].

3. The Design of Teaching Mode and Teaching Content of the Course "Mechanical Control Theory"

3.1. A New Inspiration of Teaching Mode -- Feedforward and Feedback Teaching Mode

The related teaching and research work of traditional ideological and political courses has been quite mature, which to a large extent meets the basic requirements of China's social development for education, highlights the distinctive characteristics of socialist colleges and universities, and has a strong ideological attribute. However, ideological and political education still takes the form of unified and objective examination questions as the main evaluation method of teaching effect, which does not have disciplinary characteristics and cannot well promote students to think about how to practice the socialist core values in their field of study. The feedforward and feedback control system proposed on this basis, innovates the ideological and political teaching mode of various subjects and provides a new way of thinking to solve the timeliness problem of ideological and political construction.

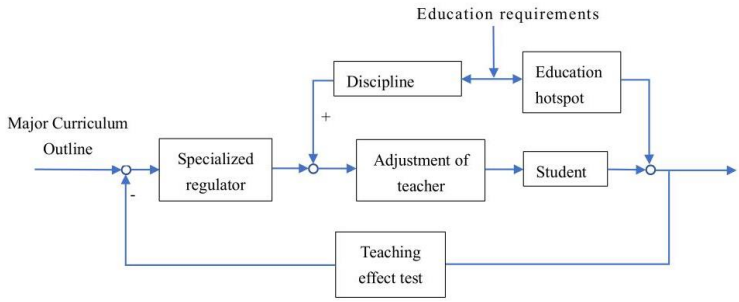

Figure 1: Feedforward and feedback teaching mode.

As shown in Figure 1, the closed-loop feedback part is the teaching mode of the traditional mechanical control theory course [4].Guided by the socialist core values, teachers conduct professional training for students according to the teaching syllabus, test students' mastery of knowledge through homework, tests and other traditional methods, and adjust the class schedule according to the test results. Under the impetus of curriculum ideological and political reform, the wave of integrating ideological and political key points into specialized courses is equivalent to a "disturbance" for each discipline. The feedforward and feedback teaching model divides this "disturbance" into two categories: One is the major disturbance closely related to a certain discipline. Each discipline builds a teaching model to meet its own requirements according to its own specialty characteristics, so that ideological and political courses have disciplinary characteristics and can quickly overcome the impact of such "disturbance"; the other type is the secondary disturbance that affects all disciplines, but not a particular discipline. Therefore, the unstable factors brought by this kind of "disturbance" to the whole teaching system are still overcome by feedback control.

3.2. The Ideological and Political Teaching Content Design of the Course of Construction of Control Theory for Mechanical Engineering

3.2.1. The Inspiration of the System Analysis Method

Course ideological and political integration point: Overall grasp the whole teaching material, we can see that the overall idea of the editor is to expect the readers to learn to design the system on the basis of mastering the analytical system method, so as to guide the students to think about the dialectical unity relationship between "understanding the world and changing the world"

Teaching exploration: quoting the development of bionic robot, this paper expounds the relationship between understanding the world and reforming the world, especially guiding students to correctly understand the profound significance of reforming the world to understanding the world. For example,

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the underwater bionic robotic fish, inspired by the nimble manta rays, has been developed for underwater exploration, ocean resource exploration and ocean mapping; Inspired by the fly's flapping movements for takeoff and landing, the robot flies are being developed to perform defense detection, monitor the growth of large areas of crops, and sniff out gas leaks; Inspired by the special wings of the flying fox, the free flying fox has been developed for military reconnaissance, disaster prevention and counter-terrorism missions [5].Through the introduction of these examples, students can understand the relationship between the analysis system and the design system, and at the same time, they can update their understanding of the relationship between the understanding of the world and the transformation of the world, that is, only by fully understanding the world can they better transform the world.

3.2.2. Inspiration from the Control Mechanism of Negative Feedback Control System

Course ideological and political integration point: the control mechanism of using negative feedback control system to control the system through deviation signals is used to guide students to deeply understand the significance of "three province what as my day" for personal development.

Teaching exploration: in the negative feedback control system, the output of the system is led to the input end and compared with the expected value, and the difference of the comparison is used as the control effect of the new input controller on the system, so as to ensure the stability of the system. A person's life is composed of several stages, and the development of each stage can be regarded as a negative feedback regulation system. We take the goals of each stage as the given input of the system, gradually improve our personal knowledge system through a period of learning and thinking, and take our personal problem-solving ability as the output of the system. The test in the student stage or the work performance after graduation can be used as the output and the expected set value comparison, according to the results of the comparison to adjust the direction of their efforts and reduce the deviation from the expected, so as to realize their own life value.

3.2.3. Mathematical Model of the Establishment of the Inspiration

Course ideological and political integration point: by learning the establishment method of mathematical model, students can think about the influence of model selection and parameter adjustment on the system in this process, and understand the "craftsman spirit" in system design, so as to realize the cultivation of their own good professional ethics [6-8].

Teaching exploration: we take Xu Liping, who is engaged in gunpowder shaping, as our example. At that time, gunpowder shaping was a problem facing the whole world. The allowable maximum error of 0.5mm accuracy was only achieved by him below 0.2mm, which let the world see the power of Chinese craftsman spirit. In the process of mathematical modeling, analytical method and experimental method are two commonly used methods to establish mathematical models. Analytic method refers to the method of analyzing the corresponding equations of the physical process or chemical reaction process. The experimental method is to record the output response of the system under the action of a given signal, and then select the appropriate approach to the equation according to the input and output response data obtained. If we want to find a mathematical model that fits the actual operating condition of the system, we need to have the craftsman spirit of striving for perfection like Xu Liping, which lays a solid foundation for the cultivation of good professional ethics in the future.

3.2.4. Inspiration from the Analysis of Linear Systems

Course ideological and political integration point: there are three analytical methods for linear systems: time-domain analysis, root-locus method and frequency-domain analysis. Time-domain analysis is an analytical method that can calculate all the information of the time response of the system in the time domain, but for the higher-order system, the second-order system is generally used to approximate the calculation; as a graphical method for analyzing linear time-invariant systems, root-locus method has strong intuitiveness and is more convenient than time-domain method in qualitative analysis of systems, especially in analysis of multi-loop systems; frequency-domain analysis is an analysis method to reflect the performance of system response under sinusoidal signal[9-10]. These three analytical methods correspond to the development law of negation of negation of things, and guide students to correctly understand the unknown things through learning the three analytical methods.

Teaching exploration: from time-domain analysis to frequency-domain analysis, although there are differences in form, they have the same idea, which is to decompose the signal into several base signals first, and the response of the system to all the base signals superposed is the response of the system to a complete and complex signal; Here are the differences: In the time-domain processing, the signal is

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decomposed into an impulse function, whose expression is more complicated, involving the translation and weighting of the impulse response, while in the frequency-domain, the signal is decomposed into several virtual exponential signals of different frequencies; In the frequency-domain analysis, the fixed frequency virtual exponential signals only need to be simply weighted. And the frequency-domain analysis is more intuitive to show how the system deals with each frequency component of the signal.

Frequency-domain analysis is the inheritance and development of time-domain analysis. It inherits the idea of signal decomposition in time-domain analysis and negates the form of signal decomposition, which coincides with the development process of Marxism. Through the combination of professional knowledge and taking the development process of Marxism as an example, it is proved that the development of things follows the law of negation of negation, and inspires students to look at their own development with dialectical negation and correctly understand the unknown things.

3.2.5. Calibration Device for the Optimization of the System Performance to Bring Inspiration

Course ideological and political integration point: calibration device realizes the optimization of system performance through proportional control, integral control and differential control. Taking the three magic weapons of the Chinese revolution (united front, armed struggle and party building) as examples, we will deepen the theme education of staying true to the original intention and keeping the mission in mind, and help students understand the influence of each control link on the system performance.

Teaching exploration: proportional control is a differential control, which enables the system to respond quickly to disturbance by controlling the output signal proportional to the deviation signal. The "united front" is a kind of "proportional control" to respond quickly to the invasion of China. Integral control is a control to eliminate deviation. Proportional control is not sensitive to small deviation, so simple proportional control is easy to produce steady-state error. In this case, the integral part is required to carry out numerical integration of small deviation to enlarge the small deviation to achieve sufficient drive output, and finally eliminate the deviation." Armed struggle" is a kind of integral control with the ultimate elimination of all deviations. It was only through countless struggles accumulated in the Chinese revolution that the peaceful environment with "no deviation" was obtained; Differential control is a kind of control to offset the unstable trend of the system, and provides advanced control function through the change rate of error. "The construction of the Communist Party of China" is a "differential control" to improve the ability of the Communist Party to resist corruption, prevent degeneration and resist risks in the new historical period.

At any time, the CPC always takes the interests of the people as its "given input". When the output is not equal to the given input, the CPC constantly carries out self-correction, self-revolution and self-reform, and always regards "serving the people" as its original mission.

4. Conclusions

The core of the ideological and political courses is to integrate the ideological and political points into the professional courses, aiming to improve the professional quality of students and realize the cultivation of the ideological and moral character of college students in the new era. The feedforward and feedback teaching mode and the ideological and political mapping point based on Mechanical Control Theory mentioned in this paper carry out the requirements of the ideological and political reform of the curriculum to cultivate people with morality and to moisten things by osmosis, and actually provide a new ideological and political construction plan with disciplinary characteristics for this specialized course, so as to better guide students to become developers and builders in the new era.

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