

# The Reform of Control Education in Tsinghua University

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From the view of history, the control education is still at its “young” stage in China. However, on the other hand, the control education is facing the two challenges in present China. One is from the market system being building in China, under which students pay more attention to meet the requirement of market and more like to take the subjects concerning computer, communication, and networks. The other one is from the rapid development and wide applications of information technology, under which the attraction of control education for students is being reduced. Our reform of control education is just based on the background mentioned above.

## 1. Development of Control Education

In this section, we will introduce simply the development of control education in Tsinghua University.

- 1935

Professor Norbert Wiener, the founder of cybernetics, pointed out in his work titled as “I am a mathematician” that I would rather chose 1935, when I was being appointed a guest professor at Tsinghua University, to be the starting point of founding cybernetics.

At that time, Professor Norbert Wiener, cooperated with Professor Y. T. Li who was a professor in MIT later, engaged in the research work on filtering in Tsinghua University.

- 1950s

A curriculum concerned with control principles, named as “Automatic Regulating Principles”, was first offered in China by Professor Shimo Zhong, who got his PhD at MIT in 1947, in the beginning of 1950s at Tsinghua University.

A new speciality named as “Industry Electrification and Automation” was set up at Tsinghua University in 1952.

The first control speciality in China, named as “Automatic Control and Remote Control”, was set up by Professor Shimo Zhong at Tsinghua University in 1956.

The first “Department of Automatic Control” in china was founded at Tsinghua University in 1958.

The Department offeres four concentrations, which are the “Control in Space Thenology”, “Control in Nuclear Technology”, “Industry Automation”, and “Analogue and Digital Computers”, and enroles 180 undergraduate students each year. The length of program is defined as six years which is longest in the universities in China, besides Xiehe medical university whose length of program is eight years.

- 1970s

“Modern Control Theory” was introduced as an advanced control course for undergraduates at Tsingua University in the end of 1970s. A lecture notes titled as “Modern Control Theory I, II” were published in Tsinghua University to introduce systematically the state space control theory. This notes was widely used as textbook by many universities in China in the early of 1980s.

The department was reconstructed as “Department of Automation”.

Begining from that time, many new control sndjects were started to offer for undergraduate and graduate students, including “Linear System Theory”, “Optimal Control”, “System Identification”, “Adaptive Control”, “Stochastic Control”, “Computer-based Control Systems”, and “Process Control”.

- Now

The department enroles about 160 undergraduate students, 100 MS students, and 35 PhD students each year.

The department offeres four concentrations for graduate education, which are “Control Theory and Control Engineering”, “Pattern Recognition and Intelligent Systems”, Instrument Technology and Automation Devices”, and “System Engineering”.

The subject system and knowledge structure are extended to meet the time’s requirement, including the subjects on advanced manufacturing, communication and networks, and electronic commerces.

## **2. Reform in Undergraduate Program for Control Education**

Since the middle of 1990s, a reform concerning the program and subjects has been made. The main attentions are paid in the following aspects.

- The first emphasizing point is that a solid mathematical foundation is required.

Six basis subjects are defined as the required subjects.

Calculus I (6 unites)

Calculus II (5 unites)

Linear Algebra (4 unites)

Engineering Mathematics (3 unites)

Probability (3 unites)

Numerical Methods (3 unites)

- The second emphasizing point is that a broader “knowledge platform” based on information science and technology is defined to be the speciality’s common foundation.

Four kinds of required core-courses are defined as follows.

**Core-Courses for Circuits and Electronics:**

Circuits I (4 unites)

Circuits II (4 unites)

Foundation of Digital Electronics (4 unites)

Foundation of Analogue Electronics (4 unites)

**Core-Courses for Control:**

Automatic Control Theory I (4 unites)

Automatic Control Theory II (3 unites)

**Core-Courses for Computer:**

Computer Language and Programming (3 unites)

Principle of Microcomputers (4 unites)

Foundation of Software Technology (4 unites)

**Core-Courses for Communication and Network:**

Signals and Systems (4 unites)

Introduction to Communication (3 unites)

Introduction to Computer Network (3 unites)

- The third emphasizing point is that a systematical training on design is occupied as an important place.

Three design trainings in different levels are arranged in different semester.

Design on Electronic Devices (3 unites)  
 Design on Control Devices or Systems (4 unites)  
 Graduaton Design (14 weeks)

- The fourth emphasizing point is that six specialized directions are offered to cover the different requirement in automation area.

Motion control  
 Process Contrpl  
 Control Theory  
 Pattern Recognition  
 Instruments and Electronic devices  
 System Engineering

- The fifth emphasizing point is that some new subjects mirroring new thechnology and new advance are introduced as unrestricted elective subjects.

The examples are virtual reality, planing of advanced manufacturing, electronic commerce, robust identification, discrete event dynamic systems, and so on.

### **3. Reform in Teaching Methodology for Control Education**

The reform is also concerned to the teaching methodology. The main reforms can be summazized as follows.

- A seamless program for both SB and MS degrees has been offered.

The motivation of making seamless program is that the developing industry in China needs more and more engineers owned MS degres to develop new and perfect products for competitive market or to undertake the design and implementation for complicated engineering projects.

The characteristics of seamless program is that keeping basically the solider and broader theoretical foundations, we especially emphasize to train the abilities for designing systems and solving practical engineering problems.

The operations of seamless program are that the curriculums are arranged in unified consideration, the application for graduate study is made in the beginning of seventh semester, and

the program is divided as two stages where 4 years is a period for undergraduate study and 2 years is a period for graduate study. The difference of our program to the universities in United States is that both graduation design and MS thesis are required for each student.

- The practical training is greatly emphasized.

The university makes an investment of 10 million yuan for each one to construct some universitywide central laboratories, such as circuits and electronics, computer hardware and interface, and so on.

Some experimental subjects are independently set up in which three kind of experiments, including essential, elective, and research-type experiments, are offered to students and the objective is defined to train the creativeness and ability for working by oneself.

An SRT program is set up to offer 40% undergraduate students the opportunities to take part in research work under the direction of professors.

- The traditional teaching method is being reformed.

The disadvantages of traditional teaching method used in China for long time are shown as paying more attention to pass on knowledge to students and to train students to answer the questions and to pass the examinations.

The core of reform is to excite the creativeness of students. Around such a basic objective, the method of "inculcation-type" in teaching is being reformed, the teaching pays more attention to guide the students to face the real world, the training is being designed to train students not only the ability of analyzing and solving the problems met in practice but also the ability of proposing problems in one's study and practice.

The another important aspect of reform is to revise the evaluating standard to make it be more beneficial to excite the creativeness and independent thinking of students.

- The teaching means is being renewed.

The means include the application of multimedia technology in teaching, the development of electronic textbooks, and the long-distance teaching by means of satellite communications.