

# Exploring practice and innovation ability for Specialty in Measuring & Control Technology and Instrumentation

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**Abstract**—Specialty in Measuring & Control Technology and Instrumentation involving multidisciplinary, it covers the fusion of multi-field technologies, and aims to prepares students a thorough knowledge in measurement technology and instrumentation science to become creative generalists who may pursue a career in research, development and management. But it is difficult to achieve the educational objectives for the traditional curriculum program of this specialty. So, the traditional curriculum settings must be reformed. Good atmosphere and platform focus on practice and innovation ability training must be given to students.

**Keywords:** *specialty curriculum program, innovation ability, practice platform, project-driven*

## I. INTRODUCTION

Specialty in Measuring & Control Technology and Instrumentation is involving multidisciplinary. It aims to train high-quality talents with solid foundation knowledge in measurement technology and instrumentation, and excellent ability of science and engineering innovation, who may pursue a career in research, development and management. The Specialty undergraduate courses would assist students to acquire fundamental theory, principle and design methods of measurement technology and instrumentation, and provide them with specialized training in instrument design and manufacturing. After completed a series of course, students would acquire solid foundation knowledge in both natural sciences and humanities & arts, good grounding in the discipline of instrumentation science & technology, outstanding skills of measurement and control technology combined with electronics, mechanics, optics and computer science, and excellent problem analyzing and solving ability, self-learning ability and innovative thinking.

However, many problems are faced to the traditional curriculum program of this specialty. The first is specialty practice resources for students are serious shortage or out-of-date. Secondly, Practice curriculum is lack of system design and integration. Furthermore, the experimental courses are almost isolated from each other. There has no systematic comprehensive practice training, which based on specialty knowledge application and specialty ability practice. As a result, it is difficult to produce excellent students according to the educational objectives.

So, the traditional curriculum settings must be reformed, good atmosphere and platform focus on practice and innovation ability training must be given to students. Through the reform on practice curriculum system, good

trend and result would be appear as these: improving the practice resources and conditions, constructing practice platform, enhancing target, enthusiasm and initiative of the students' learning, cultivating and training students' ability of practice and innovation. The main reform explores are showing as follows.

## II. INTEGRATE PRACTICE AND THEORY SYSTEM

A practice curriculum system, which is integrated with theory curriculum system, would be explored here. Practical teaching is an important loop for fostering applied technological talents. To plan and establish a complete practice curriculum can improve the students' enthusiasm and initiative, as well as the teaching effect. The practice curriculum system has been focused on advanced and systematic theory teaching, and then practical training. The students have been emphasized as the center, and been guided to active learning. Practice and theory courses have been interact and promote each other.

The practices curriculum system has including the following four parts, as shown in the Fig.1, Specialty Basic Courses, Curriculum Design, Extra-curricular Practices and Bachelor's Degree Thesis.

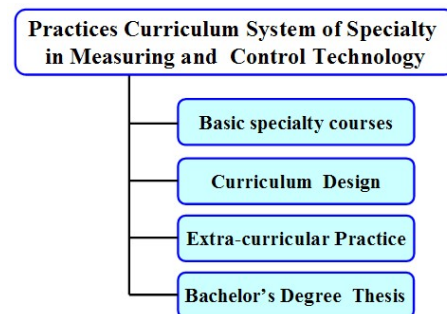


Figure 1. specialty practices curriculum system diagram

### A. Specialty Basic Courses

The Specialty Basic Curriculum include the following courses, such as Engineering Optics, Analogue and Digital Electronics, Theory of Automatic Control, Principle of Microcomputer and Its Application, Sensor Technique, Precision Instrumentation Design, Instrumentation Intelligent, Precision Measurement Circuit, Error Theory and Data Processing, Non-destructive Test, Machine Vision, Virtual Instrument and so on. The Specialty Basic Curriculum is specialty basic education. It is needed to highlight the features, provide solid and practical professional theoretical knowledge for students.

### B. Curriculum Design

The Curriculum Design is focused on how to use basic specialty knowledge to fulfill an object designing. It includes several course-designs, such as sensor's application course design, intelligent instrument course design, precision instrument course design, non-destructive test course design, virtual instrument course design, and so on. The suggested practice procession based curriculum design model is composed of four phases; analyzing → designing → implementing lecture → evaluating. Neither case, curriculum design is influenced by the pedagogy used within courses. That is to say, to teach students in the course how and why to do a course design.

### C. Extra-curricular practice

The Extra-curricular Practice activities of science and technology is very necessary to students, it is in accordance with specialty program objectives. The independence and creativity of students are needed to gradually increase. Teaching and practicing are needed to combine in a certain extent. Encouraging undergrad students to participate in extra-curricular activities in science and technology is an important means to develop students' ability. For undergraduate students, strong interest and passion is the foundation; abundant teachers resources is technical support; library and laboratory provides the material basis. With the accumulation of knowledge and experience, their independent and creative thinking would be experienced a prominent development. This rapid development provides intellectual basis for extra-curricular activities, which is a comprehensive use of their knowledge and skills to discover problems, analyze and solve problems in practice. They not only can see the value of their own, but also conducive to the cultivation of innovative consciousness and ability. Now, Extra-curricular activities of science and technology has become an important part of campus culture, students have many choices, such as the National Undergraduate Electronic Design Contest, the "Challenge Cup" national university student extracurricular works contest, the National Mathematical Modeling Contest etc.

### D. Bachelor's Degree Thesis

The Bachelor's Degree Thesis is an important link during the whole 4-year study procession. It aims to provide students with a chance, so that they can make full use of knowledge to solve a scientific problem. At the same time, it is an important test and evaluation for students' learning in university. Based on the traditional curriculum system, the requirements to Bachelor's Degree Thesis must be improved. Each thesis has to be combined with the research direction of supervisor. The Courses and practice that students have taken in early semester is the foundation of the Thesis. Students can expand or deepen the projects they have participated in to form their own Bachelor's Degree Thesis.

## III. ESTABLISH SYNTHETICALLY PRACTICE PLATFORM

A synthetically practice platform has been established, on which students can learn systematic

disciplinary knowledge and apply practice experiences better. Based on the specialty course group, a integrated practice curriculum which cope with the series specialty courses has been included on the practice platform, such as Fine Mechanics, Electronics, Engineering Optics, Sensor Technique, Computer Technology, Signal Processing and Analysis, Feedback and Control Technology, and many others. More important, good atmosphere and different levels of comprehensive innovative experiment are formed on it. During study on the platform, students can gradually receive main internship and practical training. The diagrammatic sketch of training process is shown as the Fig.2.

Starting from grade two, undergraduate students can take the above four-part major training, and experience different combinations of practices. They can make full use of platform resources and complete the innovation practice tasks, which has be mainly focused on a series of sensor and their signal transmission, conversion, data processing, evaluation module and feedback control system. They experience the whole process from information acquisition to feedback control, including signal procession and data analysis. Therefore, students have learned how to obtain information, and access to information in the right way. The appropriate method would be chosen to do signal process, and the scientific data analysis process would be fully used. Through such a tangible professional training, students can really practice and master the specialty knowledge, and get the creative inspiration. As a result, in reality, students' ability of practice and innovation can actually be fostered.

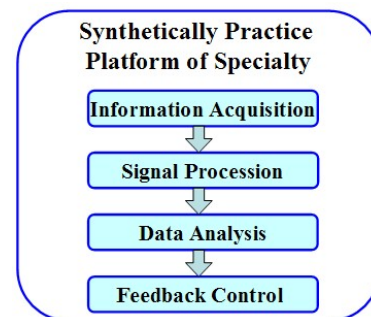


Figure 2. Process diagram of synthetically practice platform

## IV. PROJECT-DRIVEN PRACTICE AND INNOVATION

Based on multiple disciplines direction of the specialty and research achievements, a series of design practice project on measure instrument and control system have been set up. To achieve an instrument or measuring system is the goal of every project. The project results maybe an instrument model or prototype. They must hold the basic function of measurement and control analysis. Every project equipped with universal key components, parts and equipment. And the resources can be recycled.

For some of seniors who hold good specialty foundation and more extra-curricular interesting, mainly for undergraduate students in grades three or four, to take part in various kinds of science and technology research is

greatly encouraged. They can firstly form a Practice and Innovation Teams. Every team is consists of about three to five students and an advisor, who guide them to participate in some special R&D projects and carry out scientific research actively. During about one year study period, the team have to do different practice links independently, such as scheme analyzing, project task planning, software and hardware designing, system debugging, indicators testing, performance improving and even research report writing etc. These may be briefly called Project-driven Approach.

The consolidation and comprehensive utilization of knowledge are emphasized in the project-driven practice. Students' ability of practice and innovation are cultivated, their innovation consciousness is motivated, and their ability in analyzing and solving problems is enhanced too. Then, they have learned how to use knowledge comprehensively, how to do study independently and how to fulfill innovation cooperatively. For students majoring in measuring and control technology, engaging in the project-driven items is really a good practice way.

#### V. SUMMARY

In order to further develop and strengthen their practice and innovation ability, undergraduate students must be taken as the education center emphatically. A good

reformed specialty program is necessary and important. It can bring good results, such as the problem of which practice is isolated and non-systematic has been solved, synthetically practice platform based on the specialty targets has been established, and students have been trained know how to fulfill innovation and application in team work.

#### ACKNOWLEDGMENT

This research was sponsored by the Provincial Educational Reform Foundation of Hubei and Educational Reform foundation of HUST. They are gratefully acknowledged.

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