Exploration of Teaching Reform on Random Signal Analysis Based on CDIO Concept

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ABSTRACT

Based on the CDIO engineering education concept，For traditional teaching pattern of "random signal analysis"，Teaching content and method of random signal analysis are reformed, and the ability of the CDIO index is implemented in the course. the theory teaching of part of the course is reduced, the teaching theory which can be applied to the actual case is focused on and the homework is designed reasonably. Let the student practice personally, and the theory of what they have learned is practiced into practice, by this way, the students' active learning and learning enthusiasm are improved. The practice results show that the curriculum reformation has obtained good effect.

KEYWORDS

CDIO, Random Signal Analysis, Teaching Reform, Standards: 3

一、CDIO Engineering Education Concept

CDIO engineering education concept is the idea of engineering education reform model which was founded in 2004 after years of research since 2000 at the Massachusetts Institute Technology, Linkoping university in Sweden, Chalmers university of technology, The Royal Institute of Technology, etc. CDIO (conception-design-implementation-operation) engineering education concept is based on CDIO syllabus and the standard, let the students get engineering ability by way of actively and practice.The idea is the expansion of teaching method which is advocated by many education workers. That is “Practice teaching and classroom teaching must be closely combined”

“Random signal analysis "is the important basic course of electronic and information profession. The course has the characteristic of more abstract theory and complex formula deduction. At the same time it has strong practicability. In view of students' passive learning mode in the traditional teaching and CDIO engineering education concept, the teaching content is reformed in the paper first following the principle of paying equal attention to the theoretical analysis and application. The theory teaching part of the course is reduced appropriately and the theory closely integrated with the actual case is focused on. Second, let the student complete homework independently and apply theory they have learned to practice practically.

二、 Reform of teaching content

The syllabus of course stipulated period of 32 and all is the theoretical study in the classroom. Students generally reflect that they is not involved in thinking when learning abstract and boring theory before, and then gradually lost interest in the course of learning. Some of them have no idea of random signal and don’t know how to combine theory with practice after the end of study, let alone the cultivation of innovation ability. So we focus on optimizing the teaching content. We also focus on the combination of theory and practical application at the beginning of the course, training students' project learning mode of initiative and practice.

Based on CDIO mode, aiming at the cultivation of applied talents, the teaching hours is still 32 periods after reformation. According to the regulation of the syllabus, considering the

undergraduate teaching is not too deep in the content, the curriculum content is summarized into three parts simply: the basic theory of random signal, the basic theory of stochastic process and the application of stochastic process. The first part of the content is review of stochastic signal points, random signal practical distribution law, digital characteristics, the function transformation, etc.The second part of the content is the basic concepts of stochastic process, the stationary random process and the process of ergodic stationary random process, autocorrelation and cross-correlation of random process, power spectrum and cross-power spectrum of random process , gaussian process and white noise. The third part of the content is theory of random signal through the linear time invariant system and narrow band random signals. Clear the teaching content, the concept of "conception, design, implementation, operation" runs throughout the course.

First, the part content in the course is repeated, such as the inductive axioms of probability, random variables and function of a random variable in the first part of the content. The correlation theory is studied in he totem of the theory of probability. Therefore, the teaching time can be compressed from 6 periods to 4 periods.

Second, some knowledge in the course, such as the relationship of random signal characteristic function and the probability density can be understand by the knowledge of Fourier transform in the totem course of "signal and system". The relationship of power spectrum and autocorrelation function of smooth process is also can be understand by this way. The former has the similar Fourier transform of relationship, the latter is just a pair of Fourier transform. If the content of the Fourier transform in signal and system is reviewed in advance, then we can use some conclusion to analysis knowledge point directly, such as properties of the Fourier transform and Fourier transform equivalence commonly used when teaching the content. So that when learning we focus on understanding and application of relevant knowledge, and don't have a large number of mathematical analysis and derivation. The theory is easy to be accepted when the abstract mathematical concepts are introduced in this way. Therefore, the teaching time can be compressed from 14 periods to 10 periods.

Third, to strengthen the content that students can practice. We focus on the theory which can be applied to the actual case and a certain amount of homework are designed by ways of equal distribution of 6 periods compressed over the whole curriculum.

It's worth mentioning that homework content is closely linked with theory part and is also system engineering. The content before and after reform is showed in figure 1.

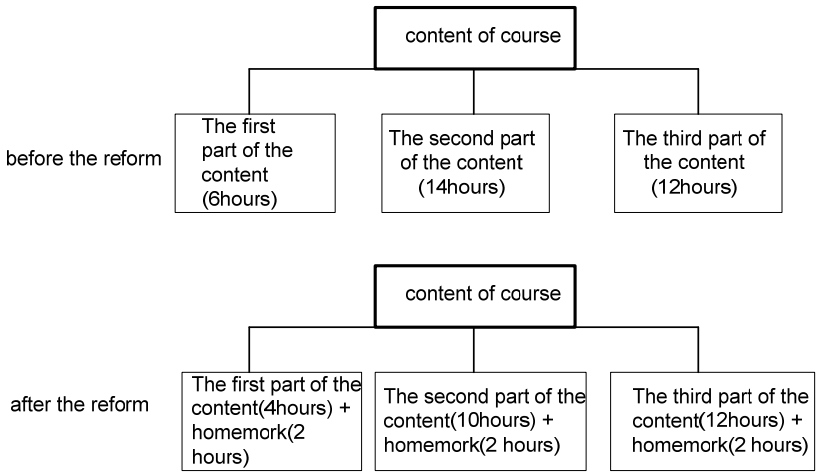

Figure 1 the contrast figure of content before and after reform

三、Teaching methods based on CDIO concept

Here let students carry on practice through three homework. The related knowledge is interpretated comprehensively before each homework. Then the students write programs and finish the homework.
The fist homework: generate random signals which has a certain correlation function. The students are required to program emulator with MATLAB and generate Zero mean stationary gaussian process which has a certain correlation function after the concept and characteristic of random signal are learned. The purpose is to let students master the basic use of Matlab software, on the other hand, let they can produce all kinds of random signal and measure them.
The second homework: program an emulator with MATLAB and analog problem that signal through the system of gaussian white noise environment. The homework is finished after the section of random signal through the linear system is learned. The problem of sine signal in white gaussian noise environment through a low-pass filter is analysised.
The third homework: program an emulator with MATLAB and analog signal matched filtering under white gaussian noise environment. The homework is finished after the section of signal processing in noise environment is learned. The problem that use the matched filter detect square wave signal in white gaussian noise environment is analysised.
Each nomework is finished after the corredponding theory content is learned on time, not do it when all theory is interpreated.

四、Conclusion

The CDIO teaching mode is introduced into the random signal analysis and the theory that can applied to practice is highlighted. By this way, the students' practical ability is cultivated through three times homework. At the same time, the self-study ability and innovation ability of them are trained. The practice shows that the method is effective and improve the students' learning enthusiasm.

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BIOGRAPHICAL INFORMATION

CHEN Hongyan, Master major in Signal Processing. She teaches signal analysis course in Chengdu University of Information Technology, and has focused on the education for signal

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