

Exploration in teaching reform of microwave circuits and devices course Based CDIO

Tang Jun, Jiguo Wen

School of Electronic Engineering, Chengdu University of Information Technology,
Chengdu, Sichuan, 610225, P.R.China

ABSTRACT

Based on the concept of constructivism and CDIO engineering education, teaching reform of "microwave circuits and devices" course is carried out by dividing it into two parts, 32 hours for knowledge teaching and 8 hours for design practice, and the latter part is discussed in this paper. Several design tasks related to the course knowledge are arranged, and the students are required to finish the design tasks on the team-based approach. i.e., one task for each team. It is shown that this reform can improve the ability of students in creative thinking and engineering implementation, and it is a useful attempt of CDIO engineering education applying in this course.

KEYWORDS

CDIO, constructivism, microwave circuits and devices, combined organically

The traditional duck-feeding teaching, the students passively listen to what the teacher teaches, finds it difficult to continue for its failing to meet the requirements of educational modernization, instead, several education concepts of actively learning while the teacher plays a role of a guide or partner are widely applied to the teaching practice and fruitful results achieved. Among them, the most typical and widely respected is the idea of constructivism and the concept of CDIO engineering education. Based on the fruitful results, we tried to apply the CDIO engineering education mode combining constructivism idea to the teaching reform practice of "microwave circuits and devices" course.

1、 Characteristics of constructivism idea and CDIO education mode

Proceedings of the 11th International CDIO Conference, Chengdu University of Information Technology, Chengdu, Sichuan, P.R. China, June 8-11, 2015.

According to the theory of constructivism, learning is a process of active construction, that is, in the process of knowledge acquisition, learners often make cognitive reconstruction according to their needs, intentions, attitudes, beliefs and emotions. Learners can obtain knowledge, skills and ideas only in a specific situation, for example, with the help of others, using the necessary learning materials, and by way of constructing meaning. Constructivism believes that the learners are the main body of information processing and the active part of meaning reconstruction, while the teachers or other students is to help and promote the construction of meaning.

CDIO is the abbreviation of conception, design, implementation and operation. Conception means to make clear the needs of customers and to formulate the corresponding schemes. Design means to make plans, drawings and algorithm of the expected product system. Implementation means the process from the design to product. Operation means to use, maintenance, optimization and elimination the product system. CDIO engineering education mode train students' professional knowledge, personal ability, occupation ability and attitude, team work and communication ability by systematic design in the life cycle from research and development to operation of products, production processes and systems, thus training the ability for conception, design, implementation, operation to product and system in the enterprise and social environment.

2. Construction of teaching reform

"Microwave circuits and devices" is a compulsory course for students majoring electronic information science and technology, and it is also a course with strong engineering practice requirement. The main contents include the basic principle and method of designing of microwave passive circuits and devices, and structure and characteristics of RF / microwave components.

In the traditional teaching of "Microwave circuits and devices" course, we ever focused on the knowledge teaching while pay attention to the engineering practice less, and the combination of theory and practice is not directly related, though the

teaching requirements highlight the solid foundation of knowledge and ability of flexible application of the knowledge. Furthermore, Its teaching content rarely reflect applications, the results is the students know how to design but fail to know why we need to design, resulting in students' failing to fully understanding the knowledge, let alone to construct the whole system and frames of knowledge. As a result, some students lose the interest and motivation in learning this course, it is a terrible course for them.

Based on the idea of Constructivism and the concept of CDIO engineering education, combining with the characteristics of the course, we implement bold reform in the course contents, practice section and teaching mode.

First, we define the teaching objective of the reform is to keep attention to the theoretical knowledge teaching, but strengthen the practice section and the combination of theory and practice contents, so that the students not only learn the theoretical knowledge, but also apply the theoretical knowledge to practical applications to cultivate and improve the students' ability of Engineering design.

According to this purpose, we reorganize the contents of "microwave circuits and devices" course as follows.

The contents of "microwave circuits and devices" course are mainly about properties, application, design and analysis of a variety of passive devices and circuits. All devices have similar traits and different characteristics.

The teaching- content was be divided into modules such as power-dividers、 attenuators, couplers, filters, switches and phase shifters. In each module, the performance, usage, technical index, design method and network analysis should be explained. The similar traits will be explained in detail in the first module while simply explained in the next modules, and different characteristics will be explained in detail in different modules. Each module are subdivided into several smaller modules according to the contents and features of the device, for example, coupler can be

subdivided into branch line coupler, parallel line coupler, magic T type coupler, etc. After the reconstruction of teaching content, characteristics of the circuit and the device itself is more prominent, teaching context is more clear, it is relatively easy for students to learn and understand. This is an important part of the reform.

Another key part of the reform is to set some of the experimental design before theoretical teaching. Students are required to complete the design on a team base, and finish time should be within two weeks after the related contents teaching corresponding to their problems. The design tasks and the requirements are directly related to the teaching content so as to focus on the knowledge application in practical design. In this way, in order to complete the design, students have to carefully study the theory and application of microwave circuits, and in the process of learning and design, they construct their knowledge learn from the microwave circuits and devices course. In addition, the team-based design approach can cultivate their teamwork spirit. In this process, teachers play a role in guide students learning, they help and guide students, or accompany with the students.

3. Implementation of teaching model reform

A, according to the situation of reconstruction of writing new textbook and prepare corresponding courseware according to the contents reconstruction of "microwave circuits and devices" curriculum.

B, In the teaching process, the adopted modes are as follows. put 4 or 5 students in a team, resulting in 14 teams in one class. The teacher prepared 14 tasks in circuit and device design, one for each team. In the team construction, the teacher should pay attention to disperse the students with good learning ability and strong design ability into each team, so that they can play a leading role in each team. At the same time, every student has his or her tasks in the team, which is part of the team task. also , the students are required to learn at least one design of other teams. In this way, each

student try to gain the ability of independent learning, work and coordination, which is useful for the ability improvement and good work habits in the future.

C, The a design task should not only close to the teaching content and theoretical knowledge, but also specific and feasible objectives and requirements based on the practical engineering design process and the actual production application, including the final form of product. The needed knowledge in the design process is partly learn from the content of classroom teaching, partly from other possible source. For example, for the design task of designing of an interdigital cavity filter, requirements are as follow. the center frequency of 2.45GHz, bandwidth 245MHz, VSWR < 1.5, passband insertion loss <1dB, attenuation>40dB at frequencies lower than 2.1GHz and higher than 2.8GHz. The design should be completed by using HFSS simulator, including modeling, simulation, optimization before achieving the expected simulation results, then, layout should be design by using CAD software.

The students need to apply what they learned in microwave circuit as well as extend their knowledge. Therefore, in order to complete the design task, they need to master the theoretical knowledge, which drive them to learn from textbook and from possible relevant reference. If the can not understand, they they will learn in the class with the a problem solving feeling or ask for help from teachers and classmates, this can improve their learning motivation, pay attention to the lecture. Since the theoretical knowledge can be applied immediately, the learning effect is better.

D, the evaluation require one thesis-based design report and oral presentation in class for each team. Take as an exmple the coupler design task, they should give current development, including the latest progress domestically and in abroad, the design configuration, simulation results of ADS or HFSS simulator, and CAD layout for printed circuit board. They should answer at least three questions in the field from teachers and students after their oral presentation, their answer should be given a clear, specific and correct.

The assessing levels can be one of the five levels, excellent, good, margin, qualified and failed, evaluated by the design report, oral presentation and answering question. Excellent level will be provided for teams that can finish the design task on time, good design report and oral presentation, as well as correct answers to the questions. Good level means the suitable design configuration and simulation results meet the requirements, CAD layout is correct in general, and the question answers are almost correct. Margin level is for teams with suitable design configuration but simulation results and CAD layout exhibit some defects. Qualified level means suitable design configuration but reasonable simulation results, and the failed level is for teams with incorrect design configuration or simulation results.

Assessment methods is announced at the beginning of this course so that the students know study hard and prepare in advance. Here we provide the assessment results for one class, 9 students rated as excellent, 17 students rated as good, 27 students rated as margin, 15 students rated as qualified, 8 students rated as failed.

E, Similar to other courses, this course also have knowledge assessment with total score of 100 points. Score below 60 points are defined failed. The result of the same class for knowledge assessment are as follows. 8 students score 90 points or higher, 15 students score 80 to 89 points, of the 27 students score 70 to 79 points, 17 students score 60 to 69 points, 9 students failed.

CONCLUSIONS

Compared with the past classes without adopting teaching reform, It is shown that this teaching reform improve the teaching effect. In the past, no design tasks are arranged, and the student number scored 90 points or higher in knowledge assessment no more than 5, while the students scored failed is more than 10.

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BIOGRAPHICAL INFORMATION

Tang Jun is a lecturer in Microwave circuits in the School of Electronic Engineering, Chengdu University of Information Technology. He works on topics related to engineering education reform in the department, and focuses on the curriculum design and the improvement of teaching and assessment in recent one year.



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