

# Course Construction of Radio Frequency Electronic Circuits Based on OBE Concept

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## ABSTRACT

Engineering education professional certification is an international engineering education quality assurance system. And it is also an important basis for achieving the international mutual certification of engineering education and engineer qualification. Its core idea is outcome based education (OBE). Therefore, it is of great significance to study how to apply the OBE concept to curriculum construction. This paper aims at three problems in the teaching of radio frequency electronic circuits Courses, explores in four areas: revision of course objectives, strengthening of course content, enhancement of course organization and diversification of assessment methods. Through the application of the OBE concept to the curriculum reform, we will be able to effectively improve the comprehensive quality of students.

**Keywords:** *Outcome Based Education (OBE); radio frequency electronic circuits; Course construction; Course Assessment*

## 1. INTRODUCTION

OBE (Outcome Based Education) is a philosophy of education that is oriented toward student learning outcomes, and holds that the goal of teaching design and teaching implementation is the final learning achievement of students through the educational process. Results-oriented education was proposed by Spady in 1981 and has gained widespread attention and application at an alarming rate[1, 2]. After about 10 years of development, it has formed a relatively complete theoretical system, has become the United States, Britain, Canada and other countries of the mainstream concept of education reform[3]. Results-oriented education is considered the right direction to pursue excellence in education[4]. Accreditation Board for Engineering and Technology (ABET) fully accepted the concept of OBE, throughout the certification standards for Engineering Education. China Engineering Education Accreditation Association's "Engineering Education Certification Standards (2015)" also fully reflects the OBE concept[5]. It explicitly requires that "the profession must meet the graduation requirements of the graduates trained by the evaluation certificate". In June 2016, China officially became a member of the "Washington Accord". Results-oriented education is relevant to guide engineering education reform[6].

As a teacher of radio frequency electronic circuits in university, I find that there are the following conditions in the study of this professional course:

(1)Underachieving students have a poor foundation of prior learning. They are not able to digest the basic knowledge of a complex subject in a timely manner.

(2)Students with an intermediate level can basically master the knowledge of the curriculum in class and can handle homework problems on time after class. However, they lack sufficient motivation for their studies, they feature "Confusing with the thoughts, drifting with the flow".

(3)Students who are good at learning can accurately grasp all the knowledge in the classroom and are comfortable studying after class. However, these students were observed to have problems such as "inability to apply what they have learned, isolated views of curriculum knowledge, and lack of curriculum coherence".

As a required foundation course for electronic information students, radio frequency electronic circuits are intended for all students. The course team reinforces the concept of OBE to all aspects of curriculum construction. While learning professional knowledge, course team hopes that students can think more, from the knowledge, ability and quality of comprehensive improvement.

## 2. CONCRETE METHODS

### 2.1. Revision of Course Objectives

According to the orientation of the school, the demand of the state and society for electronic information graduates, and the engineering certification requirements based on the OBE concept, the curriculum group sets the curriculum

objectives from three levels: knowledge, ability and quality:

Course Objective1: Students have the knowledge base of wireless communication problem analysis and understand the theoretical basis, research hotspots, development trends and frontier applications of wireless communication.;

Course Objective2: Students have the ability to apply scientific thinking and advanced tools to analyze, design and solve complex engineering problems of wireless communication systems in practice. Students have the ability of innovation, independent learning and lifelong learning awareness.;

Course Objective3: Students have perseverance, patriotism, communication and collaboration skills, scientific spirit and international perspective, respect for social values, and abide by engineering ethics.

### 2.2. Course Content Construction

The course group reshapes the course content according to the cutting-edge dynamics of the subject and the needs of social development. The team made full use of the online

platform to build a six-dimensional integrated teaching resource platform: Curriculum Ideology and Political Teaching Resources-Classroom teaching resources-Practical and innovative teaching resources-Simulation Resources-Online teaching resources-Question resolution and teaching feedback resources, taking into account both inside and outside the classroom. The reform realized the sharing of various resources and knowledge generation centered on students, and enriched the challenge degree of curriculum content. The platform has been in operation for six years and has benefited nearly 2,000 students.

(1) The course construction of ideological and political teaching resources is oriented towards the cultivation of the patriotism and the scientific spirit. Aiming at the knowledge point, the curriculum group combines the history, current situation and application of the course development, collects the actual cases, and implements the hidden education of curriculum thinking and politics. Thus, students enhance learning motivation, set up ideal belief: "based on space, for national defense services", with "innovation, truth-seeking, dedication" of the scientific spirit.

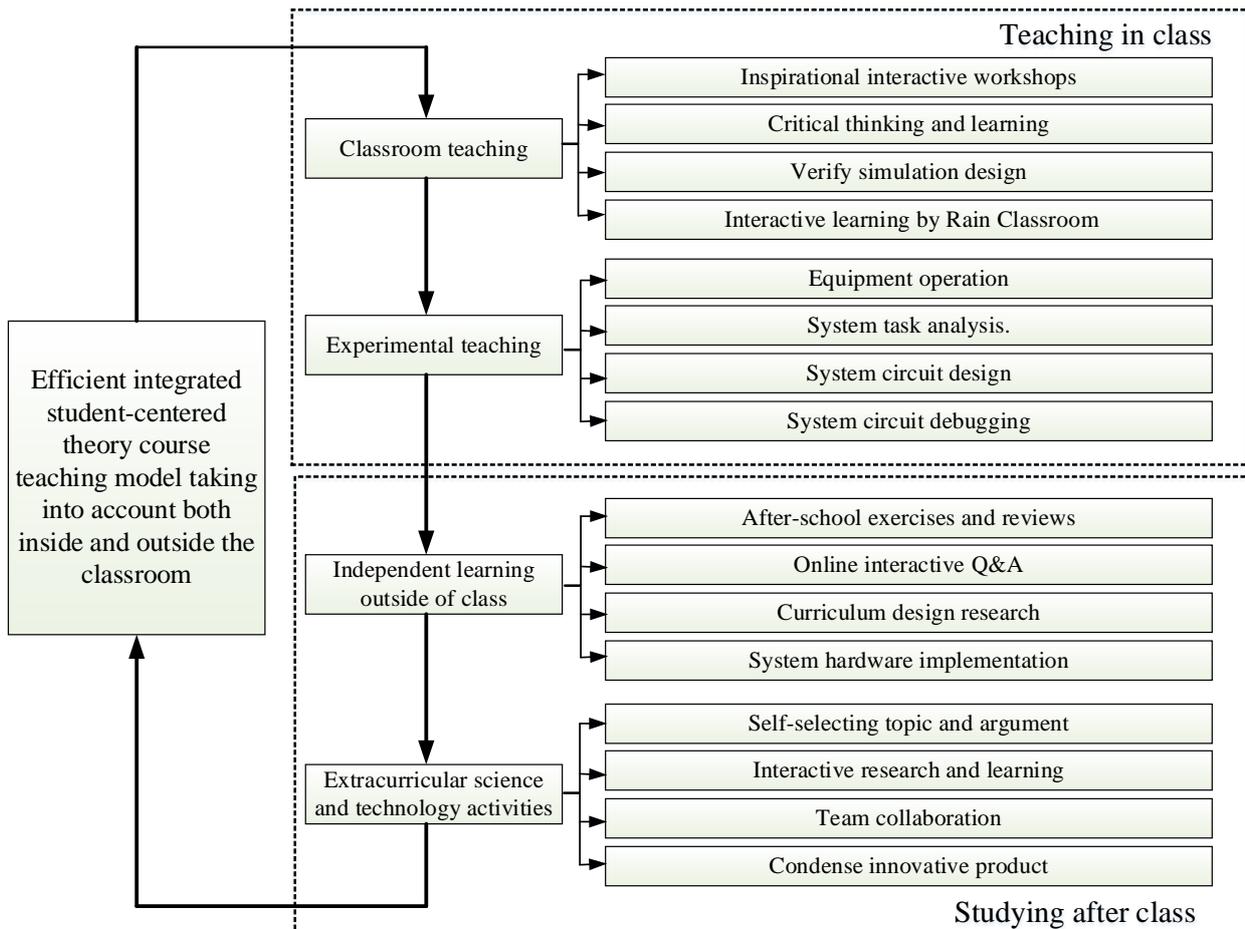


Figure 1. Curriculum teaching organization form map

(2) The construction of classroom teaching resources of "integration of science and education" oriented to the front scientific and technological achievements. Combining the front scientific and technological achievements and actual scientific research projects to showcase course knowledge points, designing case, simulation video and micro class for classroom discussion, such as adding introduction of 5g technology, satellite communication, chang'e-4 and the integration of communication measurement and control, so as to enable students to understand the development trend and application of the discipline frontier, and cultivate their scientific thinking, innovation consciousness and international vision.

(3) The construction of practical and innovative teaching resources oriented to the students' independent learning. A tutorial on the use of instrument and equipment, a question bank for curriculum design, a question bank for hardware design, and entry-level tutorial materials for subject competitions have been built. On this basis, students can carry out independent subject selection, teamwork, interactive research-based practical innovation and competition research, thereby effectively improving students' self-learning ability, innovation ability and communication and collaboration ability in engineering practice.

(4) Simulation teaching resources: build EDA simulation module library, provide simulation software use books and operation videos, and cultivate students' ability to use advanced tools to analyze, design and solve complex engineering problems of communication systems.

(5) Online teaching resources: relying on the online course service platform built by the school to complete the dynamic release of homework and regular submission, which guarantees the standardization of teaching files; regularly upload the cutting-edge achievements of the subject, the latest scientific research trends and the important national and social needs information, so that students can understand the subject Frontier development trends and applications broaden international horizons.

Regularly upload the cutting-edge achievements of the subject, the latest research trends, and significant national and social needs information, so that students can understand the cutting-edge development trends and applications of the subject, thereby broadening their international horizons.

(6) Exploration-Interactive Q&A and teaching feedback resource construction: Using QQ groups, WeChat groups, and online course service platforms, students can conduct Q&A and interactive discussions with teachers and students in real time, and feedback problems in teaching; the course assessment and learning effect feedback system can provide individualized services for each student, giving a feedback analysis form of course knowledge and ability mastery, so as to achieve efficient interaction and resource sharing between teachers and students, and effectively promote knowledge Improvement and feedback of teaching opinions, which can significantly improve teaching effects.

## **2.3. Course Teaching Organization**

The curriculum group adheres to the concept of "student-centered", According to students' cognitive laws and acceptance characteristics, a variety of teaching methods are integrated to construct an integrated teaching model that closely combines the two stages of "in class → extracurricular" and the four levels of "classroom teaching → experimental teaching → extra-curricular independent learning → extra-curricular scientific and technological activities", as shown in Figure 1 below.

### *2.3.1. Classroom teaching*

The research team strictly implements the collective lesson preparation system, constantly enriching the teaching content every semester, focusing on the characteristics of the curriculum goals and different knowledge points, designing teaching methods and teaching designs that are compatible with them, and continuously enhancing the level of education (for key question 4). In the classroom teaching process, through problem-project-based learning, students are inspired to carry out interactive seminars, critical and speculative learning is carried out for teaching content, and relevant conclusions are verified through actual simulations. At the same time, students use the Rain Classroom software to feedback the learning effect to the teacher, which can improve the quality of classroom teaching, break the silence of the classroom and activate the classroom atmosphere, and increase the communication and interaction between teachers and students (for key question 3). At the same time, teachers who participate in the school's mid-term feedback activities can obtain third-party course evaluation results.

### *2.3.2. Experimental teaching link*

Through the learning and exploration process of instrument and equipment operation, system task analysis, system circuit design and system circuit debugging, students have deepened their understanding of knowledge points and improved the use of scientific thinking and advanced tools to analyze, design and solve wireless Competence in complex engineering problems of communication systems.

### *2.3.3. Extracurricular independent learning link*

Students can conduct Feynman-style interactive discussions through the network interactive Q&A platform for the difficult problems encountered in the after-class exercises and review process, thereby comprehensively consolidating the theoretical foundation, and having the ability to analyze, design and solve the complex engineering problems of the wireless communication system in practice, and promoted the spirit of science. On

this basis, students can carry out curriculum design research. Curriculum design topics are derived from cutting-edge actual complex engineering problems, with the characteristics of high design difficulty, large debugging complexity, and strong completion challenge, which can increase the innovation, high-level, contemporary and challenging degree of students' learning.

#### 2.3.4. Extracurricular scientific and technological activities link

Students carry out open, exploratory, and innovative project research through four stages: independent topic selection and argumentation, interactive research and learning, teamwork and research and innovative results

condensing. To win awards in academic competitions and other innovative achievements, it better reflects the "two properties and one measure" of this course. It makes the students busy, the effect is real, and the students' innovation ability, communication and cooperation ability, scientific spirit and engineering ethical standards are improved.

#### 2.4. Course Assessment Method

The relationship between the assessment link and course objectives, student output and "gender once" is shown in Table 1:

**Table 1.** Course assessment method

Assessment link	Score	Teaching objectives	Student output (knowledge, ability and quality)	Standard embodiment
Participation in daily work on the network platform	10	Objective 1 and 2	Master the basic theories of wireless communication systems and expertise in analyzing and designing wireless communication systems	Highly challenging
midterm	10	Objective 1 and 2	Master the basic theories of the first five chapters and the expertise in analyzing and designing wireless communication systems	Moderately challenging
Final exam	60	Objective 1 and 2	Master the basic theories of wireless communication systems and expertise in analyzing and designing wireless communication systems	Highly challenging
experiment	10	Objective 1, 2 and 3	Master the basic theories of wireless communication systems and expertise in analyzing and designing wireless communication systems, and cultivate innovative practical capabilities and teamwork	Moderately challenging
Course Design	10	Objective 1, 2 and 3	Master the basic theories of wireless communication systems and the specialized knowledge of analyzing and designing wireless communication systems, cultivate innovative practical capabilities, teamwork, project management and broaden horizons	Moderately challenging
Hardware production	5	Objective 1, 2 and 3	Master the basic theories of wireless communication systems and expertise in analyzing and designing wireless communication systems, cultivate innovative practical capabilities, ethics, engineering ethics, teamwork, project management, and broaden horizons	Highly challenging

As can be seen from the above picture, the assessment links of this course are diverse, the assessment requirements are highly challenging, and there are many interactive, innovative and exploratory learning tasks, which fully solve the problem of insufficient exercise of students.

### 3. CONCLUSION

After the above-mentioned curriculum construction based on the OBE concept and with engineering education certification as the standard, students' academic

performance has increased year by year, hardware production participation has increased from 15% to 67%, and the hardware debugging success rate has reached 85%. After the study of this course, coupled with the follow-up competition guidance, students receive an average of 5 national competition awards, and an average of 12 provincial awards every year. The teaching effect has been significantly improved. In the future, the curriculum team will continue to improve the scientific and measurable aspects of the teaching process, provide personalized services to students, and continuously improve student output.

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