

# Examination and Evaluation System of Analog Electronics Technique for Engineering Education Professional Certification

Han Xue, Yu Guang

School of Intelligence and Electronic Engineering, Dalian Neusoft University of Information, Dalian, Liaoning, China

**Abstract:** According to the core concept of "student-centered" advocated by the professional certification of engineering education, and the talent training orientation with complex problem analysis ability and strong engineering practice and research ability, the curriculum examination and evaluation method is constructed, and the teaching organization and implementation is carried out through the parallel learning of curriculum theoretical knowledge and the practice of practical case projects, and the integration principle of "learning by doing" and "learning by doing". And according to the degree of achievement of the curriculum objectives, analyze and feed back to the teaching for continuous improvement.

**Keywords:** Engineering education professional certification; Analog circuit; Course assessment and evaluation methods; Continuous improvement

## 1. Introduction

Engineering education professional certification is an engineering education quality assurance system to realize the international mutual recognition of engineering education and engineer qualification. Its core concept is student-centered, achievement oriented and continuous improvement [1-3]. Based on the teaching results of students, the teaching results of students are organized and implemented according to the teaching objectives of students [4]. That is, what learning outcomes do you want students to achieve? Why should students obtain such knowledge and ability and improve their quality? How to effectively help students acquire such knowledge and ability and improve their quality (how)? How much has the learning achievement goal been achieved? By establishing a set of training evaluation mechanism and applying the evaluation results to teaching improvement, a closed loop of "evaluation feedback improvement" is formed to promote the continuous improvement of talent training quality, and adopt multi-channel teaching evaluation and feedback for the continuous improvement of curriculum teaching.

## 2. Examination and evaluation of courses

### 2.1. Course examination link design

Table 1: Proportion of assessment links and scores of courses

Formative assessment			Final assessment							
task	experiment	Project case analysis and design	Level III Project			Test paper (100 points * 45%)				
			Scheme demonstration project report	Circuit design and simulation	Welding commissioning	choice	Fill in the blanks	Draw a picture	Brief answer	calculation
15 points	15branch	10branch	5 points	5 points	5 points	20 points * 45%	10Score * 45%	20Score * 45%	20 points * 45%	30Score * 45%

Diversified Assessment and evaluation methods, combined with the design of teaching links and teaching methods, can effectively promote the achievement of the teaching objectives of the course. The assessment of the course of modeling electricity is divided into formative assessment and summative assessment. The formative assessment is carried out for homework, experiment and case design, which can evaluate the learning situation of students in time and help teachers find out the actual level of students, Timely understanding of students' knowledge blind spots, teachers can carry out "precise help", and timely feedback to teaching, adjust teaching strategies, correct and supplement [5] for teaching. In

addition to the closed book written examination, the final assessment also includes three-level practical projects. Students can freely form a group of four to complete a complete three-level practical project through division of labor and cooperation. The design of course assessment links is shown in Table 1.

## 2.2. Rationality analysis of curriculum objective evaluation

In order to evaluate whether the teaching objectives of the course can match the index points required for graduation of engineering education certification, and whether the teaching contents, achievement paths and assessment methods can support the achievement of teaching objectives. The evaluation of curriculum objectives adopts a multi-form, phased and whole process assessment method. In addition to the formative assessment focusing on the gradual cultivation of students' cognitive process and practical ability, it also includes three-level practical projects of the final assessment of the cultivation of complex engineering ability [6]. The teaching design of the three-level practical project is student-centered and project driven. Teachers assume the role of "technical director", conduct quantitative assessment for each stage of each student in each group, and give the results of the practical project based on the comprehensive technical indicators of the final project results in combination with the writing of the project report [7]. In student-centered project driven teaching, students "learn and do, do and think, think and realize, do and succeed, learn and be able to use, use and innovate." Let students enjoy learning, learn and learn. The total score of the course focuses on the assessment of knowledge structure and ability requirements, focusing on the assessment of students' innovation ability, problem-solving ability and practical ability. See Table 2 for the rationality analysis of curriculum teaching objective evaluation.

Table 2: Rationality analysis of curriculum objective evaluation

category	assessment link	Score percentage	Rationality analysis of curriculum objective evaluation
Level III Project	Scheme demonstration project report	5%	1) Scheme demonstration and project report Students learn to apply analog circuit knowledge or identify and judge the engineering problems of analog circuit system through literature research, conduct technical scheme and feasibility analysis, propose solutions to engineering problems, and form project reports to evaluate students' ability to analyze problems and obtain solutions.  2) Circuit design and simulation: be able to use EDA software to carry out circuit design and simulation, parameter optimization, experimental analysis and performance evaluation according to the implementation scheme of three-level project, so as to ensure the realization of system objectives and understand its limitations. Submit design simulation documents to evaluate students' engineering design ability with modern tools.  3) Project achievements after welding commissioning According to the performance index pursued by the system, design PCB or use bread board welding to build circuit, build project circuit system, use common experimental instruments to debug, test and analyze the built circuit, complete the project achievements and realize the ideal performance index of the project. Test the performance indicators of the test results, so as to evaluate the students' teamwork and experimental research ability.
	Circuit design and simulation	5%	
	Welding commissioning	5%	
Final examination paper	Choice	9%	1) Objective questions (choice, blank filling, short answer, drawing) Considering the importance of students' basic and theoretical content, the blank filling questions, multiple-choice questions and simple questions are set to mainly investigate students' mastery of basic knowledge. The content of the test questions covers the basic course content. To evaluate students' mastery of basic knowledge points of analog circuit.  2) Subjective questions (drawing, calculation) (1) Drawing title It can carry out static and dynamic analysis of typical common emission amplifier circuits, and draw the DC path of static analysis and the AC path of dynamic analysis according to the analysis requirements. (2) Analysis and calculation questions It can carry out static and dynamic analysis of typical amplification circuits (common emitter, common base and common set), calculate the main technical parameters, and compare the performance indexes of the three. Be able to analyze and calculate the voltage magnification under the condition of deep negative feedback and analyze the basic operation circuit. This part requires students to be able to comprehensively use their analog circuit knowledge, analyze problems, express solutions to problems, and comprehensively consider other influencing factors. This is used to evaluate students' ability to analyze problems and obtain technical indicators and schemes.
	Fill in the blanks	4.5%	
	Brief answer	9%	
	Draw a picture	9%	
	Calculation	13.5%	
Total		60%	

### 3. Evaluation method and basis

The teaching content is designed according to the idea of OBE. After students complete the learning of this course, they evaluate the learning effect of students through homework, experiment and case analysis design, as shown in Table 3.

Table 3: Formative assessment and evaluation methods and their weight distribution

Course objectives	Formative assessment and evaluation methods and their weight distribution			Graduation requirements	
	task	experiment	Project case analysis and design		
	15 points	15 points	10 points		
Course objective 1	0.3	0.3		Graduation requirements 1-3	
Course objective 3			0.5	0.6	Graduation requirements 3-2
				0.4	Graduation requirements 5-2
Course objective 4		0.4	0.5		Graduation requirements 4-2
			0.3		Graduation requirements 9-1

Four course objectives, test papers and three-level items are set in this course to quantitatively evaluate the learning effect of students, as shown in Table 4. Assessment methods and evaluation methods are matched with graduation requirements such as engineering knowledge, problem analysis, design / development of solutions, experimental research, team cooperation and the use of modern tools.

Table 4: Summative assessment and evaluation methods and their weight distribution

Course objectives	Summative assessment and evaluation method and its weight distribution								Graduation requirements
	Level III Project (15 points)			Test paper (100 points * 45%)					
	Scheme demonstration project report	Circuit design and simulation	Welding commissioning	choice	Fill in the blanks	Draw a picture	Brief answer	calculation	
	5 points	5 points	5 points	20 points * 45%	10Score * 45%	20Score * 45%	20 points * 45%	30Score * 45%	
Course objective 1				0.1	0.2		0.1		Graduation requirements 1-3
Course objective 2	0.2					0.6		0.2	Graduation requirements 2-1
Course objective 3		0.5	0.4						Graduation requirements 3-2
			0.6						Graduation requirements 5-2
Course objective 4	0.1	0.1	0.5	0.4					Graduation requirements 4-2
		0.3		0.4					Graduation requirements 9-1

### 4. Analysis and continuous improvement of the achievement degree of course objectives

#### 4.1. Analysis on the achievement degree of course objectives and graduation requirements

After the reconstruction of the curriculum teaching objectives and the graduation requirements indicators to be supported, the teaching links and assessment methods should be designed according to the curriculum teaching objectives, and the evaluation methods to achieve the curriculum objectives should also be determined. The learning effect evaluation of this course is presented by the degree of achievement of the course objectives. The degree of achievement = the average score of students in the assessment link / the full score of the assessment link [8]. The quantitative calculation results of the degree of achievement of the course teaching objectives and graduation requirements to be supported are shown in Table 5.

Table 5: Quantitative calculation results of course objectives

Course objectives	Supported graduation requirements	Assessment link	Achievement degree of curriculum objectives	Degree of achievement of graduation requirements
Course objective 1	Graduation requirements 1-3	(1) Homework (after class homework, online micro video learning, online test) (2) After the reconstruction, the teaching links and assessment methods are designed according to the curriculum teaching objectives, and the evaluation method of achieving the curriculum objectives needs to be determined. The learning effect evaluation of this course is presented by the degree of achievement of the course objectives. The degree of achievement of the course objectives = the average score of students in the assessment link / the full score of the assessment link [15]. The degree of achievement of the objectives of this course and the examination papers required for graduation (objective) (3) Experiment	66.62%	66.62%
Course objective 2	Graduation requirements 2-1	(1) Level III Project (scheme demonstration project report) (2) Test paper (subjective)	66.87%	66.87%
Course objective 3	Graduation requirements 3-2	(1) Project case analysis and design (2) Level III Project (circuit design and simulation)	84.2%	82.6%
	Graduation requirements 5-2			85.7%
Course objective 4	Graduation requirements 4-2	(1) Experiment (2) Level III Project (Scheme demonstration project report) (3) Level III Project (welding commissioning)	74.3%	83.3%
	Graduation requirements 9-1			83.2%

As the quantitative evaluation data of the degree of achievement of curriculum objectives and graduation requirements. According to the four curriculum objectives of this course, a student questionnaire on the degree of achievement of curriculum objectives was designed, and 94.2% of the students participated in the survey, as shown in Figure 1. Conduct self-evaluation on the achievement degree of the four curriculum objectives as the qualitative analysis result of the achievement degree of the curriculum objectives [9].

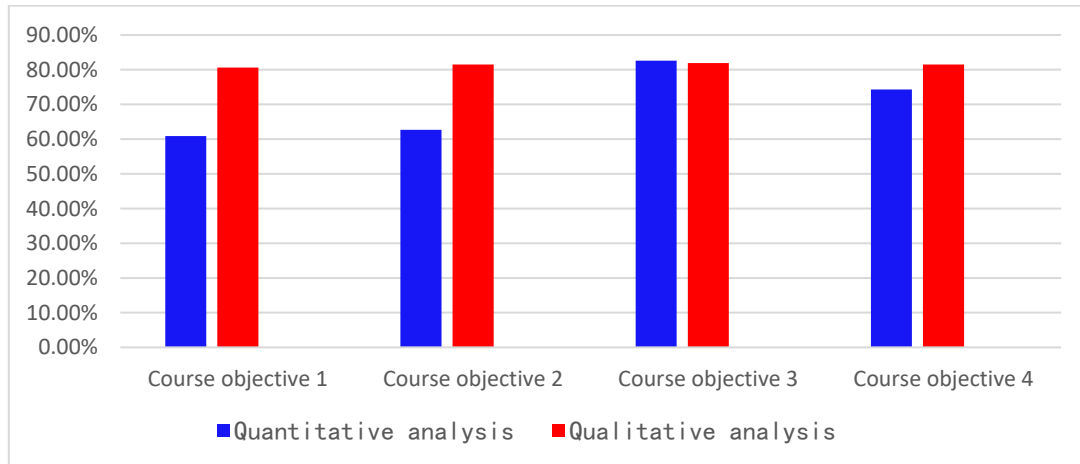


Figure 1: Schematic diagram of achievement degree of analog circuit course objectives and graduation requirements

4.2. Continuous improvement of courses

In order to continuously improve the quality of talent training and cultivate engineering and technical talents in line with social needs, the core concept of engineering education certification emphasizes continuous improvement. With the help of reaching data and feedback evaluation mechanism, problems can be found in time, rectified and improved continuously [10], as shown in Table 6.

Table 6: Analysis and improvement plan of course objectives

Serial number	Analysis of achievement	Improvement scheme
1	The achievement of course objectives 1 and 2 is less than 70%, which shows that students do not have a reliable grasp of the basic knowledge of analog circuits, and their ability to analyze and calculate typical circuits and analyze and describe engineering problems with basic knowledge needs to be strengthened.	Course objective 1: focus on knowledge points: record micro videos and assessment tests of knowledge points to cultivate students' awareness of self-study. The two-way combination of listening and self-study requires not only listening to the teacher, but also self-study after class, making full use of various teaching resources provided by the teacher to consolidate the knowledge learned, and students take notes in class for learning and review after class.
2	The achievement of course objective 2 is less than 70%, indicating that the ability to identify and judge engineering problems or express solutions to problems through literature research needs to be strengthened. The achievement degree of course objectives 3 and 4 is more than 80%. Taking project case analysis and design and three-level project as the carrier, students have been trained in analog circuit system design, research and practice, ability to solve complex engineering problems and teamwork.	Course objective 2: elaborate and refine: elaborate on typical circuits in the way of problem guidance and solution, put forward problems through description and explanation, guide students to think actively, encourage students to actively participate in discussion, analyze and understand problems, and further find solutions. Assign learning tasks, and students analyze and calculate typical circuits after class to obtain skills.

## 5. Conclusion

According to the three core concepts of "student-centered, achievement oriented and continuous improvement" in the professional certification of engineering education, this paper designs the teaching links and assessment methods, reforms the teaching methods, improves the evaluation of teaching effect (learning achievement degree), improves the teaching according to the learning effect (curriculum goal achievement degree), and cultivates the students' ability to analyze and solve complex engineering problems, Promote the continuous improvement of students' training quality.

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