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Research on Teaching Reform of Analog Circuit Course

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Abstract: The course of analog circuit is an important basic course for electronic and information majors, which aims to cultivate students' innovation ability and engineering practice ability, stimulate their interest and motivation in learning, and help them appreciate the spirit of teamwork. In view of the issues existing in the conventional teaching mode, some views on the teaching reform of analog circuit are put forward. This paper mainly expounds rational use of modern educational technology and concept, and some experimental teaching modes to strengthen the ability of system design.

1. Introduction

The novel higher education puts forward that it is of great significance to cultivate students' ability to solve practical issues and integrated practical capacity. The goal of analog circuit teaching is to strengthen project practice awareness, train learning capacity, innovative thinking, innovative capacity and practical capacity. For information students, analog circuit teaching is quite important. Theoretical teaching and practical teaching are all very important for enhancing students' quality and cultivating compound talents with innovative awareness and practical capacity. In order to transfer the conventional teaching mode and set up the analog circuit teaching system is of great significance to the cultivation of innovative awareness and integrated practical capacity [1-3].

One of the difficulties in analog circuit courses is the notion of engineering estimation. The analysis and calculation of electronic circuits have the direct bearing on some practical project issues in most cases, so it is hard to carry out precising analysis and calculation. Students can make accurate calculations in math, physics and circuit analysis courses. At the beginning of the analog circuit course, engineering estimates are difficult. In addition, it was difficult to understand how ignoring the presence of resistors or capacitors could be ignored, and students worried that ignoring these devices would result in incorrect calculations. This requires explaining the course's properties to students and shifting their thinking from accurate calculations to engineering estimates. Due to the nonlinearity of semiconductor devices, device nominal value deviation, equipment aging, the variation in ambient temperature, line-voltage variation and other reasons, it is nearly impossible and meaningless to compute the actual circuit parameters accurately. Therefore, the calculation ignores some secondary factors and only deals with the primary conditions. This approach (called engineering estimation approach simplifies complex problems, and satisfies the calculation

requirements of actual circuits [2]. However, the approach of engineering estimation cannot briefly neglect an extremely large or small equipment value, while is based on previous experience and experimental data, and ensures that the relative error resulting from the simplification is within an acceptable error band. In class, teachers should explicit the engineering estimation's aim is not to acquire precise calculation results, instead clear and qualitative concepts and conclusions can be obtained through simple analysis and estimation. These concepts and conclusions can further guide students to design circuits and systems, and quickly judge the causes of circuit faults. Provided that students comprehend the engineering estimation's meaning and aim the "hard to start" issue of analog circuit courses can be significantly solved [4-6].

2. Rational Use of Modern Educational Technology and Ideas

2.1. Adopt Project Teaching Method to Help Students Establish the Concept of Engineering

In line with the project teaching approach's idea, students are assigned a few plain project tasks before they start to learn the course content. Students learn with tasks and try to solve them. Thus, improve students' learning enthusiasm and enthusiasm, so that students' learning attitude alters from passive learning to active learning.

For instance, before teaching transistor amplifiers, assign the students an amplifier design task with voltage gains A_u greater than or equal to 100, input resistance R_i greater than or equal to 10 $K\omega$, and output resistance Ro less than or equal to 1000 $K\omega$.

The students found it difficult to obtain the necessary parameters with either their knowledge of common emitter (C-E) amplifiers or common collector (C-C) amplifiers. Then, they might wonder if they should connect a C-E amplifier to a C-C amplifier.

In the process of teaching, we will go on leading students to think deeply and pull for them to attempt to complete amplifier design using Electronic Design Automation (EDA) software simulation software, breadboard or common board. With the further learning of the course, they finished the task gradually. After students completed the aforementioned tasks, we assigned them a improved amplifier design task before teaching on field effect transistor (FET) amplifiers. Students complete the revised amplifier design task (voltage gain A_u is greater than or equal to 100, input resistance R_i is greater than or equal to 5 $M\omega$, output resistance R_o is less than or equal to 100 ω). Through posing, studying and research, students not only erect the engineering's concept step-by-step, but also have a deep understanding of the various circuits' characteristics and the voltage gain's meaning, input resistance, output resistance and other technical parameters. Practice has proved that compared with pure theoretical homework; project teaching approach can acquire preferable teaching effects.

2.2. Grasp the Key Points, Understand the Difficult Points, Find the Solution of Course Teaching

This course focuses on the most elementary, basic, and common aspects of analog electronics. In the teaching process, "three foundations" are mainly concentrated on:

- Fundamental theory: Covering basic analytical approaches for electronic circuits;
- Fundamental knowledge: General electronic devices and electronic circuits, covering their properties and main applications;
- Fundamental skills: Covering electronic test techniques, electronic circuit analysis and calculations, and interpretation of drawings [7-8].

It also is necessary to help students clear up and sum up the knowledge points that are

troublesome to understand in the textbook.

▪ Alternative current (AC), direct current (DC) feedback (FB): Deciding whether there are dynamic components in the feedback network (FBN);

Case 1: If there is no dynamic element (usually capacitance) in the FBN, the FB signal is AC and DC;

Case 2: If FBN is series capacitor, it is AC FB (as shown in Figure 1);

Case 3: If FBN is shunt capacitor, it is DC FB (as shown in Figure 2).

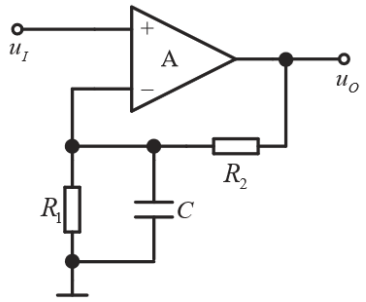

Figure 1: DC FB

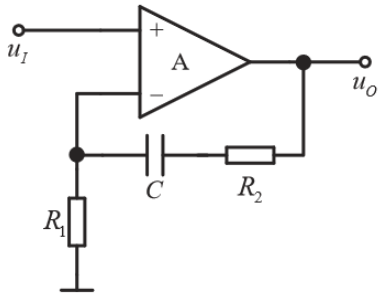

Figure 2: AC FB

▪ Voltage Current FB;

Case 1. The same point's FBN and output are voltage FB (as shown in Figure 3 and Figure 4);

Case 2. The FBN and output in the two various points are current FB (as shown in Figure 5).

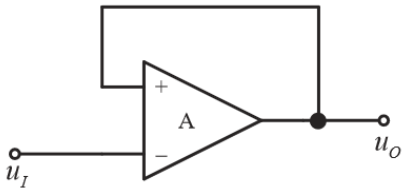

Figure 3: Voltage FB returns all output voltages back

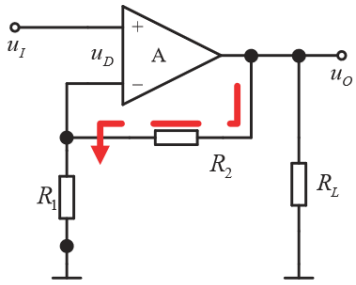

Figure 4: Voltage FB to the output voltage section

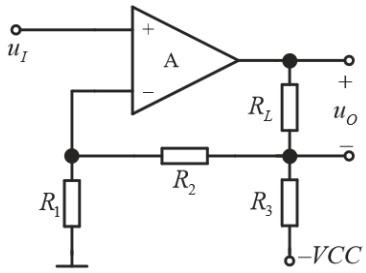

Figure 5: Current FB returns the output current part

3. Strengthen the Experimental Teaching Mode of System Design Capacity

3.1. Combination of Basic Circuits and Systems

It changed the traditional way of planning the experiments to make them concentrate on given fundamental circuits. By combining experimental content, expand the scale of the experiment, prolong the time of each experiment, and integrate more subjects into the experiment. Table 1 compares the experimental content of the pilot class and conventional class. Pilot tests emphasize integrated circuit (IC) design. Each test requires a all-sided design to implement particular system functions [9-10].

Table 1: Experimental class and traditional classroom teaching content

Classification	Experiment content	Practice time
Pilot class	Basic application of operational amplifiers	6
	Design of automatic gain-switch voltage amplifier circuit	6
	Design of single stage voltage amplifier	6
	Signal generation, decomposition and synthesis	7
	Audio amplifier design	7
	Total Hours	32
Traditional classroom	Analog operational amplifier circuit	3
	Integrator circuit, current and voltage conversion circuit	3
	Comparison circuit, rectifying circuit	3
	Single stage low frequency voltage amplifier	5
	Differential amplifier circuit	3
	Wave generator circuit	3
	Active filter	4
	Integrated timer	3
	Integrated power amplifier	5
	Total Hours	32

3.2. Combine Theory with Practice and Developing Students' Capacity to Analyse and Settle Common Experimental Failures

Practice is inseparable from theory. Complementing each other is a vital step of experimental reform. The student first designs an independent circuit that meets the requirements by using theoretical knowledge. At times they call for previewing correlated curriculum to optimize the design. Then according to the system function to determine the structure of the system, circuit and components of the parameters and the required test instruments. In the meantime, they submitted an application to their tutor online. When the design is approved by the instructor, they can go into the

lab for tests and set up their own circuits. In the traditional experimental teaching process, students will ask the teacher directly when they encounter problems.

3.3. Reform the Evaluation of Experimental Courses

Usually, if students take part in every experiment and hand in the experiment report on time, their experiment will pass smoothly. We need to reform the single evaluation of experimental teaching. Each experiment should be summarized by the students themselves; the content is mainly from the students' experimental situation and their own thinking. There should be a lot of flexibility. Therefore, the proportion of students' experimental scores in the analog circuit course scores should be increased to reflect the real results of each student in experimental skills. Each experimental result should include several aspects, such as preliminary preparation, experimental process, experimental data processing, experimental operation ability, creation and design, etc. Effective evaluation can stimulate students' interest and independence in learning analog circuits and improve the teaching effect.

4. Conclusions

The main purpose of the reform is to expand students' knowledge, train students' ability to analyse and solve problems, and improve their comprehensive quality. In order to achieve this goal, the new analog circuit teaching mode pays more attention to cultivating students' innovative spirit, using the design experiment, cultivating students' innovative ability, so that students dare to innovate, dare to innovate. Practice has proved that the new analog circuit teaching is feasible. Therefore, it is necessary to reform educational ideas, teaching contents and teaching methods to cultivate high-quality talents to meet the needs of the new era and the fierce competition.

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