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A Study of Practical Teaching Reform of High Frequency Electronic Circuits Course

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Abstract: *The "high frequency electronic circuits" course is relatively difficult, for this course, students may feel powerless at first contact, so the teaching methods are very important. The traditional teaching method for high-frequency electronic circuits involves theoretical explanation and simulation experiments, but this approach has been found to have weak practicality, lack of interaction, and flexibility. To address these issues, we propose various flexible teaching modes. Our practice has shown that this approach not only improves the quality of teaching but also enhances students' interest in learning, stimulates their curiosity, and plays a crucial role in developing their abilities to design and analyze circuits, as well as strengthening their engineering practice and independent innovation skills.*

Keywords: *High frequency electronic circuit, Teaching mode, Practical teaching*

1. Introduction

High frequency electronic circuit is a crucial field of electronic technology with widespread applications in communication, radar, satellite navigation, and other industries. The course on high frequency electronic circuit imparts fundamental circuit design principles and technologies, including power amplifier, RF filter, RF mixer, among others, which are vital for mastering advanced circuit design technology [1-3]. Additionally, the course also provides insights into the challenges and issues encountered in practical engineering applications, such as signal transmission stability, noise suppression, interference elimination, and more. These knowledge and skills are very important for students to engage in electronic engineering related careers in the future. In addition, practical teaching is also very important in the course of high-frequency electronic circuits, which can improve the practical application ability and innovation awareness of students and enhance their career competitiveness.

Through experimental simulations and project practice, students can obtain a deeper understanding of circuit properties and behavior and strengthen their grasp and application of high-frequency electronic circuit design principles. However, there are several problems in the current practice teaching of related courses: on the one hand, the practice teaching is not satisfactory due to insufficient equipment conditions, imperfect software simulations, lack of comprehensive practice programs, and other factors. On the other hand, teaching patterns are relatively simple and more flexible and diverse teaching methods are needed to stimulate the interest and enthusiasm of students in learning and improve their practical application ability and innovation awareness. Therefore, a series of measures should be taken to optimize and improve the ability of practical application and overall quality of students in the future teaching process of high frequency electronic circuits courses.

For a long time, the course gave the impression that the theory was abstract, the formulas were numerous, and analysis of circuits was quite complex, making it difficult for students to understand and master well. In response to these characteristics, many teachers have made innovations and explorations in teaching methods, which have improved the effectiveness of classroom teaching to a certain extent, but those new teaching methods are still problematic. Through teaching practices, we propose more targeted teaching ideas for different sessions in practical teaching. Inspired by new ideas, student participation and initiative in studying can be effectively improved from the perspective of teaching practice, making teaching process more diverse and interesting [4-5].

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2. The countermeasures of curriculum teaching

2.1. Innovation of experimental content

According to the current trend of practical application, comprehensive consideration of industry and technology development directions, the experimental content is closely combined with practical application, and the students are guided to think about the physical mechanism and engineering application behind the experimental phenomena. We start with the following aspects:

a) experimental content design: for different experimental sessions, the content can be set according to current trends in scientific and technological development and practical applications. For example, experiments based on 5G communication technology, radio frequency identification experiments, and measurements of RF signal parameters, etc.

b) experimental scheme design: during the experimental implementation, attention should be paid to the compactness and feasibility of the experimental scheme to ensure the accuracy and reproducibility of the experimental results. In addition, the experimental scheme design needs to be flexible and changeable to meet the experimental autonomy of the students

c) data collection, analysis, and processing: there are strict requirements for data collection and processing during the experiment. Different experimental contents require special tools for data analysis and processing, and tools such as high-performance computers, virtual laboratories, and simulation software are introduced to help students process and analyze experimental data more accurately and vividly.

Through the innovative experimental content mentioned above, the combination of theory and practice can be better promoted to improve the innovative thinking and practical ability of students.

2.2. Innovation in designing experiments

The design of experiments should meet students' knowledge level and practical application needs, and the teaching design mode of strong pertinence and guidance can be adopted to cultivate students' spirits of practice and innovation, and encourage students to think and solve practical problems from different angles.

a) introducing new experimental equipment: explore new experimental equipment, introduce signal generators, power amplifiers, full-power resonators, filters, mixers and other equipment in the experiments, and develop hands-on practical skills of students.

b) designing innovative experimental procedures: project experiments are introduced to allow students to independently conceive experimental schemes, design experimental equipment, collect and process experimental results, thereby improving students' ability to think independently and innovate.

c) introducing multi-element experimental scenarios: the involved experimental scenarios should be more diverse, such as remote debugging experiments, video display experiments, planar circuit layout experiments, and other scenarios to enrich the experimental content and display the experimental content from multiple views[6-7].

Through the design of innovative experimental sessions which not only stimulate students' interests in experiments, but also help them to grasp knowledge points and improve practical abilities better.

2.3. Innovation in teaching tools

Advanced teaching tools and technologies, such as smart laboratories and online simulation experimental platforms, have been adopted to improve the efficiency of teaching and the accuracy of experimental results, as well as to enhance the practical abilities of students. As follows:

a) application to virtual simulation experimental platforms: circuits simulation software can simulate the operation process of experimental devices or circuits, reducing the cost and time of physical experiments and thus improving experimental efficiency.

b) intelligent laboratory: the introduction of intelligent control systems can enable automatic monitoring and control of the laboratory environment, improve stability and controllability of the experimental environment, and improve laboratory safety.

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c) online simulation experiment platform: through internet technology and online simulation experiment platform, students can not only participate in experiments anytime and anywhere, but also share experiment results with other students and learn in different learning scenarios.

d) computer-aided experimental teaching system: this type of system can be connected to the experimental device, and can control the data acquisition and processing, also show the experimental data to students via data visualization to improve the experimental results.

With the application of innovative experimental tools, the actual engineering environment can be more truly restored, the experimental efficiency and accuracy of the experimental results can be improved, and the waste of human and material resources can be reduced.

2.4. Innovation of feedback mechanism

Design a two-way feedback mechanism, adjust the teaching process and experimental procedures, determine the appropriate teaching mode for students, and implement teaching improvements based on student feedback. The experimental teaching of the course on high-frequency electronic circuits is a key link in improving the practical application capabilities of students. Establishing a reasonable and effective feedback mechanism can help teachers find out problems and difficulties in the experimental operation of students in time and thus provide targeted guidance and reminders. The following are some innovations in the feedback mechanism:

a) experimental record and evaluation: during the experiments, students can use the experiment record form or the experiment report to save data, results and feelings from the experiment process to better understand the experimental phenomena and laws. Teachers can also read these records and reports to understand the experimental situation of students, detect and correct student errors and deviations promptly.

b) verbal feedback and discussion: during the experiments, the teacher can communicate with the students verbally and give feedback at any time, check the progress of the experiment, and answer questions through Q&A and discussion. At the same time, students can also communicate and discuss with each other, share their own experiences and outcomes, and promote each other's learning progress.

c) practice tests and comprehensive assessments: in order to better assess the level of students mastery during experimental teaching, teachers can design some simulation tests or comprehensive evaluations to assess students' mastery of experimental principles and techniques and to identify problems and deficiencies in their application of knowledge and skills.

d) practice project presentation and evaluation: after the experimental teaching, teachers can organize students to present practical projects and evaluate activities. By demonstrating their own practical results and experiences, students share their innovative ideas and methods with each other, while gaining a deeper understanding of their own shortcomings and directions for improvement through comparison with other students.

In short, the innovation of feedback mechanisms is very necessary in the experimental teaching of high-frequency electronic circuit courses, which can help the teacher to better understand the learning situation and level of the students, detect and correct errors and deviations of the students in a timely manner, also improve the practical application ability and innovation spirit of the students.

3. Conclusions

By exploring and innovating new teaching methods as above, it can achieve the purpose of giving students a better understanding of the core knowledge of the electronic information courses and improve their practical ability and innovation potential.

In conclusion, the course on high-frequency electronic circuits is a very important course in electronic engineering with high practical value and development prospects. Students must learn and master relevant knowledge and skills conscientiously in order to succeed in their future professional development. In the practice teaching of high-frequency electronic circuits courses, it is necessary to overcome the existing problems through various means and methods to improve the effectiveness of the practice teaching and promote the innovation capacity of the students.

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