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The Application of Induction and Comparison in the Teaching of Analog Electronic Technology

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Abstract: in this paper, an example is given to illustrate the practicability of inductive comparison method in understanding the characteristics of analog circuit components and analyzing the principles and characteristics of analog circuits.
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1. INTRODUCTION

"Analog electronic technology" is the basic course of electrical specialty. It has many contents, many kinds of circuits and many methods of analysis, so it is often confused and confused in the study. Therefore, in teaching, timely comparison, induction and summarization are particularly important for students to master the teaching requirements.

2. THE FEASIBILITY AND NECESSITY OF ADOPTING THE COMPARISON METHOD

Analog electronic technology is a study of various common electronic circuits made of semiconductor devices. From the perspective of application, a large number of contents can be compared, for example, the characteristics of various diodes, triode, field effect tubes, etc. can be compared, and the circuit structures, principles and characteristics of various rectifying and amplifying circuits, negative feedback circuits, and amplifier circuits can be compared. Since these comparable knowledge occupy almost all the contents of this course, it is feasible to adopt inductive comparison method in learning this course. By comparison, a series of scattered knowledge points can be systematically linked to make the whole teaching content clear and orderly. In the process of comparison, induction and summary of the knowledge learned, the understanding of basic concepts and basic principles can be deepened, and the general rules

and differences between the objects of comparison can be observed and the correct analytical methods are adopted. Therefore, it is necessary to adopt the comparison method.

3.THE APPLICATION EXAMPLES OF INDUCTIVE COMPARISON METHOD

3.1 Induction and comparison method to understand the characteristics of circuit elements

Analog circuit is an electronic circuit composed of all kinds of semiconductor components, so any circuit is introduced from the understanding of semiconductor components. We can use the comparison method when we recognize semiconductor components such as diode, voltage regulator, transistor, field effect tube and so on. In fact, the application of the comparative method is based on the commonality of the comparative objects. We can first sum up their common points and then compare their differences on the basis of the commonality. Because these components are based on PN junctions made up of different semiconductor materials, there are some similarities, and we can generalize the similarities of these components.

For example, the structure of a diode and a regulator is actually a PN junction, and the same structure has the same characteristics, so their positive characteristics are similar, for example, there is a pressure drop of 0.7V after the conduction. On the basis of summarizing their commonalities, we can compare their differences. There is a difference in the reverse characteristics: the diode is damaged when the reverse voltage exceeds a certain value, and the voltage regulator is using it to stabilize the voltage at both ends of the reverse zone, which is the difference. We compare their differences when we sum up their similarities, so that we can have a better understanding of diodes and regulators.

Transistor is one of the most common semiconductor components in analog circuits. It is widely used in all kinds of amplifying circuits as magnifying components, so it is necessary to recognize it for the analysis of amplifier circuits. We know that there are two different types of transistors: PNP and NPN, and these two different types of tubes, because of the similarities and differences of their structures, so the characteristics are both the same and different. For example, because they are made up of two PN knots "back to back", both have emitter and set the junction, and all have three electrodes (emitter, collector and base), so they have similar input and output characteristics, and their amplification conditions are the same, that is, the shot junction is positive, and the set reverse bias. And because of the structural difference, the amplification conditions have different meanings for different types of transistors. For NPN transistors, the amplification condition refers to Ube>0, Ubc<0, and for the PNP type transistors, the amplification condition refers to Ube<0, Ubc>0. The amplification condition is the opposite, and the direction of the current in the amplifying circuit made of different types of transistors is the opposite.

The field effect transistor is also an amplifying element commonly used in amplifying circuits. (1) from the structure, the gate g, the source s and the drain D of the field effect tube correspond to the base B of the transistor, the emitter E and the collector C, which are similar to them.

(2) from the principle of work, the field effect tube uses the gate source voltage UGS to control the leakage current ID, and the gate does not take the current basically, and the base of the transistor always takes a certain current when the transistor works. Therefore, the circuit with high input resistance should be field-effect transistor, and if the signal source can provide a certain amount of current, transistors can be selected. In addition, the voltage amplification factor of the transistor is larger than that of the field effect transistor.

(3) from the stability, the field effect tube has only a number of children to participate in the conduction; the transistors have both the multiple and the fewer children to participate in the conduction, and the number of the minority is greatly influenced by the temperature and radiation, so the temperature stability of the field effect tube is better than that of the transistor, and the radiation resistance is strong.

Therefore, the field effect transistor should be chosen when the environmental conditions change greatly.

(4) from the characteristic, the leakage and the source of the field effect tube can be used interchangeably, and the characteristics change little after the exchange; and the characteristic of the transistor's emitter is very different from the collector, so it is interchanged only when special needs are needed.

(5) from applications, FET and transistors can be applied to amplifying circuits and switching circuits. They constitute a wide variety of integrated circuits. However, the field effect tube is more and more used in large scale and large scale integrated circuits, because the field effect tube integration technology is simpler and has the advantages of power consumption and wide range of power supply.

3.2 Inductive comparison method analysis circuit principle and characteristic

The inductive comparison method can not only clearly understand the characteristics of analog circuit components, but also analyze the principles and characteristics of analog circuits well.

For example, the three basic connection characteristics of transistor single transistor amplifying circuit are summarized as follows:

(1) The common emitter circuit can amplify the current and amplify the voltage. The input resistance is centered in the three circuits, and the output resistance is large and the frequency band is wide. It is often used as the unit circuit of low frequency voltage amplification circuit.

(2) The common collector circuit can only enlarge the current can not enlarge the voltage, make the circuit with the maximum input resistance and the minimum output resistance in the three connection methods, and have the characteristic of voltage following. Commonly used in input and output stages of voltage amplifying circuits, emitter output is often used in power amplifying circuits.

(3) The common base circuit can only enlarge the voltage instead of amplifying the current, the input resistance is small, the voltage magnification and the output resistance are equivalent to the common emitter circuit, and the frequency characteristic is the best circuit in the three kinds of connection methods. It is commonly used in broadband amplifier circuits.

When observing the circuit structure, we should pay special attention to the meaning of "CO" and their differences. That is to compare the difference between the DC static parameters and the AC dynamic indexes of the three circuits. When the AC and DC coexist in the circuit, their relations and differences are compared.

Again, the rectifier circuit is an important part of the DC voltage regulated power supply. The secondary voltage of the transformer is converted to a DC voltage by the AC voltage by the rectifier circuit, and the sine wave voltage is converted to a unidirectional pulse voltage. According to the different circuit structure, the rectifying circuit has one way half wave rectifying, one way full wave rectifying and one way bridge rectifier. All kinds of different rectifying circuits are made up of rectifier diodes and have common points. But because of the different structure and characteristics, we can make a comparison of all kinds of circuits in the analysis. Compare their similarities and differences. These different rectifying circuits can be compared from the relevant aspects, from the output voltage waveform comparison, from the average of the rectified voltage, from the average current of each diode, from the maximum reverse voltage for each diode. By comparison, the difference between the circuits can be seen at a glance, and the connection and difference of various rectifier circuits can be clearly grasps.

4. THE APPLICATION AND EFFECT OF THE INDUCTION AND COMPARISON METHOD

The application of inductive comparison method can be carried out in all aspects of learning. At the beginning of our study, we are rather unfamiliar with electronic circuits. At this point, teachers can gradually guide students to compare and conclude. For example, some related knowledge can be analogous through classroom questioning. It can also guide students to compare lists and summarize the contents of chapters. The structure, dynamic index and characteristics of the three basic circuits are often used. After summarizing the list of the contents of each chapter, the phenomenon of mutual confusion has been obviously changed, and the ability to recognize the map is also improved. After a period of learning, we have accumulated a certain number of methods and experiences on learning electronic circuits. Some of the contents of induction and comparison are allowed to be carried out by students. For example, students are required to compare various negative feedback amplifying circuits and oscillating circuits in class or after class. In the course of the students' comparison, the students' interest in learning is improved, and the teaching content is not only cleared up, but also the ability to analyze and induce the problems is also enhanced. In the middle and later stages of teaching, students are familiar with electronic experiments, and students can be arranged for comparison and induction through experiments. Through the practical activities such as setting up the circuit, measuring data and component parameters, the characteristics of various circuits are compared, and the practical ability and independent working ability are enhanced.

5. CONCLUDING REMARKS

After adopting the comparative teaching method in analog electronic technology, I feel deeply relaxed in class. As a result of the active participation of the students, the students take the initiative and give play to the initiative. The communication between teachers and students is very frequent. Through the comparison of different types of induction and summary, it is convenient for students to clarify the systematic context of each class, each chapter and the whole course. At the same time, we also improve our ability to sum up and analyze the problem.

REFERENCES

[1] Tong Shi Bai. Fundamentals of analog electronic technology.[M]. Beijing: Higher Education Press.

[2] Kang Hua Guang. Simulation part of electronic technology foundation. [M]. Beijing: Higher Education Press.