Conceptual Article

Teaching Approach in Physics

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ABSTRACT

"Semiconductor devices and their applications" is a chapter introduced in the Standard XII Physics portion. This unit starts with the basic information of semiconductors and then advances to the functions of semiconductor devices such as rectifier, amplifier, oscillator, integrated circuits, digital electronics and operational amplifier.

Though the students know the importance of this unit, they avoid selecting questions from this unit. Those who select also make many common errors and lose marks. This is mainly due to the lack of previous knowledge, confusion between similar concepts and also misinterpretation of impo1iant concepts. Some of the misconceptions are identified and their remedial measures are suggested below.

Keywords: teaching approach, physics education, instructional methods, pedagogy, science teaching

INTRODUCTION

The most important and crucial stage of school education is the higher secondary level. This is the transition level from a generalised curriculum to a discipline - based curriculum. In order to pursue their career in basic science and professional courses, students take Physics as one of the subjects. It is felt that the students of the higher secondary school level must have a thorough knowledge about semiconductor devices because of its applications in various fields. To provide them sufficient background to meet the challenges of academic and professional streams, "Semiconductor devices and their applications" is a chapter introduced in the Standard XII Physics portion.

Many new concepts, circuit diagrams and various applications of Semiconductor Devices are given in this unit. A few concepts given here are little above the maturity level of students. So the students find this unit difficult and misunderstand the concepts.

Based on this chapter a Diagnostic Test was conducted in different schools. By analysing the errors committed by the pupils, the reasons for making mistakes are identified and the remedial measures are suggested here.

Remedial measures

1. **Difficult Concepts**

Students were not able to answer on complex and difficult concepts like energy band, oscillator and operational amplifier. To understand different concepts which are complex in nature, students must have a thorough knowledge about all the simple concepts. Since many new concepts are introduced in this chapter and this chapter is given in the XII Standard only, it is difficult for the students to learn all the given concepts.

Students must be encouraged to learn all the complex concepts in association with simple concepts. They can be taught ,with the help of various examples so that they can learn the concepts with understanding.

Example: oscil1ator, operational amplifier

2. **Constant Values**

Some of the constant values are given in this unit. These constant values are to be memorized and stored in the knowledge level. Due to lack of remembering and recalling, the students write wrong values and also the power terms.

Students should be taught the concepts clearly. They must be given practice to derive the values and their units with the help of fundamental quantity while using fornrnlae. Problems involved ,with these values like the charge, mass of the proton and electron should be frequently given to the students for practice. Example: charge of electron, mass of electron.

3. **Similar Concepts**

Some of the concepts given in this unit have resemblance among themselves. So students find it difficult to comprehend them.

Students must be taught the similar concepts clearly with their similarities, differences, advantages and disadvantages.

Example: donor energy level and acceptor energy level Analog signal and digital signal

4. **Units**

Most of the students memorise the units and write from memory. Since they do not know how to derive the units from the formula, they get confused and make mistakes.

Examples: resistivity, conductivity

The basic concepts of resistance, conductance, resistivity and conductivity should be explained with the help of simple examples and formulae. Students must be trained to derive the unit from the formula. For each chapter, an objective test can be conducted for units.

5. Problems

Many students commit mistakes while solving problems. So to be on the safer side, they avoid attempting application level questions.

Students are afraid of the problems in Physics due to poor understanding of concepts and lack of application of concepts. The clarity to identify which fonnula is to be used in which situation becomes essential. At times they interchange numerator and denominator terms. They go wrong in the conversion of units in one system into units in another system.

Students must be trained to select the correct fonnula. Their fear of doing problems should be removed by giving simple problems with examples. Repeated practice should be given to the students to solve problems.

6. Calculations

Students go wrong in the simplification when negative and positive terms are involved. Power term calculation also becomes difficult for a few students. Students get confused with the logarithm calculation also.

Students must be trained to do calculations carefully. They must avoid using calculators for calculations.

7. Advantages/Properties/Characteristics

Properties of similar devices are given in the case of common emitter transistor, amplifier, negative feedback and operational amplifier. Here some of the properties are common while others are uncommon. The students get confused and hence mix up all the points.

Concepts should be explained clearly to the students, so that they can write the different characteristics of the devices without confusion. In the CE transistor circuit, the resistance connected to the output should be low to draw the output current. This is the reason that the output impedance of the transistor circuit is low.

Example: characteristics of CE transistor, operational amplifier.

8. Examples

Lack of understanding about concepts along with their example leads to confusion.

Concepts of conductor can be (shown) explained ,with the help of examples such as copper, gold and silver. In the same way the concept of insulator can be explained with examples like plastic, wood, air and so on.

Students can be made to write the names of conductor and insulator available inside the class room. They can also be asked to write examples of conductor and insulator that they use in their day to day life situations, so that they can remember the concepts conductor and insulator along with their examples.

9. Symbols

Due to lack of understanding and practice, students misinterpret the symbol of devices such as diode, transistor and logic gates.

Example: zenerdiode, Light emitting diode

10. Circuit diagrams

To draw a circuit diagram various components in the circuit, biasing and the direction of flow of current must be known. Due to lack of understanding and lack of practice in electrical circuits, students make mistakes while drawing circuit diagrams and marking the direction of flow of current. Since they do not have a clear understanding of positive and negative terminals of a device students interchange the polarity when they draw circuit diagrams. If the students are not confident about these points, they commit mistakes.

Example: PNP and NPN transistors

Most of the students omit drawing circuit diagrams due to lack of confidence and practice. So the students must be trained to give proper biasing in the circuit and also the direction of current. They must be taught from the basic concepts such as charge carriers, majority carriers, minority carriers, P-type, N-type and then biasing. Practice should be given to the students in drawing the circuit diagram in practical as well as in theory classes.

11. Graphs

To draw graphs students need to know the terms taken along X and Y axes, the unit and values (milli or micro) of the term. The shape of the curve must be known to the students. They must know how to draw the slope of the curve also (input impedance, output impedance).

Students must be trained to select the proper terms along X and Y axes with the correct unit and power tem1s and also the shape of the curve. This can be done by giving proper practice in this area in practical and theory classes.

General suggestions to teach the unit Semiconductor Devices and their Applications

The teacher should make the introduction class very interesting by giving many examples connected with daily life situations related to semiconductor devices and encourage the students to participate in the teaching learning process. Students should be made to interact with the teacher while they learn this chapter. Teachers can ask some thought provoking questions and students could be helped to arrive at the answers.

Students could be shown devices such as diodes, transistors and integrated circuits (gates, operational amplifier) in the class when the teacher introduces the particular concept in the class. Pictures of different types of these devices can be shown in the class. Working models can also be shown. Teachers can help the students to give connections of various circuit diagrams to obtain the output. Students can be given assignments (i) to draw or collect the pictures of the semiconductor devices they have learnt (ii) to draw the symbol representation of all these devices (iii) the Boolean expression, truth table of the gatescircuit (iv) all the possible circuit diagrams and combination of gate circuits and (v) graphs at the end of the unit. Students should be motivated to complete this assignment. By doing this, students will develop an interest towards this unit and also will be confident in these concepts.

Conclusion

To learn this chapter well, students can be asked to conduct quiz programmes for other school students with the help of teachers. Guest lectures can be arranged to know the latest infom1ation in the field. By providing such opportunities, students will be enlightened and will be interested to know more details. By doing so the students will not have a fear of learning this particular chapter. The concepts they learn from this chapter will be retained forever.

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