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Conceptual understanding of undergraduate students of electronics and communication

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Abstract: Understand the concept of engineering is difficult to student community. Understand of student mind misconception in particular topic is very difficult for teacher .in this research we try to investigate the student mind in concept and misconception in particular topic of analog electronics before and after the lab session.

Keywords: electronics and communication, misconception, engineering education, Conceptual understanding.

INTRODUCTION

Basic introductory engineering courses based on physics principles .in this field many research already done to check student conceptual understanding and misconception of student. by the results these research introductory engineering course are improved . Now engineering education researcher are focus on more advance topic of engineering education. in case of electronics and communication, they focus on topic like , analog electronics , digital electronics , logic gate ,signal processing , electronic device and circuit ,digital communication , and many more topic . In this research we discuss on passive RC filters in Analog electronics course. We try to know the conceptual understanding of student and misconception in RC filters before and after lab .In this research we focus second year under graduate students of electronics and communication.

LITERATURE REVIEW

Many engineering education researchers focus on Student understanding of electric circuit in undergraduate course of electronics and electrical engineering. Many of them focus only in direct current (DC) only few of them focus in alternative current (AC). We think to understand passive RC filters students face flowing student difficulties in DC circuits Students often confuse direction of current with voltage and have difficulties with the physical interpretation of moving electrons. Students do not understand conservation of current. Students cannot understand the physical meaning of voltage and its definition. They cannot apply problems with applying Kirchhoff's voltage law . Students do not understand the conceptual meaning of resistance. Students are also very much confusing in series and parallel combination of resistance. Students have no functional understanding of complete circuits Students have difficulties understanding the function of a capacitor and have problems reasoning on RC circuits qualitatively Recent research on more advanced AC sources shows that students have difficulties with phases, that they do not fully understand the physical meaning of the mathematical description and that they do not always understand the frequency dependence of the capacitive reactance and impedance.

CONTEXT OF THE RESEARCH AND METHODOLOGY

In our study we included the students of two different college of same university. All student have same syllabus and curriculum and sufficient number of lecture on this topic passive RC filters. In each of the college one lab session deals with 1st order passive RC filters In college A, the lab session lasted for one hour and thirty minutes. After a short introduction, students performed the measurements for either a high-pass or a low-pass filter. They were expected to simulate the circuit at home and to include the simulations in their report. In college B, the lab sessions lasted for 2 hours and fifteen minutes. Students prepared for the lab by making an assignment. In the lab, they started with computer simulations before performing the experiments for both a high-pass and a low-pass filter.

Conceptual questions

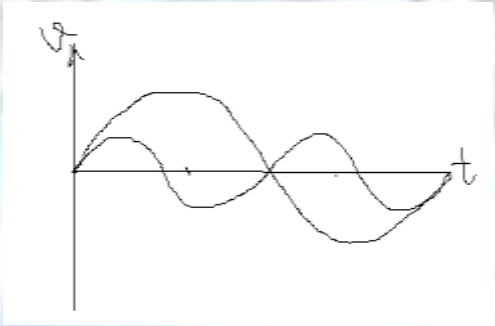
Preliminary to this study, we conducted student interviews to get insight in undergraduate students' understanding of basic first order RC filters and we recorded several lab sessions of similar labs in 2 other colleges. Based on these results, five

different questions on concepts related to RC filters were developed and administered as pre- and post-test before and after the lab session on filters. The participation in the tests was voluntary and did not affect students' grades. However, all students present in the session participated in the tests and seemed to make a genuine effort in answering the questions. All questions were open ended and students were asked to explain their reasoning as careful as possible. 27 pretests were administered at college A and 29 in college B, totaling 56 pretests. A few weeks later, post-tests were taken in both colleges: 24 students in college A and 25 students in college B participated, bringing the total number of post-tests to 49. As the students were asked to fill in their student-number, their pre- and post-tests could be matched individually. In total, 49 students filled in both tests and could be correlated. All numbers mentioned later on refer to the group of 49 matched students, unless specified otherwise. Written answers on the tests were analyzed to evaluate the student ideas and reasoning difficulties that we found in the interviews on a larger scale and to get a nuanced understanding of what it is that students understand reasonably well and what is problematic for them. We present results on three questions.

RESULTS

Signals

In interviews that students of session we clearly observed that student cannot understand the multi-frequency signals. In testing of student knowledge we asked the student in both pre and post test to draw a signal consisting of two frequency components on a given diagram.



In figure 1

Response like figure given by (20 in the pre-test and 15 in the post-test)

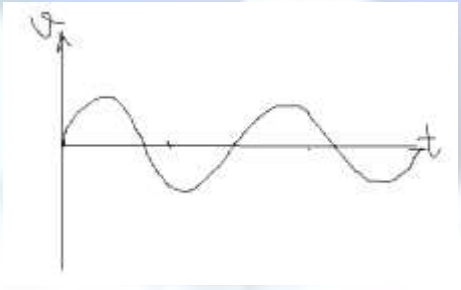


Figure 2

Response like figure 2 given by (25 in the pre-test and 19 in the post-test). correct answer Response like figure 3 given by (4 in the pre-test and 8 in the post-test)

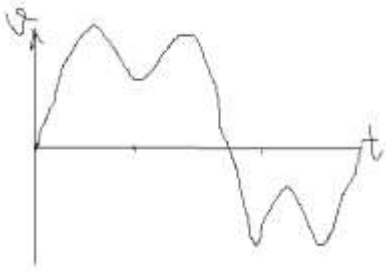


Figure 3

Phase shift

In interviews that students of session we noted that student cannot understand the phase shift.

The second question comes in my mind for understanding of a phase shift. Earlier results revealed that students have trouble with or do not take into account the phase shift between input and output voltage of RC-filters. This question given a graph of a simple cosine wave with the following question: "A time-dependent signal is shown on the figure below. Draw, on the same figure, a signal that leads the given one by 90°."

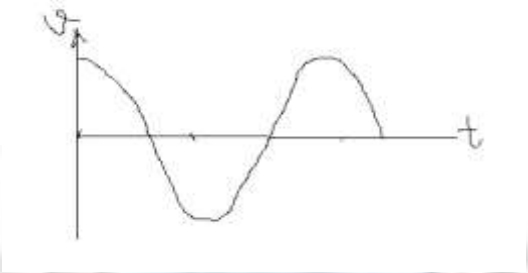


Figure 4

From both the pre- and post-test, it is clear that students have a reasonably good understanding of what is meant by a 90° phase shift, since most (10) indeed drew a 90° phase shift. 20 students sketched a signal that had a 180° phase shift in the pre-test, although most of them managed to draw a 90° phase shift in the post-test, resulting in a total of 25 students are correct out of 49.

Understanding of a basic high-pass filter

In this question, we want to know basic knowledge of high-pass RC filters. Question in given circuit diagram of filter, carefully observed and give the following questions.
Find out Cut off frequency and ratio of output peak voltage to input peak voltage

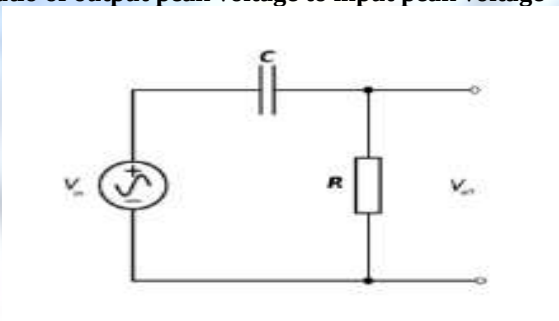


Figure 5

In this question student very few student give us clear answer at all .many students (30 out of 49) did not calculate the cut off frequency and ratio **of output peak voltage to input** peak voltage. Some student (9 out of 49) directly write the formula. Only 2 students give us correct answer with expansion.

DISCUSSION AND FURTHER RESEARCH

After detail investigation of this research it is clear before and after the lab session of student , they have very poor conceptual understanding of this topic .results of this 1st question , represents before lab only 8% and after lab only 16%student understand real life signal that is used in filter . By this part of research we recommend to both teacher and lab assistant that it is necessary to give sufficient knowledge of real life examples for student before lab session. Second question that is related to phase shift, only 20% before lab and only 50 % after lab gives us correct answer. It is clear in this question have no clear idea about leading and lagging of signal. We know that phase, phase difference and phase shift are

very important topic in electronics and communication. So we recommend for both teacher and student to give special attention on this topic.

In 3rd question related to passive high pass filter, before lab no any student give us correct answer and after lab only 4% give us correct answer with explanation. So we highly recommended to both student and teacher to learn and teach basic knowledge of filter with practical application. In future I recommended the research in all higher level topics in electronics and communication and lab session conceptual understanding.

CONCLUSIONS

Before lab session average performance of pre test is only 9 % and after lab session the average performance of post test is only 29% .It is clear in this research that significant improvement the conceptual understand standing of student in lab session.

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