New Paradigms of Education Applied to Circuit Design Course

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Abstract: - The aim of this work is to report application of new paradigms of education to the Computer Aided Circuit Design Course offered in Electronics and Telecommunication Program of Technical Education Faculty of Marmara University. New paradigms of education, problem based learning, outcome based learning issues are discussed. Application of problem based learning principles to the Computer Aided Circuit Design Course is presented and obtained results are discussed.

Key-Words: - Problem based learning, New paradigms of education, Circuit design, Simulation

1 Introduction

In contemporary engineering and technology education, significant changes are being experienced where the new paradigm of education is given priority. Due to rapid advance in electronics technology and short life times of products, curriculum of electronics and communication education programs need a special attention. For the engineering and technology education students, to teach only the technical information that continuously and rapidly changes is not sufficient [1]. In order the students can adopt themselves to the competitive real world work environment after they graduate, they need to learn how to make decisions on their own, work well with others, and sift through vast amounts of information. Therefore they must be given critical thinking, problem solving, team working, life long learning attitudes and skills in addition to knowledge and skills.

The brain of a student with the old paradigm of education resembles a blank paper on which an instructor can write with pencil or an empty cup to be filled with knowledge by the instructor and this is the only way for many instructors. With the new paradigm, knowledge is structured by instructor and student both. Student is effective, creative, discovering and learns by making connections instead of remembering. Purpose of teaching is to develop abilities of student rather than to classify or rank. Purpose of student is not to fulfill necessities and provide certification; to focus on continuous learning within a broad system. Power is shared between student and instructor [2]. By applying the new education paradigms to the curricula effective results can be obtained.

2 Purpose

The purpose of this study is to provide to students that they learn Computer Aided Circuit Design (CACD) in real life conditions by using problem based learning techniques and methods. As in real life, DC, AC, transient, worst case, Monte Carlo, etc. analyses are made to guarantee the designed circuits work in desired conditions. In this way, it is aimed that the students experience the ways of solving real life problems and instructors prepare them to life long learning after graduation.

3 Developing Learning Attitudes

One of the attitudes desired to be given to the students at primary, secondary and high school education institutes is the life long learning. The Electronics and Communication Technology students can only update their knowledge after they graduate by continuing learning life long. Besides, they are expected to gain life long learning attitude to their own students when they become instructors.

To develop and strengthen the life long learning attitude on students is quite different when compared with other attitudes and abilities that are desired to give to students. Developing of life long learning attitude contains development of some specific attitudes and desires in addition to acquire new abilities [3]. The other element of life long learning is self-learning. The self-learners generally

have specific features, attitudes and abilities. Life long learning requires being motivated, independent, disciplined and self-confident. Abilities cover the basic studying abilities and time management [4].

The learning desire should come from the heart of people; schools may help in growing of this desire. Students should be told that one of the aims of the department is to give life long learning attitudes and abilities to the students and the diploma they will get after they graduate is only a beginning. The instructor should clearly state that they should acquire the necessary attitudes and abilities through their education and the department definitely expects this from them.

However, it will not be sufficient to transfer this to them through courses and seminaries. The students should be given responsibility during their learning process to acquire and develop life long learning attitude. If it is expected from students to continue learning after they graduate, they should be given responsibility to learn and manage their own education during their education and be assisted to develop continuous learning attitude. The homework given to the students provide them to take responsibility for learning the subjects not included in the course content and face with learning out of classroom. With such homework, their team working abilities develop and they are ensured to apply engineering and technological problems to practical problems. Written and oral communication skills of students develop and as they meet with engineering equipment and sources, their ability to use them improves [5].

The instructors and students must give up passive education understanding and realize active learning methods. To present activities like design to students instead of close-end problems may assist in development of life long learning attitudes and abilities as they will integrate the learned material and require discovery of knowledge through experiments and research.

4 Problem Based Learning

Problem based learning (PBL) is a student centered education method. More responsibility is given to the PBL students and they are ensured increasingly being more independent from the instructor for their self-learning process. With this method, PBL students may continue learning independently during their work life [6]. As PBL is depended on the real work life problems, a student who struggles with the problems of the real world is stimulated for learning. The students may integrate and arrange what they learn, and remember and apply them in the future prospect problems. Problems in PBL applications are designed to provide effective problem solving and develop critical thinking abilities of students [7].

In learning process with PBL, a student gets use of knowledge he/she learnt previously and recognizes what he/she learnt in what extent. So, he/she may determine what he/she needs to better understand and solve the problem. After the student determines what knowledge he/she needs to solve the problem, he/she learns them by making researches from various sources. Within this period, the student realizes a self-management learning process. With this way, learning is individualized according to the needs and learning style of individual. Students then try to solve problems by getting use of what they learn. When a student solves the problem, he/she evaluates himself/herself and to each other with other students. The self-evaluation is a significant process for the effective and independent learning. When PBL applications are realized as a group study, as the group member students will study in cooperation, they gain effective and harmonized team working abilities [8].

The ability to work in harmony with team is a valuable ability required by the employers in their working team because of multi disciplined structure of today's world [9].

When students participate to PBL actively, they are directed to learning, as they will struggle with the problems of the real world and what they learn will be suitable and valuable for their future life. The role of instructor in PBL learning is to prepare education materials and provide guidance to activate learning. In PBL process, power is shared between the instructor and student.

5 Application Methods of the Course

Computer Aided Circuit Design (CACD) course was developed by considering the problem based learning and active learning facts. This course is given in seventh semesters. The course is carried out as two hours theory and two hours laboratory. Students complete the most of electronics and communication courses until they take this course. In this course, students are expected to integrate what they have learnt in previous electronic courses and synthesize them by using computer software for design. Previously, the laboratory part was given by working on examples at the computer laboratory. However, as we thought that the PBL methods was a suitable method for this course and would ensure

more advantages to the students, we realized the course with project based and supported by PBL principles. Accordingly, the application flow chart of CACD course is given in Figure 1.

In the course, circuit design issues on the basic electronics structures such as amplifiers, oscillators, digital circuits etc. are discussed and computer software are presented to the students in the first 4 weeks. After 4 weeks instructors' role is changing from teacher to a coach. In the laboratory hours PSpice is presented. Students work with the laboratory sheets and performing various analyses which they will practice them in their project later. When the course begins, design problems are given to the students and which they will study on throughout the semester. Students may work in small groups of 2-3 people or individually. Students are asked to select a problem from the list previously prepared, instructor of the course gives a problem or she/he can decide also one. The common feature of problems they contain circuit design. As it can be observed in the flow diagram in Figure 1, the definition of problem is made and its design purposes and criteria are determined. Students are asked to research and for library work for their projects. With this phase of curriculum students are expected continue study outside lecture hall. Then, the design calculations of circuit are made by hand and then by using student version of PSpice analysis and simulations are realized on the circuits.

If the circuit meets the previously determined purposes and criteria after simulation, the next realization phase is followed. If the simulation results do not meet the purposes, it is returned to the design process and literature is reexamined if necessary. This circulation is continued until the simulation results meet the determined circuit conditions and students may ask assistance by consulting to the instructor. In this phase, the students analyze the circuit and simulate it. When simulation results are satisfied students design the printed circuit by using printed circuit design PCB software. Free version Eagle is used for PCB design. With establishment and installation of the printed circuit, it is passed to laboratory studies. After that, students set up the circuit on a printed circuit board and make laboratory works to determine whether the results are in conformity to the design purpose and criteria. The circuit working under desired conditions is presented to the instructor for confirmation, and the students write their reports. In case the circuit does not work according to the defined criteria, students consult to the instructor for support and by returning back to the literature research, design and simulation phases, continue until the desired conditions are obtained. The finalized work are delivered in reports and presented to other students orally. The evaluation of the work to be taken into account 40% of the success mark and accepted in place of mid-term exam. In Figure 2 and Figure 3 the circuit diagram and simulation result screens of 10W Audio Amplifier, one of the students' projects, are shown respectively.

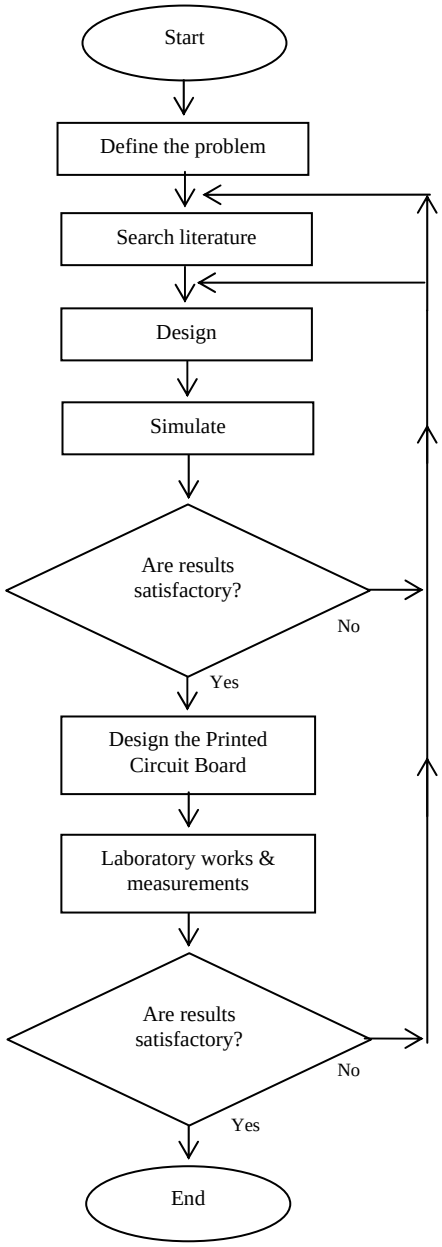

Fig.1 Flow Chart of Design Work

6 Conclusion

Most important result of this application is nearly all students were successfully. Lecturers' new role to guide students and to help to develop abilities of the

students ensures that nearly all projects were completed. It was observed that participation rate of students to the course increased and their motivations rose. During CACD course, it was observed that students frequently used the department library; internet center, electronics and computer laboratories. Self learning and life long learning attitudes and skills of students were improved. During the laboratory and workshop hours students were encouraged to work within the teams to improve their communication abilities. By orienting students to self-learning, some contributions can be made for development of their critical thinking, problem solving, written and oral communication, self-learning and team working skills and attitudes and for acquisition and development of life long learning attitudes.

In our information time, to support the students to gain life long learning skills and attitudes is as much as important to educate them in their fields.

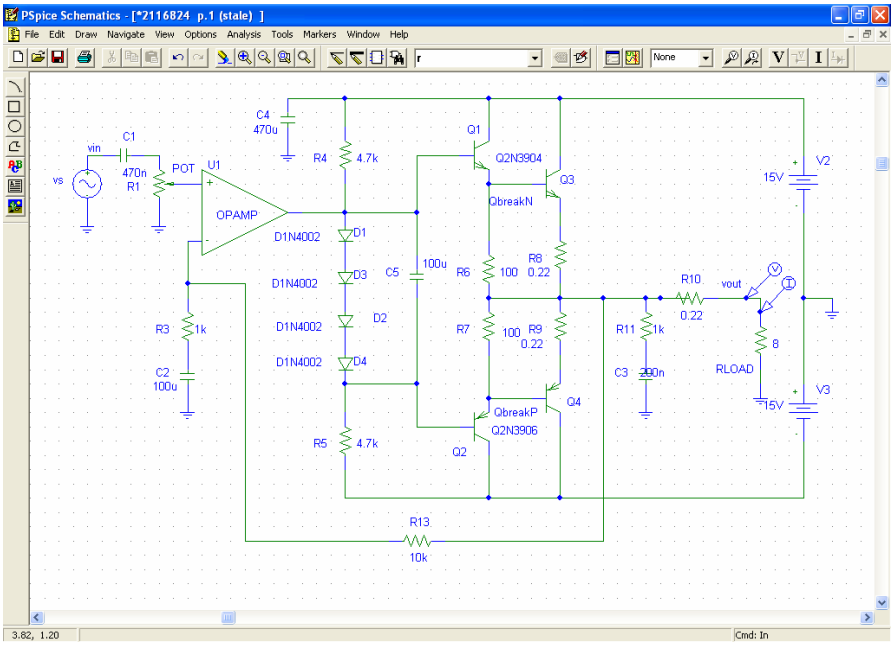

Fig.2 Pspice Schematics Screen of 10W Amplifier

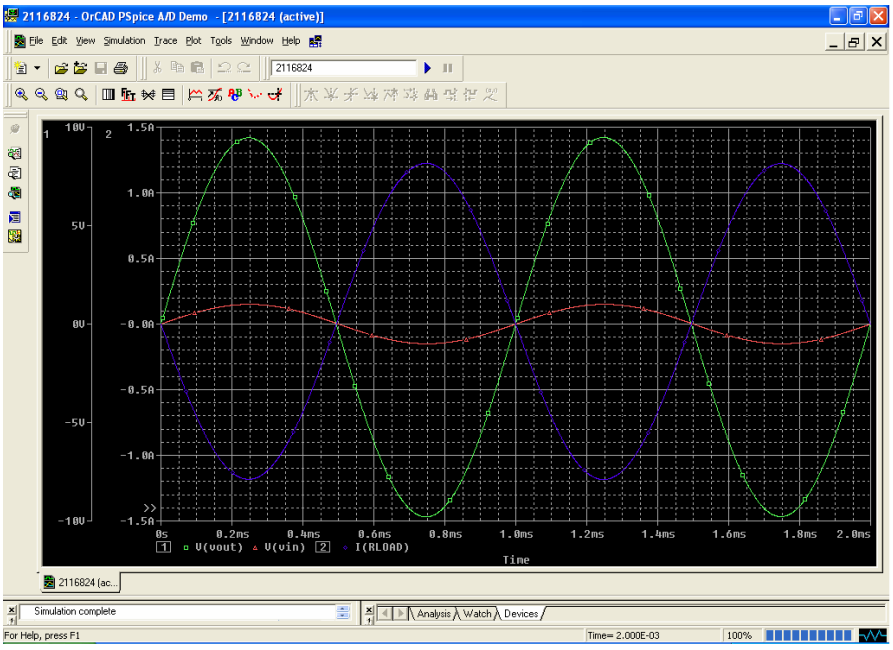

Fig.3 Transient Analysis Screen of the Amplifier

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