Apply Simulation E-learning in an Electronic Communication Course

Jui-Chen Yu, Hsueh-Chih Lin, Lung- Hsing Kuo, and Hung-Jen Yang

Abstract**—**In this study, an e-learning platform and circuit simulation approach would be applied to an electronic communication course aimed at sophomore students in department of technology education. The goals are to enrich the students' understanding on basic topics such as electronic components, filter circuit concepts, circuit theory, and measuring the signals, as well as to provide remote support, course materials and simulation tools. In the course, students can study electronic communication circuit concepts through e-learning platform, circuit simulation tool and practice activities. By using e-learning platform, students can download materials, experimental manual, submit experiment report and online discussion without time and environment limit, the circuit simulation tools will help students to pre-experimental, learning characteristics of electronic components and verification of electronic circuit theory. Finally, students use hard-wired circuits and electronic components to implement experiment activities. The purpose of this study is tries to adopt of new technologies to enrich the students' understanding in filter circle theory of electronic communication and hope students can to assimilate the new technologies as a part of their learning experience.

Keywords**—**e-learning; simulation technology; electronic communication; circuit experiment

I. Introduction

TRADITIONAL methods and resources in teaching activities such as board, slides, projector etc., It is true; nowadays there are much media tools available, thanks to the development of information and technologies.

By developing of multimedia tool open a new way of assist teaching and learning; the characteristics of multimedia tool inclusive of interactive, instantaneous, visual, and intuitive. Using tools available for presents course material and offers new intuitive approach, such as: circuit simulation tool and electronic learning platform.

E-learning is a word used to describe a particular pedagogical approach to the delivery of education using modern technology. E-learning has in recent times become a "catch-all" phrase for just about any educational resource uploaded and accessible on the internet [1].

Many benefits can be gained from e-learning accommodates individual needs, access to online learning from anywhere at anytime, each student devise their own tailor made learning program and reduce delivery the costs of delivering information [2].

With adopt of new multimedia technologies, students can start to assimilate the new technologies as a part of their learning experience. And the multimedia such as: video, speech, and avatar are used for enhancing efficiency, effectiveness of the interface, and learners' satisfaction [3].

The content characteristics of technology education program drawn from areas, inclusive of bio-related, communication, production, and transportation [4]. In subjects of communication, emphasis is put on electronic communication and electronic theory, such as: signal analysis and processing, analogue and digital convert and communication theory.

In this study, would apply new approach in electronic communication course aimed at sophomore students in department of technology education. The goals are to enrich the students' understanding in signal analysis and processing, such as filter circuit concepts, electronic components, and circuit theory.

In course of electronic communication, there are many circuits theory need to be experimented and verified. E-learning platform provides a structured set of resources to the students such as: learning path, chat room, notices area and e-mail, increasing the student's opportunities to access course materials and remote teacher support. By using e-learning platform, students can download materials, experimental manual and online discussion without time and environment limit [5].

The students interacted with the teachers through a web page that host a video session in a frame and text based 'chat' session in another frame. Both frames were in the same web page. Teachers would have their teaching instructions through video, and students could respond to those instructions through the text message [6].

About the circuit simulation tools, the theoretical analysis, the simulation and the lab evaluation shown superior performance compared to conventional designs [7].

And simulation tool do not require extensive laboratory facilities, and a computer provides a safe and effective laboratory environment [8]; through simulation tool, circuits can be modified easily, and analysis results provide faster and better feedback than a series of lab experiments using hard-wired circuits, the simulation tools will help students to pre-experimental and verification of electronic circuit theory.

By using the media tool inclusive of platform and simulation tool, students will develop full understanding of the filter circuit theory. This method is interactive, which will encourage student participation in the learning process and helpful in concepts learning.

With the implementation of digital learning, the complete network environment is also important. In 2010, Taiwan academic network environment constructed completed, and home broadband users are 5,130,252, and the ratio is 70% [9]. Based on this foundation, Taiwan's educational institutions can

provide complete E-learning network environment.

The author being teacher of electronic communication course since 2002, he used e-learning platform and simulation tool in recent five years.

II. COURSE CONTENT

The course on electronic communication at the university, has a total of 72 contact hours assigned. The contents of course are divided into three parts included of electronic theory, simulation experiment, and practice activity.

In the course of electronic communication, there are many topics are studied, the main core of the course is signal filter and circuit experiment. When the students face this course, students have already received concepts of technology education and communication technology theory as well as basic courses in mathematics and physics. On completion of the course, the student should have an adequate understanding on electronic components and filter circuit theory, how can signals be filtered or gained, and how filter theory influences signal transmission in communication system.

A. Content of electronic theory

1. Introduction of electronic components.
2. Introduction of filter circuit theory.

In the electronic communication course, there are many electronic components will be introduced such as: capacitors, resistors, inductors, transformer, transistor, diodes, IC, and board, etc. The figures of electronic components are presented as followed figures 2.1.1 & 2. 1. 2.

About the filter theory of the low-pass and high-pass filters, the expected cutoff frequency of the filter can be calculated based on the circuit component values, the equation as in (1). And about the band-pass and band-pass filters, the equation of center frequency of the filter as in (2).

$$\text{Cutoff frequency equation } fc = \frac{1}{2\pi RC} \quad (1)$$

$$\text{Center frequency equation } fo = \frac{1}{2\pi\sqrt{LC}} \quad (2)$$

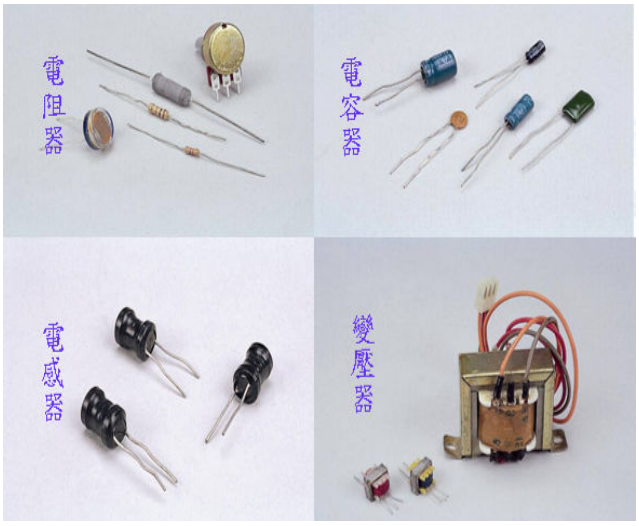

Fig.2.1.1 the figure of electronic components

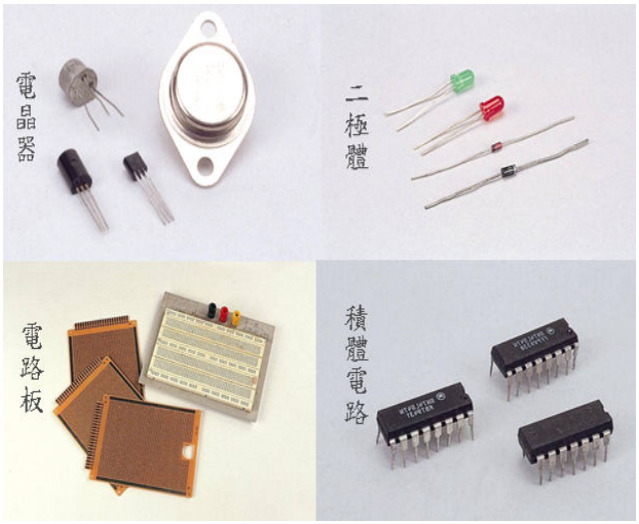

Fig.2.1.2 the figure of electronic components

B. Content of simulation experiment

1. Passive low-pass and high-pass filters.
2. Passive band-pass and band-stop Filters.
3. Active low-pass and high-pass filters.
4. Active band-pass and band-stop filters.

There are four passive filters simulation circuits presented as figures 2.2.1~2.2.4. And four active filters simulation circuits presented as figures 2.2.5~2.2.8.

C. Content of practice activity

1. Measuring by millimeters
2. Soldering practice
3. Cross-over circuit experiment
4. Circuit works

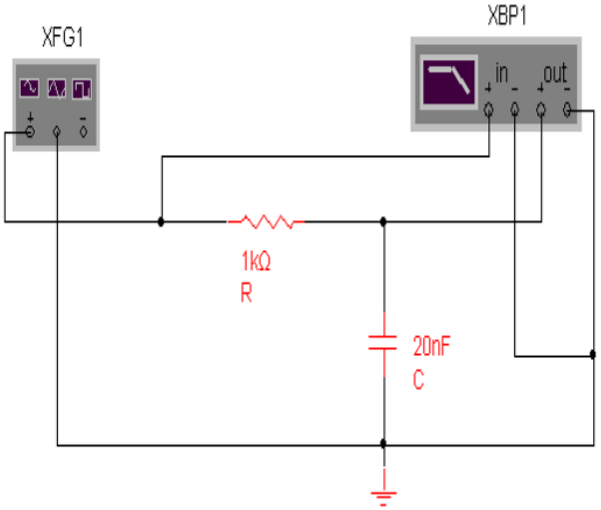

Fig.2.2.1 simulation circuit of passive low-pass filter

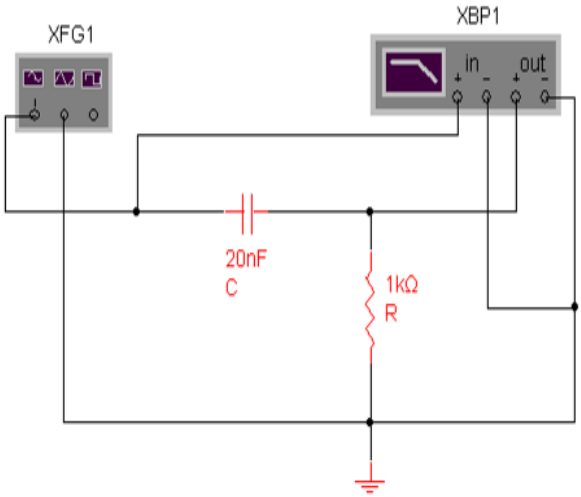

Fig.2.2.2 simulation circuit of passive high-pass filter

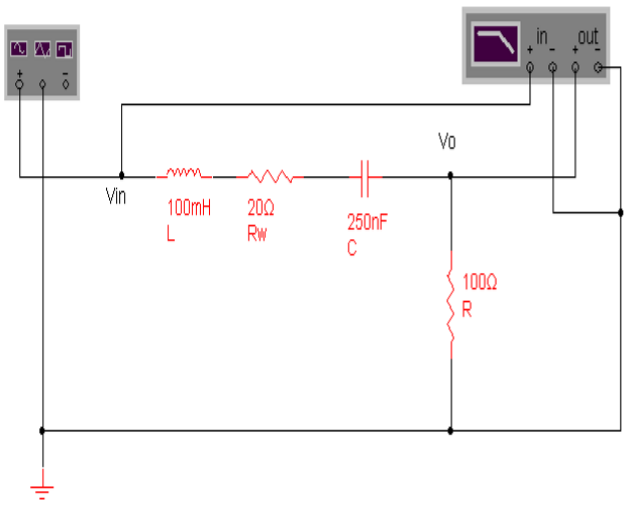

Fig.2.2.3 simulation circuit of passive band-pass filter

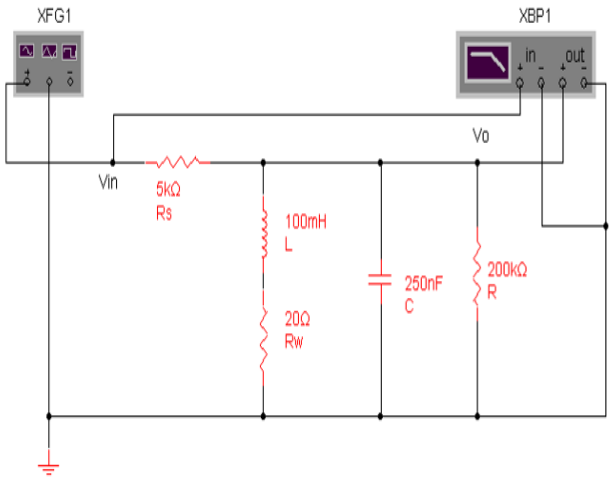

Fig.2.2.4 simulation circuit of passive band-stop filter

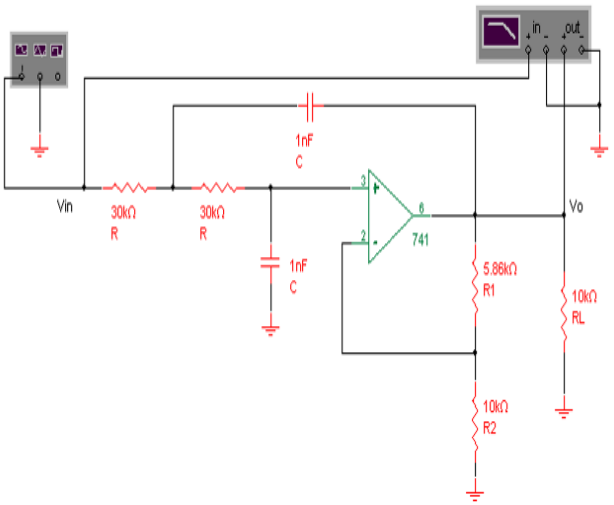

Fig.2.2.5 simulation circuit of active low-pass filter

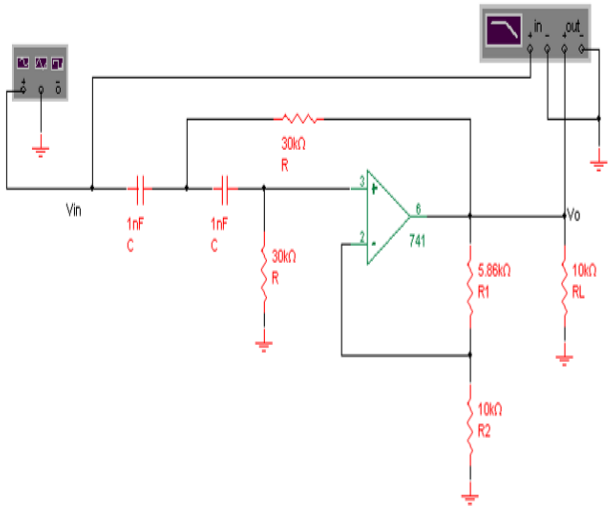

Fig.2.2.6 simulation circuit of active high-pass filter

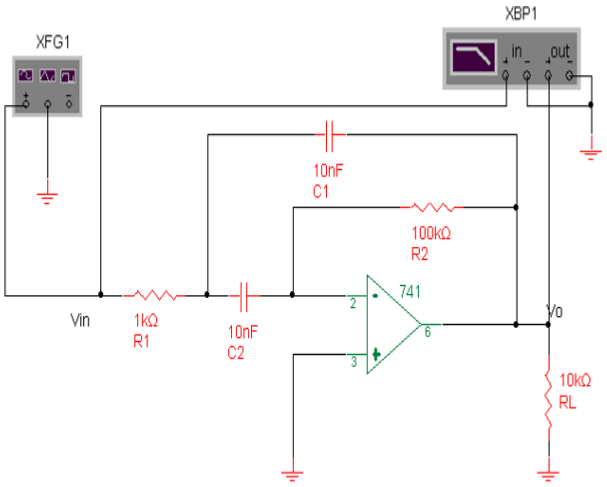

Fig.2.2.7 simulation circuit of active band-stop filter

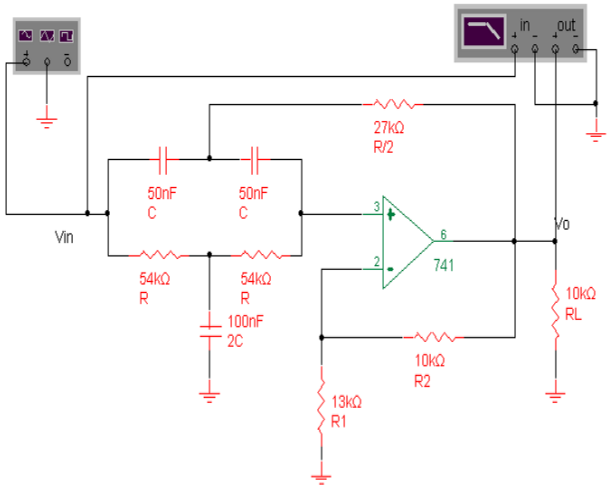

Fig.2.2.8 simulation circuit of active band-stop filter

III. AVAILABLE CURRICULUM RESOURCES AND SUPPORT

As mentioned before, the aim of this curriculum was to provide the electronic communication circuit theory with an e-learning platform where the students had downloaded materials, manual, submit report and online discussion without time and environment limit, which students could access through the e-learning platform with a web browser, such as: internet explorer, firefox and google chrome.

A. Platform tools

E-learning platform tools included of learning path assignments, tests, questionnaires, discussion forms and chat room, etc. About learning path which all the materials of the course are scheduled. Teachers can setup the path to include manuals, papers, e-book. With a comprehensive arrangement, students are able to study step-by-step and gain better results. Figure of learning path and interface of E-learning platform is presented as followed figure 3.1.1

In this section, e-learning platform tools still have four components will be described as follows:

1. Assignments

An assignment is a combination of questions. Teachers can create and edit questions and apply them to the different assignments. Once teacher have created the questions, it can combination with other questions and create an assignment. About midterm exam and final Exam in e-learning platform, the program is very modular, so that it suffices to change the database with the questions to adapt it to another course.

2. Tests

Teacher can create and edit exam questions and apply them to the different tests. If the exam questions need to attach files, it can select the file to be uploaded.

3. Discussion forms

The function of discuss forum for students to share their thoughts. Teacher can add new topics to discussion or group discussion for students to express their opinions. About group discussion is the discussion forum for students of the same group and the instructors can set the properties on this page.

4. Chat room

The function of chat room is for students to join the real-time discussions. A chat room window contains participants' action logs and participant lists. In chat room, teacher can be a manager or assign another person as the chat room manager; manager can hold an online discussion at a specific period of time, providing extra opportunities to interact with the students. Figure of chat room is presented as followed figure 3.1.2.

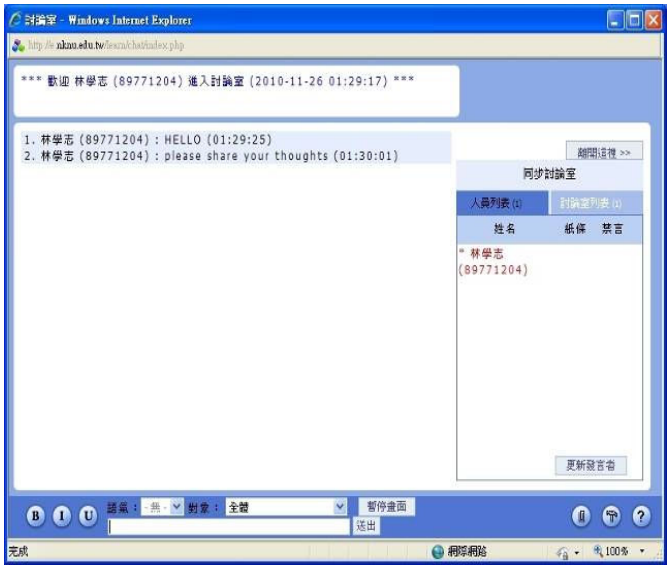

Fig.3.1.2 chat room of course

Fig.3.1.1 Learning path of course

B. Resource

1. Course contents. All the course chapters both in WORD, PPT, SWF, FLASH PAPER and PDF formats.
2. Online exam, provide students with self-assessment and semester exams.
3. Additional material: provide additional reference or documents related links, etc.
4. Off-line tools, E-mail and messages for private communications between teacher and students.
5. Interactive circuit simulation tool, providing an intuitive approach to complex concepts. Figure of simulation circuit is presented as followed figure 3.2.3

C. Electronic circuit simulation tool

In this section, electronic circuit simulation tool has many experiment instruments will be introduced such as: function generator, bode plotter, oscilloscope, and spectrum analyzer will be described as follows:

1. Function generator

The function generator is a voltage source and has three terminals through which waveforms can be applied to a circuit inclusive of sine, triangular or square waves. It provides a convenient and realistic way to supply stimulus signals to a circuit. The waveform can be changed and its frequency, amplitude, duty cycle and DC offset can be controlled. Analysis graph of bode plotter is presented as followed figure 3.2.4

2. Bode plotter

About experiment instruments, the bode plotter is used to measure a signal's voltage gain or phase shift, and bode plotter produces a graph of a circuit's frequency response and is most useful for analyzing filter circuits. Analysis graph of bode plotter is presented as followed figure 3.2.5

3. Oscilloscope

About instrument of oscilloscope, the oscilloscope displays the magnitude and frequency variations of electronic signals. It can provide a graph of the strength of signals over time, or allow comparison of one waveform to another. Analysis graph of oscilloscope is presented as followed figure 3.2.6

4. Spectrum analyzer

The spectrum analyzer is used to measure amplitude versus frequency, it is capable of measuring a signal's power and frequency components, and helps determine the existence of harmonics in the signal.

The spectrum analyzer displays its measurements in the frequency domain rather than an oscilloscope performs in the time domain. Analysis graph of spectrum analyzer is presented as followed figure 3.2.7

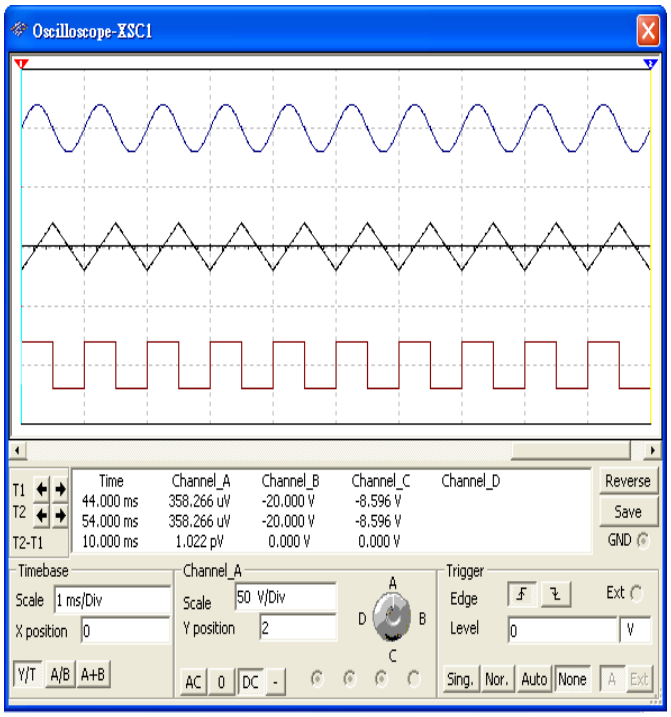

Fig.3.2.4 analysis graph of function generator

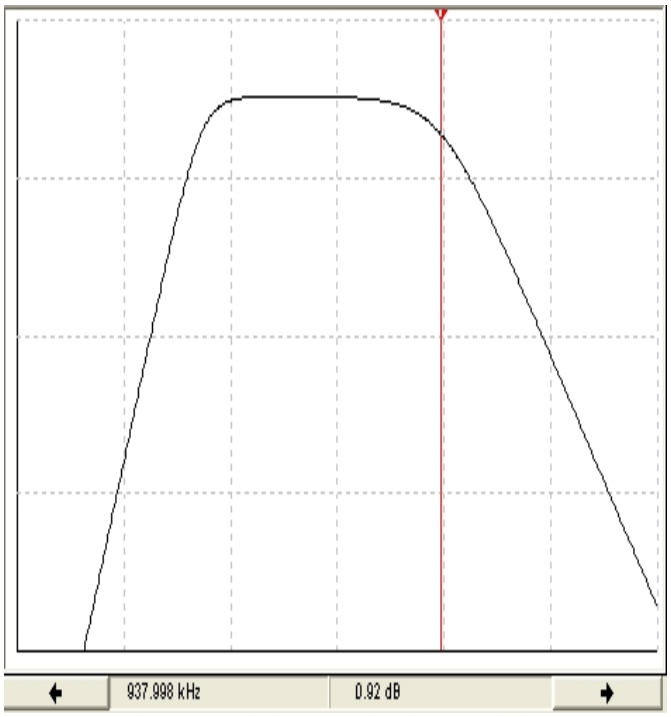

Fig.3.2.5 analysis graph of bode plotter

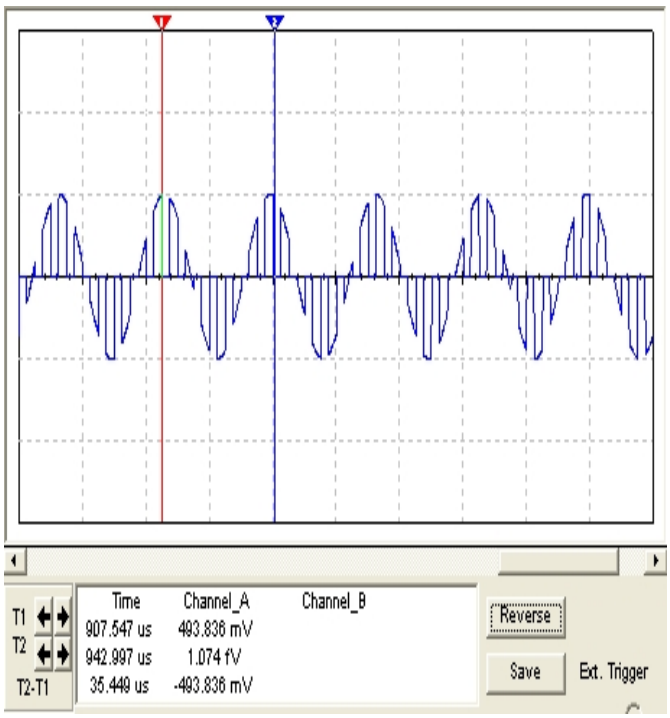

Fig.3.2.6 analysis graph of oscilloscope

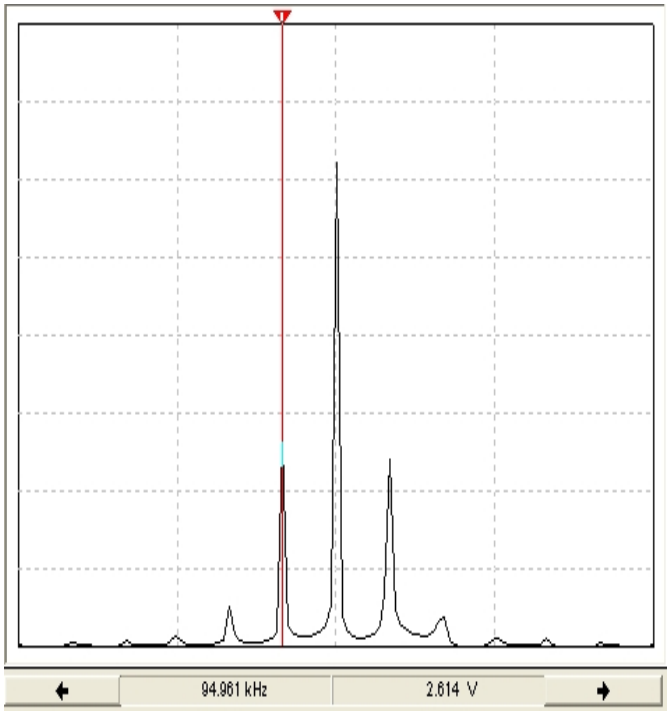

Fig.3.2.7 analysis graph of spectrum analyzer

The simulation tool provide a more intuitive approach to certain concepts such as filter circuit and signals analysis, the characteristics lead students to learning concepts more visual and intuitive, for instance, figure.3.2.1. show the main screen of simulation tool, aimed at the study of different types of circuit experiment inclusive of signals processing and theory. The student can setup simulated signal frequency, amplitude, and duty cycle and to verify the filter theory. Through circuit

simulation to adjust the result of signal filter from bode plotter, oscilloscope and spectrum analyzer, as shown in figure.3.2.9.

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IV. Conclusion

The media tool described in this paper offers students the possibility of experiencing the fundamental concepts of filter circuit and signals analysis, with their theoretical study by using simulation tool and platform, and by accessing additional material of course. Such an environment has been working for five years now and the experience of the author is very positive and teacher has found the students to have a cleaner understanding of the concepts of filter theory.

The acceptance of the media tools inclusive of e-learning platform and simulation tool incorporated has been very good, as reflected by the statistics of use of the resources shown in Table 1, corresponding to the autumn semester of 2010.

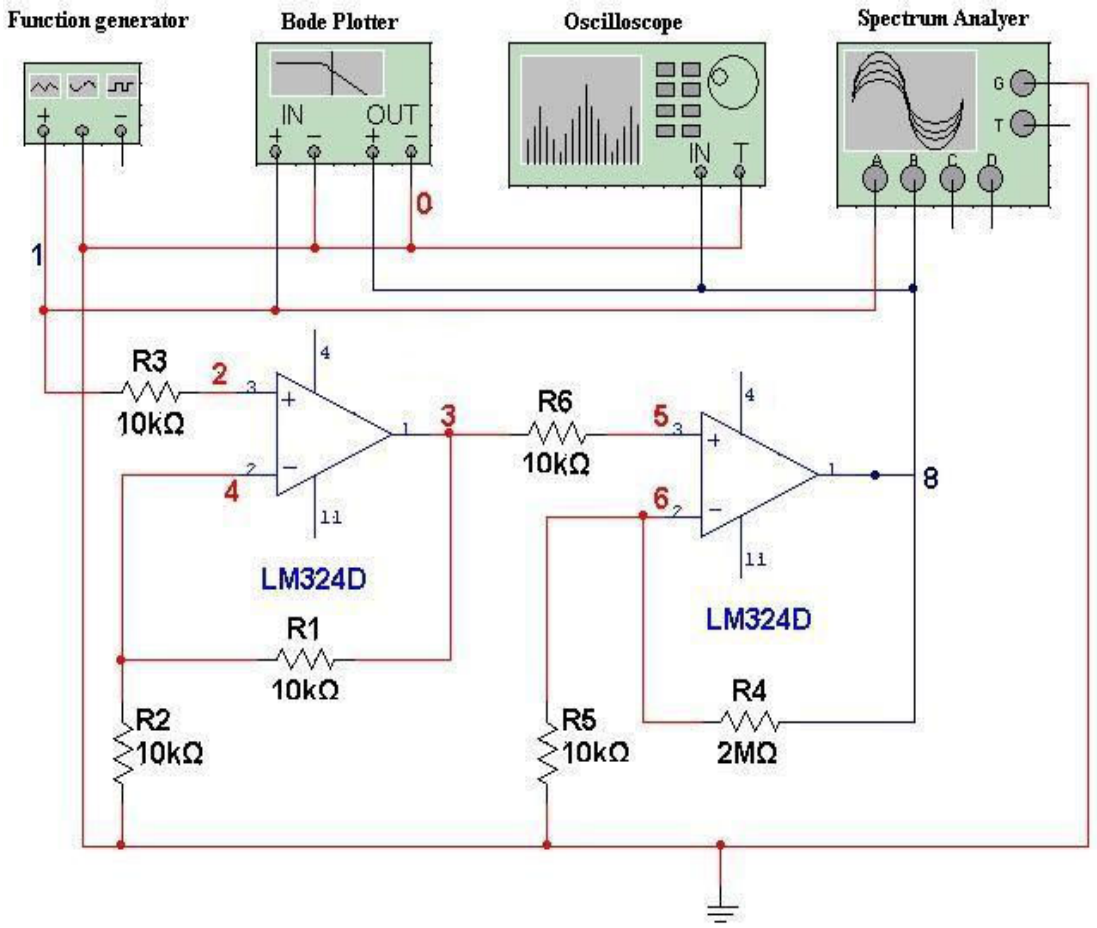

Fig.3.2.3 simulation circuit

TABLE 1 Statistics of use of the media tool (autumn semester 2010)

Parameter Value	value
Number of accesses to the platform	993
Average number of accesses per student	34
Percentage over the total number of students enrolled in the course	100%
Average hours of accesses per student	13.5
Number of access to the simulation tool	three hours a week

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