The Interactive Multimedia Intelligent Tutoring System (IMITS)

--User's Manual –

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Preface

The IMITS Software environment was developed by a dedicated team of graduate and undergraduate students at Temple University. The beta version of this software has been developed over a period of three years. Special thanks are due to:

- Michael Duarte who worked on the project both as an undergraduate and graduate student in the Department of Electrical and Computer Engineering (ECE) in the College of Engineering,
- Matthew Bartels, an undergraduate student in the Broadcasting, Telecommunications and Mass Media (BTMM) Department in the School of Communication and Theater,
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Brian P. Butz
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1. Introduction

The Interactive Multimedia Intelligent Tutoring System (IMITS) is an intelligent tutoring system that is focussed on the instruction of undergraduate electrical engineering students. The material covered is that typically presented in courses on introductory circuits. At present, it consists of three modules: DC, AC and Transient Analysis.

IMITS is intended as a course supplement. While there is a substantial amount of multimedia material and interactions, the software package is intended as a tutor, providing extra help for a student taking a face-to-face, on-line, or self-directed course. As the student progresses through the material, the expert system that is embedded in the software will watch and analyze the student's activities. By doing this, it is able to determine the student's strengths and weaknesses and determine what material should be presented in what order.

During initial development of IMITS, it quickly became apparent that the presentation of the subject material must not only be pedagogically sound and rich in content but also should be engaging. To be engaging, it must allow the student a flexibility that is unusual in intelligent tutoring system development. A story line was adopted so that the student could play a role and make choices allowing him/her to choose how to solve entry level engineering assignments. The story line chosen was that of a junior engineer newly hired by the multinational IMITS Corporation.

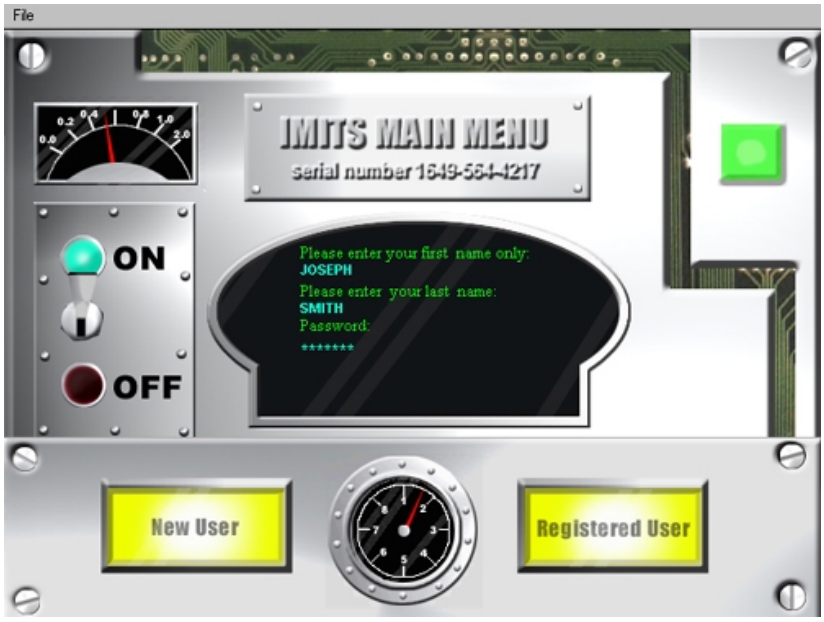


Figure 1. The Login Screen

When the student first runs IMITS, he/she is asked to login (Figure 1). Logging in consists of supplying the student's first and last name as well as a password. **(NOTE: YOU DO NOT HAVE TO USE YOUR ACTUALLY NAME AND EMAIL ADREESS.)** Next, the student is welcomed to the IMITS corporation via a video and is

shown how to use the resources within the office. Finally, the student selects a design team to join (Figure 2). The design team selected specializes in the area in which the student desires tutoring (i.e. DC analysis, AC analysis or transient analysis). Once a member of the team, the student is given an office, shown in Figure 3. A series of assignments is received from the virtual team leader. The team leader "appears" before the student in a series of teleconferences (see Figure 4). The assignments are made during these teleconferences and followed-up with email communications. The assignments become increasingly complex and require that the student has a thorough understanding of the material.

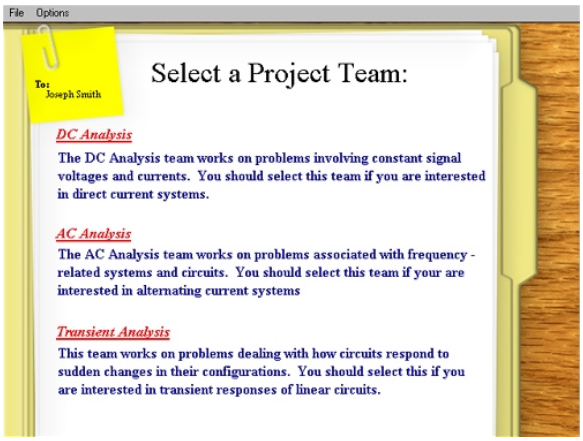


Figure 2. Project Team Selection

Figure 3. The Student's Office

Once the assignment is given, the student may complete the assignment using any of the resources available. Resources include books containing explanations of material needed to perform the assignment. This expository material is highly interactive and asks the students many questions. Each question is asked for a specific reason and has a learning objective* associated with it. Questions may be multiple choice, short answer, or drag and drop. Additional resources consist of file cabinet drawers containing corporation notes and specifications about various corporation products. The student interacts directly with the virtual team leader and, if needed, the virtual skills advancement director. The student also has access, through a door in the office, to a virtual laboratory (Figure 5) where the student may build and test possible designs. In addition, the IMITS Corporation provides some internal training on its own using case studies that serve as assignments.

2. The Office

The office is the student's operations center. Here the student may choose to communicate with the supervisor, read books from the bookshelves, peruse company notes and plans in the file cabinet, make notes in his/her notebook, or visit the virtual laboratory to set up and test a circuit or system.

The **books** contain interactive instructional material about topics that are usually covered in an introductory circuits course. Currently three books are "active": DC Analysis, AC Analysis and Transient Response. Clicking on one of these books will bring up a table of contents (see Figure 6). The student may read the contents of the book in any order just by clicking on the chapter or subchapter heading of interest.

Figure 4. The Team Leader

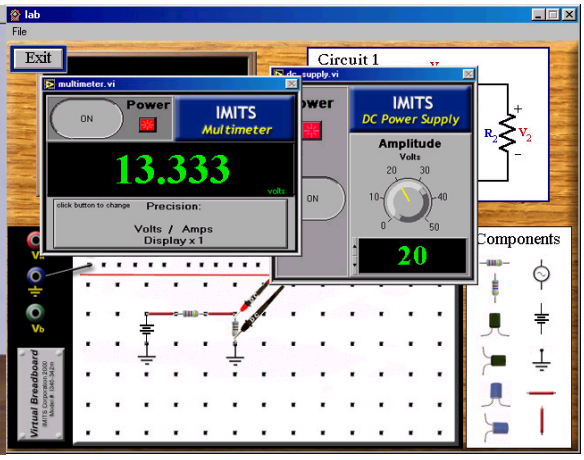


Figure 5. An Experimental Set-up

The **DC Analysis book** is composed of:

Chapter 1 Introduction
- 1.1 What is an Electric Circuit?
- 1.2 Current and Voltage
- 1.3 Power

Chapter 2 Kirchoff's Laws
- 2.1 Kirchoff's Current Law
- 2.2 Kirchoff's Voltage Law

Chapter 3 Sources

Chapter 4 Resistive Circuits
- 4.1 Resistance and Ohm's Law
- 4.2 Voltage and Current Dividers

Chapter 5 Nodal and Mesh Analysis
- 5.1 Node Voltage Analysis
- 5.2 Mesh Current Analysis

Chapter 6 Equivalent Circuits

Chapter 7 Thevenin Equivalent Circuit

The **AC Analysis book** consists of:

Chapter 1 Phase and Phasors
- 1.1 Sinusoidal Review
- 1.2 What are Phasors?
- 1.3 Manipulating Phasors

Chapter 2 Impedance
Chapter 3 Impedance and Frequency
Chapter 4 Frequency Response
- 4.1 Introduction
- 4.2 Transfer Functions
- 4.3 Bode Plot Derivation
- 4.4 Bode Plot Approximation
- 4.5 Filters

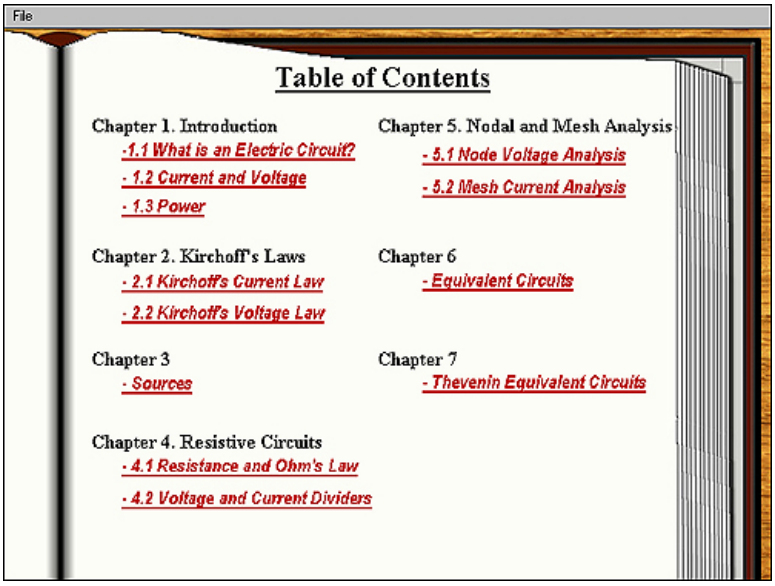


Figure 6. DC Analysis Book Table of Contents

Chapter 5 AC Power
- 5.1 Energy and Power
- 5.2 Instantaneous and Average Power
- 5.3 Effective Power
- 1.4 Instantaneous and Average Power
- 1.5 Effective Power

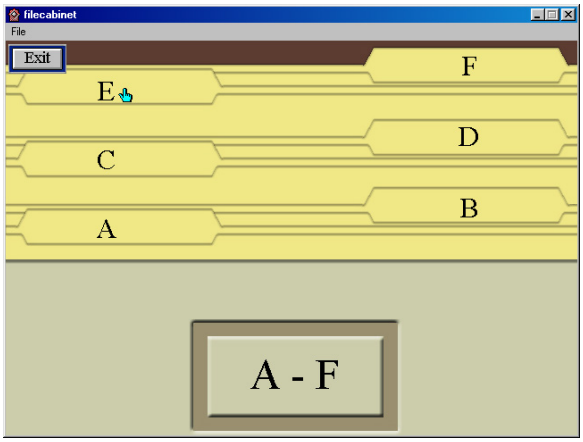
Chapter 6 Transforms
- 6.1 Laplace Transforms
- 6.2 Inverse Laplace Transforms
- 1.6 Inverse Laplace Transforms

Chapter 7 Demonstrations
- 7.1 Experimental Determination of Frequency Response
- 7.2 Power Plant

The **Transient Analysis** book consists of:
Introduction
- Circuit Example
- Motor Example

Chapter 1 Time Constants
Chapter 2 Initial Conditions
Chapter 3 Inductors and Capacitors
Chapter 4 Step Response
Chapter 5 First Order Systems
Types of Response
5.1 Natural Response
5.2 Forced Response
5.3 Forced Response to a Constant Input
5.4 Forced Response to a Time Varying Input
5.5 Complete Response
Chapter 6 Second Order Systems
6.1 Introduction
6.2 Natural Response
6.3 Applying Initial Conditions
6.4 Forced Response
6.5 Complete Response

Now and then the student is referred to company drawings, specifications, reports and notices that are found in the **file cabinet**. The student opens the file cabinet drawer (Figure 7), finds the corresponding letter of the document and clicks on that letter's folder (Figure 8) to see the appropriate information.



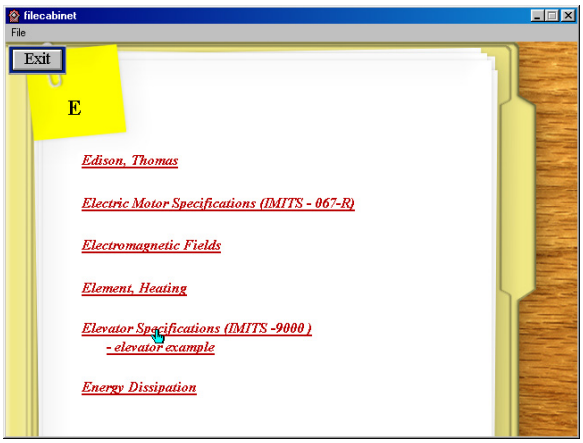


Figure 7 File Cabinet Drawer

Figure 8. File Cabinet Folder

The **computer monitor**, when clicked upon, yields the screen shown in Figure 9. Clicking on *Scratch Pad* gives the student access to his or her notebook where notes or data may be kept. Each entry has its own identifier and each entry is saved for the student. A sample of a notebook page is shown in Figure 10. The entry is given a title, in this case assignment 2. The title is chosen by the student.

The note area allows a student to write whatever notations are desired. The area

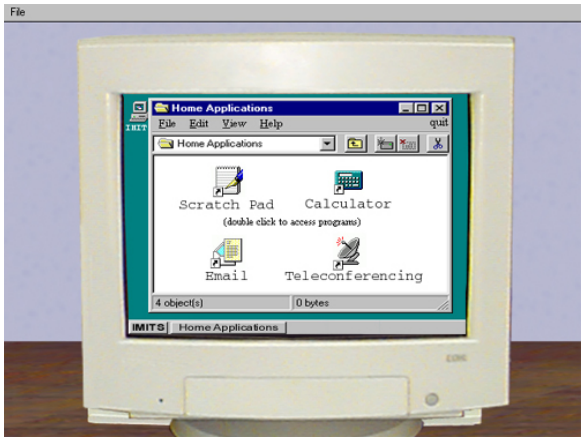


Figure 9. The Computer Monitor

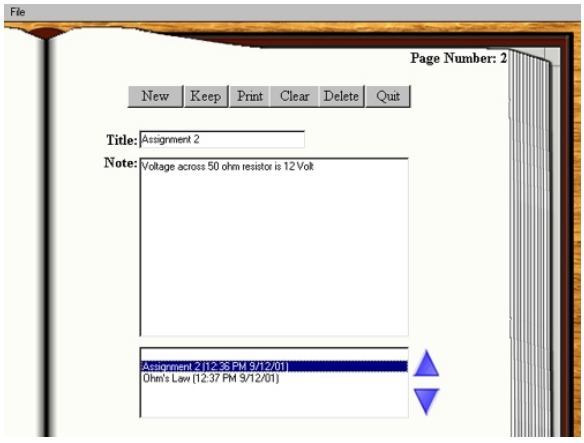


Figure 10. Notebook Page

at the bottom of the page is a listing, by date and title, of all the student notations made thus far. The assignment 2 notation "voltage across 50 ohm resistor is 12 volt" is the last notation made. A previous notation called "Ohm's Law" represents notes made by the student at a previous time.

If the student clicks on "calculator the standard Microsoft Windows© scientific calculator appears. Clicking on "email" allows the student to receive (Figure 11) or send (Figure 12) virtual email. Email is sent from the student's supervisor to give the necessary details of a student's assignment. Once the student devises a solution to the assignment, it is sent to the supervisor via email.

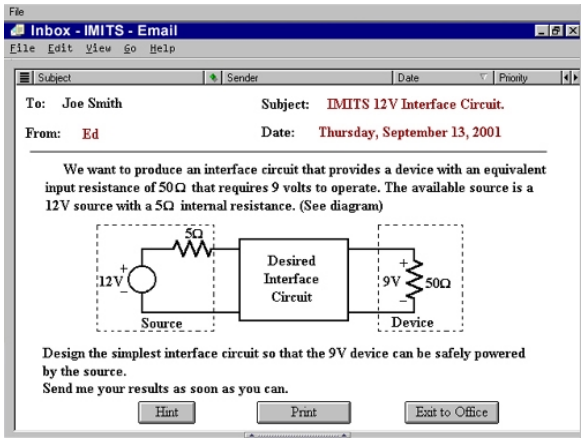


Figure 11. Email from the Supervisor

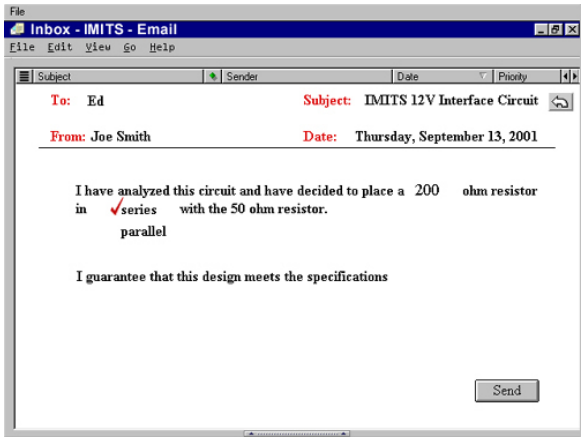


Figure 12 Email from the Student

Clicking on "teleconferencing" allows the student to receive a video message from the supervisor. The student is informed that this message exists by the sound of a ringing telephone. When the student clicks on the computer monitor icon in the office, and then on the teleconferencing icon, a video message is played. The video message

might be a straightforward message from the supervisor (Figure 4) announcing the problem and describing how assignment particulars may be obtained. The video might also be a vignette that sets up the problem.

3. The Laboratory

The student may visit the virtual laboratory by clicking on the lab door from the office. The Virtual Laboratory consists of a breadboard, components, and miniature instruments. Figure 13 is the main workspace given to the user. The Virtual Laboratory users can build and test circuitry with the following components: resistors, capacitors, inductors, and jumper wires. In addition, the laboratory consists of the following instruments: a DC power supply, function generator, multimeter, oscilloscope, and spectrum analyzer with frequency sweep generator

There are a variety of ways to connect these components and instruments to the breadboard. To connect a resistor, capacitor, or inductor to the breadboard, simply drag and drop the component to the desired hole on the breadboard. After the component is dropped, a chart with appropriate values for that element appears. Select the desired value, or simply type any value into the dialog box. Another way to connect the components is to "double-click" on the component. The dialog box will ask where you wish to place the component. At this point you can either click on the hole you desire to place the component or type in the coordinate of the hole in the format of "letter space number" (ex. "a 3"). See Figure 14 for coordinate view of breadboard. Once the component is on the breadboard, you can right click on the component to see its value. You may also move or remove the component by simply "single-clicking" on the component and following the directions from the dialog box or by performing the same steps explained above.

To connect a jumper wire to the breadboard, simply "double-click" on the wire. Once the dialog box appears either type in the starting and ending coordinate of where you wish to place the wire, or simply click on the starting and ending hole. Jumper wires can be placed anywhere on the breadboard, and have variable lengths. Two different locations must be entered or clicked to place the jumper wires. These two locations are the starting and ending points of the wire. To move or remove the wire, "single-click" on the wire and follow the dialog box directions.

To connect the instruments to the breadboard, simply "single-click" on the appropriate output hole of the miniature instruments (see Figure 13). Once clicked, you can either enter the coordinate of the hole you wish to place the cable, or simply click on the hole on the breadboard. Just like above, to move or remove the cables of the instruments, click on the hole of the instrument and follow the dialog box. To access the larger versions of the instruments, simply "double-click" on the instrument, and the larger version will appear in a separate window. These larger versions allow you to change and set certain settings innate to each instrument. For an example, see Figure 15.

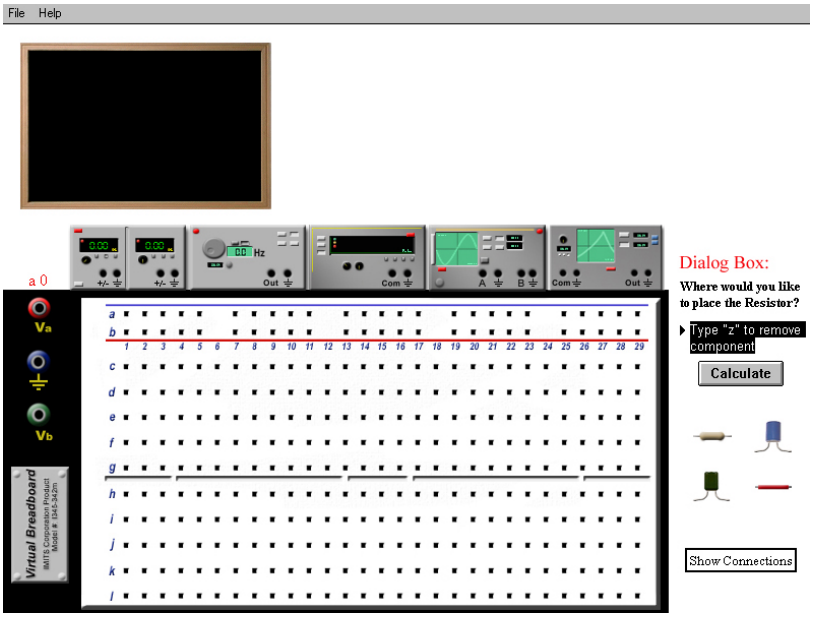


Figure 13. Virtual Laboratory Workspace

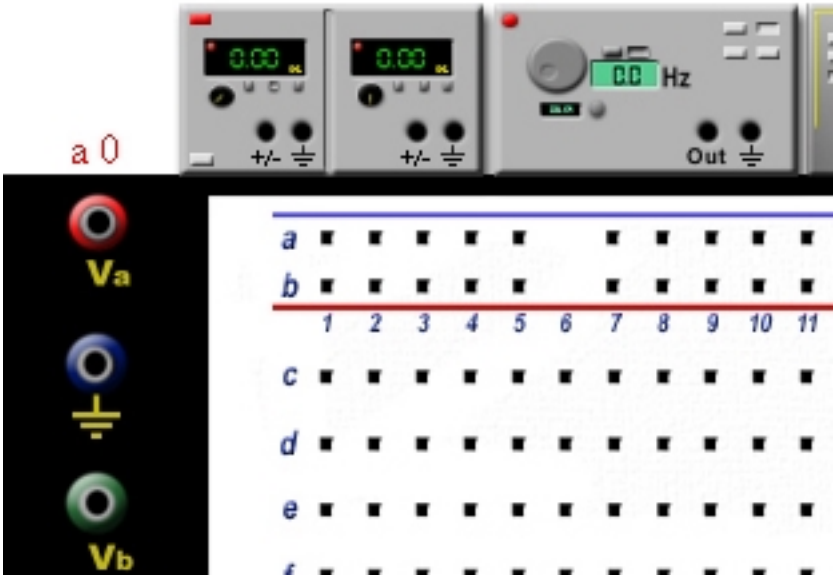


Figure 14. Coordinate View of the Breadboard

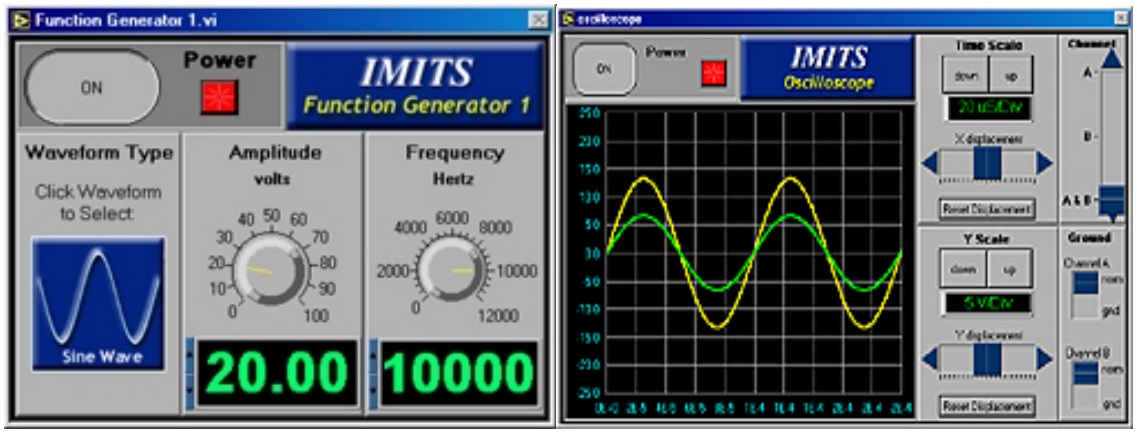


Figure 15. Large Versions of the Function Generator and Oscilloscope

Once the circuit is built, and the appropriate instruments are connected to the breadboard, simply "single-click" on the calculate button (see figure 13). Once clicked, the circuit is analyzed, and the instruments are updated. Any changes made on the breadboard will not be updated on the instruments until the "calculate" button is pressed. So for example, if a cable from the oscilloscope is moved from one hole to another, the "calculate" button must be pressed in order for the changes to take place.

To save, load, or clear a circuit, go to the file menu to locate these options. Under the help menu, more information about the laboratory can be found. To exit the laboratory, use the "Return to Office" command found in the file menu.

4. Other Features

When the student is in the virtual **office**, he/she has access to a pull down menu at the top left of the office window. Clicking on this menu yields two choices: "File", and "Options".

Under the "File" selection, the student has three choices: *Minimize, maximize, and quit*. "Minimize" shrinks the IMITS window to its minimum while "Maximize" shows the IMITS window in its largest configuration. The "Quit" option allows the user to exit from the program and allows the user to re-enter the program at the point of exit.

Under "Options", the user is given the opportunity to change project teams. If this option is selected, the user is returned to the original "memo" screen in which the user chooses what project team to join. Caution must be used here. If a user changes teams, the history of the work done on the previous team is lost. If the user decides later to re-choose the original team, the user must start going through the assignments from the beginning.

When the student is in the virtual **laboratory**, he/she has access to two menus: "File" and Help".

Under the “File” menu, the user has a choice of:

- Minimize which works the same as the minimize option in the office pull down menu,
- Maximize which works the same as the maximize option in the office pull down menu,
- Print Screen, which allows the user to make a hard copy of the circuit on the breadboard,
- Save which allows the user to save the circuit being placed on the breadboard,
- Open which allows the user to open or load an existing circuit that has been saved,
- Clear which allows the user to clear the breadboard,
- Return To Office which allows the user to return to the office.

Under the “Help” menu there are two options:

- Tour which gives the user a brief tour of the laboratory,
- Help Pointer, which gives the user more, detailed help on any component clicked on in the laboratory.