EE101 Laboratory 6   (FL03)   **Name** _____

Date _____   **Partner's name** _____

<u>*NOTE:*</u> *You need to have a free MSU computer account AND ECE printing permission BEFORE you arrive for this experiment! Sign up for an MSU computer account by following the instructions at URL:* http://www.montana.edu/wwwitc/docs/studacc.html . *Then go to the ECE office, 610 Cobleigh, to sign up for departmental printing permission (also free).*

Instructional Objectives (at the end of this lab you should be able to:)
- Enter data into Matlab^{TM}
- Create a line graph and bar graph using Matlab software.
- Create data sets representing sinusoidal signals using Matlab.
- Graph these data sets and create appropriate titles and axis labels.
- Copy Matlab graphs into a word processor and produce a graph with documentation.

Description and Background
Matlab^{TM} is a software package intended for use by engineers and scientists in solving complex problems. The name "Matlab" is short for "matrix lab," since Matlab is very efficient at processing arrays and matrices of numbers. One generally interacts with Matlab by typing special words and symbols in a command window on the computer screen. Matlab contains commands and features for many specific applications, such as plotting (`plot` and `bar` are two such commands). Also, the user can readily create custom software routines for specialty needs. These user-created routines can be used in the same manner as the commercial routines provided with the Matlab package.

To find out about how to use Matlab, keep in mind that a help option is always available: to get help about any command, type `help <command>` and hit return. For example, `help plot` gives information about using the command `plot`. Fortunately, Matlab uses many familiar notations for its commands, such as `plot` to generate a graphical plot, `sin(x)` for the sine function, `pi` for the number π, etc.

Matlab has the ability to handle complex-valued numbers ('a + jb') with the same ease as for real-valued numbers. It also can handle matrix-valued arrays in a similar manner as single values. For example, to multiply a matrix A times a vector B, simply write `A*B`. The appropriate combinations of rows and columns are handled correctly.

A few other useful Matlab commands are: `grid` to toggle grid lines on or off for a graph; `figure` to open a new plotting window so you can produce a new graph in a separate window without erasing the graph in the previous window; `hold` or `hold on` to hold the current plot so that a second plot can be written on top of the original graph; `hold off` releases this feature.

Another helpful feature is that Matlab keeps track of the history of commands you enter. After entering several Matlab commands, use the up or down arrow keys to see previous commands which can now be edited and re-run by simply pressing the enter key.

Equipment
Computers and Matlab in the ECE computer lab, room 625.

Procedures

P1. Launch the Matlab program using the desktop icon or the 'Start' menu. The program will open with several window panes.

Explore Matlab by typing the command `help` at the >> prompt in the command window, then for any of the topics listed, type `help <topic>`. It is not necessary to write the directory name preceding the topic of interest. Also try `help plot`, `help cos`, and `help bar`. Type `help demo` and try out one or more of the available demonstrations.

P2. Use the `plot` command:

→ Create a line graph of V_o vs time for the following data set, with V_o in volts on the vertical (y) axis and time in minutes on the horizontal (x) axis.

Time [minutes]:	0	5	10	15	20	25	30	35	40	45
V_o [volts]:	3	5	0.2	-0.3	6	6.5	-7.8	-2.7	6.3	-0.5

→ Place an appropriate <u>descriptive title</u> on the graph (including the problem number, P2). <u>Also label the x and y axes with the proper quantity names and units</u>.

P3. → Create a new Microsoft Word document and copy the P2 graph from Matlab into the Word document. Underneath the graph write a brief description about what is shown.

P4. → Repeat P2, but this time create a <u>bar</u> graph instead of the line graph. Copy the bar graph from Matlab into the same Word document and add a brief description about what is shown.

P5. → Again in Matlab, create a cosine wave with frequency f = 60 Hz, and create a line plot of about 5 cycles of this signal, with "volts" for the vertical scale and time in seconds for the horizontal scale. You need to think about how to specify the argument for the cosine function and how many points per waveform cycle is appropriate. What is the time interval in seconds for 5 cycles of a waveform with 60 Hz frequency?

→ Be sure to label the graph and axes appropriately, and copy this plot into the Word document and give a written description.

P6. → Repeat P5, but with a *phase shift* of +30 degrees. This requires changing the argument to the cosine function. Be sure to account for degrees or radians when using the cosine function.

P7. → Now create one graph with both signals from P5 and P6 overlapped on the same graph. Choose different line styles for the two signals, keeping in mind that the printer in the lab is monochrome (colors won't show up). Label the graph and axes, then copy the plot into the Word document and give a written description.

P8. → Add a report title at the top of the first page, along with the date, class number and section, and your name. Check the graph sizes, page boundaries, and text wrapping so that the graphs and their corresponding descriptions fit on the proper pages without wasting space. Print this report and turn it in as your lab report for today.