

**ET 332a**  
**Graphing Using Spreadsheets**  
**Experiment 1**

The charting function of Excel can quickly produce a professional-looking graph for use in technical reports. These charts can then be cut from the spreadsheet, along with the data, and pasted into a word processor document.

A spreadsheet is a 2-D array of cells that can hold data or formulas. The formulas can be copied to do repetitive calculations with different inputs. The 2-D array consists of columns that are labeled with letters and rows that are labeled with numbers. To identify a cell location, refer to the column and row labels. (e.g. A1)

Data for the graphs is entered in these cells and then selected for graphing using the chart wizard on the program toolbar. Including labels at the top of each column will name the x and y axis of the graph automatically. Following the instructions in the chart wizard leads to a completed graph.

**Simple X-Y plots**

The best graph type to use for technical plotting is the X-Y scatter plot. This is one of the first options given in the chart wizard dialog inputs. Use the option that connects the points with curves for all data that has non-linear relationship between X and Y. Plotting experimental data with significant error should be done with no interconnecting lines.

Linear regression techniques, which are available in Excel, can also be used. Plot the following data and print the graph. Make sure that both axis are labeled and units are included along with a title for the graph. The units for the time data, t are seconds and the units for the v(t) data are volts. The x-axis should be the time data and the y-axis the voltage data. Title the graph: Capacitor Voltage Response. Include grid lines on the plot.

t	v(t)
0	0
3	2.592
6	4.512
9	5.934
12	6.988
15	7.768
18	8.347
21	8.775
24	9.093
27	9.328
30	9.502
33	9.631
36	9.727

Two graphs can be included on the same plot by including more than two columns in

the data range. For best display of data when more than one Y range is included, the values of the ranges should not be widely different in scale. For example,. 0-100 and 0-0.1 should not both be plotted on the same y axis. For the data below, plot both the columns of y data against the same values of x. Print the plot. Make sure that both axis are labeled and units are included along with a title for the graph. Include grid lines on both the x and y directions.

The load torque  $T_L$  , given in N-m, is the X variable The data  $n_L$  and  $n_m$  are the speeds of a mechanical load and a shunt connected dc motor respectively. The speed data is in rpm. Determine the load torque that the motor must supply from the graph. This is the point were the two curves intersect.

$T_L$ (n-m)	$n_L$ (rpm)	$n_m$ (rpm)
20	2500	1798
40	1250	1796
60	833	1794
80	625	1792
100	500	1790
120	417	1788
140	357	1786
160	313	1784
180	278	1782
200	250	1780

### Semi-log Plots

Another form of plot that occurs frequently in electrical analysis is a semi-log plot. For this type of graph the x-axis is scaled logarithmically. The y-axis is scaled linearly. Excel does support this type of plot, but it can also be produced using the standard X-Y scatter plot connected with curved lines. The  $\log_{10}(x)$  must be taken. The result of these calculations is then plotted on the x-axis of the X-Y graph. The semi-log plot is used when the x data range varies over a wide range: typically covering several powers of 10. (e.g. 10 100 1000).

To create a semi-log plot with Excel using the procedure above, enter the x data into a column. In an adjacent column use the log math function of Excel to find the logarithm of the x values. (Note: after entering the first value, use the copy/paste commands to fill the remaining cells.) Finally enter the y data. Select the  $\log(x)$  data and y data for plotting. Remember to note on the x axis that the log of the x data is plotted. Now try this with the magnetic circuit data given in the next section.

To use the logarithmic scaling in Excel, create a graph using the procedure for linear plotting. After the graph is constructed by the program, the scaling of the axis can be

change by clicking on the appropriate graph axis. An axis format dialog box should appear. Clicking on the scale tab will bring up a dialog box that shows a logarithmic scale check box. Checking this option will change the scaling of the axis to logarithmic from linear. Semi-log or log-log plots can be generated without converting the data with this feature.

The following data are from a test of a magnetic core material used to make electromagnetic relays. Graph the data using Excel. See the textbook B-H curves for the appropriate type of scales to use (linear, log, semi-log). In the report indicate the level of magnetic field intensity that causes the material to saturate. Title the graph and indicate the units by including text regions.

H (Oersteds)	B (T)
0.1	0.00
0.2	0.04
0.3	0.06
0.4	0.075
0.45	0.08
0.5	0.20
0.7	0.60
0.8	0.80
1.0	1.08
1.2	1.32
2.0	1.4
4.0	1.46
8.0	1.52
10.0	1.56
20.0	1.60
40.0	1.67
80.0	1.72