Overview
Excel is a widely used spreadsheet developed by Microsoft. Although used widely by business professionals, it can be very useful to the engineer as well. An excellent paperback book which highlights the engineering use of Excel is, “Spreadsheet Tools for Engineers”, B.S. Gottfried, McGraw-Hill.

Think of a spreadsheet as a table (the worksheet) containing cells. Each cell has a column-row address such as A1 (column A, row 1) or B7 (column B, row 7). Cells have contents; either text or numbers (data) or formulas. The power of a spreadsheet is you can update the data and the formula cells will automatically update their calculation. In operation, one typically enters some data as numbers, and then one or more formulas to analyze the data. Results can be presented as columns or tables of numbers or as plots.

On-Line Help
You don’t need a manual; Excel has excellent on-line help. Double-click the “?” button to open. Follow the instructions to find a topic. Use the “Search” button to find other topics.

Entering numbers (data) or text into a cell
Click on the cell and type a number. What you type or appears in the area at the top of the window. Press Enter to set the contents. Scientific notation can be entered. Examples of valid numbers include 7, .33, -6.2, 4.6E9, 3.2E-9. Or, type in any text into the cell for use as labels.

Entering formulas into a cell
A formula is preceded by an equals sign so Excel knows to calculate the formula rather than interpret your entry as a text string. Example formulas are: “=A3” (make this cell the same as cell A3), “=A3+A2+A1” (make this cell the sum of what’s in A3 plus what’s in A2 plus what’s in A1). Most common operators are allowed in formula expressions. Exponentiation is represented by ‘^’ (for example, A1^3). Formulas always start with an equals sign.

Editing a cell
Double click on cell, then make changes. To clear contents, single click on cell then start typing.

References
If you are in Cell B3 and you enter “A1” into a formula, you are using a relative reference which means, “look at the cell one up and two to the left”. This is the normal mode. However, if you enter “$A$1” into the formula, it is an absolute reference which means, “look at cell A1”. This is handy if a formula uses a constant which is defined in cell A1. For many engineering “what-if” problems, there are a number of constants which are used in formulas throughout the spreadsheet. It is convenient to locate all of them (with adjacent labels) near the top of the spreadsheet and to refer to them by absolute reference (e.g. $A$1 rather than A1) in the spreadsheet formulas.

Defining Names for Cells
Sometimes, entry of complicated formulas can be simplified if you use labels rather than cell numbers to refer to constants. Although the name definition is case insensitive, use upper-case for clarity. For example, if you have the number 23.4 in Cell A1, You can define a name DENSITY which points to this cell. Then, in formulas, you can enter the word “DENSITY” rather than “$A$1” to refer to the contents of this cell. Defined cell names are absolute (rather than relative) references. To define a name, click on the cell, then click on the cell name box in the top left corner of the screen, type the cell name then press Enter. You can also define a name by using the Name function under the Insert menu.
Functions
Excel has a large number of built-in functions for performing mathematical, statistical and economic operations in formulas. Apply built-in functions to any formula by entering “function_name(range)” or “function_name(num)” where range is a range of cells in the spreadsheet (typically a column of data), for example “A3:A25” and num is a constant or the value in a single cell, for example “B2”. Or, find function name by selecting Function... from the Insert menu. For range, click on one cell or drag through multiple cells. Or, you can use the Function Wizard button on the toolbar to find and enter a function. For example, “=SUM(A2:A12)” (make this cell the sum of the column of data running from cell A1 to cell A12).

Useful Functions
- SQRT(num): Square root
- ABS(num): Absolute value
- SIN(num): Sine
- COS(num): Cosine
- TAN(num): Tangent
- LN(num): Natural log
- LOG10(num): Base 10 log
- EXP(num): Raise e to num
- PI(): Returns value of pi
- POWER(num,pwr): Raise num to pwr
- SUM(range): Add numbers
- AVERAGE(range): Average
- STDEV(range): Standard deviation
- VAR(range): Variance
- MAX(range): Maximum
- MIN(range): Minimum
- COUNT(range): How many in range
- MEDIAN(range): Median
- MODE(range): Mode
- RAND(): Returns random number (0-1)
- ROUND(x,n): Round x to n decimal places
- SIGN(x): Returns the sign of x

Formatting Hints
Adjust column width by dragging or double-clicking the right column heading border (i.e. just to the right of the column heading letter at the top of the spreadsheet. Adjust row height by dragging or double-clicking the bottom border of the row heading. Or, select Row or Column under the Format menu.

To change the cell format, select the cells, then select Cell under the Format menu. Or, select the appropriate buttons on the Formatting toolbar at the top. These allow you to change the format to currency, to percent, to add commas, or to add or decrease the number of decimal places. The latter is most useful when reducing the number of significant figures to what is appropriate for the calculation (which for most engineering calculations is two or three).

To make nice looking headings, select the heading row and make double height. Then pick Cells under the Format menu, pick Alignment and then center vertically and horizontally in the cell. In the same Cell formatting, pick Font and then Bold. There are also horizontal centering and bolding buttons in the toolbar to do some formatting without going into the Format menu.

To make a nice title, make a triple height row which contains the title, then bold it and make it a slightly bigger font. To center the title over the spreadsheet, highlight the title row across the appropriate spreadsheet columns. Then pick Cells under the Format menu, pick Alignment and choose Center Over Selection. Also, center vertically in the row.

Charts and Plots
Highlight the data you wish to plot, choose the Plot Wizard button from the toolbar, then click and drag an area where you want to place the chart on the current sheet. The Chart Wizard will then guide you along with the appropriate choices. Or, pick Chart under the Insert menu to place the chart either right on the current sheet or on a separate sheet. A nice feature is that when you change the data in the cells, the plot will automatically update. For X-Y plots (where one column has the x data and the adjacent column has the y data), choose “Scatter Plot” from the chart wizard. The default chart style is usually ugly. Delete the legend, change the background to white, delete grid lines, label x and y axes, at a minimum. When plotting experimental data, always show the data points and make the data markers large and dark. When appropriate, connect the data points with a line, so long as the line does not imply there is data between the points. When plotting theoretical equations, use a line without points.
Fitting a Line to Data
Excel can fit a straight line, polynomial, power or exponential curve to an experimental data set using the least squares method. Create an X-Y scatter plot of your data set without connecting the data points. Highlight the plot. Choose Trendline... from the Insert menu (or Add Trendline from the Chart menu, depending on your version of Excel, or just double click on a data point). For a best-fit straight line, pick the Linear trendline, then under Options, select the checkboxes to display the equation and R squared value on the chart. The line and fitted equation will appear automatically. Fit other forms of equations by picking different types of trendlines.

Finding a Value That Solves a Formula
To find the value of a variable that gives a specific result, select the cell with the desired formula. From the Tools menu, select Goal Seek and fill in the appropriate entries. For details, select Help in the Goal Seek dialog box. Warning: Goal Seek will not find solutions to formulas which have multiple roots. For example, if you ask it to find the X which makes X^2 = 4, it will only find X = 2 and not X = -2.

Solving Optimization Problems
Many engineering problems require optimization (minimize the weight given constraints on size, minimize cost, etc.). Use the Excel Solver for problems where you need to find the optimum (minimum or maximum) for a particular cell by adjusting the values of several cells, or when you need to apply specific limitations (e.g. a maximum value) to one or more values used in a calculation.

Note: Excel Solver is an add-in that may not be installed on your system. If the Solver command does not appear under the Tools menu, choose the Add-Ins command from the Tools menu and see if the Solver appears and is checked. If Solver is not there, you must run the Excel (or Office) setup program to install.

To start Solver, choose it from the Tools menu. In the Set Target Cell box, enter the cell you want to minimize, maximize or set to a specific value. Enter the changing cells in the By Changing Cells box. If you have any constraints (e.g. a dimension must be kept less than Y), put those in the Subject To The Constraints box. You may constrain to target cell, the changing cells, or any other cell on the spreadsheet. Press the Solve button to start the optimization. For more details on Solver, consult the on-line help. Warning: If you have complex formulas or multiple constraints or a slow computer, it may take the Solver a long time to reach a solution.

Hint: If you know your problem is linear (e.g. formulas contain only additions, subtractions or multiplication’s by cells or constants which do not change), from the Solver dialog box choose Options, then check the Assume Linear Model box. The solution will come much faster.

More Hints
- Use the Fill Down or Fill Right commands (under Fill which is under the Edit menu) to copy values or formulas to a range of cells. Use Fill Series.... to enter a range of numbers that increment or decrement. Or, to fill down, enter the desired number or formula into the first cell, highlight the cell, grab the lower right corner of the highlight box and drag down. To enter a series, enter the first two numbers in the series, highlight both cells, grab the lower right corner of the highlight box and drag down.
- Look at the menu commands to find fast keyboard equivalents.
- To show the formulas in the cells (useful if you have to turn something in where you are showing your work), choose Options from the Tools menu, select the Views tab, then under Window Options check the Formulas checkbox.
- Use File > Print Preview before printing to make sure things are the way you want them; this will save paper.
- Use File > Page Setup to adjust the margins (centering on the page is recommended), to adjust the scale (sometimes scaling to 75% will get a spreadsheet to fit all on one page), to show or hide gridlines, and to add headers or footers.