FUNCTIONS IN MATLAB
Structured Programming

Exercise 1
Trigonometrical functions require the angle argument to be expressed in radians.
- Write and use an *inline* function 'deg2rad' that converts degrees to radians.
- Write 'deg2rad.m' function that performs the same task.
- Use the function in a script to plot a sinusoid, the amplitude and the angle range (in degrees) of which are entered from the keyboard.
- Label the graph accordingly.
  If the amplitude is assigned to, say, variable A, try the following line to show the current value of the amplitude in the title of the graph. Investigate the help on 'sprintf'.
  ```matlab
title (sprintf( 'The amplitude = %.2f units', A))
```

Exercise 2
Write a function to convert degrees Fahrenheit to Celsius. Use the function to demonstrate graphically that -40°F and -40°C both represent in fact the same temperature.
Example (the code must be saved in a file called f2c.m). Afterwards try 'help f2c':
```matlab
function c = f2c(f)
    %Function f2c converts degrees Fahrenheit to Celsius
    %Usage: celsius = f2c(fahrenheit)
    c = (f – 32) / 1.8;
```

Exercise 3
Throughout a larger software application there is a need to determine, on many occasions and for different set of variables, the dimensions of cross-section and the mass of simply supported rectangular shaped beams with a point load. In order to accomplish this task it has been decided to incorporate an appropriate function. As other team members are utilising the function it has been agreed in advance that the prototype of the function is:
```matlab
function [width, height, mass] = beamSize(load, length, x, aspect ratio height/width, …
    safe bending stress, material density)
```

\[ R_g = \frac{P \cdot x}{L} \]
\[ R_d = P - R_g \]
\[ M = R_d \cdot x = R_h \cdot (L - x) \]
\[ \sigma = \frac{M \cdot y}{I} \]

where
\( \sigma = \) maximum bending stress
\( M = \) maximum bending moment
\( I = \) second moment of area \( \frac{ah^3}{12} \)
\( y = \frac{h}{2} \) distance to the extreme fibre
You have been allocated the task of writing the function and the relevant help on its use.

To illustrate the use of the function write an *.m script that plots the mass of the beam versus the aspect ratio of the cross section from 0.1 to 5.0 for the given load conditions. Add the grid and label the graph with relevant data.

Modify the function `beamSize.m` in such a way that the width, height and mass are returned in one structure variable.

**Exercise 4**

The motion associated with free vibration of an undamped second order system (mass on a spring) with the natural frequency of $f$ Hz and the initial phase $\varphi_o$ can be expressed as

$$x(t) = x_o \cos(2\pi f t + \varphi_o)$$

Write a function that returns \{x\} for the given time vector \{t\}, the frequency and the initial phase. Using `nargin` and `nargout` allow the following default behaviour: the frequency 1000 Hz, the phase 0, and the optional plot.

Notice that a sinusoid is the same as cosinusoid with the initial phase of $-90^\circ$.

Investigate graphically the effect of summing more and more terms of a series of sinusoids in the time span of one second by applying the following pattern of amplitude:

1, 1/3, 1/5, 1/7, 1/9 etc and the corresponding pattern of frequency: 1, 3, 5, 7, 9 etc.

Using the `pause` statement between consecutive graphs may help.

Consider two cases:

- the initial phase is 0 for all terms.
- the initial phase varies and is allocated from the uniform random distribution between $-\pi$ and $+\pi$ radians (or $-180^\circ$ and $180^\circ$).

The summations of the first 2, 4 and 6 terms for the two cases are illustrated.