ENSC 180: Introduction to Engineering Analysis

Assignment 2

Due: 6.00 p.m., January 29, 2018

Note: *MATLAB codes should include definition of all variables; headings to identify the program structure plan; and appropriate captions and labels for tables and figures. Marks will be deducted for poorly documented answers.*

1. Consider the equations *cos(x) = x* and *tan(x) = x*. Plot these functions and write a MATLAB code to find their roots in the range $-2\pi < x < 2\pi$ to a precision of 0.01 radians. (15 marks)
2. Students in a class have the following final marks.

   x= [73 92 65 41 37 80 67 54 90 82 85 69 76 74 82 87 69 78 85]

   The grading scheme is: >= 90 A+; 80-89 A; 75-79 B+; 68-74 B; 60-67 C+; 50-59 C; 40-49 D; <40 F. Write a MATLAB code to assign grades for this class. Print the marks and corresponding grades in two columns. (20 marks)
3. Wind tunnels are extensively used in airplane and spacecraft design to assess drag, which is the force generated by an object when moving through a fluid such as air. Inside a wind tunnel an object (e.g., model of a plane) is held stationary and air flows through the tunnel at different speeds. The object is instrumented to collect data. Drag is calculated using the following equation.

   $$F_d = C_d(\rho V^2 \mathrm{A}/2)$$

   where C_d, ρ, V and A denote the drag coefficient, air density, velocity of the aircraft and the surface area over which the air flows.

   Write a MATLAB code that requests the measured drag force, air velocity, surface area and air density as input, calculate the drag coefficient and plot drag force over the velocity range 0 to 300 km/h. (15 marks)
4. The height of a rocket is approximated by the following equation.

   $$H = 2.13t^2 - 0.0013t^4 + 0.000034t^{4.751}$$

   where H is the height (meters) and t is the time (seconds).

Calculate the maximum height reach by the rocket using MATLAB, time to reach the maximum height (one second accuracy) and the time the rocket hit ground (one second accuracy). Compare your answers using analytical methods. Plot H and t from t=0 to until the rocket hit ground. (20 marks)

5. The parking hours to be used by three people at Vancouver Airport over 10 days are given below.

4.0	1.5	6.0	0.75	12.0	72.0	0.0	0.0	4.0	2.75
48.0	0.0	5.5	1.00	3.00	2.00	1.5	2.5	4.0	1.5
1.0	1.5	5.0	8.0	1.5	2.0	1.5	1.75	12.0	2.0

The rate structure for parking is:

Short-term parking: First 30 minutes $2.50 and each additional 15 minutes or fraction thereof is $ 1.00. Daily maximum is $ 25.00.

Long-term parking: First 3 hours $ 10.00 and each additional hour or fraction thereof is $3.00. Daily maximum is $ 18.00. Weekly maximum is $ 80.00.

Write a MATLAB code to decide which parking lot (short-term or long-term) should be used each time to minimize the cost and calculate the total minimum parking bill over the 10 days for each person. (30 marks)