Problem I (25%)

1. Write a MATLAB sequence code to create an array of length 450 with alternating zeros and ones.

2. Are the series below convergent or divergent? What are the values of S1 and S2?
   
   \[ S_1 = \sum_{n=1}^{\infty} \frac{\sin(n)}{n^2} \]
   
   \[ S_2 = \sum_{n=1}^{\infty} \frac{n}{n^2 + 1} \]

Problem III (35%)

Sketch and label the curve C (y Vs x) defined through the following parametric equations on the same figure with (x Vs t) and (y Vs t):

\[
x(t) = \begin{cases} 
  t + 2 & \text{for } -3 \leq t < -1 \\
  +1 - \frac{1}{\sqrt{3}} \tan \left( \frac{\pi}{3} (1 - t^2) \right) & \text{for } -1 \leq t < 0 \\
  -1 + \frac{1}{\sqrt{3}} \tan \left( \frac{\pi}{3} (1 - t^2) \right) & \text{for } 0 \leq t \leq 1 \\
  0 & \text{for } -3 \leq t < -1 
\end{cases}
\]

\[
y(t) = \begin{cases} 
  \frac{1}{\sqrt{3}} \tan \left( \frac{\pi}{3} (1 - t^2) \right) & \text{for } -1 \leq t < 0 \\
  -\frac{1}{\sqrt{3}} \tan \left( \frac{\pi}{3} (1 - t^2) \right) & \text{for } 0 \leq t \leq 1 
\end{cases}
\]
Problem IV (25%)
Write a MATLAB function M-File that inputs the sum and product of the roots of a quadratic function and outputs the value of this function for an arbitrary array of data x.

Problem V (25%)
Up-Down algorithm is described as follow:
1- Let N be some positive integer.
2- If N is even, divide it by 2.
3- On the other hand, if it is odd, multiply it by 3 and add 1.
4- Repeat until N becomes 1.
It appears that this algorithm converges to 1 for all numbers N. Write a MATLAB sequence code to implement this algorithm. Your code should compute the number iterations this algorithm will need to converge for a specific scalar number. **Hint: Check the MATLAB command “rem”**