Instructions: Solve all four problems. Every problem is worth 10 points. Write your codes following the strategy discussed in the "Structure of the program and program design" video and the format used in the sample programs discussed in the class and lecture videos. Make sure that your code is clear, readable for users other than yourself, and properly commented. Once finished, include all your program files and figures into a zip file named after your last name and homework number (e.g. "Ullah_HW1.zip") and submit it through canvas. Submitting individual files for each problem or part of the problem will not be accepted and disregarded. There is no need to include big data files generated by your programs unless the data files are read by your programs (that is the program reads data from the file and uses that data). Email me any questions or concerns about the homework either through canvas or directly my email address.
Note: You are allowed to submit incomplete codes for partial credit.

Problem 1: Write a program that reads the length, L, of a simple pendulum and gives the period, T, as output, where

$$T = 2\pi \sqrt{\frac{L}{g}} \qquad (1)$$

Problem 2: Write a program to calculate $y(t)$ from the equation

$$y(t) = \begin{cases} -3t^2 + 5 & t \geq 0 \\ 3t^2 + 5 & t < 0 \end{cases} \qquad (2)$$

for values of t between -9 and 30 in steps of 3.

Problem 3: The power series for $(x+y)^n$ is

$$(x + y)^n = x^n + nx^{n-1}y + \frac{n(n-1)}{2!}x^{n-2}y^2 + ... + y^n \qquad (3)$$

(a) Write a program that calculates $(x+y)^n$ for $x = 0.1$, y=0.2. Use a fixed $n = 4$. Compare the result with intrinsic Fortran formula (x+y)**n by calculating the relative error

$$Error = \frac{|\text{Approximate value } - \text{ Actual Value}|}{\text{Actual Value}}, \qquad (4)$$

where Approximate Value is from equation (3) and Actual Value is the value from intrinsic Fortran formula. Remember that absolute value of y, |y|, is written as abs(y) in Fortran. Write your output in the format

x   Error
…   …

(b) Change your program in (a) to calculate Error for different values of $n = 1, 2, 3,$ ……10. Plot Error versus n using matlab.

Hint: You will need nested iterative loops.

Problem 4: The root mean squared (rms) average and harmonic mean of a set of numbers is given as

$$rms = \sqrt{\frac{1}{N}\sum_{i=1}^{N} x_i^2} \qquad (4)$$

$$harmonic \quad mean \; = \frac{N}{\dfrac{1}{x_1}+\dfrac{1}{x_2}+....\dfrac{1}{x_N}} \qquad (5)$$

Write a program to find rms and harmonic mean of five numbers 82, 17, 112, 19,131. Have your program exit when either the last number is reached or a negative number is entered.