**ENEL101**

**Problem set 6**

**M File Programming**

**Important Notes:**

* This assignment is about writing user defined functions for applications. The questions are based on content from chapters 8 and 9 of the textbook “Matlab, An introduction with applications”.
* The function files will be tested by the auto-tester using randomly generated data.
* Do NOT make any plots in your code.

**Make sure your final submission runs without syntax error.** As usual, template files that do not run without syntax error will be rejected by the auto-marker, and you will have to visit Chris in person to demo your code and get the marks.

**Q1.** Write a function that adds an input polynomial to the polynomialthen finds the root with the largest real part (most positive real part) of the result, and outputs the real part of that root. Hint: you will first have to add leading zeros to either the input polynomial vector or (whichever is shorter).

**Q2.** Write a function that accepts the vector of data points and and a number *n* as input arguments, and determines a linear equation in the form of that best fits the data and also an *n*th order polynomial that fits the data (. Then output the average error between the data points and the regression curves in a 2 x 1 row vector . Use the Matlab polyfit() and polyval() functions. The input arguments are the boiling temperature of water at various altitudes as in

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **(meters)** | 0 | 608 | 1520 | 2280 | 3040 | 6384 | 7904 |
| **(Celsius)** | 100.00 | 98.88 | 95.00 | 92.22 | 90.00 | 81.11 | 75.55 |

Do not plot your results in the assignment file! However, if you want to see the result in graphical form for your own interest cut and paste this code into your Matlab window:

hplot=linspace(h(1),h(end),100);

plot(hplot,polyval(T1,hplot))

title('Question 2')

xlabel('h')

ylabel('T')

hold on

plot(hplot,polyval(T2,hplot),'--')

legend('1st order fit','nth order fit')

plot(h,T,'o')

hold off

**Q3.** Write a function that accepts the vector of data points and as input arguments and determines the best exponential equation in the form of that best fits the data, using the Matlab polyfit() function. Then output 1x2 vector . The input arguments are the number of bacteria measured at different times as

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **(min)** | 10 | 20 | 30 | 40 | 50 |
|  | 38,000 | 60,000 | 250,000 | 500,000 | 1000,000 |

Do not plot your results in the assignment file! However, if you want to see the result in graphical form for your own interest cut and paste this code into your Matlab window:

figure(2)

plot(t,N,'o');

hold on;

t=[0:1:max(t)];

plot(t,b\*exp(m\*t));

xlabel('t');

ylabel('N');

title('Question 3');

hold off;

**Q4.** Write a function that accepts input *b* and finds the positive root of . Use the Matlab fzero() function for this. Hint: use the @(x) method of creating a function from Section 7.9.1.

**Q5.**  The following wind tunnel data shows the aerodynamic drag force on a car, , as a function of the car velocity, .

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | 20 | 40 | 60 | 80 | 100 | 120 | 140 | 160 |
|  | 10 | 50 | 109 | 180 | 300 | 420 | 565 | 771 |

Write a function that accepts an arbitrary value for and output the corresponding interpolated value of . Use Matlab function interp1() with the ‘spline’ method for the interpolation.



**Q6.** An RLC circuit with an alternating voltage source is assumed. The source voltage is given by , where in which is the driving frequency. The normalized amplitude of the current, , in this circuit is given by

where (), (H), and (F) are the resistance of the resistor, the capacitance of the capacitor, and the inductance of the inductor, respectively. Write a function named that accepts , , and as input arguments and finds the natural frequency of the circuit (the frequency at which is maximum). The natural frequency of (Hz) is the output argument. Use Matlab’s fminbnd() for this application and search over . Note that minimizing is equivalent to maximizing .

**Q7**. The electric field *E* due to a charged circular disk at a point at a distance *z* along the axis of the disk is given by

where is the charge density and is the permittivity constant. Given input *z,* write a function to determine the electric field at a point located *z* m from a disk with radius m charged with First find the solution using Matlab’s quad() and then find the solution using Matlab’s ode45(). Have the function return the difference between these two solutions. Hint: in this case we have a *dE/dr = f(r)* but the ode45()function is trying to solve a system *dE/dr = f(r,E)*, so for the second part of the question you have to create a f=@(r,E) even though E doesn’t actually appear in the function. Note that both quad()and ode45()are numerical approximate solutions to the integral. We will calculate the actual correct answer in the next assignment using symbolic math.