Program Study Aerospace Engineering
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HW #4 Regression, Interpolation, ODE, Integral

WF-2202 Engineering Analysis and Numerical Method

Given Out : 26 May 2025, Due Date : 2 Jun 2025 7AM

1. The specific heat of aluminum varies with temperature in the following table:

T (°C)	−250	−200	−100	0	100	300
c_p (kJ/kg·K)	0.0163	0.318	0.699	0.870	0.941	1.04

   a.) Determine the polynomial function by using Lagrange interpolation method
   b.) Determine the polynomial function by using Newton Method, create the table to determine the number of polinomial constants that will be needed
   c.) Plot the data points and the the polinomial functions a) & b) in the same graph, and then analyze them. Use matlab to plot them.
   d.) Calculate the value of C_p at T = 200^0C and 400^0C by using the above two methods, and then analyze the results

2. The data for the early steam engines are given in the table below. Using the least square fit for linear regression, do the following:
   a. Fit a straight line, quadratic, and cubic regression lines to the data
   b. Compute the standard deviation, determine which regression line that has the best fit
   c. Plot the best fit regression line and overlay it to the data points. Use matlab for plotting the data.

Year	Efficiency (%)	Type
1718	0.5	Newcomen
1767	0.8	Smeaton
1774	1.4	Smeaton
1775	2.7	Watt
1792	4.5	Watt
1816	7.5	Woolf compound
1828	12.0	Improved Cornish
1834	17.0	Improved Cornish
1878	17.2	Corliss compound
1906	23.0	Triple expansion

3. Solve the following initial value problem ODE over the interval from t = 0 to 5 where y(0) =4, and y'(0)=0. Display all of your results on the same graph. Compute your numerical solution with a matlab subroutine:

$$\frac{d^2y}{dx^2} + 0.6\frac{dy}{dx} + 8y = 0$$

   a. Analytically
   b. Euler's method with h = 0.5
   c. Second-order RK Method with h = 0.5
   d. Fourth-order RK method with h = 0.5
   e. Predictor-Corrector method with h = 1.0

Plot your answer for a to e in the same graph using matlab. Intrepret your results

4. Use the numerical integration method to solve the following integral:

y = $\int_1^{100} \exp(-x)/x dx$ 1< x < 100,

Use various number of partitions/panels N = 10, 20, 40, 100, 1000:

a) Calculate y with Trapezoidal Rule
b) Calculate y with Simpson 1/3 Rule
c) Calculate y with Simpson 3/8 Rule
d) Plot y vs N in the same graph.