ECOR 2606 Lab #10

Question 1: The temperature (in K) and constant pressure specific heat (in kJ/kg-K) of carbon dioxide at 78 bar are tabulated below.

Temperature	300	305	310	315	320
Specific Heat (c_P)	4.1354	10.0120	6.5956	3.5266	2.6559

Plot the data points plus i) an interpolating polynomial, ii) a regular cubic spline (using the "not a knot end" condition), and iii) the results of piecewise cubic Hermite interpolation. Estimate the value of c_P at temperatures of 303 K and 312K using each of these interpolating techniques.

You will find that calculating the interpolating polynomial produces a warning message (although things still work). Eliminate this message by scaling and centering the temperature values (as described in the set of posted notes from lecture 18).

Use the interpolating polynomial to precisely estimate the temperature above 306 K at which c_P is 6.

Question 2 : (from *An Engineer's Guide to MATLAB*) In order to determine the load distribution in axial thrust bearings under an eccentric load, the following integral must be evaluated:

$$I_m(\varepsilon) = \frac{1}{2\pi} \int_{-a}^{a} \left[1 - \left(1 - \cos(x)\right) / 2\varepsilon\right]^c \cos(mx)dx$$

where $a = \cos^{-1}(1-2\varepsilon)$
$m = 0 \text{ or } 1$
$c = 1.5 \text{ (ball bearings) or } 1.1 \text{ (roller bearings)}$
$\varepsilon > 0$

What is $I_1(0.6)$ for a ball bearing?

P.S. Any students who continue to doubt the value of this course are welcome to solve this problem analytically.

Question 3: (from text 17.8, modified) The table below tabulates velocity against time.

t (sec)	1	2	3.25	4.5	6	7	8	8.5	9.3	10
v (m/s)	5	6	5.5	7	8.5	8	6	7	7	5

(b) Use the trapezoidal rule to estimate the distance travelled between $t = 1$ and $t = 10$. You may use the appropriate Matlab function.

(c) Find the cubic that best fits the data and estimate the distance by using Simpson's 1/3 rule and the value of this cubic at $t = 1$, $t = 5.5$, and $t = 10$.

(d) Integrate the cubic between 1 and 10 using classical integration techniques (implement the necessary operations in Matlab). How does the answer obtained compare with your answer from part (b)? Add a comment that explains the difference (or the lack of a difference) at the end of your Matlab code.

Note: The material required by question 2 will be taught by lecture 19

Create one .m file that solves all three parts sequentially Call it q1.m and submit it as proof of attendance.