EML3041 Computational Methods

Fall 2023

Week 11: Oct 30 – Nov 3

Answer each question in sequence on a fresh sheet of paper. *Solve the problem as if you were submitting them for a test.* Identify each part separately if a question has parts. You will be asked to submit Problem#1 at the end of the class.

1) The following data is given for the linear coefficient of thermal expansion, α vs. temperature, *T* for steel.

Temperature, T	Linear Coefficient of Thermal Expansion, α
٥F	µin/(in-ºF)
80	6.47
0	6.00
-40	5.72

A steel cylinder of radius 7" and length 9" is left for a long time in a fluid maintained at $-20^{\circ}F$. The density of steel is given as 7800 kg/m^3 and its elastic modulus is 207 *GPa*. The cylinder was initially at room temperature of 80°F. Given is the formula

$$\Delta L = L \int_{T_{room}}^{T_{fluid}} \alpha dT$$

a) Write the expression for calculating ΔL showing the value of L and the limits of integration.

b) How are you planning to approximate the integral? Write a couple of complete sentences explaining the plan.

c) Using *Trapezoidal rule with unequal segments or any other scientific method*, estimate the change in length of the cylinder.

d) You used a method in part (c). Enumerate another method that is different from part (c). You do not need to estimate the change in length of a steel cylinder

Answer: a) Not given intentionally b) Not given intentionally c) Depends on the method: $\Delta L = -0.005555$ " is an answer d) Not given intentionally

2) Given

$$f(x) = \begin{cases} 2.4x, & 0 \le x \le 0.22, \\ 3.2x^2, & 0.22 < x \le 2.4, \\ 5x^3, & 2.4 < x < 5 \end{cases}$$

a) At how many points would the function be evaluated if you are estimating the value of the integral $\int_0^{2.4} f(x) dx$ by using the composite trapezoidal rule with two segments?

b) How many function evaluations are made if you are estimating the value of the integral $\int_0^{2.4} f(x) dx$ by using the composite trapezoidal rule with two segments?

c) Estimate the value of the integral $\int_0^{2.4} f(x) dx$ if using the composite trapezoidal rule with two segments?

Answer: a) Not given intentionally, ask when done b) Not given intentionally, ask when done c) 16.588