

Temperature Measurement and Analysis

Purpose:

The purpose of this lab is to learn how to use the computer to measure temperature versus time and then to process the data.

Equipment:

- Bluetooth Temperature sensor.
- Capstone Software
- Excel
- MathCAD

Procedure:

1. Connect the USB toggle to the laptop
2. Turn on the temperature sensor.
3. Start the Capstone software
4. Under available wireless sensors select the sensor number that matches yours by double clicking.
5. The sensor should show as ready to go.
6. Go to the far right, under Displays and double click on Graph. On the upper left, click the x next to Tools. This expands the graph to fill the page.
7. Under the horizontal axis click on Select Measurement. Then select Time(s).
8. Next to the vertical axis click on Select Measurement and select Temperature($^{\circ}\text{C}$).
9. Below the graph, change the sample rate to 2.00 s.
10. Above the graph, click on the Gear. Then choose Active Data Appearance. Deactivate Show Run Symbols and Show Connecting Lines; then OK.
11. In the tools palette under Data Summary, click on Time(s). A Gear appears to the right. Click on the Gear. Then choose Numerical Format. Change the Number of Decimal Places to 6. Then OK. Similarly, on the vertical axis change the Temperature data to 6 decimal places.
12. In the lower left click on **Record** (big red button). Collect data for 30 seconds and then click on **Stop**.

13. Under File, choose Export Data. Give the file a name and Save to your flash drive.
14. Open Excel and copy the data from the text file into the excel worksheet.
15. Look over the data to make sure it looks OK--no missing numbers, reasonable temperatures and times, etc.
16. Open MathCAD to transfer the data to it from excel. Perform the following steps:
 - a. Place the cursor a 1/4 of the page below the top of the page.
 - b. In Mathcad type t: and then paste the time data from excel.
 - c. To the right of the time data type T: and paste the temperature data from excel.
 - d. Below the two entries type the following entries. Put one entry per line. (Remember \diamond means click outside the region)
 - e. $i:0;15 \diamond$
 - f. $s:cspline(t,T) \diamond$
 - g. $h(x):interp(s,t,T,x) \diamond$
 - h. $x: 0,0.01;30 \diamond$
17. To find the area under $h(x)$ from 0 to 30, type the following in Mathcad.
 - a. $f:\& \diamond$ (this will give you the integral. Refer to the Mathcad tutorial)
 - b. $'f=' \diamond$ (this will evaluate the integral. Refer to the Mathcad tutorial)
18. Plot T and $h(x)$ in the y-axis and t and x in the x-axis.
 - a. Type @; to create a plot region.
 - b. On the y-axis type: T[i (hit the space bar once) , $h(x)$. \diamond
 - c. On the x-axis type t[i (hit the space bar once) ,x. \diamond
19. MathCAD will insert the limits and graph both functions.
20. Submit the MathCAD file through Canvas.