Lab 3 - Thermal System

3/25/21 Michael White Section 3 / Online

```
close all;
clear all;
clc;

% Import data table for voltage
tData = readtable('thermalData.xlsx');

% Define parameters for resistance calculations
L_air = 48e-3; %m
t_glass = 3e-3; %m
K_cond = 0.025; %W/m*K
h_conv = 0.79; %W/m^2*K
K_glass = 1.41; %W/m*K
r_waterplate = 15e-3; %m
r_airplate = 16.4e-3; %m
r_flask = 0.02; %m
H_cone = 0.083; %m
A_waterair = pi*r_airplate^2; %m^2
A_waterplate = pi*r_waterplate^2; %m^2
A_water = (pi*r_flask*sqrt((r_flask^2)+(H_cone^2))-...
    (pi*0.0164*sqrt((0.0164^2)+(0.066^2)))); %m^2

% Calculate resistances
R_H = t_glass/(K_glass*A_waterplate);
R_G = t_glass/(K_glass*A_water);
R_cond = L_air/(K_cond*A_waterair);
R_conv = inv(h_conv*A_waterair);
R_A = inv(inv(R_conv)+inv(R_cond));
R_L = inv(inv(R_G)+inv(R_A));
R_sys = R_H+R_L;

% Capactitance calculation
Cp = 4.184e3; %J/kg*K
m = 15e-3; %kg
C = Cp*m;

% Time Constant calculation
TheoTau = R_sys*C;

% Calculate parameters related to time constant value
maxTemp = max(tData.Temp);
minTemp = min(tData.Temp);
rangeT = maxTemp-minTemp;
ExpTau(2) = 0.632*rangeT+min(tData.Temp);

% Find the closest point to the calculated time constant value
absDiffList = abs(tData.Temp-ExpTau(2));
ExpTau = ...
    [tData.Time(absDiffList == min(absDiffList)),...
     tData.Temp(absDiffList == min(absDiffList))];

% Plot figure of shifted data with time constant point.
figure;
hold on;
```

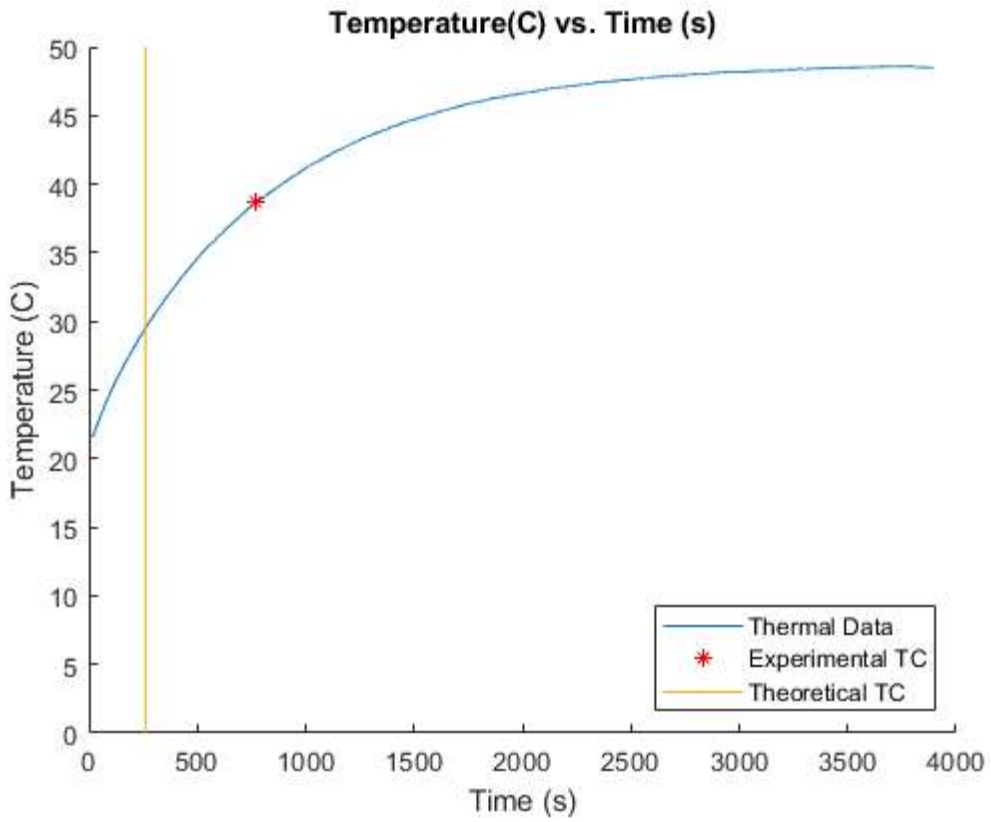
```
plot(tData.Time,tData.Temp);
scatter(ExpTau(1),ExpTau(2),'*r');
plot([TheoTau,TheoTau],[0,50]);

% Cleanup graph and add legend, title, and labels
title('Temperature(C) vs. Time (s)');
legend({'Thermal Data','Experimental TC','Theoretical TC'},'Location','southeast');
xlabel('Time (s)');
ylabel('Temperature (C)');

% Display results to command window
disp('Theoretical TC =');disp(TheoTau);
disp('Experimental TC =');disp(ExpTau(1));
```

```
Theoretical TC =
  260.5925

Experimental TC =
   769
```



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