Test Reflection – Exam 2

The second exam for MET 440 Heat Transfer asked us to utilize the concepts reviewed in class since the first exam in addition to some concepts from the first part of the class. We were asked to solve a differential equation to obtain a temperature profile analytically. Then, we were to use a computer program named Comsol to numerically solve the same problem and compare the results.

The first part of the exam required us obtain a temperature profile using a differential equation and boundary conditions which were chosen based on the geometry and characteristics defined in the problem. The scenario in the given problem was a spherical container filled with waste having heat generation and convection at the outside surface. This lead to using equation 5-38a on page 160 of the book. The boundary condition at the inner radius was given and we were asked to solve for the temperature profile. I have not had a lot of experience with differential equations but made my way through most of the calculation without issue. Where I went wrong was breaking down the equation used in the boundary condition at the inner radius. The equation given used hbar, which was defined for us, however, I did not introduce it to the temperature profile equation and simplify it correctly, giving me the wrong temperature profile equation. This mistake also lead to my answers for parts b and c being wrong, as they were based off of the derived equation from the first part.

The second part of the exam required us to use Comsol to numerically solve the same problem as above. We were to take the variables given to us in the exam and define them in Comsol, as well as the geometry and boundary conditions. While it seemed straight forward while watching Professor Ayala explain it in the lectures, I struggled to arrange the equations properly and place them in the proper areas. At first, I was not able to get Comsol to analyze the problem correctly and create the graph required. I was frustrated to say the least. Once I defined the boundary conditions correctly and modified some parameters I was able to obtain a graph from Comsol, though it turned out to not be correct.

I was not able to generate a graph using my calculated temperature profile in Comsol, therefore I was not able to complete the exam. At the time, I was not sure if the equation I was entering was not correct or if I wasn't entering it into the program correctly. As it turns out, as discussed above, my temperature profile equation was not correct. Perhaps if I had had additional practice with both differential equations and the Comsol software, the outcome would have been different.

Being able to determine temperatures throughout a body of any shape or configuration is important from a design and safety standpoint. From the design side, an engineer must have an idea of what type of temperatures are being generated to be able to decide what material is best for the job and how thick should those material layers should be to withstand the anticipated temperatures. If the wrong material is chosen for a given application with high heat, the material could melt or be subjected to premature failure. If there are people near this equipment, safety precautions must be made. Is insulation needed to cut the temperature down to safer levels? Again, what material and how thick? These are just some of the considerations that must be taken into account when designing something with high heat levels.

These types of heat problems are not something I encounter in my current job. However, the process of being able to determine theoretical values for design considerations is important in most any field. It is important for us as engineers to know the limits and constraints for given materials and processes, and how they are affected in different situations to be able to create a safe and robust design.

While the heat concepts we are studying in this class do not pertain to my current work, I never know where I may end up in the future. It is important to have a well-rounded education and though I may not use many of these concepts, it good to have an idea that these concepts exist and the basic principles they are founded on.

Grading Rubric	
Writing	
Purpose	0.4
Drawings	0.6
Sources	0.5
Design Considerations	1
Data & Variables	0.5
Procedure	2
Calculations	0.5
Summary	0.3
Materials	0
Analysis	0
Weighted Total	0.58
Problem 1	
Right Diff Eq	1
Right Boundary Cond	1
Integrate Diff Eq	1
Obtain C1 and C2	0.8
T Equation	0.5
Tci, Tsi, Tso Eq.	0.3
Units of C2	0
What if g=0?	0
Result Correctness	0
Weighted Total	0.5111111
Problem 2	
Right Geometry	1
Right Material Properties	1
Right BC and g	1
Comparison Plot for T	0
Final Result Correctness	0
Weighted Total	0.6