This test demonstrates my work towards two of the course objectives. The first being "Solve steady one-dimensional heat conduction problems, multi-dimensional heat conduction problems, and unsteady heat conduction problems". My work on the first question accomplishes this. The hemispherical fuel element in problem one was a steady one-dimensional heat conduction problem since the heat travelled radially outward in one direction. I developed a temperature profile equation within the fuel element and heat transfer equation at the outer surface of the hemisphere. The second objective is "Use commercial computer programs to numerically solve heat transfer systems". My work on the second question definitely accomplished this. I solved problem one numerically using COMSOL to find the temperature profile of the fuel element and to find the heat transfer at the surface of the element. I also compared the temperature profiles and heat transfer from the analytical and numerical methods.

My test matches the available solution very well. I didn't make any mistakes on this test. The advice I would give myself would be to keep studying like I do and take my time.

WRITING RUBRIC (looking at the whole test, not to a particular problem)

| | |
|---|---|
| Purpose | 0.5/10.0 |
| Drawings | 1.0/10.0 |
| Sources | 0.5/10.0 |
| Design considerations | 1.0/10.0 |
| Data and variables | 0.5/10.0 |
| Procedure | 2.5/10.0 |
| Calculations | 2.0/10.0 |
| Summary | 0.5/10.0 |
| Materials | 0.5/10.0 |
| Analysis | 1.0/10.0 |
| TOTAL | 10.0/10.0 |

PROBLEM 1)

| | |
|---|---|
| Right Diff Equation | 1/10 out of 1/10 |
| Right Bound Cond | 1/10 out of 1/10 |
| Introduce g and k before integration | 1/10 out of 1/10 |
| Integrate Diff Eq | 1/10 out of 1/10 |
| Get C1 and C2 with BC | 1/10 out of 1/10 |
| T equation | 1/10 out of 1/10 |
| Q equation | 1/10 out of 1/10 |
| Units of C1, C2, and Q | 1/10 out of 1/10 |
| What if go=0? | 1/10 out of 1/10 |
| Final result correctness | 1/10 out of 1/10 |
| TOTAL | 10/10 out of 10/10 |

PROBLEM 2)

| | |
|---|---|
| Right geometry | 1/6 out of 1/6 |
| Right material properties | 1/6 out of 1/6 |
| Right BC and g | 1/6 out of 1/6 |
| Comparison plot for T | 1/6 out of 1/6 |
| Heat transfer comparison | 1/6 out of 1/6 |
| Final result correctness | 1/6 out of 1/6 |
| TOTAL | 6/6 out of 6/6 |

FINAL GRADE:

10.0/10.0 + (80/2)*(10/10+6/6) = 90

My strength on this test was definitely on the second question of the test. I felt quite strongly about my ability to use COMSOL. I was able to successfully answer the second part of the test relatively easily. I felt confident in my ability to find the temperature profile and heat transfer on the outside of the hemisphere. I would say my weakness was on the first question. Calculus has never really been my strongest subject. I had to work slowly and tried to be very careful in developing the analytical temperature profile equation. However, considering how many steps were involved to develop it, I would say I still did pretty well.

One thing that I encountered while working on the test was an error in my temperature profile equation on problem 1. I found the temperature profile numerically in COMSOL and when I compared it to the temperature profile from the equation I developed in problem one, they did not match. At this point, I felt quite strongly about the numerical solution. I went back and checked my analytical temperature profile equation to discover that I had dropped a negative. After correcting this, they both matched. I would say that I felt quite strongly about my ability to troubleshoot the error in my equation. The steps I use are to read each question and look at drawings, if they are present, one at a time and not worry about the next question. Next, I write the purpose, create a drawing, write the sources, design considerations, data and variables, write the procedure based on what needs to be calculated from the purpose, perform the calculations and check my numbers again, read the problem again to ensure that I have solved the problem correctly and answered all parts, write the summary, materials, look back over the problem and write the analysis. I did this for both problems. I wouldn't change anything about it, I believe it worked quite well since my test solution matches the available solution very well. I have learned about heat generation and how it affects the temperature profiles and the rate of heat transfer within a body. I have also learned how to use COMSOL to numerically solve these problems.

Engineers would use these concepts in the field of power generation such as nuclear power. An engineer may need to look at the heat being generated within a body to determine how much heat will be released at the surface that can be used to heat water and turn it into steam and be converted into electricity. If an engineer were designing a new system, they would use COMSOL to look at the temperature within the body to determine if the solid they intend to use can withstand those temperatures. Engineers who design electric heaters would use the concepts of heat generation and COMSOL to determine what the temperature will be throughout the element for a specified ambient temperature. They could use this information to choose a material. Engineers who design electronics would also use this to determine the temperatures of components and how much heat is being transferred to other components within a circuit. Once they determine the temperatures and heat transfer from COMSOL, they could use this information to determine if fins are needed to transfer the heat away from the circuit. They could also use COMSOL to model these fins to determine if they are enough to transfer to heat away from the components. At this point, I don't know where I'll be using these new concepts as I haven't decided on the field I want to pursue. I am confident that I will need it because heat is everywhere and always needs to transferred to or removed from somewhere. I haven't been able to apply it yet to my work or other courses yet. I spent approximately 5 hours in total working on this test. My time was fairly well organized. I spent quite a bit more time on the first question

because of the problems I encountered with the temperature profile equation. I spent approximately 3 hours on the first, one hour on the second, and about another hour reviewing all my calculations, COMSOL,  formatting, and writing.