Test Reflection – Exam 1

The first exam required us to recall and utilize multiple concepts from the first module of the MET440 Heat Transfer class. These concepts include differentiating between the different modes of heat transfer, the laws of conduction and convection, and applying thermal circuits to obtain heat and temperature values. The problems required us to be able to recognize the mode of heat transfer, the geometry of the assembly in question and any boundary conditions, if applicable. This exam provoked a deeper thought process than simply regurgitating equations and ideas taught to us in class. It required us to analyze the problem and to come up with ways to combine the ideas that we had learned throughout the first module in the class.

I felt comfortable with the first problem on the exam. We had reviewed the concepts involved in class and worked numerous problems combining the ideas of conduction and convection and using thermal circuit analysis to solve for heat and subsequently, temperatures. The thermal conductivity values were taken from one of the tables in the back of the book and had to be converted from W/m*°C to BTU/hr*ft*°F. There was a discrepancy between the value I chose to use for *k* of the stagnant air in the wall and the value used in the posted solution. I used a value of .025 W/m*°C which I borrowed from an example problem out of the book which contained stagnant air between two glass panes, while the solution used .02624 W/m*°C from the table in the back of the book at 300 K.

Part a asked us to calculate Q and the temperature at the inside surface of the wall if the air in the wall space was stagnant and there was a 5mph wind blowing outside. I calculated a Q of 3.984 BTU/hr with an inside wall temperature of 74°F while the solutions showed a Q of 4.122 BTU/hr with an inside wall temperature of 73.969°F. The temperature was virtually the same while there was a 3.46% error between the heat transfer values which could easily be explained by the discrepancy in the *k* values or a result of rounding.

Part b of question 1 asked us to calculate Q and the temperature at the inside surface of the wall if the air in the wall space was moving and there was a 5mph wind outside. For this scenario I calculated a Q of 26.405 BTU/hr with an inside wall temperature of 68.38°F. The posted solution showed a Q of 28.620 BTU/hr with an inside wall temperature of 67.845°F, which leads to a 8.39% error for the heat transfer and .79% error in the wall temperatures. Once again, close enough to be explained by the difference in *k* values or rounding errors.

Part C asked us to calculate the temperature of the moving air trapped in the wall if there is a 30mph wind outside. I calculated a temperature of 56.52°F for the air in the wall space while the solutions listed it as 56.659°F giving me a .25% error which requires no explanation.

The second problem on the exam asked us to analyze a bushing/shaft assembly, choose a temperature profile to use and to calculate the desired length of the shaft for given parameters. Unfortunately, I chose the prescribed temperature equation which was not the correct equation to use in the given scenario. The proper equation was the adiabatic equation with no heat loss at the tip of the shaft. I think I did not fully understand the applications for each equation and chose the prescribed temperature equation because we knew the temperature at the end of the shaft and were solving for L. The problem with this is that in this scenario X=L and given the equation I was using it led to the majority of the terms being cancelled.

After further explanation of the applications for the available equations by Professor Ayala, I know understand why the correct equation to use was the adiabatic equation. This equation fits the given scenario because the bushing/shaft assembly is symmetric with the coolest spot of the shaft being in the middle of the bushings, which is where we were analyzing the shaft. In addition, there is not heat loss at that point of the shaft which is another indication of needing to use the adiabatic equation.

The third problem contains a steel pipe embedded in a concrete block. The pipe is carrying hot water and we were asked to calculate the heat transfer through the concrete block with the given parameters and to calculate the mass flow rate of the water in the pipe. I calculated the Q as 74.33 kW with a mass flow rate of 3.534 kg/s while the provided solution listed Q as 75.06 kW with a mass flow rate of 3.5711 kg/s. These figures lead to a .098% error in the heat transfer and a 1.05% error in the mass flow rate. Again, these minimal discrepancies could be explained by a simple rounding error.

The concepts discussed in this module and covered in this exam are important to engineers for designing of HVAC units, heat exchangers and anything involving heat being generated in undesirable locations. Fluids and machine parts could fail if subjected to large amounts of heat for extended periods of time. A designer must be able to either design machine parts to withstand the heat being generated or be able to dissipate the heat and move it away from susceptible parts.

I have worked as a mechanic for the majority of my life, and working with machinery you are always faced with some type of heat, whether it be from a motor, a fluid or friction. Too much heat in an area can cause warping, melting of parts or fusing parts together so they no longer work as intended, if at all. Many engines I have worked with have cooling fins on their cylinders and heads to help dissipate heat. These concepts are all around us whether we realize it or not.

While I do not use the equations and deeper analysis studied in this course in my job or in my day to day life, the basic concepts are something that everyone should understand. I do not know where I will end up working or what my focus will be on, so I cannot say that I will or will not use the material and concepts learned in this course. However, at this point in the class I can say that if I do run into heat transfer in my career I will feel more comfortable having been exposed to it as I have in this course.

Grading Rubric			
Writing	**Problem 1**	**Problem 2**	**Problem 3**
Purpose	0.5	0.5	0.5
Drawings	1	1	1
Sources	0.5	0.5	0.5
Design Considerations	1	1	1
Data & Variables	0.4	0.5	0.5
Procedure	2.5	2.5	2.5
Calculations	2	0	2
Summary	0.5	0.3	0.5
Materials	0.5	0.5	0.5
Analysis	1	0.25	1
Weighted Total	0.99	0.705	1
Problem 1			
Thermal Circuit			
Air Space Stagnant	1		
Air Space Moving	1		
Individual Resistances	1.5		
Total Resistance	0		
Air Space Stagnant	0.5		
Air Space Moving	0.5		
Heat Both Cases	0.8		
T at Plasterboard	1		
T of Air in Wall Space	2		
Result	1		
Weighted Total	0.8454545		
Problem 2			
Justification for T Eq.	0		
Variables	1		
Use of COSH	0		
Results	0		
Weighted Total	0.2		
Problem 3			
Thermal Circuit	1		
Resistances	1		
Shape Factor	1		
Heat Loss	1		
Mass Flow Rate	1		
Results	1		
Weighted Total	1		