Carter Fishback 23-09-2019

MET 440: Test 1 Reflection

1.) Learning Objectives Covered

Test 2 expanded upon the learning objectives covered in test 1 by adding in the concept of heat generation within an object. This concept still required us to understand and implement thermal circuits, convection, conduction, and one-dimensional heat transfer. To successfully navigate this test, we had to understand how to apply the different boundary conditions within the given shape. We were then able to apply our knowledge of convection and conduction within the shape with given expressions that needed to be substituted into the partial differential equation provided, prior to integration. Overall this test was used to challenge us with a more in depth understanding of earlier problems used in the semester.

2.) Test Comparison (Lessons Learned)

Problem 1:

There were two mistakes found in the first problem. When deriving the second constant of integration, C2, I substituted the expression given in the problem for conduction, k. Instead of using the boundary radius, b, for the variable, r, in the conductivity expression, the variable, b, was not cancelled out properly. This resulted in an incorrect final temperature equation. Had I cancelled out the variable, b, in that one specific expression, the final temperature equation would have been able to be derived completely. The temperature equation found is not considered incorrect, but rather, incomplete. If I were to substitute b into the temperature equation for radius, r, the variables would cancel out to simplify down to the final equation found in the solutions posted.

The same mistake was also done when deriving the amount of heat generation dissipated at the outer most boundary layer, with radius b. A heat generation equation was able to be derived but the variable, b, was not substituted into r in the expression used for conductivity. Like the issue discussed above, the equation is not necessarily wrong, but rather, incomplete; if the radius of the outer most boundary, b, is substituted into this equation, it would be identical to the solution.

Problem 2:

The mistakes made in this problem were based on lack of procedure. I found the correct temperature profile with the numerical method conducted by the program itself. I did not include much information regarding the location of my drawn object as well. I left many settings as default when setting my parameters and material properties of the shape. However, since I did not derive the complete final temperature equation in problem 1, it led to an incorrect plot for the comparison of the analytical and numerical methods. The temperature profile computed by the program of the object does make since as it is in degrees Kelvin.

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3. Estimated Grade

Writing		Problem 1			Problem 2		
Purpose (0.5/10.0)	0.5	Right Diff Equation	1/10 out of 1/10	1	1. Right geometry	1/6 out of 1/6	1
Drawings (1.0/10.0)	1	Right Bound Cond	1/10 out of 1/10	1	2. Right material properties	1/6 out of 1/6	0.5
Sources (0.5/10.0)	0.5	Introduce g and k before integrat	1/10 out of 1/10	1	3. Right BC and g	1/6 out of 1/6	1
Design considerations (1.0/10.0)	1	Integrate Diff Eq	1/10 out of 1/10	1	4. Comparison plot for T	1/6 out of 1/6	0.5
Data and variables (0.5/10.0)	0.5	Get C1 and C2 with BC	1/10 out of 1/10	0.75	5. Heat transfer comparison	1/6 out of 1/6	0.5
Procedure (2.5/10.0)	2	T equation	1/10 out of 1/10	0.8	6. Final result correctness	1/6 out of 1/6	0.5
Calculations (2.0/10.0)	1.75	Q equation	1/10 out of 1/10	0.8			
Summary (0.5/10.0)	0.5	Units of C1, C2, and Q	1/10 out of 1/10	1			
Materials (0.5/10.0)	0.5	What if go=0?	1/10 out of 1/10	1			
Analysis (1.0/10.0)	1	Final result correctness	1/10 out of 1/10	0.5			
Total Points (x/10.0)	9.25						
Total Test Points	62.99166667						
Total Grade (Before HW Addition)	70%	Total Points		8.85	Total Points		4

4. Final Thoughts

The mistakes that I made on this test were served as a valuable lesson by teaching me how valuable software programs can be in calculating complex problems. However, it also reiterated the effectiveness of an analytical solution. After reviewing the provided solutions to the test, I feel as though I had a firm grasp of the heat generation concepts that were taught in this unit. The only issue that was found to affect my final result was failing to substitute the boundary radius, b, with the radius, r, to cancel out the variable. My solution can still be assumed correct though as I would only have to plug in the variable, b, for r.

Heat generation is an important concept that engineers must consider for modern technology. Many new technologies utilize electrical circuits or computerized systems, which generate heat in their individual components. Depending on the purpose, engineers must find a way to either dispel or harness such internal heat generation and how it will affect the overall system. This concept may also be important for the concept of friction induced heat transfer that is at a steady state. Heat generation concepts only broaden the scope of an engineers to effectively design mechanical systems that are capable of undergoing specific heat loads.

After completing this test, I understand heat generation better and how to apply methods of solving for the change in temperature throughout an object. By seeing the mistakes that I made on this test, I understand how to approach similar problems with a differential equation and how to obtain an equation for an analytical solution. I also have learned how to better utilize the software COMSOL to determine the heat transfer through a CAD drawing. Each of these lessons will be important in my future career as an engineer.