Approach

The approach below gives a guideline in how to solve the problems presented during this course. Correctly applying this approach will lead to a good understanding of the concepts presented in this course.

Analysis

1 Explain the problem: which physical phenomena are important in this problem?

2 Make a sketch of the problem

3 Give the known variables (with the appropriate units!)

Approach

1 Explain the assumptions you make to solve the problem

2 Show the solution method for solving the problem

Elaboration

1 Show the calculation steps and explain the equations you use

2 Give references if values are found online or in tables

Evaluation

1 Check the units of your solution

2 Is the answer realistic/expected?

3 Did you answer all the questions asked?

4 Iterate if this is required

Assignment 6

For Christmas dinner, the potato's and a turkey are prepared in the oven. Both dishes will have to cool down before they can be eaten.

(a) Turkey

(b) Potato

a) Based on which criteria can the lumped capacity model be applied?

b) For which of the two dishes is the lumped capacity model the most suitable to determine the cool down time? Explain why. And why will it give more accurate results for one than the other?

A potato ($k = 5.6$ W/mK, $\rho = 950$ kg/m^3, $c_p = 3000$ J/kgK) with a diameter of 6 cm, which initially has a surface temperature of 90 ^{o}C, is located in a room with an room temperature of 20 ^{o}C. It cools down due to convection ($h = 30$ W/m^{2}K).

c) Using the lumped capacity model, determine the time that it takes for the potato to cool down to 50 ^{o}C.

d) Evaluate the accuracy of the found answer in c).

e) Determine the amount of energy that the potato has lost, when cooled down from 90 ^{o}C to 50 ^{o}C.

f) Determine the maximum diameter of the potato, for which the lumped capacity model is still valid.

g) Provide a sketch of the temperature profile as a function of time, in the case that we would have let the potato cool down in the room for a very long time.

Note: clearly indicate the temperatures for t=0 and t$\rightarrow \infty$