Heat Transfer Questions & Answers

Question by Student 201428239

Professor, I am confused about Assignment 3, there are two #4 questions. you said do #1, #4, #5. What question should I solve?? Thank you.

I fixed the problem. It should be clear now.

Question by Student 201312147

professor, I did assignment#4, Q7). I solved that Lumped Capacity Analysis. because Bi=0.073<0.1. so I got the question (a) the answer at 6000s. but, your answer is 5400s. Why is it so different?

Hm, your Biot number is not well calculated.. You shouldn't be using LCA here.

Question by Student 201428239

Professor, I have a question about Design 1 of Questuon #4. Is it fine to use shape factor of hollow cylinder? In the tabel, there is restriction (L>>r). But I think L is not enough larger than r. Is it correct to use shape factor? Thank you.

Well, you have to make this assumption anyway when solving for the 1D H-T in the fins..

Question by Student 201428239

Professor, I have a question #4 of design 1. Can I use Efficiencies of rectangular fins table?? I think I can't use because it is not insulated tip. I am confused about this.

The efficiency chart in the tables can be used when the tip is not insulated. When the tip is insulated, you can also use the efficiency chart but you need to set $L_c = L$ instead of $L_c = L + t/2$.

Question by Student 201542124

In design #1, problem #4, I have a question about the number of fins.

$$q = \frac{T_{gas} - T_i}{R_{conv}}$$

So I substitute values and get

$$q = \frac{1200}{\frac{1}{h_i * 2\pi * r_i * 1m}} = 7540W$$

There are 8 fins. I am wondering if q should be divided by 8?

Hm, maybe, maybe. But you should be able to deduce this from the problem statement..

Question by Student 201427135

I have a question what you taught us professor. On march 18th, you taught us about convective heat transfer and conductive heat transfer. I thought it can be solved by finite element method and I tried

node 1 is T_i *, node 2 is* T_s *, node 3 is air's temperature*
element 1 is between node 1 and 2 , element 2 is between node 2 and 3

$$q_i = -kA\frac{T_{i+1} - T_i}{l} = kA\frac{T_i - T_{i+1}}{l} \tag{1}$$

$$q_{i+1} = \frac{kA}{l}(T_{i+1} - T_i) \tag{2}$$

$$\begin{pmatrix} q_i \\ q_{i+1} \end{pmatrix} = \frac{kA}{l}\begin{pmatrix} 1 & -1 \\ -1 & 1 \end{pmatrix}\begin{pmatrix} T_i \\ T_{i+1} \end{pmatrix} \rightarrow \textit{conduction}$$

$$\begin{pmatrix} q_i \\ q_{i+1} \end{pmatrix} = hA\begin{pmatrix} 1 & -1 \\ -1 & 1 \end{pmatrix}\begin{pmatrix} T_i \\ T_{i+1} \end{pmatrix} \rightarrow \textit{convection}$$

$$[K]^{1G} = A\begin{pmatrix} k/l & -k/l & 0 \\ -k/l & k/l & 0 \\ 0 & 0 & 0 \end{pmatrix}$$

$\rightarrow$ *stiffness matrix of element 1 between node 1 and 2*

$$[K]^{2G} = A\begin{pmatrix} 0 & 0 & 0 \\ 0 & h & -h \\ 0 & -h & h \end{pmatrix}$$

$\rightarrow$ *stiffness matrix of element 2 between node 2 and 3*

$$[K]^{G} = A\begin{pmatrix} k/l & -k/l & 0 \\ -k/l & k/l + h & -h \\ 0 & -h & h \end{pmatrix}$$

$\rightarrow$ *Global stiffness matrix*

Applying Boundary conditions

$$A\begin{pmatrix} 1/A & 0 & 0 \\ -k/l & k/l+h & -h \\ 0 & 0 & 1/A \end{pmatrix}\begin{pmatrix} 50 \\ T_s \\ 20 \end{pmatrix} = \begin{pmatrix} 50 \\ 0 \\ 20 \end{pmatrix}$$

$$A(-50k/l + T_s(k/l+h) - 20h) = 0$$

$$l = 0.1m, k = 1.37W/m * celcius, h = 4.5W/m^2 * celcius, A = 0.1 * 0.3m^2$$

So T_s = 42.582 celcius. It's actually correct with what you taught us . Would you check for me whether it's right approaching or not ?

Also, I'm wondering that these equations are really used when heat transfer problems occur like in factory..

This seems ok, but is beyond the scope of this course thus. But thanks for sharing this with us!