PROJECT 2

ME 353 Heat Transfer 1
Department of Mechanical Engineering
University of Waterloo

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You are required to do Problem 4.68 of the 4th Edition of *Fundamentals of Heat and Mass Transfer* by F.P. Incropera and D.P. DeWitt. The parameters will be changed to the values: $b = 20\,mm, L = 100\,mm, h = 75\,W/m^2K, k = 20\,W/mK, T_b = 125°C, T_\infty = 20°C$.

Express the local half-thickness of the straight fin as

$$y(x) = b\left(1 - \frac{x}{L}\right) \qquad 0 \leq x \leq L$$

where b is the fin half-thickness at the fin base $x = 0$ and L is the fin length. The local fin conduction area is

$$A(x) = 2wy(x) \qquad 0 \leq x \leq L$$

where w is the fin width usually taken to be unity. The total convection surface area is

$$S = 2wL\sqrt{1 + \frac{b^2}{L^2}}$$

Divide the fin into N control volumes of equal length, then let $N = 10$ as stated in the problem.

a) Check the magnitude of the Biot number $Bi = hb/k$.

b) Compute the fin heat transfer rate numerically by finite difference method outlined in the lecture and by means of the fin efficiency given in Table 3.5.

c) Compute the heat transfer rate through the fin when the width of the fin is $w = 750\,mm$.

d) Explain any differences between the numerical value and the value found by means of the fin efficiency method.

I recommend the use of *Maple V Release 4* for this project. *Maple V R4* is available on the Watstar system. You are permitted to use any other Computer Algebra System or a spread-sheet such as Excel.

The Due Date of Project 2 is 11:30 AM, Wednesday, November 5.