

BASIC HEAT AND MASS TRANSFER: COMMENTS [March 10, 2004]

Page

- 13 7 Lines from bottom: Delete flux, two places.
- 40 Exercise 1-2, 1-3. Strictly speaking we should say rate of heat transfer, but we usually drop the rate of. The former is precise and appropriate to thermodynamics; the latter is simply common usage in heat transfer practice.
- 105 Exercise 2-6 figure: the arrows at each end of specimen indicate force applied in a load cell.
- 173 Nonsymmetrical Boundary Conditions.
The analysis is incorrect: to do the analysis we let the slab be of thickness L with $0 \leq x \leq L$, and specify temperatures $T_{s'}$ at $x = 0$ and T_s at $x = L$. Again, we let:

$$T(x,t) = T_1(x) + T_2(x,t)$$

$$\frac{d^2 T_1}{dx^2} = 0$$

$$x = 0, T_1 = T_{s'}; \quad x = L, T_1 = T_s$$

$$\text{then } T_1 = T_{s'} + (T_s - T_{s'}) \frac{x}{L}$$

$$\frac{\partial T_2}{\partial t} = \alpha \frac{\partial^2 T_2}{\partial x^2}$$

$$x = 0, L : T_2 = 0$$

$$t = 0, T_2 = T_0 - T_1$$

Referring to the analysis following Eq. (3.38),

$$T_2(\zeta, \eta) = e^{-\lambda^2 \zeta} (A \cos \lambda \eta + B \sin \lambda \eta)$$

$$T_2 = 0 \text{ at } \eta = 0, 1$$

$$T_2 = 0 \text{ at } \eta = 0 : 0 = e^{-\lambda^2 \zeta} (A + 0), A = 0$$

$$T_2 = 0 \text{ at } \eta = 1 : 0 = e^{-\lambda^2 \zeta} B \sin \lambda$$

$$\sin \lambda = 0, \lambda = n\pi, n = 0, 1, 2, \dots$$

$$T_2 = \sum_{n=1}^{\infty} B_n e^{-n^2 \pi^2 \zeta} \sin n\pi\eta$$

$$T_2 = \sum_{n=1}^{\infty} B_n e^{-n^2 \pi^2 Fo} \sin n\pi\eta \frac{x}{L}$$

- 245 Line 2: For an incompressible liquid we take $c_p = c_v = c$, and neglect $\Delta P/\rho$; see Eq. (1.6b).
- 394 Line 17: Notice that, for a constant density and fully developed velocity profile, there is no change in kinetic energy along the tube.
- 401 Line 6: The statement “negligible work done by the viscous stresses” applies only to the derivation of the energy conservation equation. The viscous stresses do work to reduce the kinetic energy of the freestream fluid as it enters the boundary layer. Consistent with the negligible work for the energy equation is a negligible change in kinetic energy when using Eq. (1.4) to derive Eq. (5.40).
- 417 Figure 5.22: The indicated value of u_{\max}/U is too high—should be 0.146
- 443 Exercise 5-19: Some texts interpret the $\frac{1}{2} \rho u_b^2$ in the definition of f as kinetic energy; others interpret ρu_b^2 as the dynamic pressure. Actually, both are incorrect. The Darcy friction factor essentially applies to fully developed turbulent flow in a tube. The governing equation is the time-averaged momentum conservation equation: if this equation is made dimensionless it is seen that ρu_b^2 is properly interpreted as scaling the turbulent shear stress. For laminar flow, the laminar (molecular) shear stress is appropriate.
- 444 Exercise 5-20: k in the table is the conductivity of fluid inside the tube surface held normal to the sun’s rays.
- 468 Comments should not be in bold type.
- 486 Of course, G_0 is the flux incident on a surface held normal to the sun’s rays.
- 492 Example 6.10: By assuming a well-insulated roof we obtain an upper limit on T_s . Of course, if the roof were perfectly insulated there would be no additional load on the cabin air conditioner.
- 587 Equation (7.38): the coordinate x is measured from $\phi = 0$.
- 704 Comment No.1: Note also that St/f is independent of Reynolds number, so no iteration is required.