ME 353 M.M. Yovanovich

Week 10

Lecture 1
Correlation equations for internal flow: developing flow and fully-developed flow, laminar and turbulent, isothermal and isoflux walls.
Correlation equations for external natural convection: vertical flat plate; horizontal rectangular plates; sphere, other geometries
dry air properties at $T_{film} = (T_w + T_\infty)/2 = 330\,K$ obtained by means of properties calculator on Web site.

Lecture 2
Return Problem 2 of the midterm exam; course critique; discuss forced convection from a finite circular cylinder in axial and cross flow; discuss the blockage parameter $P/\sqrt{A}$ which appears in the general solution.

Lecture 3
See ME 353 Web site for convection material (9 pages). Examples of natural convection from horizontal finite circular cylinder and cuboid. Discuss the dimensionless shape factor relations for $S_D^\star$ for finite cylinder; one for $0 \le L/D \le 8$ and one for $L/D \ge 8$. Conversion from $\mathcal{L} = D$ to $\mathcal{L} = \sqrt{A}$. Range of values: $3.20 \le S_{\sqrt{A}}^\star < 7.5$; smallest value for circular and square disks and largest value for extremely long circular cylinders and square bars; for cuboids having comparable height, depth and length use $S_{\sqrt{A}}^\star = 3.5$; show how to compute heat transfer rate from horizontal, isothermal cuboid: H, L, W; discuss Prandtl number function $F(Pr)$ and body gravity function $G_{\sqrt{A}}$ (see convection notes and Maple worksheet); limiting cases: horizontal rectangular ($H = 0, L > W$) and square ($H = 0, L = W$) plates; vertical rectangular ($H > 0, L > W$) and square ($H = W > 0, L = 0$) plates; long horizontal square bars ($H = W, L > H$); discuss example where Q, T_∞, A and fluid are known, but T_W is unknown; this requires an iterative procedure.
See related Maple worksheets on Web site:
FCTURB1.MWS, FCEXP1.MWS, FCEXP2.MWS, NCEXP1.MWS, NCEXP2.MWS, BGFCUBOID.MWS

Convection Sections from Text
Chapter 6: Sections: 1, 2.1, 2.2, 3, 6.1, 6.7, 8.3, 10, and Table 6.2
Chapter 7: Sections: 1, 2.1, 2.2, 2.3, 3, 4.1, 4.2, 5 and Table 7.9

Chapter 8: Sections: 1.1, 1.2, 2, 2.1, 2.2, 2.3, 3.1, 3.2, 3.3, 4.1, 4.2, 5, 6 and Table 8.4
Chapter 9: Sections: 4, 5, 6, 6.2, 6.3, 6.4, 8.2, 8.3
