SUMMARY OF STEADY STATE HEAT TRANSFER

OVERALL HEAT TRANSFER

$$q = \frac{T_1 - T_2}{R_{tot}} = UA\Delta T \quad \text{where} \quad UA = \frac{1}{R_{tot}}$$

See page 116 (or 6th ed. page 100).

THERMAL RESISTANCE

→ For all expressions below, resistance R has units of K/Watt

→ If the area A is not explicitly indicated, choose a basis area of 1 m^2.

CONDUCTION:

Plane wall: $$R_{t,cond} = \frac{L}{kA}$$ Eq. 3.6. Note that L here is the wall *thickness*!

Cylinder: $$R_{t,cond} = \frac{\ln\left(r_2 / r_1\right)}{2\pi Lk}$$ Eq. 3.33 (or 6th ed. 3.28). Note that L here is the cylinder *length*!

Sphere: $$R_{t,cond} = \frac{1}{4\pi k}\left(\frac{1}{r_1} - \frac{1}{r_2}\right)$$ Eq. 3.41 (or 6th ed. 3.36).

CONVECTION:

All cases: $$R_{t,conv} = \frac{1}{hA}$$ (Eq. 3.9. A is the surface area for convection.)

RADIATION:

All cases: $$R_{t,rad} = \frac{1}{h_r A} = \frac{1}{\varepsilon\sigma A\left(T_s^2 + T_{sur}^2\right)\left(T_s + T_{sur}\right)}$$ (Eq. 3.9. Also see Eq. 1.9.)

COMBINING RESISTANCES

SERIAL: $$R_{tot} = R_1 + R_2$$

PARALLEL: $$\frac{1}{R_{tot}} = \frac{1}{R_1} + \frac{1}{R_2} \quad \text{or} \quad R_{tot} = \left[\frac{1}{R_1} + \frac{1}{R_2}\right]^{-1}$$