Equations you should memorize

Conduction:

$$\mathbf{q} = -k\nabla T.$$

Convection:

$$q = h\Delta T.$$

Heat equation: general form for incompressible flow

$$\rho c_v \frac{\mathrm{D}T}{\mathrm{D}t} = \nabla\cdot(k\nabla t) + \dot{q} + \Phi.$$

Neglect Φ, the viscous dissipation. With no fluid motion, k constant and $c_p = c_v$, get

$$\frac{\partial T}{\partial t} = \alpha\nabla^2 T + \frac{\dot{q}}{\rho c_p}$$

with $\alpha = k/\rho c_p$.

Lumped system: if the Biot modulus (ratio of internal resistance of solid to external resistance) $\mathrm{Bi} = hR/k < 0.1$, temperature in the body is a function only of time. With no heat sources,

$$\rho V c_p \frac{\mathrm{d}T}{\mathrm{d}t} = hA(T_\infty - T).$$

Nondimensional numbers for convection: Nusselt number $\mathrm{Nu} = hD/k$: ratio of conductive resistance of fluid to convective resistance. Prandtl number $\mathrm{Pr} = \nu/\alpha$. Stanton number $\mathrm{St} = \mathrm{Nu}/(\mathrm{Re}\,\mathrm{Pr})$. Grashof number $\mathrm{Gr} = \gamma L^3 \Delta T$. Rayleigh number $\mathrm{Ra} = \mathrm{Gr}\,\mathrm{Pr}$.

Correlations: I will give all the correlations you need.

Heat exchangers ($F(R,P)$ method): single-pass single-tube

$$Q = UA\frac{\Delta T_2 - \Delta T_1}{\ln(\Delta T_2/\Delta T_1)} + UQ\Delta T_{lm}.$$

More complicated: use $Q = UAF\Delta T_{lm}$.

Heat exchangers (NTU method):

$$\varepsilon = \frac{\text{actual heat transfer}}{\text{maximum possible}}, \qquad \mathrm{NTU} = UA/C_{min}.$$

Radiation: $\rho + a + \tau = 1$: reflectivity; absorptivity; transmissivity. Opaque body: $\tau = 0$. Black body: $a = 1$. Grey body: $a < 1$ independent of frequency.

Kirchhoff's law: $a = e$ for a system in thermodynamic equilibrium.
Planck's law:

$$q^e_{b\lambda} = \frac{2\pi c^2 h \lambda^{-5}}{\exp\left(ch/\kappa\lambda T\right) - 1}.$$

Stefan–Boltzmann law: $q^e_b = \sigma T^4$, where $\sigma = 5.67 \times 10^{-8}$ W m^{-2} K^{-4}.
View factors: F_{12}: fraction of black body radiation leaving A_1 which reaches A_2. Satisfies $A_i F_{ij} = A_j F_{ji}$ and $\sum_{j=1}^{N} F_{ij} = 1$.