24 April 2014 PAMorrison (finals prep) ①

Brain Exercise:

- Page thru lectures
- look for main topics, subjects, examples
- jot down
- Ask: What is the organizational structure of all this?

"Clean up the playroom by putting things in their bins"

2 SECTIONS: 9AM, 11AM →

Macroscopic

Bi < 0.1

Lumped Parameter Analysis ↺

Dimensional Analysis

↳ Low Biot #

↳ Moderate Biot # → Heissler Chart

↳ High Biot #

Newton's Law of Cooling

$$q_{in} = hA(T_b - T)$$

↑ obtain total Q_{in}

Microscopic

(Distribution in space and time)

Dimensional Analysis ↺

Fourier's Law ↳ $Nu = Nu(Re, Pr, \frac{L}{D})$

$$\frac{q_x}{A} = -k\frac{dT}{dx}$$

Newton's Law of Cooling (B.C.)

$$\left|\frac{q_x}{A}\right| = h\left|T_{bulk} - T_{wall}\right|$$

→ Bi > 0.1 ⟹ use Heissler charts or literature solns

Could divide also both columns into {steady / unsteady}

Thank you Elie!

(9Am)

macroscopic

steady

solve for T value
(see Felder + Rousseau problems)

microscopic

steady

- 1-D-slab (q_z = constant)
  - cylinder ($q_r \propto \frac{1}{r}$)
- Fourier's Law (can also be unsteady)
- Dimensional Analysis ($Nu(Re, Pr, \frac{L}{D})$) ← dimensionless h
  - temperature distribution in space

unsteady

- Newton's Law of Cooling (gives total Q)
- Dimensional Analysis
  - → Bi, Fo (time)
    - h vs k
    - $Bi < 0.1$ → lump parameter analysis
      - temperature distribution in time ONLY

unsteady

- semi-infinite solid
  - ↳ "will my pipes freeze"
  - dunk cold sphere in hot water

} classic problems (unsteady)

- Newton's Law of Cooling (B.C.)
- Dimensional Analysis ($Bi > 0.1$)
  - h vs k → Bi, Fo (time)
    - temperature distribution in space & time

← boundary conditions →

- Heisler charts & the literature (soln to microbial pbms)

Thank you Mallory!