ChE 436
Exam 2 Review

Chapter 2 - Unsteady-State Balances

- mass or moles
- energy
- degrees of freedom (make sure you have enough equations for the unknowns)
- dynamic balance equations for process

Chapter 3 - Laplace Transforms

- general solution technique (Table 3.1)
- time delays, initial and final value theorems
- partial fraction expansion (Heaviside theorem, etc.)
- repeated factors
- complex variables
- solution of differential equations

Chapter 4 - Transfer Functions

- what are they, why are they useful
- how to get them from ODE's
- properties of transfer functions (parallel, series, process gain)
- linearization (Taylor series expansion)
- deviation variables

Chapter 5 - 1st and 2nd Order System Response to Simple Inputs

- First Order Systems (step, ramp, sinusoidal)
- Integrating Processes
- Second Order Systems
  - general form (K, ζ, τ)
  - step response
    - overdamped, critically damped, underdamped
    - t_r , t_p, t_s, overshoot (OS), decay ratio (DR), period (P)
  - sinusoidal response (at long time, after exp terms have died out)
    - input = A sin(ωt)
    - output amplitude ($\hat{A}$)
    - amplitude ratio $\left(AR_N = \frac{\hat{A}}{KA} \right)$
- Use in solving for system performance

Chapter 6 - More Complicated Systems

- Poles and Zeros
  - impact on stability
  - plots on real-imaginary plane
  - definitions (lead-lag, inverse response)
- Systems in Parallel
- Time Delays (Padé approximation)
- Approximations to Higher Order Systems
  - Taylor's series combined with simplified Padé
  - Skogestad's "Half Rule"

Chapter 7 - Curve-Fitting

- SSE techniques (easy in Excel) for both linear and non-linear systems
- "Quick and dirty" methods for estimation
  - 0.632 rule for first-order systems (Fig. 7.3)
  - Inflection point for 2nd order systems (Fig. 7.5)