2.04A Concepts

Linear time invariant systems
Solution in the time domain (ordinary differential equations – ODEs)
Solution in the Laplace domain (transfer function – TF)
  Poles and zeros; their physical meaning
  Stability: stay on the left-hand plane
1st order systems
  Impulse, step, and other responses
  Time constant
  Steady state
2nd order systems
  Impulse, step, and other responses
  Dominant pole (slow/fast poles)
  Over-/critically/under-damped response
  Damping ratio, natural frequency, damped oscillation frequency
  Rise time, settling time, peak time, overshoot
  Steady state
State space: formulation only
  Eigenvalues of system matrix ⇨ system poles
Certain physical implementations
  Flywheel
  DC motor with flywheel load and with/without inductance
  Simple RC / RL / RLC circuits, impedance and voltage divider
  More generally: physical model ⇒ ODE ⇒ system behavior

Feedback
Feedback loop architecture and feedback transfer function
  Feedback loop terminology: plant, controller, open/closed loop TFs
  The significance of feedback gain and steady-state error
Root Locus (finding the location of closed-loop poles as gain changes)
  Theorems for drawing Root Locus (but not in exhaustive detail, as in the
  book; what we covered in class only)
  Root Locus concepts and their physical meaning: branches, asymptotes, real
  and imaginary axis intercepts, break-out/break-in points
Controlling the transient response
  P-control (simplest, limited)
  PD-control (stabilizes and speeds up)
  I-control (terrible but it does fix steady-state error)
  PI-control (fixes steady-state error at cost of slight slowdown)
  PID-control (good compromise of all the above)