University of California at Irvine
MAE106 Midterm Review Sheet

The Midterm is scheduled for Tuesday, February 1, 2005. There are several practice midterms on the course web site: **http://www.eng.uci.edu/~dreinken/MAE106/mae106home.htm**

- Circuit Analysis
  - Charge, voltage, current
  - Kirchoff's current and voltage laws
  - Power
  - Resistors
    - Ohm's law
    - Parallel and series resistances
    - Voltage Divider Circuit
    - Potentiometers
  - Operational Amplifiers
    - Input/output relationship (i.e high-gain differential amplifier)
    - Golden rules (true only if op-amp has appropriately-connected negative feedback and is not saturated)
    - Design of op-amp circuits for amplifier, inverter, buffer, addition, subtraction, filters
  - Capacitors, Inductors
  - RC circuits, time constants, cut-off frequency for low-pass and high-pass filters
- Solving a Linear Differential Equations
  - Generals: Finding general solution to homogeneous equation
  - Particular: Solving particular equation
  - Initial Condition: Finding total solution by solving for initial conditions
  - Doing the above steps for a 1^{st} order differential equation
- DC Brush Motors
  - How they work (Lorentz force law, commutation)
  - Torque/ Current Relationship
  - Mathematical model, back EMF, use as tachometer
  - Torque versus velocity relationship, stall torque, no load speed, mechanical power
- Power Control
  - MOSFETS – (n-type) voltage controlled resistor characteristic; gate resistance
  - Use as a voltage-controlled switch
  - Physical structure, basic description of how it works
- Control Theory
  - Block Diagrams
  - Basic concepts of feedforward control and feedback control
  - Using negative feedback for disturbance rejection and to compensate for plant variations
  - Positive feedback/instability
- Time Domain Analysis
  - Time constant of a first-order system
- Frequency Domain Analysis
  - Basic idea of frequency response; sine wave in $\Rightarrow$ sine wave out, amplitude scaled and phase shifted
  - 1^{st} order low-pass and high-pass filter characteristic, corner frequency and relationship to time constant
  - Complex variables
  - Laplace Transform (of step function, exponential, sinusoid, derivative, integral)
  - Transfer Functions (what are they how do you find them?)
  - Impedances (of resistors, capacitors, and inductors)

You should also review your lecture notes and laboratory exercises 1- 3.