# Final Exam

- When: 1:30-3:30 pm Monday, May 10th
- Location: here (Felgar 334)

- Coverage: comprehensive

- Per our agreement: open notes and books
- No electronic devices/books/other notes

# Sources of Information

- Homework assignments
- Finals in 2007 and 2008
  - Note somewhat different coverage
- Assigned readings
- Lecture slides
- D2L discussion board
- Notes that you took in class
  - Note that we did many things in class that are not covered in the slides…

# Basic Electronics

- Potential (voltage)
- Current (amperage)
- Work per unit time (watts)
- Ohm’s Law
- Kirkoff’s Current Law
- Diodes
- Transistors
- Storing charge: capacitors
- Operational amplifiers

# Digital I/O

- Atmel digital I/O control hardware
  - PORTx, PINx, DDRx
- Pull up/down resistors
- PWM

# Serial Communication

- Asynchronous vs synchronous protocols
- Specific protocols:
  - RS232-C
  - I2C
  - SPI
- How do the protocols work?
  - Timing, addressing, arbitration

# Analog/Digital Interface

- D2A conversion
  - Pulse Width Modulation (with RC circuit)
  - Resistor lattice
- A2D conversion
  - Op-amp cascade
  - Successive approximation

# Timer/Counters

- Prescalars
- TimerX counter
- Software counters

-> Cascade of frequency dividers

# Interrupts

- Types of interrupts
- ISRs
- Shared data and the shared data problem

# Finite State Machines

- Definition
- Use
  - Control of actuation and sensing
  - Communication protocols
- Differences between the theory and their use in control
- Some more examples of FSMs in the AME 3623 Real Time Embedded Systems course (homework 4)

# Scheduling

- Real-time constraints
  - Regular frequency of execution
  - Deadlines
- Rate monotonic analysis
- Working out specific schedules