

# ECSE-4790

# Microprocessor

# Systems

Russell P. Kraft  
JEC 6028  
kraftr2@rpi.edu  
Tel: 276-2765  
Fax: 276-6261

# Teaching Assistant(s)

- TBD TBD
- TBD TBD

???.@rpi.edu

???.@rpi.edu

# Catalog Description

- Hardware and software for real-time microprocessor based digital systems. Basic concepts and operations of on-chip components related to digital system functionality. Architectures, instructions sets, and interfacing with peripherals through serial or parallel ports. Introduction to 16- and 32-bit machines with in-depth treatment of 8-bit machines. Emphasis on C language cross-compilers. Laboratory exercises are included to demonstrate hardware and software development techniques practiced in industry.
- Weekly laboratory exercises in programming microprocessors and a final exercise design enhancement are required.

# Course Goal

- Goal
  - ◆ To provide fourth year ECSE students with a hands-on laboratory experience with more advanced features of state-of-the-art microprocessor systems
- Means
  - ◆ Exploratory laboratory exercises for the microcontroller (fixed procedures plus small student enhancements)
  - ◆ An extended design augmentation is part of the final exercise

# Course Project Objective

- Objective
  - ◆ A culminating experience applying much mathematics, science, and engineering from previous terms
  - ◆ Provide an environment where students develop skills necessary to complete the projects without structured instruction
- Required Component
  - ◆ Analysis and Reports documenting exercises & enhancements
  - ◆ Must be completed by due dates

# Course Prerequisites

- Prerequisites by topic
  - ◆ Fundamentals of logic design
  - ◆ Fundamentals of circuit design
  - ◆ Computer programming
  - ◆ Computer instruction sets
  - ◆ Microcontroller operations
  - ◆ Peripheral operations and control of external hardware

# References

## ■ Books

- ◆ Many references are available, but none are required for the class
- ◆ Gene H. Miller, *Microcomputer Engineering*, Second Edition, Prentice Hall, Englewood Cliffs, NJ 1998. (First Edition is fine.)
- ◆ Alan Clements, *Microprocessor Systems Design*, PWS Publishing Company, Boston, MA, 1992. (Covers the 68000 family)

## ■ Online ([www.ecse.rpi.edu/Courses/CStudio](http://www.ecse.rpi.edu/Courses/CStudio))

- ◆ Most important reference (free download)  
C8051F120 Technical Summary (Rev. 1.4)

# MPS is a WebCT Course

- <http://rpilms.rpi.edu/>
  - ◆ Log in
  - ◆ Pick 'ECSE\_4790\_XXXX - Microprocessor Systems [...]'
- (alternative access to most information at <http://www.rpi.edu/dept/ecse/mps>)
- Class handouts are here plus several reference manuals



# Course Handouts (available on the web)

Course & Lab Exercise Handouts	Final Project Handouts
MPS_Intro.ppt (only PPT)	[Loose guidelines for small course project]
MPS_Sched,Syll&Project.doc	ECSE_Guidelines_for_Design_Lab_Notebooks.doc
Student-Guide.doc	Guidelines_Proj proposal_Fall_03.doc
IDE_&_SDCC_C_Compiler.doc (SFR list & ASCII table)	Guidelines_Final_Report.pdf (only PDF)
F020 guide (abridged) w/ C Programming (Ch 6)	
M6812_Users_Man.doc	RPI_Technical_Writing_Manual.ppt (only PPT)
LCD_Screen.doc	ECSE_Guidelines_Final_Oral_Presentation.doc
MPS_Lab_Ex1-IDE_ANSI.doc	Studio-AV-Manual.doc
MPS_Lab_Ex2-Intrpt.doc	
MPS_Lab_Ex3-Serial.doc	
MPS_Lab_Ex4-ADC.doc	
MPS_Lab_Ex5-Memory.doc	
MPS_Lab_Ex6-Magic8Ball.doc	
MPS_Lab_Ex7-CAN.doc	
Fuzzy Logic.ppt (and PDF)	

# Microcontrollers Available

- C8051F120 — 8 bit machine introduced about 2002
- C8051F040 — 8 bit machine introduced about 2000
- MC6811 — 8 bit machine introduced about 1985
- MC6812 — 16 bit machine introduced late 1997
- MC68332 — 32 bit machine introduced about 1990

# Software Available

- Cross-assembler — SDCC & Motorola
- C language cross-compiler — SDCC & Introl
- Microprocessor simulator — Motorola

# Typical Topics

- Introduction to the C8051F120 microcontroller  
(information available on the MC6811, MC6812 & MC68332 microcontrollers if desired)
- Software development techniques
- Hardware development techniques
- ANSI Terminal features and simple graphics
- Timers & Interrupt programming
- Synchronous & Asynchronous serial communication
- Interfacing memory to the microprocessor bus
- Analog conversion
- Controller Area Network control

# Grade Computation

- Grades are assigned based on both team and individual effort
  - ◆ Teams of 2 (due dates subject change, check WebCT calendar)
    - ✦ 67% Six C8051 exercises (NOT uniformly weighted)
    - ✦ 33% Post-project and general course clean up, final project, mini-quizzes, TA evaluation of student lab preparation, performance & participation

# What This Means to You

- You get a chance to learn what you need to know to select and apply microcontrollers to applications of your own choosing
- Specific tools you will be using
  - ◆ IDE (Integrated Development Environment)
  - ◆ C cross-compilers
  - ◆ Debuggers
  - ◆ Simulators
  - ◆ Logic Analyzers

# Next Steps

- Reprise the C8051F020 knowledge
  - ◆ Do things that you formerly did in Embedded Control
    - ✦ Host input/output
    - ✦ Interrupts
    - ✦ Hardware interfacing
    - ✦ etc.
- Follow up action items required of you
  - ◆ Make a list of things you need to know about a new microcontroller to be able to understand their functionality and use all the built-in peripherals efficiently & effectively.

# Class Requirements

- Writing Center
  - ◆ MPS requires written reports for each lab exercise. You are expected to write well-organized reports and will be graded on style as well as content.
  - ◆ Use the Writing Center resources to improve your reports
  - ◆ All software **MUST** be well documented in the program listing



# Lab Policies

- Lab experiment work (other than project) must be done in teams of only two students
- Attendance will be taken and will count toward your performance grade
  - ◆ Unfair to partner when you don't show up
  - ◆ Students with missing partners may team up for experiments
- Academic Integrity: collaboration is encouraged but outright copying of other's work is unacceptable
- To get the highest grade on a lab exercise, something unique beyond the required tasks must be accomplished and demonstrated as an enhancement to each exercise
- [Final design augmentation may be done in teams of 4 students, if the group desires to tackle a more ambitious effort]

# Lab Policies (cont.)

- Lab reports are due by the posted due date. A penalty of 5 points per day late will be assessed.
- New labs build on the results of previous labs. Once a program works for a given exercise, save it and archive it. Use a copy to begin a new exercise. When things stop working you will be able to go back to a known good program and determine if the problem is in the hardware or software.
- Creating a new project file (.wsp) for each program is highly recommended. This keeps track of all .c and .h files used in a build.
- Make sure you explain and demonstrate any enhancements to the TA during check-off.

# Important Dates

- Since there have been several semesters with the new format, the experiment schedule will be fairly rigid
- There will be a schedule posted on the web for when exercises should be in progress and when reports are due.
- All Reports due Mon., **Dec. 10** in my office (JEC-6028) at 4:00 PM

Note: dates may be subject to change; check the course WebCT calendar for the latest information.



# The End

(Let's have some fun!)

# Grade Computation

- Grades are assigned based on both team and individual effort
  - ◆ Teams of 2 (dates subject change, check WebCT calendar)
    - ✦ 67% 6(?) C8051 exercises
  - ◆ Teams of 2 or 4
    - ✦ 18% Student selected course project
      - 4% Final demonstration
      - 14% Final project report

Due Monday, Dec. 10, at 4:00 PM
    - ✦ 15% Post-project and general course clean up, mini-quiz, TA evaluation of student lab performance & participation

# Important Dates

- Since this is the third semester with the new format, the experiment schedule will be fairly rigid
- There will be a schedule posted on the web for when exercises should be in progress and when reports are due.
- Course Project Demonstrations by **Dec. 6** (sec. 1)
- Final Project Reports due Mon, **Dec. 10** in my office or JEC-6048 at 4:00 PM

Note: dates are subject to change; check the course WebCT calendar for the latest information.

# Special Projects - 2003

- Part of a MDL (Multidisciplinary Design Lab) Project
- Automobile Enhancements & Others
  - ◆ Using eye tracking & computer vision
  - ◆ Various Sponsors
  - ◆ Project to continue as Independent Senior Design Project through next semester
- More details will follow in later weeks