

# Introduction to Microcontrollers - Syllabus



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**Webpage:** [www.scienceandmathacademy.com/academics/microcontrollers/](http://www.scienceandmathacademy.com/academics/microcontrollers/)

**Text:** The following links will be used extensively in class. Download each of these documents and have them accessible on your flash drive.

- MPLAB<sup>®</sup> XC Getting Started Guide  
<http://ww1.microchip.com/downloads/en/DeviceDoc/50002173A.pdf>
- MPLAB<sup>®</sup> XC8 C Compiler User's Guide  
<http://ww1.microchip.com/downloads/en/DeviceDoc/52053B.pdf>
- PIC18(L)F2X/4XK22 Data Sheet  
<http://ww1.microchip.com/downloads/en/DeviceDoc/41412F.pdf>
- PICkit<sup>™</sup> Programming/Debugger User's Guide  
[http://ww1.microchip.com/downloads/en/DeviceDoc/PICkit\\_3\\_User\\_Guide\\_51795A.pdf](http://ww1.microchip.com/downloads/en/DeviceDoc/PICkit_3_User_Guide_51795A.pdf)

**Course Description:** The focus of this course will be programming microcontrollers to be used in robotic applications. Students will learn some of the fundamentals of microcontrollers as well as relatively sophisticated applications. Students will have an understanding of basic digital electronics. Students will use digital oscilloscopes throughout the course to gain deeper understandings of the analog and digital circuits.

**Course Outline:** The following is an outline of the topics we will cover.

## Lecture topics (This is not a complete list, only a sample.)

- Basics
  - Schematics
  - Components
  - Breadboarding
  - Microchip XC8 C
  - Oscillators
  - Outputs (LEDs, servos, motors, etc.)
  - Inputs (Buttons, capacitance sensors, DIP switches, etc.)
  - ADC (Potentiometers, Flex sensors, etc.)
  - Interrupts
  - Timers
  - Counters
- Advanced topics
  - Thermometers (Digital and/or analog)
  - Serial LCDs
  - Infrared (IR) (basics and transmission protocol)
  - Rotary encoders
  - Real-time clock
  - H-bridge
  - Serial communication (with computers, VB)

- 802.15.4 wireless protocol (XBEE)
- GPS
- I<sup>2</sup>C Communication protocol (Real-time clock, LCD, 9 Degrees of Freedom – Sensor Stick)
- Text messaging and email (possible)

**Projects: (This is a very rough outline. Topics maybe be added or subtracted from this list.)**

- Wire breadboard for PIC18F45K22
- LED control
  - Blink
  - Count in binary
  - Count on 7-segment LED
  - Two-digit multiplexed 7-segment LED
  - Experiment with internal and external oscillators
- Basic inputs
  - Push button
  - Capacitance sensor
- Output to an LCD
  - Simple text
  - Serial and Oscilloscopes
  - DIP-8, binary (from DIP switch) to decimal on LCD
- Digital thermometer
- Analog to digital conversion (ADC)
  - Potentiometers
  - Flex sensors
- Motor control
  - PWM
  - Servo motor control
  - H-bridge
  - External motor controllers
- Serial communication w/ a computer
  - Values from microcontrollers to computer
  - Values from computer to microcontroller
  - VB
    - Computer control
    - Microcontroller controlled by computer
- Interrupts and timers
  - Button with an interrupt
  - Timer (counter) external pulses – generated by function generator, 555 timer, or IR emitter phototransistor pair w/ an encoder strip
  - Rotary encoder
  - LCD clock or count down timer (Real-time counter)
  - Turning a microcontroller “off” with a momentary button
- IR
  - Make an IR-remote
  - Make an IR-receiver
- In-circuit debuggin

- 802.15.4 wireless protocol and GPS
  - Communicate between the computer and microcontrollers
  - Communicate between microcontrollers
  - Receive data from a serial GPS
- I<sup>2</sup>C (Inter-Integrated Circuit)
  - 9 Degrees of Freedom – Sensor Stick
    - Basic output to computer or LCD
      - Magnetometer
      - Accelerometer
      - Gyroscope
    - Compass to computer
    - Control a servo with sensor
    - Angle to computer (a box or some other “3D” object would move)

### **Grading:**

- Projects: The majority of points will come from projects. Projects will include programming and wiring a circuit on a solderless breadboard.
- Class assignments: There will be some in-class assignments to reinforce concepts from lectures.
- Homework: Homework will be minimal. I will have some required reading at times and you may have to write some programs at home.
- Quizzes: To ensure that all students understand the programming, there will be periodic quizzes.

### **Classroom Expectations:**

- Be on time. Sharpen your pencil if necessary and get in your seat before the bell rings. If you are not in your seat when the bell rings, you are late.
- Be prepared for class. (Pen, lab notebook, and flash drive)
- You will not be permitted to go to your locker during class.
- Use of the bathroom is a privilege that is allowed at the discretion of Mr. Evans. You will be permitted to use the restrooms on the third floor only.
- Make up work will be given for excused absences only. You will be allowed to make-up missed work according to the HCPS policy. It is your responsibility to see the teacher for the assignment.
- All work must be on time to be accepted for credit. Field trips, rehearsals, or any other absences known in advance are not an excuse for late work. Submit it early or give it to a classmate to submit it for you.
- Students may only use a computer when directed by Mr. Evans.
- You must clean up all supplies prior to leaving the classroom.