# BME590.06: Medical Device Software Design (Fall 2016)

Instructor: Mark L. Palmeri, M.D., Ph.D.

Lecture: Tues/Thurs, 08:30—09:45 (Room TBA)

## Course Overview

Software plays a critical role in almost all medical devices, spanning device control, feedback and algorithmic processing. This course focuses on software design skills that are ubiquitous in the medical device industry, including software version control, unit testing, fault tolerance, integration testing and documentation. Experience will be gained in both dynamically- (Python) and statically-typed (C/C++) languages. Efficient programming practices for low computational resource devices will be covered.

The course will be structured around several small projects working with biosignals to develop software design fundamentals. The course will culminate in a larger project working with clinical/research data and/or designing software for a small, embedded device. Students will be expected to work in small groups.

Prerequisites: Introductory Programming Class (e.g., EGR103)

## Course Topics

* Define software specifications and constraints
* Device programming fundamentals
  + Review of data types
  + Analog-to-digital / digital-to-analog conversion
  + Python (v3.5): numpy, scipy, pandas, scikit
  + C/C++
  + Simplified Wrapper and Interface Generator (SWIG)
  + Data management (variables, references, pointers, ASCII/Unicode/binary data)
  + Compilation, make, cmake
* Software version control (git)
* Project management (Redmine)
* Biosignals
  + Anatomy/physiology review
  + Signal transduction
  + Noise & artifacts
* Signal processing
  + Convolution & correlation
  + Filtering
  + Peak detection
  + Envelope detection
  + Spectral analysis
  + Wavelet analysis
* Documentation
  + Docstrings
  + Markdown
  + Sphinx / Doxygen
* Testing
  + Unit testing
  + System testing
  + Continuous integration (Jenkins)
* Fault tolerance
* Resource profiling
* Debugging

## Project Topics (subject to change)

* ECG arrhythmia detection
* Cardiac simulator
* EEG characterization
* Neuromuscular stimulation
* Respiratory trainer
* Motion detection