1. **Department, number and title of course:** Electrical Engineering and Computer Sciences: EECS 145M, Introductory Microcomputer Interfacing Laboratory

2. **Catalog Description:** (3 units) Laboratory exercises constructing basic circuits and interfacing them to a microcomputer for the filtering and periodic sampling of analog signals. Programming exercises to sample analog signals, and perform digital filtering, numerical analysis, real-time control, and display.

3. **Prerequisites:** CS 61B, EECS 40.

4. **Textbooks and/or other required material:**

5. **Course objectives:**
   - To use the LabVIEW programming language, and digital and analog interfacing in an interactive, microcomputer environment
   - To learn to use digital timers, digital interfacing, and simple handshaking with expansion cards and external devices.
   - To learn the principles of operation and use of D/A and A/D converters and build a data acquisition circuit
   - To learn to sample digital data, use anti-aliasing filters and windows, and perform the FFT
   - To learn to use digital filters, and digital control strategies for both linear and non-linear systems
   - To learn to design anti-aliasing filters that meet specific requirements
   - To make programs and analog circuits work together (design and debugging)

6. **Topics covered:**
   Laboratory exercises constructing basic interfacing circuits and writing LabVIEW programs for data acquisition, storage, display, and control. Use of the IBM PC microcomputer running the Windows XP operating system and a subsystem containing a dedicated processor, analog and digital I/O, timers, and memory. Circuit components include operational and instrumentation amplifiers, anti-aliasing filters, the sample-and-hold amplifier, A/D and D/A converters. Exercises include the timing of external events, digital interfacing with handshaking, effects of aliasing in periodic sampling, fast Fourier transforms of basic waveforms, the use of the Hann filter for spectral leakage reduction, Fourier analysis of the human voice, digital filters, and control using Fourier deconvolution. Students perform ten laboratory exercises working in groups of two and then individually write five long and five short laboratory reports. General list of topics include:
   - Computer architecture
   - LabVIEW programming
   - Bits and numbers, timers
   - Event timing
   - Student's t analysis
   - Digital I/O
   - Single and multiple word transfers, handshaking
   - Analog interfacing, D/A converters
   - Introduction to A/D converters
   - Periodic sampling, aliasing
   - Integral Fourier transforms
   - Windowing, discrete Fourier transforms
   - Aliasing and anti-aliasing filters
   - Spectral analysis
   - Sampling system design summary
• FFT of periodic signals, resonant systems
• FFT control of linear time-invariant systems
• On-off and proportional control algorithms
• A Real-time digital filters vs. analog filters
• PID control
• Interfacing techniques
• Data analysis
• Design problem examples

7. **Class/laboratory schedule:** Three hours lab and two hour lecture per week.

8. **Contribution of course meeting the professional component:** This course contributes to engineering topics. It is approximately 1/3 science and 2/3 design. It provides a major design experience.

9. **Relationship of course to program objectives:** This course requires students to apply their basic knowledge of mathematics, science and engineering to identify, formulate and solve engineering problems. Students learn to communicate effectively with members of their lab team. They have an opportunity to use modern engineering tools, skills and techniques in the lab.

10. **Prepared by:** Professor Stephen Derenzo; April 6, 2006.