ECE 510 Instrumentation and Measurements I
January 2014 Syllabus
Rick Campbell

ECE 510 Instrumentation and Measurements I
Course Description: Physics-Engineering introduction to instrumentation and measurement hardware at the graduate level. Topics include: noise and interference; dynamic range; microphones and hydrophones; simple antennas; temperature sensors; analog signal processing electronics; front-end for DSP. Each topic illustrated with in-class hardware demonstrations and basic projects.

Schedule--Winter Quarter 2014
Monday and Wednesday 4:40 - 6:30 p.m. FAB 150

Course Outcomes  Students will be able to:

Quantify electrical and acoustic measurement noise from first principles, including contributions from thermal, 1/f, electronic, the natural environment, near field and far field interference sources, and specify the need for local shielding, system isolation, and the use of screen rooms for sensitive measurements.

Specify measurement and sensing system dynamic range and make strong-signal measurements including two-tone third-order distortion, Adjacent Channel Power, and power amplifier output noise.

Design, build, measure and deploy RF sensors and the RF/analog signal conditioning circuitry used between the sensor and DSP systems.

Design, build, measure, and deploy analog signal conditioning filters to limit noise and interference bandwidth and satisfy anti-aliasing conditions for downstream DSP.

Design, build, measure and deploy reduced size antennas for near-field, near-far, and far-field signal-to-noise enhancement.

Each student will make a unique contribution to an aggressive time scale graduate level concept-to-deployment hardware development effort. White board sketch to deployed hardware in ten weeks.
Supplementary Textbooks:
2013 Handbook for Radio Communications, ARRL, chapters 8, 13, 20
Op-Amp Applications Handbook, Jung editor, Newnes, chapters 2, 3, 4, 5
Low Level Measurements 5th Edition, Keithley, chapters

Problem sets and study guides:
Each topic will include a weekly problem set and study guide, available online at web.cecs.pdx.edu/~campbell under ECE510 IM 1 Study guides. Each week’s study guide is posted Monday, and due in class the following Monday. Collaboration on the study guides is expected and encouraged.

In-class Midterm
In-class exam questions are taken from the study guides. Exams are closed-book without notes, calculators, or assistance. Exam focus is on depth of understanding of the various components of the class project.

Classroom environment
Each class will include a lecture and active discussion. After the mid-term exam classes will include live student project demonstrations. Class attendance is expected and worthwhile.

Projects and Demonstrations
The emphasis is on making a connection between fundamental physics and working instrumentation and measurement hardware. Each week will include a classroom demonstration illustrating a current topic, and after the 3rd week students will work with basic projects that illustrate principles studied in class. The lab component of the course is exploratory and informal, to foster depth of understanding and build basic hands-on hardware skills.

Prerequisites by Topic
Basic Electronic Circuits
Basic Classical Physics
Mathematics through Fourier Transforms
Senior or Graduate standing or BS in Science-Technology-Engineering-Math