EE4133: Instrumentation Design

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WEB via **Blackboard** course management system

ABSTRACT

This course is primarily concerned with the design of a general-purpose data acquisition system. The electronic design engineer of today can no longer be thought of a digital or analog designer. Consequently, this course melds the analog and digital electronics areas with a unified engineering approach emphasizing the practical aspects involved.

As most instrumentation is concerned with real-world variables, the course starts out in the analog realm with some examples of the different types of transducers available to the engineer. This will include examples involving some of the more commonly measured physical parameters such as strain, temperature and displacement. This leads naturally into the area of signal conditioning and linearization, as most of these transducers do not readily give signals that can be fed directly into the ubiquitous computer. This section will also introduce some modern components and techniques that allow analog circuitry to be run from single supplies. Rounding off the analog section will be an introduction to continuous time filters. This will be dealt with as a pre-requisite to sampling, highlighting the trade offs between filter complexity and sampling rate.

The digital section of the course will start with the conversion of continuous time variables into the discrete time domain of the digital computer. Dynamic range and quantization will be covered along with a discussion of signal-to-noise ratio. The bandgap voltage reference will be introduced and compared to the breakdown diode approach covered in earlier courses. Moving towards the microprocessor end of things, the I^2C and SPI serial busses will be discussed highlighting the benefits and disadvantages of each. The digital section will wrap up with a survey of some common peripherals that can be serially connected to most microprocessors.

Finally, if time permits, the course will wrap up with a discussion of noise, which ultimately limits the resolution of any instrumentation system. This will cover basic noise sources, noise modeling and measurement techniques.

This course will involve assignments and laboratory exercises that will involve computer simulations using ***PSpice™***. These are intended to reinforce the material presented during class time and provide an illustration of the effect of component tolerances on system performance.

