EE4133: Instrumentation Design

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WEB via **Blackboard** course management system

1. DEFINITIONS (4 hours)

1.1. General discussion of an instrumentation system
1.2. Static characteristics
1.3. Dynamic characteristics
1.4. Terminology

2. TRANSDUCERS (7 hours)

2.1. Foil & semiconductor strain gauges
2.2. RTDs and thermistors
2.3. Semiconductor temperature sensors
2.4. Inductive sensors & the LVDT

3. SIGNAL CONDITIONING (8 hours)

3.1. Modern op-amps & single supply operation
3.2. Low level synchronous rectification (*for LVDT*)
3.3. Bridge circuits & differential amplifiers
3.4. Modeling non-linear components using ***PSpice***
3.5. Linearization techniques

4. FILTER DESIGN (6 hours)

4.1. Ideal low-pass filters
4.2. Mathematical models
4.3. Derivation of transfer functions
4.4. Pole visualization with MATLAB
4.5. Circuit implementations
4.6. Filter design with FILTERPRO

5. DIGITIZATION (5 hours)

5.1. Sampling & quantization
5.2. SNR and quantization errors
5.3. Flash, dual slope & successive approximation A-to-D conversion
5.4. Oversampling
5.5. Bandgap voltage references

6. MICROCONTROLLER INTERFACING (4 hours)

6.1. Serial & parallel interfacing

6.2. SPI 4-wire serial bus

6.3. I^2C and SM bus 2-wire interface

7. INTERNAL SYSTEM NOISE *(time permitting)*

7.1. Sources of noise

7.2. Noise models

7.3. Concepts of noise matching

8. IN-CLASS TEST (1) & REVIEW (3 hours)

TOTAL: 37 hours

LABORATORIES:

The laboratories for this course will be selected from the following list. Some of these will be conducted using the ***PSpice*** circuit simulation software package, while others using a PIC family microcontroller. Manuals and user guides for ***PSpice*** can be found in PDF format on **Blackboard** under *PSpice Support*.

1. Modern op-amps & single supply operation
2. Differential amplifier design
3. Precision rectifier & the effect of resistor tolerance
4. Design & comparison of two bridge amplifiers
5. Linear temperature sensor using a NTC thermistor
6. Sallen & Key low pass filter
7. A comparison of two low-pass filter designs
8. Programming timers on a PIC microcontroller
9. ADC signal-to-noise ratio and ENOB (effective number of bits)
10. Serial interfacing with the I^2C bus.
11. Noise analysis using ***PSpice***