Measurement and Instrumentation
EE 3321-501, MW 7-8:20pm
Spring 1994 Course Syllabus

General Info: Instructor: J. H. Losh
                      Office: 142b NH
                      Hours: MW 8:20- pm
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Textbook: None. Handouts will be provided.

References: Brown, David, E. P. Hamilton III, <u>Electromechancial Energy Conversion</u>,   MacMillan, 1984, ISBN 0-02-315590-6.

Dally, James W., *et. al.*, <u>Instrumentation for Engineering Measurements</u>, 2nd ed., John Wiley and Sons, Inc., New York, 1993, ISBN 0-471-55192-9.

Dorf, Richard C., <u>Modern Control Systems</u>, 4th ed., Addison-Wesley, Reading, MA, 1987, ISBN 0-201-05326-8.

Gonzalez, Rafael C., Paul Wintz, <u>Digital Image Processing</u>, 2nd ed., Addison-Wesley, Reading, MA, 1987, ISBN 0-201-11026-1.

Hutchinson, Charles L, ed., <u>The ARRL Handbook for the Radio Amateur</u>, 62nd ed., ARRL, Newington, CT, 1985, ISBN 0-87259-062-3.

Ogata, Katsuhiko, <u>Discrete-Time Control Systems</u>, Prentice-Hall, 1987, ISBN 0-13-216102-8.

Tompkins, Willis J., John G. Webster, eds., <u>Interfacing Sensors to the IBM PC</u>, PTR Prentice Hall, Englewood Cliffs, 1988, ISBN 0-13-469081-8.

Vlach, Jiri, Kishore Singhal, <u>Computer Methods for Circuit Analysis and Design</u>, Van Nostrand Reinhold, New York, 1983, ISBN 0-442-28108-0.

White, Donald, R. J., <u>EMI Control Methodology and Procedures</u>, 3rd ed., Don White Consultants, Inc., Gainsville, VA, 1982, LOCCC 76-39643.

Williams, Arthur B., Fred J. Taylor, <u>Electronic Filter Design Handbook</u>, 2nd ed., MacGraw-Hill, New York, 1988, ISBN 0-07-070434-1.

Dates: Census Date   Tuesday, 1 Feb 94
                    Test I   Monday, 21 Feb 94
                    Drop Date (UG)   Friday, 25 Feb 94
                    Midsemester   Friday, 11 Mar 94
                    Spring Break   Monday, 21 Mar 94
                    Spring Break   Wednesday, 23 Mar 94
                    Test II   Monday, 4 Apr 94
                    Last Date to Drop (UG) Friday, 15 Apr 94
                    Project Defenses   Wednesday, 4 May 94
                    Test III   Wednesday, 11 May 94 @ 8:15pm

Topics: Introduction to instrumentation systems
- Electronic instrumentation systems
- Electronic -vs- non-electronic systems

Discussion of instrumentation system applications
- Process control
- Control system concepts
- Feedback

Overview of instrumentation errors and performance issues
- Linearity and offsets
- Sensitivity
- Stability and repeatability
- Noise sources
- Transducer-induced error
- Transducer interface errors

Modeling transducers and conditioning circuits
- Simple dependant models and short review of circuit analysis
- Non-linear -vs- linear device modeling
- Step-wise linearization of non-linear devices
- Discussion of frequency analysis issues
- Discrete devices: resistors, capacitors, inductors, diodes, transistors
- Analog devices: op amps, instrumentation amps, comparators, multipliers, dividers, oscillators
- Digital devices: gates, counters, timers

Survey of transducers for measuring:
- Electrical quantities: voltage, current, resistance, capacitance, inductance
- Electromagnetic quantities: B-field, E-field
- Optical quantities: luminance, wavelength, image recognition
- Temporal quantities: time, frequency
- Mechanical quantities: strain, force, pressure, moment, torque, displacement, velocity, acceleration, flow rate (mass, volume)
- Thermal quantities: temperature, heat flux, specific heat, thermal conductivity

Discussion of transducer interfacing
- Shielding, grounding, and isolation
- Transmission line and lead-wire effects
- Impedence and matching considerations
- Advanced topics: telemetry, digital links

Signal processing issues
- Filtering (low-pass, high-pass, band-stop, band-pass)
- Amplification and offset correction
- Digital -vs- analog systems
- Analog to digital (A/D) converters
- Quantization and linearity errors

Grading: All final grades will be assigned and composed as follows:
- Test I (25%), Test II (25%), Test III (25%), Project (25%)
- A (>= 90%), B (80-89%), C(70-79%), D(60-69%), F (<60%)

No grade of incomplete (X) will be awarded.

Any cheating will result in a grade of zero on the work submitted and subsequent filing for disciplinary action with the Associate Dean of Engineering.

Any requests for regrading of material must be written.

Prereqs: Circuits I (EE 2315), Physics I (PHYS 1443), Physics II (PHYS 1444), Useful, but not required: Electronics I, Digital, Microprocessors, Statics, Dynamics, Strength of Materials, Thermodynamics.