ABE 6031 Course Syllabus
Instrumentation in Agriculture Engineering Research

Instructor:
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Course Description:
Principles and application of measuring instruments and devices for obtaining experimental data in agricultural engineering research.

Learning Outcomes and Objectives:
Student will study fundamental aspects of instrumentation and data acquisition applicable for Agricultural and Biological systems, such as, zero, first and second order systems characterization, uncertainty analysis, error sources and propagation, probability and statistics in data collection, data acquisition, analog and digital circuits, along with various typical sensors used in Ag & Bio Eng. They will also gain practical hands-on experience as they build electrical circuits, and learn to program and build data acquisition systems for various applications using Labview and Ardunio based devices, which will give them a breadth of exposure to various sensors, data management, and analysis tools. In addition, the students will learn how to use LabVIEW for image acquisition and image processing to do fundamental machine visions tasks.

Course Pre-requisites: Students must have taken an undergraduate Differential Equations class, and will benefit from have taken an undergraduate engineering or physics based electrical circuits class. Familiarity with Matlab or other programming experience would also be beneficial.

Course Texts:
Theory and Design for Mechanical Measurements, 5th ed., R.S. Figliola and D.E. Beasley, John Wiley and Sons,Inc. (Denoted by MM)

Recommended Text:

Introduction to MultiSim, 11th ed., Nilsson and Riedel, Pearson Education, Inc. (Denoted MS)

Hands-On Introduction to LabVIEW, 4th ed., John Essick, Oxford University Press. (Denoted by LV)

Supplemental Text:

Instrumentation and Measurement for Environmental Sciences, Z.A.Henry, ASAE (denoted as IMES)

Course Meeting, Structure, and Objectives:

Lecture Period: Monday 8th and 9th period in room 211 Rogers Hall

The lecture period will be used to develop a basic theoretical understanding of key issues in experimental/instrumentation design, signal conditioning, analog devices, data acquisition and sampling, and fundamental sensor applications. Some days lecture may take longer or shorter than a full class period, and transition to lab will be accordingly. Once lecture time is completed, the remainder of the 2nd period of class will be used on laboratory related topics.

Lab Period: Wednesday 8th and 9th period in room 214 Rogers Hall

The lab will be used to provide hands on experience with instrumentation equipment such as oscilloscopes, function generator, data acquisition boards, bread boarding circuits, and other practical techniques. Demonstration and assignment labs will be provided and required, respectively. Additionally, the laboratory will be used to introduce the student to Arduino and LabVIEW applications in instrumentation. The student will be given moderate guidance with ample opportunity to explore and learn at one's own initiative.

Grading Criteria:

Homework	25%
Lab Reports	10%
Technical Presentation	15%
Term Projects	20%
Comprehensive Take Home Final Exam	30%

1) There will be approximately one homework and/or lab assignment per week. Late homework will not be accepted without prior approval. You may discuss homework with others, but you may not copy verbatim homework from another student. Cheating on homework will affect all parties involved.
2) Some laboratories will require preparation, others are primarily demonstrations. It is mandatory to attend Labs. Get advance approval if you can't attend lab. Some labs will require a report by team members.
3) Each student will make a 10 minute technical presentation and turn in a minimum 3 to 5 page typed summary report covering a topic in instrumentation and sensor technology not covered in the text. The presentation must be thorough and technically accurate. The student should select a topic based on his/her personal research interest.
4) Each student will complete a term instrumentation project using LabView. The project will incorporate data acquisition design, programming, data collection, and basic data analysis. A class presentation and project report will be required. In addition, each student will complete a series of Arduino exercises using the supplied toolkits and user manuals.
5) There will be a take home comprehensive final at the end of semester covering course materials.

Academic Honesty: In the process of enrolling and registering for classes at the University of Florida, every student has signed and presumably understands the following statement: *I understand that the University of Florida expects its students to be honest in all their academic work. I agree to adhere to this commitment to academic honesty and understand that failure to comply with this commitment may result in disciplinary action up to and including expulsion from the University.* The following information will be placed on examinations. On my honor, I have neither given nor received unauthorized aid on this examination.

Recommended Readings from Instrumentation and Measurements for Environmental Sciences to compliment textbook material (not on exam):

1) IMES-1: Planning the Experiments	ASAP
2) IMES-11: Systems Response	Chapter 3
3) IMES- 14: Indicating and Recording	ASAP
4) IMES-15: Analysis and Interpretation	Chapter 4
5) IMES- 10: Signal Conditioning	Chapter 6
6) IMES- 13: Digital Data Acquisition	Chapter 7
7) IMES- 16: Interfacing Microcomputers for Data Acquisition and Control.	Chapter 7

Lecture Material Covered:

There will be an approximate 1h and 15m lecture during the Monday meeting time from the primary textbook (MM). At the end of each textbook lecture, class time will be spent doing a review of basic circuits as applies to this class. As the semester progresses the remaining time will be spent on Arduino experiments, MultiSim applications and usage from MultiSim text, and LabVIEW programming concepts from LabVIEW text.

Week 1. MM-1: Basic Concepts of Measurement Systems; Intro to Arduino Kits
Week 2. MM-2: Static and Dynamic Characteristics of Signals; Basic Circuits Review
Week 3. Labor Day Weekend Holiday on Monday
Week 4. MM-3: Measurement Systems Behavior; Circuits Network
Week 5. MM-4: Probability and Statistics; Circuits Network
Week 6. MM-5: Uncertainty Analysis; RLC Circuits
Week 7. MM-6 Analog Electrical Devices
Week 8. MM-6 Analog Electrical Devices
Week 9. MM-7: Sampling, Digital Devices, and Data Acquisition
Week 10. MM-7: Sampling, Digital Devices, and Data Acquisition
Week 11. MM-8: Temperature Measurements
Week 12. MM-9: Pressure and Velocity
Week 13. MM-10: Flow Measurement
Week 14. Thanksgiving Week Holiday on Wednesday
Week 15. MM-11: Strain Measurement
Week 16. LabView Vision and Image Processing

Laboratory Topics Covered:

The laboratory time will consist of both instructor lead demonstrations and teaching, and hands on laboratory experiments. In many cases, laboratory experiments will be introduced and started during the in-class laboratory time to be finished later by the student with lab partners. A brief lab reported will be submitted by the teams on each lab experiment assignment.

Week 1: Introduction to Arduino self-paced exercise assignments
Week 2: Introduction AC & DC laboratory Instruments using passive Analog Devices
Week 3: Introduction to Multisim Circuit Simulation using passive Analog Devices
Week 4. Introduction to LabVIEW, and While Loop and Waveform Chart
Week 5. LabVIEW For Loop and Waveform Graph, Arrays and Clusters
Week 6. LabVIEW Mathscript Node and XY Graph
Week 7. LabView Data Files and Character Strings
Week 8. LabVIEW Data Acquisition using MAX, and DAQ Assistant
Week 9. LabVIEW Shift Registers and Case Structures
Week 10. LabVIEW Data Acquisition, and Signal Processing: Curve Fitting
Week 11. LabVIEW Data Acquisition, and Signal Processing: Fast Fourier Transform
Week 12. Simulating and building Analog Electrical Devices-Passive and Active
Week 13. LabVIEW VISION and Image Processing
Week 14. LabVIEW VISION and Image Processing (Thanksgiving)
Week 15. LabVIEW VISION and Image Processing
Week 16. LabView Term Projects