

## **Instrumentation in Agriculture Engineering Research**

ABE 6031 Section 18D5

**Class Periods:** M & W, 8<sup>th</sup> and 9<sup>th</sup> period, at 3:00PM to 4:50 PM

**Location:** 214 Rogers Hall

**Academic Term:** Fall 2019

### ***Instructor:***

Tom Burks

Email Address: tburks@ufl.edu

Office Phone Number: 352-294-6728

Office Hours: M or W, 5:00PM to 5:30PM, 225 Rogers Hall

### ***Teaching Assistant/Peer Mentor/Supervised Teaching Student:***

Please contact through the Canvas website

- Name, email address, office location, office hours

### ***Course Description***

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

### ***Course Pre-Requisites / Co-Requisites: 3 Credits***

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 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 Arduino 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. Students will also learn to use National Instrument's MultiSim to build, test and evaluate common circuits and devices such as; passive and active filters, operational amplifier circuits and other.

### ***Materials and Supply Fees***

\$40 per student

### ***Required Textbooks and Software***

- *Theory and Design for Mechanical Measurements*, 5<sup>th</sup> ed
- Author: Figliola and D.E. Beasley
- Publication: John Wiley and Sons, Inc
- ISBN: 978-1118881279

### ***Recommended Materials (Provided as desk reference in Lab)***

- Title: *Introduction to MultiSim*, 11<sup>th</sup> ed.
- Author: Nilsson and Riedel
- Publication: Pearson Education, Inc.
- ISBN: 978-0134739342

**Recommended Materials (Provided as desk reference in Lab)**

- Title: *Hands-On Introduction to LabVIEW*, 4<sup>th</sup> ed
- Author: John Essick
- Publication: Oxford University Press.
- ISBN: 978-0190853068

**Recommended Materials (Provided as desk reference in Lab)**

- Title: *Instrumentation and Measurement for Environmental Sciences*,
- Author: Z.A.Henry,
- Publication: American Society of Agricultural and Biological Engineers
- ISBN: 0929355164 (Out of print, limited availability used at AddAll.com for under \$10)

**Course Meeting, Structure, and Objectives:**

Lecture Period: Monday 8<sup>th</sup> and 9<sup>th</sup> 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 2<sup>nd</sup> period of class will be used on laboratory related topics.

Lab Period: Wednesday 8<sup>th</sup> and 9<sup>th</sup> 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.

- 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.

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-8: Temperature Measurements  
Week 11. MM-9: Pressure and Velocity  
Week 12. MM-10: Flow Measurement  
Week 13. MM-11: Strain Measurement  
Week 14. Thanksgiving Week Holiday on Wednesday  
Week 15. LabView Vision and Image Processing  
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

### ***Attendance Policy, Class Expectations, and Make-Up Policy***

- a) No make-up exams will be given except for valid medical reasons or unless prior arrangements are made.
- b) Laptops and cellphones may be used during class to review slides and take notes, (please no surfing, texting or email during class). Cellphones may not be used during exams, only WIFI disabled tablets or laptops can be used during exam, so that everything must be on your hard drive.
- c) Attendance is mandatory, unless excuse is valid. Absence will affect you and lab partner's ability to do projects, so it is necessary to attend.

- d) Students may drop one homework from their lowest score.
- e) Excused absences must be consistent with university policies in the undergraduate catalog (<https://catalog.ufl.edu/ugrad/current/regulations/info/attendance.aspx>) and require appropriate documentation.

**Grading Criteria:**

Homework	25%
Attendance	10%
Lab Reports	10%
Technical Presentation	15%
Term Projects	20%
Comprehensive Final Exam	20%

***Grading Policy***

The following is given as an example only.

<b>Percent</b>	<b>Grade</b>	<b>Grade Points</b>
90.0 - 100.0	A	4.00
87.0 - 89.9	A-	3.67
84.0 - 86.9	B+	3.33
81.0 - 83.9	B	3.00
78.0 - 80.9	B-	2.67
75.0 - 79.9	C+	2.33
72.0 - 74.9	C	2.00
69.0 - 71.9	C-	1.67
66.0 - 68.9	D+	1.33
63.0 - 65.9	D	1.00
60.0 - 62.9	D-	0.67
0 - 59.9	E	0.00

More information on UF grading policy may be found at:

<http://gradcatalog.ufl.edu/content.php?catoid=10&navoid=2020#grades>

***Students Requiring Accommodations***

Students with disabilities requesting accommodations should first register with the Disability Resource Center (352-392-8565, <https://www.dso.ufl.edu/drc>) by providing appropriate documentation. Once registered, students will receive an accommodation letter which must be presented to the instructor when requesting accommodation. Students with disabilities should follow this procedure as early as possible in the semester.

***Course Evaluation***

Students are expected to provide professional and respectful feedback on the quality of instruction in this course by completing course evaluations online via GatorEvals. Guidance on how to give feedback in a professional and respectful manner is available at <https://gatorevals.ua.ufl.edu/students/>. Students will be notified when the evaluation period opens, and can complete evaluations through the email they receive from GatorEvals, in their Canvas course menu under GatorEvals, or via <https://ufl.bluera.com/ufl/>. Summaries of course evaluation results are available to students at <https://gatorevals.ua.ufl.edu/public-results/>.

***University Honesty Policy***

UF students are bound by The Honor Pledge which states, “We, the members of the University of Florida community, pledge to hold ourselves and our peers to the highest standards of honor and integrity by abiding by the Honor Code. On all work submitted for credit by students at the University of Florida, the following pledge is either required or implied: “On my honor, I have neither given nor received unauthorized aid in doing this assignment.” The Honor Code (<https://sccr.dso.ufl.edu/policies/student-honor-code-student-conduct-code/>) specifies a number of behaviors that are in violation of this code and the possible sanctions. Furthermore, you are obligated to report any condition that facilitates academic misconduct to appropriate personnel. If you have any questions or concerns, please consult with the instructor or TAs in this class.

### ***Commitment to a Safe and Inclusive Learning Environment***

The Herbert Wertheim College of Engineering values broad diversity within our community and is committed to individual and group empowerment, inclusion, and the elimination of discrimination. It is expected that every person in this class will treat one another with dignity and respect regardless of gender, sexuality, disability, age, socioeconomic status, ethnicity, race, and culture.

If you feel like your performance in class is being impacted by discrimination or harassment of any kind, please contact your instructor or any of the following:

- Your academic advisor or Graduate Program Coordinator
- Robin Bielling, Director of Human Resources, 352-392-0903, [rbielling@eng.ufl.edu](mailto:rbielling@eng.ufl.edu)
- Curtis Taylor, Associate Dean of Student Affairs, 352-392-2177, [taylor@eng.ufl.edu](mailto:taylor@eng.ufl.edu)
- Toshikazu Nishida, Associate Dean of Academic Affairs, 352-392-0943, [nishida@eng.ufl.edu](mailto:nishida@eng.ufl.edu)

### ***Software Use***

All faculty, staff, and students of the University are required and expected to obey the laws and legal agreements governing software use. Failure to do so can lead to monetary damages and/or criminal penalties for the individual violator. Because such violations are also against University policies and rules, disciplinary action will be taken as appropriate. We, the members of the University of Florida community, pledge to uphold ourselves and our peers to the highest standards of honesty and integrity.

### ***Student Privacy***

There are federal laws protecting your privacy with regards to grades earned in courses and on individual assignments. For more information, please see: <https://registrar.ufl.edu/ferpa.html>

### ***Campus Resources:***

## Health and Wellness

### **U Matter, We Care:**

Your well-being is important to the University of Florida. The U Matter, We Care initiative is committed to creating a culture of care on our campus by encouraging members of our community to look out for one another and to reach out for help if a member of our community is in need. If you or a friend is in distress, please contact [umatter@ufl.edu](mailto:umatter@ufl.edu) so that the U Matter, We Care Team can reach out to the student in distress. A nighttime and weekend crisis counselor is available by phone at 352-392-1575. The U Matter, We Care Team can help connect students to the many other helping resources available including, but not limited to, Victim Advocates, Housing staff, and the Counseling and Wellness Center. Please remember that asking for help is a sign of strength. In case of emergency, call 9-1-1.

**Counseling and Wellness Center:** <http://www.counseling.ufl.edu/cwc>, and 392-1575; and the University Police Department: 392-1111 or 9-1-1 for emergencies.

### **Sexual Discrimination, Harassment, Assault, or Violence**

If you or a friend has been subjected to sexual discrimination, sexual harassment, sexual assault, or violence contact the **Office of Title IX Compliance**, located at Yon Hall Room 427, 1908 Stadium Road, (352) 273-1094, [title-ix@ufl.edu](mailto:title-ix@ufl.edu)

### **Sexual Assault Recovery Services (SARS)**

Student Health Care Center, 392-1161.

**University Police Department** at 392-1111 (or 9-1-1 for emergencies), or <http://www.police.ufl.edu/>.

## Academic Resources

**E-learning technical support**, 352-392-4357 (select option 2) or e-mail to [Learning-support@ufl.edu](mailto:Learning-support@ufl.edu).  
<https://lss.at.ufl.edu/help.shtml>.

**Career Resource Center**, Reitz Union, 392-1601. Career assistance and counseling. <https://www.crc.ufl.edu/>.

**Library Support**, <http://cms.uflib.ufl.edu/ask>. Various ways to receive assistance with respect to using the libraries or finding resources.

**Teaching Center**, Broward Hall, 392-2010 or 392-6420. General study skills and tutoring.  
<https://teachingcenter.ufl.edu/>.

**Writing Studio, 302 Tigert Hall**, 846-1138. Help brainstorming, formatting, and writing papers.  
<https://writing.ufl.edu/writing-studio/>.

**Student Complaints Campus:** [https://www.dso.ufl.edu/documents/UF\\_Complaints\\_policy.pdf](https://www.dso.ufl.edu/documents/UF_Complaints_policy.pdf).

**On-Line Students Complaints:** <http://www.distance.ufl.edu/student-complaint-process>.