Session 01 Lecture Notes

Instructor Information

Prof. Joe Hass
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Office: Dana 306

Student hours: MWTh 1-3, by appointment, and whenever my office door is open.

Web Sites

The full syllabus, lecture notes, homework assignments, and other supplemental materials will be available on the instructor's course web page:

`http://www.eg.bucknell.edu/~kjh016/courses/eceg201s20`

Course grades will be posted to Moodle after each exam.

After-class homework assignments will appear on the course web page by 5:00 pm after a lecture.

Email or call me if there is a bad link!

Accommodations and Excused Absences

Please note that absences from exams and labs can only be excused **in writing**. Other than sudden illnesses, absences must be excused **at least one week in advance**.

Homework/Lab Policies

If you want a good grade in this class your work must meet certain professional standards, which are described in *Getting Full Credit*.

Everything you hand in **must** be on US Letter size paper! Some of your work will be scanned and used (anonymously) to support the ECEG department's ABET accreditation review next. It is vital that all submitted work is on paper with the same size, 8.5 by 11.0 inches, with no ragged edges. You **will** lose points if you don't follow this guideline!

It is particularly important that all answers on exams, homework, and lab reports include the proper engineering units.

After-class homework is due **at 11:00 a.m.** on the due date, according to the instructor's computer clock. There is a penalty for late homework.

Homework should be hand-written unless you are explicitly told otherwise. You may not submit homework by email unless explicitly instructed to do so.

Grading

Homework	20%
Laboratory Exercises/Reports	30%
Quizzes	30%
Final Exam/Report/Project	20%

Exams are usually be closed-book, closed-notes. Generally, calculators will be provided if needed.

Any material discussed in class may appear on an exam, even if not included in the online lecture notes. However, most exam problems will be similar to homework or laboratory problems.

You may lose up to 3 points from your course grade for distracting or disrupting your fellow students.

Lab Policies

- You **must** read and sign the ECE Lab User Agreement **before** coming to the first lab session.
- Bring your Analog Discovery to **every** class meeting. Laboratory activities may occur on any day. Don't plan to eat breakfast or lunch during class.

Coming to class and reading the lecture notes will not be sufficient. You will be required to read real-world technical documents. They won't make sense the first time you read them. Ask questions and read them again.

Announcements

1. Reading:
   (a) Read the full course syllabus on the course web page
   (b) Read Getting Full Credit
   (c) Read and sign the Electrical and Computer Engineering Laboratories Safety and Access agreement
   (d) In Test and Measurement: Know It All
      i. Chapter 1, *Fundamentals of Measurement*
2. To Hand In:
   (a) No homework today

Course Outcomes

At the conclusion of this course, you should be able to:

- Use modern techniques and equipment to design, fabricate, populate, and troubleshoot a functioning printed circuit board.

  This outcome will not be emphasized.
- Design a test protocol and conduct appropriate experiments to determine the level of functionality and performance of an electronic device.

  We are going to learn about **testing**.
  - Why? Testing is hard. Testing is not as fun as design. So why do we do it?
  - When? At what stages in the lifecycle of a product is testing done?
  - What? What are we observing when we test?
  - How? The **how** of testing must include a significant discussion about **making measurements**.
- Effectively communicate the details and results of an experiment in a manner that would be appropriate for practice in electrical or computer engineering. We will practice **communicating** complex data. Good communication is absolutely vital in engineering. It is one of the most important skills that your next employer is looking for.

  Complex engineering data is typically communicated through **tables** and **graphs**. In this course you will learn about the "best practices" for creating tables and graphs, and you will practice by presenting your actual test data.

Along the way, we also want to improve your Python programming skills.

Verification vs. Validation vs. Testing

According to IEEE Std 1012, *System, Software, and Hardware Verification, and Validation…*

- **Verification** is the "process of evaluating a system or component…to determine whether the products of a given development phase satisfy the conditions imposed at the start of that phase."
- **Validation** is the "process of evaluating a system or component…to determine whether it satisfies specified requirements."
- A **test case** is "a set of test inputs, execution conditions, and expected results developed for a particular case"

According to IEEE Std 24765, *Systems and software engineering –Vocabulary…*

- **Verification** determines whether "The system has been built right."
- **Validation** determines whether "The right system has been built."
- **Testing** is an "activity in which a system or component is executed under specified conditions, the results are observed or recorded, and an evaluation is made of some aspect of the system or component"

Common Engineering Tests

- Component or Unit tests

  According to IEEE Std 1012, a **component** is "One part that makes up a system. A component may be hardware or software and may be subdivided into other components."

  Component testing is "Testing of individual hardware or software components."

  This is an extremely important aspect of testing for large projects. As an engineer, it allows you to demonstrate that your part of the design is correct even before the entire system is assembled. The disadvantage of component testing is that the design team must agree on **detailed** and **formal** specifications for each component, and how it interfaces to other components, separately.

- Regression testing

  According to IEEE Std 24765, **regression testing** is "selective retesting of a system or component to verify that modifications have not caused unintended effects and that the system or component still complies with its specified requirements."

  Because your component design **will** change and you **will** need to repeat all of the testing you did on your original design, it behooves you to make the component testing as automated and fool-proof as possible. Write simple programs to control the test equipment and evaluate the results.

- Integration test

  According to IEEE Std 1012, **integration testing** is "Testing in which software components, hardware components, or both are combined and tested to evaluate the interaction between them."

  If you haven't done a good job with component testing you will certainly suffer greatly during integration testing. This testing phase will validate your specifications for the individual components.

- Qualification test

  According to IEEE Std 1012, **qualification testing** is "Testing conducted on a hardware element, software element, or system to evaluate conformance with specified requirements."

  This is where the rubber meets the road. Qualification testing verifies that the element meets **all** requirements. The element must do what it was designed to do, and not do what it was designed not to do, for all possible combinations of input conditions.

- Manufacturing test

  Manufacturing test is intended to show that the system was manufactured as it was designed. Since this testing may be performed on every manufactured unit there is a strong incentive to make this testing as fast and cheap as possible.

  Manufacturing test doesn't validate user requirements, instead in seeks to find defects in the manufactured product.

- Acceptance test

  According to IEEE Std 1012, **acceptance testing** is "Testing conducted to determine whether a system satisfies its acceptance criteria and to enable the customer to determine whether to accept the system."

  You may design a system that can be sold to several customers, and each customer's acceptance criteria could be different. Your design requirements should be able to satisfy the acceptance criteria of **all** expected customers.

- Characterization test

  Characterization testing is not a pass/fail test. Instead, characterization testing seeks to understand **how well** your system works. This information can be used to guide quality improvement and manufacturing process changes.

  For example, a power supply might be required to produce a voltage of 5 V with a tolerance of 5%. Any manufactured unit that produced a voltage between 4.75 V and 5.25 V would pass a validation test. However, it would be very helpful to know how well the power supply works. . . is the voltage very close to 5.00 V in manufactured units? If the manufactured units provide voltages very close to 5.24 V then this is a sign that your design and/or manufacturing is not robust and any small perturbation could cause most of the units to fail.

- Maintenance test
- Disposal test