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# ECE 403 - Senior Design II

Fall 2023 - [www.BisonAcademy.com](http://www.BisonAcademy.com)

## Course Information:

Instructor: Jake Glower, Jeff Erickson  
Class Times: Fr 3pm, AgHill 334  
Office: ECE 201  
Office Hours: Mo/We/Fr 11am - noon  
Textbook: none  
OneNote is required as your lab notebook.  
On-Line Reference: [www.BisonAcademy.com](http://www.BisonAcademy.com)

## Bulletin Description:

Capstone experience in formulation and design of a system or device. 1 lecture. Prereq: ECE 401.

## Course Objectives:

Senior Design is a 3-course sequence at NDSU. The overall goal of this sequence is

- To work in a group of 2-4 engineers,
- Demonstrate your ability to apply knowledge related to electrical and computer engineering, and
- Take a project from concept to design, build, test, and demonstration.

This is broken down into three courses:

**ECE 401 Senior Design I:** This course covers

- Project Management (how to coordinate a group of engineers, how to split a larger project into smaller, more manageable pieces)
- Tools you will need in the later courses (CircuitLab, PCB layout, etc).
- The second half of the course has students build a small electronic device to practice these skills.

**ECE 403 Senior Design II** applies what you learned in ECE 401 to a larger, more complex project. The major deliverables in this course are:

- Requirements Capture.
- Gantt Chart
- Simulation of major sections
- Breadboard of major sections

The Requirements Capture are all important. The requirements determine what you are going to build, how you are going to test it. At the start of a project, this is usually the first presentation to a customer: what we think you want in engineering terms.

Gantt Charts are timelines that identify what the major components are in the project, who is responsible for each part, and when these parts need to be completed to finish on time. Gantt Charts are also useful for management: they are a good way to assess how far along a project is (is it ahead of schedule? behind schedule? does it need more resources to finish on time?) Requirements Capture and Gantt Charts are typically paper designs - meaning relatively inexpensive. Once you start using hardware, costs go up.

The culmination of ECE 403 are the breadboard prototypes. One way to design a complex system is to break it down into smaller, more manageable subsystems. At the end of ECE 403, you should have each subsystem designed and tested in simulation (CircuitLab) as well as on a breadboard.

Note that a major goal of senior design is to demonstrate that you are able to apply knowledge of electrical and computer engineering. Likewise, this is often done by

- Splitting the project into smaller parts,
- Having different members of the team work on different parts.

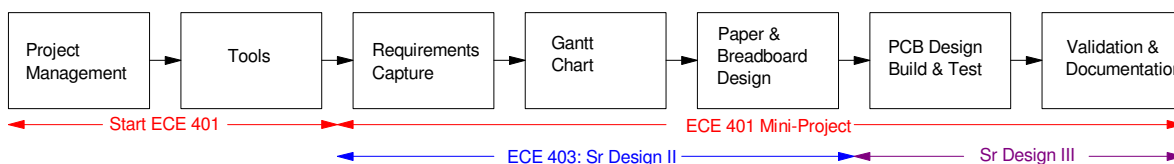
This allows each member the chance to demonstrate his/her skills in electrical and computer engineering.

**ECE 405 Senior Design III** applies what you designed in Senior Design II to produce a single combined system ready to deliver to the customer. In theory, if the requirements for each subsystem are specified correctly, the parts should fit together without any problems.

In ECE 405, the goal is to

- Combine all subsystems into a single overall system
- Build a printed circuit board (PCB) for the overall system,
- Test and validate each subsystem as well as the overall system, and
- Package and deliver a working prototype to the customer.

PCB's are used in this sequence since they are fairly inexpensive and can last several semesters. In industry, one more step, creating an application-specific integrated circuit (ASIC) often happens. ASICs typically cost over \$1 for the first copy, pennies thereafter. That first copy is outside our budget at NDSU - hence we don't do this step.



Components of Senior Design at NDSU

### Lab Notebooks (OneNote)

Lab notebooks are essentially your diary in Senior Design. Everything you do should be recorded in your design notebook. This serves several purposes

- If you ever want to go back and see what you did, it should be in your OneNote document
- If you want to see what others in your group are doing (or did), it should be in your OneNote document
- OneNote is essentially your final report for ECE 403 and 405.

OneNote is required for each group and each student (a single OneNote document per group). This document will be used for both ECE 403 and ECE 405.

### Syllabus

Please visit [www.BisonAcademy.com](http://www.BisonAcademy.com) for an updated syllabus

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**Senior Design 2: Evaluation Procedures and Grading Criteria**

Due Date	Content	% of Grade
Week 2	HW1: Project Selection <ul style="list-style-type: none"> <li>Rank top three projects</li> </ul>	5%
Week 3	HW2: Work Breakdown Structure <ul style="list-style-type: none"> <li>Level 1: Project Requirements</li> <li>Level 2: Project Breakdown</li> </ul> <i>The role of each student in the project</i>	5%
Week 4	HW3: Work Breakdown Structure (each student) <ul style="list-style-type: none"> <li>Level 3: Major Activities for ECE 403</li> <li>Level 4: Tasks to complete in ECE 403</li> <li>Gantt Chart</li> <li>What four ECE concepts will you apply?</li> <li>What two ECE tools will you use?</li> </ul>	10%
Week 7	HW4: Apply and demonstrate knowledge of ECE <ul style="list-style-type: none"> <li>Advanced ECE concept #1</li> </ul>	12%
Week 9	HW5: Apply and demonstrate knowledge of ECE <ul style="list-style-type: none"> <li>Advanced ECE concept #2</li> </ul>	12%
Week 11	HW6: Apply and demonstrate knowledge of ECE <ul style="list-style-type: none"> <li>Advanced ECE concept #3</li> </ul>	12%
Week 13	HW7: Apply and demonstrate knowledge of ECE <ul style="list-style-type: none"> <li>Advanced ECE concept #4</li> </ul>	12%
Week 15	HW8: Apply and demonstrate proficiency with ECE tools <ul style="list-style-type: none"> <li>Usually oscilloscopes plus one other</li> </ul>	12%
Week 15	HW9: Solder practice PCB <ul style="list-style-type: none"> <li>Includes surface mount parts</li> <li>One board per group</li> </ul>	5%
Week 15	HW10: Lab Checkoff <ul style="list-style-type: none"> <li>Demonstrate ability to use oscilloscopes and multimeters</li> </ul>	10%
Week 16	Attend ECE 405 Demonstrations <ul style="list-style-type: none"> <li>What you liked, what could be improved</li> </ul>	5%

## Grading

Grades are rounded to the nearest 1%, with your final grade being

F	D	C	B	A
59% or less	60% - 69%	70% - 79%	80% -89%	90% or more

Note again that each member of each team should be able to

- Demonstrate an ability to apply engineering knowledge, and
- Demonstrate an ability to use engineering tools

for all three courses (Senior Design I, II, and III).

## 401 vs. 403/405

	ECE 401	ECE 403/405
PCB Size	2" x 2"	up to 60 square inches
Mounting Holes	200 mils	200 - 250 mils
Ground Plane	yes	yes
Power Plane	yes	Depends upon design
Trace Width: Power	40 mils	8 mils to 600 mils
Other Traces	20 mils	8 mils to 600 mils
Test Points	yes Through Hole	yes Surface Mount or Through Hole
Components	Through Hole	any (0805, TSOP, DIP, etc.)
Silk Screen (top)	yes include date & group number	yes include date & group number
Silk Screen (bottom)	no	yes if components placed on both sides of board
Font Size	50 mil or larger height/10 for thickness	50 mil or larger height/10 for thickness
Digikey Trace Width Calculator	optional	Longest trace with highest current
LEDs	5mm Through Hole 10mA current Power, Signals	Any size, any number 0805 recommended Power, Signals
Power	9V battery 7805 to step down to 5VDC	any
Fuse	1 Ohm resistor Add reverse polarity protection	optional

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## Legal Stuff:

**Attendance:** According to NDSU Policy 333 ([www.ndsu.edu/fileadmin/policy/333.pdf](http://www.ndsu.edu/fileadmin/policy/333.pdf)), attendance in classes is expected. Students are responsible for the material covered in class and in assignments regardless of their attendance. Note that all lecture notes, homework sets, and solutions are available on-line at [www.BisonAcademy.com](http://www.BisonAcademy.com)

**Students with Special Needs:** Any students with disabilities or other special needs, who need special accommodations in this course, are invited to share these concerns or requests with the instructor and contact the Disability Services Office ([www.ndsu.edu/disabilityservices](http://www.ndsu.edu/disabilityservices)) as soon as possible.

**Academic Honesty:** The academic community is operated on the basis of honesty, integrity, and fair play. NDSU Policy 335: Code of Academic Responsibility and Conduct applies to cases in which cheating, plagiarism, or other academic misconduct have occurred in an instructional context. Students found guilty of academic misconduct are subject to penalties, up to and possibly including suspension and/or expulsion. Student academic misconduct records are maintained by the Office of Registration and Records. Informational resources about academic honesty for students and instructional staff members can be found at [www.ndsu.edu/academichonesty](http://www.ndsu.edu/academichonesty).

**Academic Honesty Defined:** All written and oral presentations must “respect the intellectual rights of others. Statements lifted verbatim from publications must be cited as quotations. Ideas, summaries or paraphrased material, and other information taken from the literature must be properly referenced” (Guidelines for the Presentation of Disquisitions, NDSU Graduate School).

**ECE Honor Code:** On my honor I will not give nor receive unauthorized assistance in completing assignments and work submitted for review or assessment. Furthermore, I understand the requirements in the College of Engineering Honor System and accept the responsibility I have to complete all my work with complete integrity.

**Veterans and Student Soldiers:** Veterans and student soldiers with special circumstances or who are activated are encouraged to notify the instructor in advance.