ECE 405 - Senior Design III

Spring 2025 - www.BisonAcademy.com

Course Information:

Instructor:	Jake Glower, Jeff Erickson
Class Times	Mo 3pm, Offerdahl West (ECE) 125
Office:	ECE 201
Office Hours	Tu/Th 10-11am (pretty much all day Tu/Th)
Textbook:	none
	Lab notebook is required (OneNote). Add to your OneNote document from Senior Design 2.
On-Line Reference:	www.BisonAcademy.com

Bulletin Description:

Capstone experience in formulation and design of a system or device. 1 lecture. Prereq: ECE 403.

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 managable 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 delivarables 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 resourses 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 managable 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.

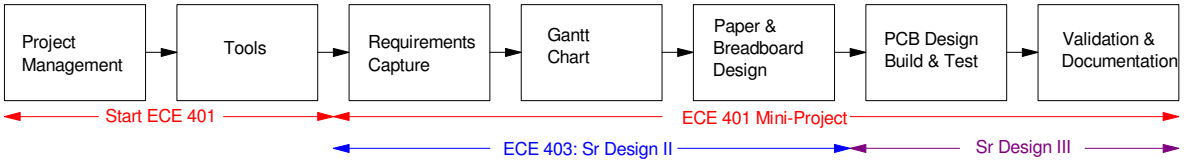
This allows each member the chance to demonstrage his/her skills in electrical and comptuer engineering.

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 subsestion 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 inexpansive 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)

OneNote is required for all ECE 405 groups. Essentially, add to your previous OneNote document from ECE 403. For ECE 405, separate sections for each student are not needed - ECE 405 is more of a group effort as you put the sections together to create a single working device.

Hy-Flex Model for Spring 2025

Students are welcome to take this course however they like:

- In-Person: Students are welcome to addend class at the designated class time and location. Note that face masks are required for everyone.
- Live-Stream: Students are also welcome to live-steam the class. A link with how to connect will be sent out at the start of the semester on BlackBoard and to your NDSU email address.
- On-Line: Students are also welcome to take the class on-line and fit lectures into their own schedule.

It's completely your choice how you take the class.

Syllabus

Please visit www.BisonAcademy.com for an updated syllabus

401 vs. 403/405

In ECE 401, you were limited to the size of your PCB and to using through-hole components.

In ECE 405, you're free to use larger PCBs and various types of surface-mount components.

	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

Senior Design 3: Evaluation Procedures and Grading Criteria

HW	Target Due Date to get an A...	Homework Set & Task	% of Grade
1	Week 2	Gantt Chart	10%
2	Week 5	System Breadboard	10%
3	Week 7	Breadboard Test Base Grade = D	10%
4	Week 10	PCB Layout Base Grade = C	10%
5		Test Equipment	10%
6	Week 13	PCB Build & Test Base Grade = B	10%
7	Week 15	Packaging Base Grade = A	10%
8	throughout the semester	Attend Biweekly Meetings	10%
9	Week 15	2-Minute Video	10%
10	Week 16	Present at Sr Design Expo	10%

Grading

Senior Design III is pretty much a group grade based upon how far you get on your project.

Grade	Rubric
A 93% - 100%	Working PCB, meets all requirements. Packaged and ready to deliver to customer. Demonstrated at Senior Design Expo.
B 83% - 92%	Breadboard works, PCB works. Some requirements not met or not packaged and ready to deliver to customer.
C 73% - 82%	Project built,tested, and working on breadboad level. PCB ordered and soldered but only partially working.
D 63% - 72%	Project built and partially working at the breadboard level. Unable to test at the PCB level
F < 63%	Unable to demonstrate a working device at the breadboard level. Unable to demonstrate a working device at the PCB level.

Grades can be adjusted for individuals in the group based upon observations from the instructors and project sponsor:

Grade	Rubric
+1 letter grade	Student was largely responsible for getting the project to work. Made contributons well beyond the rest of the group.
-1 letter grade	Student put in minimal effort in ECE 405 and let the group carry him/her
F	Student did not show up meetings and made no apparent contribution to the 405 project

Legal Stuff

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) 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.

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.