ECE 403 - Senior Design II

Spring 2024 - www.BisonAcademy.com

Course Information:

Instructor:	Jake Glower, Jeff Erickson
Class Times	Fr 3pm, ECE 125
Office:	ECE 201
Office Hours	Mo/We/Fr 11am - noon
Textbook:	none
	OneNote is requred as your lab notebook.
On-Line Reference:	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 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.

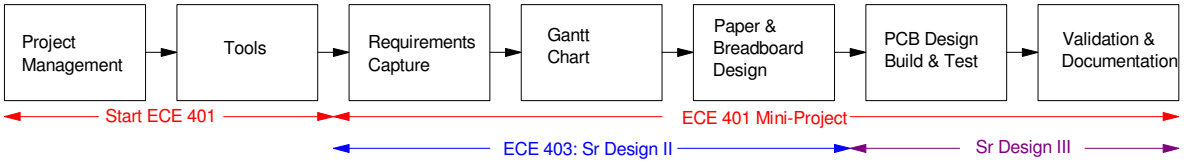
This allows each member the chance to demonstrage his/her skills in electrical and comptuer engineering.

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)

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 for an updated syllabus

Senior Design 2: Evaluation Procedures and Grading Criteria

All homework sets are submitted as sections in your group's OneNote document

Homework sets 1 and 2 are group assignments

Homework sets 3-10 are individual assignments:

- They should be different for each person in your group (different roles)
- They should be placed under each student's section in OneNote

	Content	% of Grade
HW1	Project Selection • Rank top three projects	5%
HW2	Project Charter • Level 1: Project Requirements • Level 2: Project Breakdown *The role of each student in the project*	10%
HW3	Tasks & ECE Concepts (each student) • Level 3: Major Activities for ECE 403 • Level 4: Tasks to complete in ECE 403 • Gantt Chart • What four ECE concepts will you apply? • What two ECE tools will you use?	10%
HW4	Apply and demomstrate knowledge of ECE • Advanced ECE concept #1	10%
HW5	Apply and demomstrate knowledge of ECE • Advanced ECE concept #2	10%
HW6	Apply and demomstrate knowledge of ECE • Advanced ECE concept #3	10%
HW7	Apply and demomstrate knowledge of ECE • Advanced ECE concept #4	10%
HW8	Apply and demomstrate proficiency with ECE tools • Usually oscilloscopes plus one other	10%
HW9	Test Equipment • Demonstrate ability to use o-scope and multimeter • (doessn't need to appear in OneNote)	10%
HW10	Senior Design Expo • Attend Sr Design Expo • Note which project you liked and why	5%
	Biweekly Meetings • Meet with your group & project supervisor • Points off if you miss or are unprepared for 2+ meetings	10%

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

Many of the limitations placed on you in ECE 401 are lifted in ECE 403 & 405. From this point onwards, you're free to use surface mount components and larger PCB's. You can also use *any* microcontroller - provided each student is able to demonstrate knowledge of ECE while doing so. (Finding working code on the web doesn't count.)

	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

Legal Stuff:

Attendance: According to NDSU Policy 333 (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

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.