ECE-492
SENIOR ADVANCED DESIGN PROJECT
Meeting #1
ECE-492
SENIOR ADVANCED DESIGN PROJECT

- Course Coordinator (CC): Dr. Pachowicz
- Faculty Supervisor (FS): (a faculty associated with ECE Dept.)
- Associate Chair (AC): Dr. Kurtay
- Enrollment requirement: Senior status (!)
- Course materials on the web:
  - Pamphlet, Schedule, Meeting presentation slides, Resources
- Senior Design Project Lab: Rm.3511; and Fabrication Lab: Rm.3503
  - Available to ECE492/3 students only
  - Access for ECE492 students from Week#10
Course Materials

- PPT meeting presentation slides
- Seminar PPT slides
  1) Electronic Prototyping: Methods, Tips, Tools, and Skills
  2) PCB Design
  3) SMT in Practice

Textbooks:
- “Design for Electrical and Computer Engineers” by Ford and Coulston (Required)
- “The Engineering Design of Systems: Models and Methods” by Buede (Recommended)
GMU Library Resources

➢ Circuit Cellar Magazine
  o Huge source of practical projects to learn from
  o Practical advice in every issue
  o Particularly useful for teams working with microcontrollers (!)
  o Check on-line resources for older articles, as well
  o If you want: Student subscription is 50% off

➢ Elektor Magazine
  o More material on electronics and practical aspects
This is a business arrangement where you proceed through all steps of a typical engineering design and prototyping process as practiced in the industry.

This is a large engineering effort where you have to solve a larger scale difficult problem:
- This is NOT yet another homework (!)
- This is NOT your typical college course
- You will run a real project with specific deliverables and under crisp restrictions such as time, schedule, and funds
ECE Senior Design

- Multidisciplinary aspect
  - A combination of EE, CpE, Math, Physics, CS, science, engineering, and also system engineering
  - All above complemented by business and entrepreneurship practice

- Please remember that:
  - You will need to carry formal business meetings – do not be late (!)
  - The role of CC is limited to coaching and advising through this process
  - Your evaluation will include systematic work and progress
  - You run your ‘show’ and are fully responsible for the progress and outcomes
Coaching Materials on the Course Page

- Meeting presentation slides
  - To serve as a guidance for your team
  - To avoid mistakes made by previous teams
  - To provide essential information on the design process, etc.
  - Topics include:
    - Engineering design; Teams and Teaming; Project selection;
      Requirements specification and analysis; Conceptual design; System
      design; Presentations; Project management; Testing

- Design Case Studies
- ECE Seminars slides
- Fabrication guidance and other help
- Study textbook seriously (!)
- Search the Web for sample documents
Scheduled Meetings

- **Class meetings**
  - See Schedule and Due Dates sheet
  - Attendance is mandatory (signup sheet)

- **Team meetings**
  - Mandatory team meeting required at least once a week! All team members must attend. This is a formal requirement.
  - Meetings must be documented by “Weekly Task Allocation/Delivery” sheet. These sheets will be submitted to CC and/or FS on request.

- **Meeting your FS**
  - Coordinate with your FS, but . . .
    You should establish some rules for getting feedback – e.g., meet your FS on Monday after delivering a document on Friday
Presentations

The following are formal presentations in front of your FS and at least one more faculty:

- Week #7
  - Proposal Presentation
- Week #11
  - Design Review Presentation
## ECE-492 Activities and Milestones

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Deliverables

- Per request
  - Homeworks
- Week #3
  - Project Title Form
- Week #7
  - Proposal
- Week #11
  - Design Review Presentation slides
- Week #15
  - Design Document

(For cover page format – see ECE-492 pamphlet)
For successful completion of ECE 492 you must have all four issues resolved and documented:

1) **Detailed design of your system**
   - Schematics down to the component/resistor/capacitor value
   - Algorithms

2) **Model of your system operations**
   - Functional model
   - System architecture

3) **Prototyping effort**
   - Simulations
   - Experimentation with selected components

4) **Implementation plan**
   - Gantt chart for the next semester effort
   - List or tasks and team member allocation/responsibilities
Key to Success

✓ Apply top-down system design approach

✓ Start simple – complicate later

✓ Run extensive early prototyping effort

✓ Show discipline in organization and planning

✓ Review and use course materials frequently
Grading

- This is only a guidance – your FS may apply his/her own priorities
- Components:
  1. Proposal (overall quality) (15 points max)
  2. Proposal presentation (overall quality) (15 points max)
  3. Design Review (design progress) (15 points max)
  4. Functional design, Requirements analysis, and System architecture (based on Design Document) (15 points max)
  5. Detailed design at circuit/algorithm level (based on Design Document) (20 points max)
  6. Early prototyping (based on Design Document and presentation to FS) (10 points max)
  7. Experimentation plan; Task decomposition, description and scheduling for the ECE-493 semester (based on Design Document) (10 points max)

- Two team evaluations will be completed
Costs

- Parts/materials/software cost should not exceed $600, if covered by students
  - Establish procedures for parts purchasing
  - Set rules for cost sharing

- Consider different strategies to limit costs
  - Free samples
  - Donations/Sponsors

- Costs of sponsored projects – under individual considerations
Motivation

- This is a very competitive effort – seriously!
  - During the final presentation, your project will be compared against the other projects (and past projects)
  - Your project will be evaluated by many people
  - Continuity of project progress will have a significant influence on your grade

- Resume and job factor

- Hook up early – do not waste time

- Warning
  1. If your project is delayed, you will have a real difficulty to make up lost time. The quality will suffer.
  2. ECE Dept. does not hesitate to issue unsatisfactory grades
You have another 2 weeks to select your topic and build your team (this includes research devoted to this task)

Consider (3) alternative projects

Do not rush with the final selection

DO YOUR HOMEWORK

Analyze each alternative and make your decision based on preliminary study of the domain

Do not consider very easy or very difficult projects
  – There is not much time to educate yourself from scratch
  – Your project will compete against others
  – Avoid toy-problem projects
  – Talk to me regarding difficult projects – the goal is to structure them properly: a core and optional tasks
Consider projects that can be continued (advanced further) or are a continuation of previous work

- Very serious work can be done if a project is undertaken by next ECE-492/3 teams
- Proper credits must be given to all previous work and students involved

Many projects involve microcontrollers - plan accordingly

- Take ECE447 and/or ECE450 early
- Arduino? Do not use it.
- MSP430 (there are few problems)
- Learn a better technology (?)
- Use the ECE fabrication lab
- Development boards are for development only – But you need to deliver a product, so do not rely on development boards at the end

Do not forget about a FUN factor !!!
Sources of Project Topics

- **Faculty suggested projects**
  - A list of faculty suggested topics is provided
  - Talk to the faculty suggesting these topics to learn more

- **Independent topics suggested by students**
  - You need to discuss a suggested topic with the CC first
  - Project must be doable, but not trivial/oversimplified

- **Industry sponsored topics**
  - Sometimes we have projects provided by corporate sponsors; or you can look at your own workplace for such a project
  - Special considerations are needed in such a case
  - You cannot use company employees to work on your project
How to Define Your Own Project?

- Do not reinvent the wheel

- Instead, identify a need for an improvement, new add-ons, etc.

- Stay away from projects involving hazards and no ‘flying objects,’ please
Next slide shows all stages of the design process you need to go through ECE492/3.

Essential slides have been extracted from all class materials and combined into a single file (called “ECE492 Design Process”) for your convenience.

A simple project titled “CaseStudy#1: Pendulum Clock Timer” was run and documented to illustrate this design process on a practical real-world example.
1. Identification of Need

2. Operational Scenario & Requirements Specification

3. Conceptual Design

4. Functional Decomposition

5. System Architecture

6. Behavioral Modeling

7. Background Foundations

8. Early Prototyping

9. Detailed Design

10. Testing Plan

11. Project Management
STEP 1: IDENTIFICATION OF NEED

- Once you determine a candidate topic, do your research!
- Write an “Identification of a need”
  - Briefly and clearly state the need being addressed
  - Refer to Heilmeier’s questions (next slide!)
  - Do not talk about a solution
  - You can provide supporting information, statistics, etc.
  - Describe current limitations
- Having this step done in writing will test your understanding of each preselected topic
- If you propose your own topic, you need to do it very carefully to attract other students
Heilmeier’s Questions

1) What are you trying to do? Articulate your goals.
2) How is it done today, and what are the limitations of current practice?
3) What is new in your approach, and why do you think it will be successful?
4) Who cares? If you are successful, what difference will it make?
5) What are the risks and payoffs?
6) How much will it cost? How long will it take?
7) What are midterm and final milestones to check for success?
CASE STUDY:
Pendulum Clock Timer

< Step1: Identification of Need >

(Separate set of slides distributed through email)
Specify a “Need” in writing for a chosen topic (in a bulleted format)

Answer all Heilmeier’s questions in writing (!)

Be sure that all team members participate in this process and understand the “Need”
Motivation

- Engineering projects are far too large to be carried out by a single person: You must work with a team
- High-performance teams can significantly outperform equal number of individuals working in isolation
- Employers desire it – consistently listed as one of the top skills required of engineers

What is a team?

“A small group of people with complementary skills, who are committed to a common performance, performance goals, and approach for which they hold themselves mutually accountable,”

Katzenbach and Smith
ECE-492/3 is a Team Effort

- Teams of ~5 students to be formed at a time of topic selection
- Each student must be actively involved in team forming

Important:
- All team members must be familiar with ALL technical aspects of the project
- Team members should complement their skills and knowledge
- Share your knowledge
- Learn new material

Plan ahead
- Planning will help you to run project faster and ‘safer’
- Think what can go wrong and always have a ‘Plan B’
For the Next Meeting

- Read ECE-492 Pamphlet
- Research topics of potential interest – you should have a grasp of what it takes to succeed at the end
  - Identify a “Need” for each topic selected
- Talk to a topic FS immediately
- Read textbook – Chapter 2 and Chapter 9
Project Selection Session

- Goal: identify your preliminary interests

- List of projects on the blackboard
- Please put your initials on 3 topics
- Identify other students of similar interests
- Student suggested topics will be put on the blackboard in a separate section. You will be given 2 minutes to introduce your topic.