

ECE 4007 – ECE Culminating Design Project (2-6-4)

Prerequisites: ECE 3042

Prerequisites with Concurrency: ECE 4001

Catalog Description: Team-oriented culminating design project in electrical/computer engineering, incorporating engineering standards and realistic constraints. Requires formal reports and group presentations

Textbook(s): No textbook specified

Course Summary:

This course satisfies the major design requirement for EE and CmpE majors and provides senior ECE students with the necessary skills to address and solve open-ended design problems.

Working individually, students will research and write a topical background summary, including an annotated bibliography.

Working in teams, students will complete a semester-long project requiring specification, design, implementation, and testing. Projects must be based on the knowledge and skills acquired in earlier course work, and incorporate appropriate engineering standards and multiple realistic constraints. For teams including CmpE majors, the project must incorporate both hardware and software design elements and trade-offs. Emphasis is placed on the design process, the technical aspects of the design, and on reducing the proposed design to practice.

The course includes a weekly one-hour common lecture to provide supporting information and instructions to all design teams. Lecture topics include the following:

- Course overview and deliverables
- Proposal/PDR written report and oral presentation
- Codes and standards
- Project specifications
- Project budget and schedule
- Ordering parts
- Intellectual property and laboratory notebooks
- Design considerations, constraints and tradeoffs
- Engineering documentation
- Final written report and oral presentation
- Project demonstration

All ECE 4007 projects must include, as a minimum, the following elements, with all deliverables submitted electronically. Faculty supervising individual projects may impose additional requirements or constraints.

Regular Progress Reports

Minimum of four periodic (weekly reporting may be required) progress reports, including both team and individual contributions. Each report should include:

- Goals from the previous reporting period
- Current status relating to each goal and actions since the previous report
- Goals for the next reporting period
- Quantitative contributions of each team member

Formal Written Design Proposal/Preliminary Design Review (PDR)

Each design team must submit a formal written project proposal or PDR to:

- Enable evaluation of the project's feasibility/progress and the technical approach
- Identify quantitative project specifications

The report must include the following sections, as a minimum:

- Qualitative project goals
- Quantitative project specifications
- Background and context of project (i.e., state of the art)
- Engineering standards (identification and applicability to project)
- Constraints
- Design rationale narrative and details, including major trade-offs
- Current status (for PDR)
- Schedule (Gantt chart with tasks and milestones)
- Financial (budget, marketing if appropriate)
- Plans for demonstrating quantitative and measurable results

Proposal/PDR Oral Presentation (requires significant participation by each team member)

The proposal/PDR presentation should be prepared using standard presentation software and include:

- Introduction with project overview, motivation, and relevance
- Relevant coverage of all written report elements
- An abstraction level appropriate to the project scenario and audience

Final Written Report

Each design team must submit a formal, written final report that is sufficient to allow project replication by a suitable engineering team, or, if appropriate, project continuation by another student team. The report must include the following attributes, as a minimum:

- All elements of the written proposal/PDR updated to reflect current project realities
- How standards and multiple realistic constraints were addressed in the design
- Results (current status, demonstration, comparison with quantitative specifications, recommendations for future work)
- Supporting materials (appendices/files including software code, data sheets, schematics, measurements, CAD files...). If appropriate, these may be made available as an online archive, with only a summary and references in the final report.

Final Oral Presentation (requires significant participation by each team member)

The final presentation should include all the characteristics of the Proposal/PDR Presentation with the addition of an emphasis on results.

Project Demonstration

Prior to the end of the semester, each team must demonstrate their project to their faculty advisor and compare functional results with project design goals and specifications. This demonstration could take place either during the final presentation or at a mutually convenient time. If the project is not suitable for a final demonstration, then some visual representation of project functionality should appear in the final presentation.

Peer evaluation

Each design team should participate in a formal peer review process to assess both team and individual performance at both the project proposal and the project completion stages.

Course Grading:

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| 7.5% | Individual written background summary |
| 7.5% | Individual lecture attendance and assignments |
| 10% | Individual portion (evaluated by UCP) of group proposal/PDR presentations |
| 75% | Project design, demonstration, and documentation (may include individual and group aspects) |

Course Educational Objectives:

Upon completion of the major design course, students will be able to:

1. Work in teams to propose, formulate, and solve a challenging open-ended design problem of sufficient scope, depth, and breadth requiring substantial knowledge and skills obtained from previous course work.
2. Understand and incorporate engineering standards and multiple realistic constraints (e.g., economic, environmental, sustainability, manufacturability, ethical, health and safety, social and political), while adhering to realistic design time, budget, and performance objectives.
3. Prepare and update qualitative design goals, quantitative design specifications, realistic budgets and realistic schedules. Utilize these to develop a prototype of the proposed design and demonstrate the prototype in accordance with the specifications (i.e., reduce the design to practice).
4. Effectively communicate information relating to all aspects of the design process in written, oral, and graphical form.

Course Educational Outcomes:

Upon successful completion of this course, students will have demonstrated (through the course elements listed in braces) the ability to:

1. Effectively work in teams to produce a final design project. {peer review}
2. Define the scope of a challenging open-ended design problem, research technical literature, and propose a design approach. {individual background summary, proposal/PDR report}
3. Identify and apply appropriate engineering standards to a design project, consider how multiple realistic design constraints affect design alternatives and tradeoffs, describe qualitative design goals, and determine quantitative design specifications. {proposal/PDR report, final report}
4. Prepare and update a project timeline in the form of a Gantt Chart, including tasks and milestones. {proposal/PDR report, final report}
5. Prepare and update a realistic project budget of actual development and prototyping costs. If appropriate, estimate manufacturing costs and profit. {proposal/PDR report, final report}
6. Reduce the design to practice in the form of a working prototype, and demonstrate performance of the prototype as compared to the quantitative specifications. {final report, project demonstration}
7. Prepare a thorough documentation package that is of sufficient detail so that other engineers could understand and recreate the project (e.g., flow charts, schematics, data sheets, software listings, wiring diagrams, block diagrams, etc.). {final report}
8. Write documents with factually correct technical content, sufficiently detailed explanations, properly formatted technical documentation, and proper spelling, punctuation, grammar, and usage. {individual background summary, proposal/PDR report, final report}
9. Make effective oral presentations incorporating significant technical content using standard presentation software. {proposal/PDR presentation, final presentation}