

## **ECE 190DA-DB Syllabus**

### Goals:

The purpose of the course sequence is for students to learn research and advanced design by conducting it in the context of a faculty research group, that can include other undergraduates as well as graduate students. Students will be expected to master the relevant technical literature, apply knowledge learned throughout the undergraduate program, propose hypotheses and methods for evaluating them, perform the experimental procedure, and if necessary make changes and iterate to yield improvements. This process will be documented in interim reports (both written and verbal). The final written thesis will additionally place the research in its societal context and document team interactions that were required for producing the research results. The final oral presentation will be a public event, showcasing ability to explain technical topics to a broader audience. The course will provide honors credit, as well as satisfying ECE department requirements for a capstone design course.

### Schedule:

Weekly research meeting with faculty mentor; weekly research/lab work

### General Tutorial Content:

A pre-recorded set of video units on the research and design process is available. These tutorials serve for training both research mentors and mentees (since it is expected that graduates will be mentors during their careers). Topics are listed below.

- Value Propositions
  - Research as craft and career; mentoring as craft and career
- The Basics
  - Making students welcome, public speaking, lab experience prep, one-on-one interactions
- Safety
  - Safety (Standard Operating Procedures, SDS, etc)
  - What to do in case of emergencies
- Inclusion and Decorum
  - How to be a role model for respectful and ethical behavior among diverse student populations; implicit bias; reporting of problems
- Team Dynamics
  - Role assignment, accountability mechanisms, benefits of technical discussion, dealing with difficulties
- Structure of Knowledge
  - How concepts flow into each other within and across disciplines; use of concept map for diagnosing and ameliorating student difficulties
- Fostering Student Learning
  - How students learn, how to encourage effective learning habits;
- Designing the Research Experience
  - Use of concept map in creating successful research experience for team with varying preparation
- Learning by Doing
  - Simulation and lab experiment fundamentals

- The Technical Literature
  - How to efficiently engage with textbooks, papers and patents; tools for automatic documentation of references
- Formulation and Testing of Hypotheses
  - Fundamentals of causal reasoning
- Iterative Design
  - Evolution of research/design generations; learning from failure
- Research Documentation
  - Best practices for documentation of research; personal and public uses
  - Software archiving standards
  - UCLA Research Week and ECE Department Annual Research Review participation
- Intellectual Property
  - Patents and copyright; UCLA and industry procedures

It is expected that faculty mentors will supplement this general set with focused discussions and readings related to the research project as it progresses.

The major student activity is research and its documentation in a thesis. The research will be determined in discussion with the faculty mentor.

Grading:

For ECE 190DA, grading will be in progress. It is expected that students will present a research proposal no later than week 5 and then create a report that documents experimental methods and preliminary results no later than exam week. An oral presentation will be made.

For ECE 190DB, a letter grade will be assigned based on work of both quarters, with equal weighting among them. A second interim report will be prepared midway through the quarter, with an oral presentation. A final presentation will be prepared for a broad audience, and a thesis will be prepared with the following format:

- Abstract
- Introduction
  - Subsection on problem societal context<sup>1</sup>
  - Subsection on problem technical context, written for a broad audience
  - Outline of contributions, and remainder of thesis
- State of the Art<sup>2</sup>
  - Describes methods used in thesis, or that the work is to be compared against
  - Describes innovations in experimental or simulation methods to be used
- Methods and Results
  - Describes methods and results in detail, with their interpretation<sup>3</sup>
  - Discusses research team interactions that led to these results<sup>4</sup>
- Conclusion

- Recapitulates most significant results, makes suggestions for future work
- References
  - Complete list in professional style

Notes on UCLA Learning competencies evaluated:

<sup>1</sup> Attitudes and values outcomes: relates the technical contributions to societal needs

<sup>2</sup> Knowledge outcomes; shows how fundamentals of the domain are related to the research problem

<sup>3</sup> Skills outcomes: demonstrates how knowledge has been applied to solve an open-ended engineering problem; communication skills demonstrated in report as a whole, and in oral presentations.

<sup>4</sup> Behavioral outcomes: demonstrates effective innovation in a collaborative setting