Electrical and Computer Engineering

Capstone Design Projects Handbook

14:332:449
&
14:332:448
Courses sequence

Last updated: January 2024

Electrical and Computer Engineering Department
Rutgers University, Piscataway, NJ 08854

1. Introduction

The purpose of this handbook is to provide students and advisors with general guidelines, dates, **deadlines,** and deliverable requirements for the Fall 2022 and Spring 2023 semesters and general guidelines as for students and advisors responsibilities and roles.

2. Capstone project timeline and guidelines

The Introduction to capstone course 14:33:449 will include two tracks:

Track 1: Teaming up, choosing a project, and getting an adviser

Track 2: Information sessions, including faculty panels, industry panels, alumni panels, and various workshop.

Track 1: Includes the following activities and deliverables:

- **Teaming up:** done in the first three weeks of the semester. Use the networking events to try and team up of TEAMs channels.

  Deliverable: Once you have a team, please report this info using the assignment available on CANVAS.

  Please contact Dr. Sasan Haghani (sh867@soe.rutgers.edu) or Demetrios Lambropoulos (dpl60@scarletmail.rutgers.edu) if any assistance is needed.

- **Find a project topic & and adviser:** During the semester we will be holding faculty panels where faculty will share their expertise and any possible projects that are available in their groups. We will also hold industry panels where you will learn about opportunities to work on industry-sponsored projects. Attendance to at least three of these panels is required. Additional information on faculty and industry collaborators will be made available on Canvas.

  Deliverables: Once you have an adviser, please submit the info using the *'Project adviser information submission'* assignment.

- **Framing your project scope of work (SOW):** After brainstorming with your team and discussing with your adviser, please submit a tentative writeup of your SOW using the template available on canvas.

  Please include the following information: Team project number, project title, team members names, and advisor(s) name(s). Background information about the problem addressed by the project. Proposed solution and how/why is it different than existing solutions. Tentative work plan.

  Deliverables: Please submit your tentative SOW using the *'Project SOW Submission'* assignment available on Canvas.

- o **Project presentations Round I**: will be held during the last two weeks of the semester

  Project presentation sessions information:
  - We will hold 8-12 sessions, each 1 hour and 20 minutes long. More information will be provided as we get close to the end of the semester on the dates and times.
  - Up to seven (7) teams can sign up to present on each session. Please check your calendar for availability.
  - All students are required to attend at least 2 sessions (the session you present in will count as one).
  - Presentations will be peer-graded and will count towards the final grade.
  - Please invite your advisor to join.
  - At least 50% of each team needs to attend the presentation session in full to get credits.
  - All slides need to be submitted on canvas under '***Presentation Material Submission***' assignment.
  - To be eligible to present, teams need to be in within the first 10 minutes of the session and sign in.

  Presentation guidelines:
  - Each team will have around 7 minutes for the presentation & 3 minutes for Q&A.
  - The deck of slides should include the following information:
  - Cover slide: Team project number, project title, team members names, and advisor(s) name(s).
  - Background information about the problem addressed by the project.
  - Proposed solution and how/why is it different than existing solutions.
  - Describe the tentative project scope of work and preliminary conceptual design.
  - Review general work plan and its allocation among the team members

  Evaluation rubrics:
  - The team presented themselves clearly, their adviser(s) and their project title
  - Slides organization and visualization
  - Project motivation clearly explained
  - Presentation was creative and the information was easy to follow

- Team members demonstrated sound understanding of the relevant technical material

o **Project Conceptual Design report**: Conceptual design is a high-level visualization of your project.

Template used for the report is the IEEE Conference Proceedings one, that can be found on canvas in MS Word format and in LaTeX format here: https://www.ieee.org/conferences/publishing/templates.html

The report page number is limited to a maximum of 6 pages and a minimum of 3 pages.

The report should include:

*Abstract***:** a 250-word summary of the proposed project idea

I. *Recognize the need (gather info)*: Describing the problem addressed in the project. Detail results of preliminary research done to collect relevant information, critical to the project Design, development, and feasibility evaluation. Examples of some of the questions addressed in this part are: What are the needs? Does a system like the one proposed exists? If so, how are they working? What are some of the common exiting approaches to solving the problem at the core of the project? Targeted audience?

II. *Define the scope of the project:* Outlining the need that the project will solve. Includes project goals, project steps for completion and design constraints

III. *Preliminary design:* high-level design, bridging the gap between design concept and detailed design. Include system block diagram, sub systems info, algorithms, etc. Expand the discussion on external sources, data, hardware/software needs, testing strategy and more. What are some core objectives that need to be implemented and what are 'nice to have'?

IV. *Plan the project:* evaluation of the potential of a proposed project to get to completion and identifying roadblocks. Some relevant questions to be asked: What is needed in order to implement the projects? Any essential hardware/software tools? What are some constraints (use, environmental etc.) your project might be subjected to? How will work distribute in the team? Etc. Include a preliminary Gantt chart and cost estimation for the project.

Deliverables: A final project conceptual design report needs to be submitted online using the 'C*onceptual project design report submission'* available on canvas by 12/9/2022.

Track 2: Professional skills development is the focus of this track including: industry, alumni, and faculty panels, workshops and training sessions for software and hardware tools, project management, ideation, and how to run a sprint.

The following sessions are planned for the fall semester (Dates for each activity are subject to change and students will be informed via Canvas Announcements of any possible changes).

Events / Deliverables	Schedule / Due Dates
Session 1: Introduction and Course Requirements	01/16/2024
Session 2: Fast-tracked workshop on Ideation	01/23/2024
Session 3: Teaming Up	01/30/2024
Session 4: Faculty Panel I	02/6/2024
Session 4: Faculty Panel II	02/13/2024
Session 5: Tracking Progress I	02/20/2024
Session 6: Industry Panel I	02/27/2024
Session 7: Industry Panel II	03/05/2024
Session 8: Tracking Progress II	03/12/2024
Session 9: How to run a Sprint	03/19/2024
Team and Advisor Information Submission	03/26/2024
Session 10: Tracking Progress III	04/02/2024
Session 11: Intellectual Property	04/09/2024
Round I Presentation Submission	04/23/2024
Scope of Work (SOW) Submission	04/23/2024
Session 12: Presentations Round I	04/30/2024
Project Conceptual Design Report	04/30/2024
Registration for 448 for Fall 2023	Second Week of May 2024

Deliverables: **Students need to attend 6 of the special lectures marked with (*).** There will be follow up surveys or assignments for these sessions posted on canvas as assignments that need to be completed. Please submit feedback for the events you attended. They will count towards participation credits.

3. ECE Capstone Design project timeline and guidelines

Here are important deliverables:

- o Project presentations session II. Times and dates will be published on canvas. Presentations need to be submitted on canvas.

- o Update *Project Conceptual Design report* to be submitted to the advisors for grading and on canvas by the team POC

- o Project presentations session III. Times and dates will be published on canvas. Presentations need to be submitted on canvas.

- o Final revision of approved *Project poster* to be uploaded on the canvas site & *'Elevator pitch' video .* The pitch video is a short presentation that is generally made to potential employers or investors. Your pitch video will be shared with the Judges or the ECE Capstone. The goal of a pitch is to hit on several key points about your project in a compressed amount of time, providing a visual description of the project. Start by stating the motivation/need of the project and continue with your proposed solution. The pitch video should not exceed 5 minutes.

- o Poster Day/ Capstone Expo. A project competition will be held, and team members are required to be on site for the presentation.

- o The following should be submitted on canvas and to the team adviser for grading:
    - ▪ Final report
    - ▪ Exit survey for seniors

- o deadline for submission of capstone course grades by the advisors.

Capstone design project is divided into three main phases, each corresponding to a period of a month, leading up to the final project submission in the end of the semester. These phases are separated by the presentation days, which define mid-project millstones while the last millstone is the poster day presentation.

The department will hold several project presentation sessions. The team POC needs to coordinate with the project advisor and sign up to one of these sessions. Students' participation is mandatory and will be reported back to the advisor. The students need to attend the full presentation session.

The objective and deliverables of each phase are as follows:

a. Phase I: getting organized with a final project scope of work (SOW), individual team members responsibilities allocation, project design objectives and constraints, and project plan, cost, and deliverables.

Project deliverables:

- o *Updated project conceptual design report* will be submitted to the adviser after the second round of presentation.

- o *Second round of presentation*: progress report detailing project progress, implementation, performance, and challenges.

Guidelines for the second round of Presentations:

- o Several presentation sessions will be held. Sign up will be available on Dropbox Paper. Please coordinate session choice with your advisor.

- o At least 50% of each team needs to attend the presentation session in full to get credits.

- o All slides need to be submitted on canvas under 'Deliverables Upload'.

- o To present, teams must be in within the first 10 minutes of the session and sign in.

- o Presentations will be peer-graded and will count towards the final grade.

- o Each team will have up to 10 minutes for the presentation and 2 minutes for Q&A.

- o The deck of slides should detail the following:

  - o Team project number, project title, team members names, and advisor(s).

  - o Review of the project scope of work (recap from session I in the fall), task allocation among team members.

  - o Detail the project design and status. Including project progress, implementation, performance, and challenges.

  - o Project tasks and milestone.

b. Phase II: project design and development, including modeling, simulation, prototyping, and any required purchases (if not done in phase I).

Project deliverables:

- o *Third round of presentation*: Progress report and demo/prototype.

Guidelines for the third round of presentations:

- o Several presentation sessions will be held. Please use the 'Sign up' tab on canvas to sign to one on the sessions. Please coordinate session choice with your advisor.

- At least 50% of each team needs to attend the presentation session in full to get credits.
- All slides need to be submitted on canvas under 'Deliverables Upload' at least 5 hours before the session.
- To present, teams must be in within the first 15 minutes of the session and sign in.
- Presentations will be peer-graded and will count towards the final grade.
- Each team will have up to 10 minutes for the presentation and 2 minutes for Q&A.
- The deck of slides should include the following information:
  - Team project number, project title, team members names, and advisor(s).
  - Discuss material detailed in the project final report and provide a short demo.
  - Project implementation, performance, and challenges.
  - Detail prototype costs, project expenses and estimated cost of mass production

c. Phase III: prototype debugging and project finalization.

Project deliverables:

- Project video ('elevator pitch'): Should provide a visual description of the project. This will be shared with the capstone expo judges.
- Poster draft: to be submitted to advisers for approval and uploaded on canvas
- Final poster submission.
- Final report submission.

4. Getting started

4.1 Checklist for Phase I:

The project team needs to:

- Make sure the team meets periodically and works towards project deliverables. The first month of the semester is when most students have more available time.
- Set periodic meetings for the team with the project advisor.
- Make sure the bill of material (BOM) is ready on time and the budget is approved before moving forward with purchases.

General deliverables: project presentation session I & II, Conceptual design report & SOW.

4.2 Checklist for Phase II:

The project team needs to:

- Make sure any required material is available and there are no bottlenecks that might result from ordering schedule.
- Make sure the team in on schedule with tasks and millstones.
- Keep the advisor updated with any issues and delays with project execution.

General deliverables: project presentation session II and final version of the Conceptual Design report

4.3 Checklist for Phase III:

Special attention needs to be given in this phase to the project report. There are ABET requirement with respect to this report. Both students and advisors need to work together to make sure the report is compliant with these requirements.

The project report template includes detailed information on what needs to be addressed in each section. Please refer to the template (available on the canvas under the Resources module) for guidelines.

Some important topics that need to be covered in the report are:

- List of relevant standards used in the project
- Detailed cost analysis of the project prototype (when relevant), work invested, time, resources, software platform, services etc.
- Sustainability aspects of the project
- Inclusion of a detailed references list
- Copyright violation - make sure that the students have generated any figures used in the report.

General deliverables: project poster and project video, project report, and presentation on Capstone Expo Day.

5. Capstone project Lab space and Funding

5.1 Lab space and training

The ECE department allocated EE 109 laboratory for capstone project needs. The team POC should contact Mr. Kevin Wine (room EE118; email: kevin.wine@rutgers.edu) if you want to access the lab.

During weekdays from 9AM to 5PM teams may get access to the lab from Mr. Kevin Wine (room EE118; email: kevin.wine@rutgers.edu) or Ms. Arletta Hoscilowicz (room EE124; email: ah860@soe.rutgers.edu). After 5PM, the lab will have a designated departmental supervisor. Please check the home page on canvas for weekdays late PM hour and weekend lab availability.

Students that need to work in a lab must attend safety training sessions. These will be held during the month of January (info to follow on canvas). Please follow announcement on

canvas as for training session scheduling. Please contact Mr. Kevin Wine (room EE118; email: kevin.wine@rutgers.edu) with any questions regarding lab use and training.

5.2 Project budget and funding

The ECE department allocates a budget of $300 per capstone project. Prior to making any purchases, the capstone advisor needs to approve them.

Capstone teams looking for additional funding can apply for '*Seed Money*' grants by contacting Dr. Sasan Haghani (sh867@soe.rutgers.edu). Seed money grants application will be accepted up until the third week of February.

Important FAQ:

1. How to place a Purchase Order?

All purchases need to be placed through the department. We can accommodate 2 days delivery or express, but they need to be made with the help of the Capstone Program administrator listed on the canvas homepage.

Students should place orders using an order form posted on canvas under 'Resources' and 'Assignments' using the 'Order Form' assignment. Orders forms should be uploaded by students under the 'ORDER Forms' assignment on canvas.

IMPORTANT: We will not be able to reimburse any purchases made by students. Please make sure to get all parts through the department.

2. What happens when an order is placed?

The course TAs will process submitted order forms daily. If we have any of the part in stock, you can borrow them immediately. If not, we will place your order.

3. What are the parts borrowing Policies?

Some equipment and devices are available from the ECE to borrow for the duration of the projects. Please check with Mr. Kevin Wine (room EE118; email: kevin.wine@rutgers.edu) for equipment and devices availability. Arduino, Raspberry PIs, and some sensors are available in the department to be loaned for the semester.

All borrowed equipment must be returned by the end of the first week in May. Equipment borrowers assume full responsibility for damage, loss, or theft. Advisors will be notified when their students borrow equipment. Grades should not be posted until advisor get confirmation of equipment return.

4. Can teams get access to storage in the EE building?

We have lockers for capstone use in the EE building. Mr. Kevin Wine (room EE118; email: kevin.wine@rutgers.edu) can provide you with a dedicated locker for the semester.

6. Students and Advisors Responsibilities

6.1 Students responsibilities

Capstone design team members have full responsibility and ownership for their capstone project. A POC needs to be selected for each team. The POC is responsible to making all communication with the advisor and the department. He/she are not responsible for the project, the responsibility for the project executions is equally split between all group members. Team members should decide in the first week what is the role each member takes in the project, both technical and administrative, and share this information with the advisor. Please make sure all are taking a fair share of the project load. Students are responsible, among others, for:

- Reviewing and understanding the project timelines, milestones and deliverables.
- Signing up to the advisor capstone course.
- Coordinating and agreeing with the advisor on the project scope of work (SOW) and deliverables.
- Managing tasks, project milestone, budgeting and purchases for the project.
- Tracking project progress and making sure the team is on schedule.
- Setting time to meet periodically with all team members and with the team advisor.
- Keeping the advisor informed in a timely fashion with the project progress and any roadblocks.
- Keeping the department informed with any issues that require the department attentions or assistance.
- Preparing the required material for project presentations and getting advisor feedback in advance.
- Working on the project in a consistent fashion and allocating an appropriate amount of time for its execution.
- Delivering any reports, poster, presentation, and other project deliverables on time.
- Being responsive to the advisor and department communication and requests.
- Participate in Poster Day and all presentations.

Students will be graded individually for their performance in the capstone design project. Remember, every team member has full responsibility to the team's success.

6.2 Capstone advisor role

Capstone design project advisors are required to supervise the planning and progress of the project and the team. The advisor needs to

- Assist the students with defining the project scope of work
- Provide students with registration information
- Provide the student with feedback on proposed project solutions and purchases
- Meet with the students on a regular basis to review their progress
- Be available to the students in person or via email to support the students with problem solving if needed

- Review the proposal, abstract, presentations, poster and reports and verify compliance with department requirement as detailed in this booklet and in the report guide
- Attend capstone presentations
- Grade the students (individual grading)

7. Capstone project grading

14:332:449 Course

Grading breakdown (P/NC course grading). In order to Pass the course you must score 80% or above. Here is the details of grading for 449:

1. 10% - presentation rounds I grade; based on peer review (team submission)

2. 30% - participation in events (6 out of the 8 marked, individual) and presentations (2, individual; includes your presentation attendance); you can replace on presentation attendance with event participation.

3. 20% - Submission of a detailed scope of work (team submission)

4. 20% - Submission of Project Conceptual Design report (team submission). This document should be approved by the adviser and will lay the plan for the spring semester. Submission is required in the fall semester and will count toward grade in the spring semester when a final version is submitted at the end of February.

5. 20% Completion of Assignments throughout the semester.

14:332:448 course: The grades are not a group grade but an individual one. Your grade will be calculated based on:

- o Round II Presentation (group grade)
- o Round III Presentation (group grade)
- o Updated Conceptual Design Report
- o Final Project Report
- o Project at a Glance Abstract
- o Capstone Team Evaluation Form
- o Elevator Pitch Video (not to exceed 5 minutes)
- o Project Poster

A more detailed grade calculation will be provided before the beginning of the Spring 2024 Semester.

8. Capstone Deliverables

The advisor is grading students' performance. ECE advisor should upload grades directly and others should send the grade to the POC within the ECE department that will coordinate the grade submissions. The grades are not a group grade but and individual one.