

5. Evaluation Method for Capstone Courses

5.1. Evaluation of Fall Term Capstone Systems Design for ECSE I

The progressive development of the capstone design project by each student group will be assessed via a variety of assessment tools of unequal level of difficulty. Throughout the Fall term, students will be required to submit/present the following deliverables related to their specific capstone design project:

- Problem Identification, Research and Requirements Specification Report (R1) (30%)
- Concept Generation, Conceptual Design and Prototype Report (R2) (30%)
- A preliminary proof of concept prototype/simulation demonstration presented via an oral group presentation (20%);
- Apply project management methodologies (10%);
- Perform an assessment of their team (10%).

1) Problem Identification, Research and Requirements Specification Report (R1) (30%)

- Normally due during the 6th week of the Fall term.
- Marked by the academic advisor.

R1 should include:

- 1. Problem Identification (3%):** A description of the scope of the design project at hand that has been discussed and agreed with the relevant capstone academic advisor and/or industrial partner. This may change over the course of the project, but the discussion provides a starting point for both the student group and the stakeholders. This is also a unique opportunity to document these agreements and thereby eliminate any miscommunication.
- 2. Project-related Background and Research Review (3%):** Every group has the challenge that they have to learn about the domain of the project. Hence a brief section giving background information related to the specific capstone design project and research review of the domain are required.
- 3. Design Process (3%):** The success of any project is related to the ability of the project team to follow a design process. A good design process will identify:
 - a. the overall flow of activities, actions, and tasks and the interdependencies among them
 - b. the degree to which work products are identified and required
 - c. the manner which quality assurance activities are applied
 - d. the manner in which project tracking and control activities are applied
 - e. the degree to which the customer and other stakeholders are involved with the project
 - f. the degree to which team organization and roles are prescribed

4. **Scenarios and/or Use Cases (5%):** Nearly all design commences with a capture of scenarios and/or use cases that help define the functional requirements of a system. These scenarios are helpful in also defining the acceptance tests.
5. **Stakeholder Requirements and Traceability Matrix (10%):** The thorough capture of the stakeholder requirements is an important step to delivering what the “customer” wants. There are many techniques available to capture requirements that you have learned throughout your program. The expectation is that you apply these techniques in your project. Good requirements are a clear “translation” of the list of customers’ needs using precise engineering language that includes measurable and comparable variables indicating limitation values expressed in engineering or other units (e.g., power consumption less than 10 kW, voltage rating greater than 10 kV, less expensive than \$400.00, etc.). This list of engineering requirements needs to be traced throughout the entire course of the development of the project until completion.
6. **Definition of Acceptance Tests (3%):** At this stage you should also be able to define a set of acceptance tests that will eventually be refined and executed to demonstrate that the product has met the requirements.
7. **Project Plan (3%):** You should present an overall and reasonable project plan for achieving the deliverables outlined in this handbook.
8. **Contribution matrix:** All reports should include a contribution matrix detailing how each member has contributed to the content of the report both in writing and material. The faculty advisor can use this information to decide on individual grading.

2) Concept Generation, Conceptual Design and Prototype Report (R2) (30%)

- R2 is normally due during the 10th week of the Fall term.
- Marked by the academic advisor.

R2 should include:

1. **Concept Generation and Analysis (10%).** Most system design projects include a concept generation stage. This concept design stage is an early stage design of the product that defines a set of alternative solutions to the product at a systems level. Concept generation is a form of problem analysis as the process helps to further clarify the problems in the project through the generation of potential “high-level” solutions. It is reflected primarily as a system design exercise since hardware and/or software components and their relationships are defined to achieve the requirements of the product. At this stage one is trying to determine what solutions exist and can be adopted, what new components need to be created and how these will interact with each other. Evaluations of suitable solutions are based typically on non-functional and business requirements such as cost, complexity, and value to the product. Note that this process can lead to the refinement of the requirements. Approaches to concept generation can vary across projects but fundamentally it will include:

- a. A process for generating concepts, i.e brainstorming.
 - b. Structural and relational models that describe a solution.
 - c. Sensitivity analysis and ranking of the models against the requirements.
2. **Conceptual System Design (10%).** In the end several concepts (1 or 2) must be specified in more detail even though several concepts might have been generated. This typically is the result of a functional decomposition of the system into components and hence a specification of the responsibilities and interfaces of the components of a system is required. Connections among the components needs to identify information transferred, frequency, and constraints. Key operations of components is required. Behaviour of the components can also be specified at this stage. Basically structure, behaviour and parameters are defined at this stage. You need to leverage and clearly show that you successfully applied what you have learned in the previous courses in your program.
3. **Definition of Integration Tests (3%).** At this stage you should also be able to define a set of integration tests that will eventually be refined and executed to demonstrate that the components of the product work with each other.
4. **Estimated Cost of the project (5%).** At this stage in the project a reasonable estimate of the cost of the project should be performed that includes equipment needs and manpower. This analysis could also be one of the criteria for the analysis of design alternatives.
5. **Updated Project Plan (2%):** Your original project plan should be updated.
6. **Contribution matrix:** All reports should include a contribution matrix detailing how each member has contributed to the content of the report both in writing and material.

3) Preliminary Prototype Demonstration via an Oral Presentation (20%)

- Take place during regular lecture and/or lab hours during weeks 11 and 12.
- Marked by both, the course coordinator and the academic advisor.

This deliverable includes a 15-minute preliminary **proof-of-concept prototype/simulation demonstration** via an oral presentation. The student group must have something up and running that can include something physical, simulated and/or virtual. The objective of this presentation is to assess that the project is at a stage where conceptual design and analysis have been performed the group is ready to enter the detail design stage and final product demonstration stage. Ideally all features of the product are in place but perhaps not fully functioning or delivering the quality that is required. The presentations are open to all students and the project advisor. Students should be aware that the oral presentations may be videotaped and/or photographed.

4) Project Management and Participation (10%)

- Monitored on a weekly basis.
- Marked by the course coordinator.

Teams are expected to demonstrate continual management and participation in the capstone project by leveraging project tracking schemes and regular meetings with their team and faculty advisors. This consists of a continual assessment of the team's capability to identify and prioritize actions and act upon these actions such that the project deliverables are met. The project plan defined in R1 and refined through out the project's lifetime is a high level perspective of what actions need to be performed to achieve these deliverables. Grading will reflect the following overall key project management items:

- Definition of action items
- Assignment of action items to particular team members
- Completion of these action items
- Review of the action items by the team.
- Attending and capturing action items from meetings held with the team, faculty advisors, and stakeholders.

5) Team Assessment (10%).

- Performed twice during the term.
- Marked by the course coordinator.

Capstone teams are expected to evaluate the strengths and weaknesses of each of the members of their team by performing a peer assessment of each other and a reflection on the results. This is not the contribution matrix requested for each report as its principal goal is to help identify the team's weaknesses and strengths so that they can improve on this. Typical individual competencies that are measured consist of: commitment, communication, knowledge, professional standards, and focus that the individuals bring to the team.

6) Marking Scheme for Capstone Courses Offered in the Fall Term

For informing the students about their progress in a timely manner the respective capstone faculty advisors are required to grade the submitted reports no later than ten calendar days after the deliverable due date, respectively. Then, the submission of the final mark would be the responsibility of the course coordinator, but the assignment of final grades will be done in consultation with faculty advisors. The table below outlines the marking scheme for the Fall term capstone course.

Deliverable week #	Deliverables	Weight (%)	Marked by Coordinator (%)	Marked by Advisor (%)
6	R1	30	0	100
10	R2	30	0	100
11-12	Group Presentations <ul style="list-style-type: none"> • Prototype Demonstration 	20	50	50
Continual	Project Management	10	100	0
5 & 11	Team Assessment	10	100	0

IMPORTANT GRADING NOTES

It is understood that some team members might not be actively participating and contributing to the project within a Group environment and hence the faculty advisor and coordinator reserves the right to apply a differential grade to individual members of a group.

- All reports have to be well written and readable. The Academic advisors can deduct up to 5% of the overall grade of the report if it is poorly written.
- Individuals in the team can receive different grades in the submitted reports and participation in the project. This differential grade is reflected in the submitted reports that are graded by the Faculty Advisor as well as in the project management and participation deliverables.
 - Reports: The faculty advisor will specify the proportion of the report grades that will apply to each student in the team based on contribution to the project. For example, if all students are to receive the same grade they will specify for each member of the team that 100% of the grade of the report be applied to the member of the team.
- Team members are expected to be physically present at meetings with the faculty advisors (expected to occur on a weekly basis). A student can fail the course if they do not attend up to up to 85% of these meetings without prior agreement with the faculty advisor and course coordinator. The academic advisor will report any meeting attendance concerns of a student to the course coordinator.