Introduction

The document is provided to Lead Engineers and students involved in the Department of Mechanical and Aerospace Engineering Capstone Design Projects as guidance to carry out and interpret performance evaluations on the projects.

For students, this document should be used to set goals for their work on the project and to help understand their term and final marks from Lead Engineers.

Engineering Design Project – Definition of Engineering Design

"Design: An ability to design solutions for complex, open-ended engineering problems and to design systems, components or processes that meet specified needs with appropriate attention to health and safety risks, applicable standards, and economic, environmental, cultural and societal considerations."
Canadian Engineering Accreditation Board

Overall Project Marking Scheme

The following overall marking scheme will be used by all Engineering Capstone Design Projects. Students must pass the first three individually graded components to pass the course.

- Term Design Review presentations 20% (10% Fall, 10% Winter)
- Performance evaluations 40% (20% Fall, 20% Winter)
- Written reports (DRs, memos and formal report) 35%
- Manager's discretion (to be defined by Project Manager during first meeting) 5%

General Performance Expectations

Students are expected to conduct themselves in a professional manner on the Capstone Projects as they would in any engineering workplace or co-op placement. Effective, open and timely communication is one of the keys to success on the projects. If students have concerns or questions they need to raise these with their Lead Engineer or Project Lead at the earliest opportunity. If there are still unresolved issues then the students should discuss these with the Capstone Project Coordinator or Undergraduate Associate Chair. Attendance at all scheduled meetings is **mandatory.** Absences without valid justification will be noted by the Lead Engineers and will have a significant negative impact on the student's final grade.

Below are some general guidelines to help in the interpretation of the final letter grades on the projects:

- **A+/A/A-:** Excellent or very good performance in **all** aspects of the project including Fall and Winter performance, communications (oral and written) and team work.
- **B+/B/B-:** Satisfactory performance in all aspects of the project or very good performance in one area and satisfactory or marginal performance in other areas.
- **C+/C/C-:** Marginal performance in all aspects of the project or satisfactory performance in one area and marginal or poor performance in the other areas.
- **D+/D/D-:** Poor performance in all aspects of the project or marginal in one area and poor performance in the other areas.
- **F:** Unacceptable performance in **any** area of the individually marked portions of the project will result in a grade of **F** being assigned.

Oral Presentation Marking Scheme (20% of total, 10% Fall and 10% Winter)

- For the Fall and Winter terms students will deliver Formal and Informal presentations which will be evaluated by the Lead Engineers. The assessments may be carried out by the Lead Engineers as well as invited external and internal evaluators depending on the nature of the project. Marks for Formal Design Review Presentations should be compiled from all evaluators and averaged for each student. Each student should have access to both components of their mark for Formal Presentations (average only). Each project has its own specific template that will be used and students should discuss with their Lead Engineers the expectations for their project.
    - **Presentation quality**
        - Ability to speak clearly and logically and effective audience engagement
        - Quality of images and drawings, free of typographical errors, etc.
        - Clear and coherent response to audience questions.
    - **Technical content**
        - Accuracy of design calculations, experimental results explained, sources of error identified, design requirements, thorough evaluation of design alternatives, etc.
        - Accurate and correct response to audience questions.

Fall and Winter Term Performance Evaluation Rubric (40% of total, 20% Fall and 20% Winter)

The evaluation rubric shown in Tables 1, 2 and 3 will be used when assessing each student's individual performance during each term. The Fall term evaluation mark should be made available to and discussed with the students in December or early January so that any concerns can be addressed and areas for improvement identified with Lead Engineers. Students will receive a score of 1-6 in each of the five categories. The scores are then multiplied by the weight and added to give a score out of 60 for each term for each student. These evaluations should be discussed between the students and their Lead Engineers to identify areas of strength and opportunities for improvement for each student. Additionally, evaluation data collected during project assessments will be used to assess Graduate Attributes outlined in Table 3. Lead Engineers may combine the two assessment tools as needed to simplify record keeping.

Table 1: Blank performance marking template [adapted from 2] – part marks are acceptable.

Ranking and Score / Area of Evaluation	Unacceptable	Poor	Marginal	Satisfactory	Very Good	Excellent	Weight	Total (multiply weight by score)
	1	2	3	4	5	6		
Design and Technical Contributions							6	
Communication							1	
Management of Resources							1	
Initiative and Commitment							1	
Attitude and team spirit							1	
						Final Mark		/60

Student name: _____

Student number: _____

Project: _____

Lead engineer: _____

Table 2: Explanation of performance categories [adapted from 2]

Ranking and Score / Area of Evaluation	Unacceptable	Poor	Marginal	Satisfactory	Very Good	Excellent
	1	2	3	4	5	6
Design and Technical contributions	Technical work is largely incorrect and inaccurate.	Work must be redone by others to meet standards	Keeps a consistent quality of work, but falls short of satisfactory standards.	Quality of work is generally of acceptable or good quality. Rarely added depth or quantity.	Work is of high quality and typically above standard. Occasionally added depth and quantity.	Technical work is of always of exceptional quality and accuracy. Consistently more depth and quantity than required.
Communication	Ineffective communicator with no effort to improve.	Skills ineffective. Makes little effort to improve.	Frequently confusing - improper use of terms, descriptions of methods and results unclear, with little effort to clarify or improve.	Sometimes confusing but effort is made to clarify and improve.	Clear communication but with occasional errors in terminology, methods, and results. Concerted effort to improve weak areas.	Clear communication with proper use of terms, methods, and results that are immediately understandable by group members, project members, and external stakeholders.
Management of Resources and Planning	Little to no useful work. Takes away from the productivity of the team as a whole. No individual plan and no contribution to group plan.	Not enough useful work done in group or out. Sometimes wastes his/her time and others. Work is typically late and no consistent planning done. No plan.	Does not work well within the team, occasionally wastes team's time. Has trouble in doing productive work. Some tasks completed late. Plan includes some tasks.	Is not time-efficient in working with the group, but works hard when a deadline is near. Most tasks completed on time. Plan includes all tasks but incomplete dates.	Uses time effectively in and of group. Completes all tasks on time. Plan includes tasks and dates but interdependencies not noted.	Uses time effectively in and out of group and works to get others to do the same. All tasks completed on or ahead of schedule. Complete plan with list of tasks, task interdependencies, dates of completion.
Initiative and Commitment	Must be constantly told what to do by supervisors and peers. Performs few if any assigned tasks.	Lets others do the work; does the minimum he/she thinks is needed to get by. Performs few assigned tasks.	Tends to watch others work, but does get involved when necessary. Volunteers to help when only when a necessity. Performs most assigned tasks.	Gets involved enough to complete tasks. Does his/her share and volunteers for multiple tasks.	Readily accepts tasks, sometimes seeks more work. Gets involved in the project. Sometimes does more than required. A producer.	Takes initiative to seek out work, concerned with getting the job done. Very involved in the technical project. Consistently does more than required and motivates others.
Attitude and Team Spirit	Negative attitude that adversely affects other members. Never participates in team or group meetings. Frequently absent without notifying Lead Engineers.	Negative attitude that adversely affects other members. Rarely participates or contributes to team or group meetings.	Negative attitude toward project and/or project. Occasionally participates in group meetings or discussion	Neutral attitude. Always participates in team meetings. Contributes moderately to the discussions and team effort.	Positive attitude toward project and the team. Actively involved in team activities. Shares knowledge with team members. Communicates design updates with other team member when requested.	Positive and professional attitude that provides a positive influence to other team members. Organizes team meetings. Shares knowledge with team members. Proactively communicates design updates with team members.

Table 3: MAE Capstone Graduate Attributes matrix

Project Evaluation Category	Area of Evaluation / Ranking and Score	Beginning	Developing	Accomplished	Exemplary
		1	2	3	4
Design and Technical Solutions	Clear design goals (GA 4.1)				
	Detailed design specifications and requirements (GA 4.2)				
	Alternate solution(s) definition and evaluation based on engineering principles (GA 4.3)				
	Design solution(s) (GA 4.4)				
	Design implementation/Task(s) definition (GA 4.5)				
	Use of engineering tools (GA 5.3)				
	Limitations of engineering tools and the assumptions inherent in their use (GA 5.5)				
Management of Resources	Personal and group time management (GA 6.1)				
	Project definition techniques (GA 11.2)				
	Project management techniques (GA 11.3)				
Attitude and Team Spirit	Group culture, group dynamics (trust and confidence, ethics, and conflict resolution) (GA 6.2)				
Initiative and Commitment	Leadership including initiative and mentoring, areas of expertise, and interdisciplinary teams (GA 6.3)				
Written Reports	Professional documents (writing, design notes, drawings, attributions and references) (GA 7.1)				
Oral Presentations	Presentations (presentation materials and delivery) (GA 7.2)				

Written Report Guidelines (35% of total)

Due to the diversity of project topics, industries represented and range of documentation formats available, it is not possible or practical to produce a single all-encompassing rubric for written reports produced by students on MAE Capstone Projects. Students should discuss with their Lead Engineers the specific expectations for their respective project. Here is a list of the general expectations across all MAE Capstone Projects:

- All students are expected to contribute to both individual and group reports throughout the Fall and Winter terms.
- The types of reports will vary by project and may include some of the following: Design Reports, Technical Memos, Journal or Conference papers, Technical Design Reports, Standards and Specifications, Wiki Articles, Test Reports, and Formal Reports.
- Students are expected to demonstrate a thorough grasp of the topic on which they are writing and present their reports in a professional, high quality manner as would be expected in an engineering workplace or for an external client. They should also demonstrate a clear understanding of the intended audience of the report.
- The reports may include a mixture of design, analysis, critical discussion and experimental work supported by written text, tables, drawings, software code, solid models, finite element analysis, computational fluid dynamics, heat transfer analysis or other industry-specific design and analysis tools.
- It is expected that Lead Engineers will provide feedback on the accuracy of technical content, quality of design and analysis work described in the reports, relevance to the project, and other areas of importance to the project.
- All students will contribute to a group Formal Report prepared in a format to be defined for each project. These reports must be substantive, technical and professionally prepared and presented. These reports will be evaluated as part of the Written Report Mark and will be deposited and archived in an electronic formal with the Departmental Office at the end of the Academic Year.

References

[1] G. Platanitis and R. Popiliev, "Establishing Fair Objectives And Grading Criteria For Undergraduate Design Engineering Project Work : An Ongoing Experiment," vol. 5, no. December, pp. 271-288, 2010.

[2] Technical University of Delft, *Engineering Design Project Guidelines*, 2010.