University of British Columbia Department of Mechanical Engineering

MECH328 Guide for Students 2019w

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Summary

In the MECH328 Mechanical Engineering Design Project students will work in teams to address a proposal by the BC Mobility Opportunities Society to develop an improved design for their TrailRider hiking wheelchair. This guide is intended to help students take on the project. It describes course expectations, provides general recommendations for moving ahead and lists resources available. It also includes instructions on Weekly Reports and on major assessments such as the Concept Selection Reviews, Final Report and Oral Presentation. Major deadlines are also listed.

Contents

Glossary

Analytical Hierarchical Process (AHP) – a means to convert approximate rankings of relative importance to numerical values (weighting) to factors (Evaluation Criteria) used to compare comprehensive conceptual solutions.

Evaluation Criterion – a factor of very high value to the main stakeholders in a project used to compare competing, acceptable solutions.

Need – a desire of, or a condition imposed by a stakeholder.

Need Statement – a phrasing of a need in the most general terms for the purpose of identifying the essence of that need and to inspire the broadest exploration for eligible solutions.

Requirement – a quantification of a need that is so important such that failing to satisfy the need would be unacceptable; a measurable or otherwise clearly determinable condition that must be satisfied for a solution to be deemed acceptable.

Stakeholder – an entity, typically a person or group of persons with a strong influence on a project. While typically human-centric, an example of a non-person stakeholder is the environment.

Introduction

In this course you will exercise and expand your design skills by working through a design project based on a proposal by a fictitious client (see Project Proposal document). You will work with an assigned team of fellow students and will report regularly to an assigned teaching assistant. One of the 4 course instructors will be your supervisor. It is the supervising instructor's role to provide overall guidance and instruction. Your supervisor will be the primary assessor of your team's work. The TA also plays a role in assessment of team and individual work.

For your planning purposes over this term, expect to spend the great majority of your time in class in this course working on project-related activities. Lectures will review topics to support you with advancing your project as well as discuss design project issues in broader contexts. In-class activities are intended to provide an opportunity to verify application of project management and design tools.

Expectations

It is assumed that you are familiar with the design process introduced in MECH223 and are able to select when and how to use design process tools introduced in 223. Students who have not taken MECH223 should obtain a copy of the MECH223 textbook. It is available from the UBC Bookstore (The Engineering Design Process, Ostafichuk et al., ISBN 9780992058715).

MECH223 should have provided you with the understanding that open-ended problems can be solved multiple ways and the design process taught in 223 encourages you to objectively compare multiple ways (comprehensive concepts) for solving the design problem.

This project will be much more like project assignments you can expect when doing real engineering projects, e.g. working in product development and consulting involving clients. In real projects, completing the problem definition is the responsibility of the designer. Unlike the projects you were given in MECH223, in this project, your team will have to work a bit to fully determine the needs and associated requirements for the project and will also have to identify the appropriate criteria for evaluation of candidate solutions. While the project proposal gets you started on this, expect to do some digging to figure out who all of the major stakeholders are and what they need and want. As would be the case for a real project, for this project, each team member is expected to maintain an understanding of the problem definition, regardless of the team roles that the member is taking on.

Note that each team member is expected to work 8 hours per week on this course. This includes class and meeting time. Teams are free to adjust the scope of their project accordingly and provide the client with estimates of work effort.

iPeer

iPeer will be used 4 times as outlined in the syllabus. Three iPeer sessions will be used for teammates to give feedback to each other using the standard MECH Design rubric as you may have seen in MECH 223. The fourth iPeer will be a confidential iPeer assessment whereby team members give feedback to the supervising instructor using the same rubric.

The quality of feedback provided on iPeer by each team member will be graded as part of that providing team member's mark according to the rubric posted Module: Rubrics on Canvas (iPeer Feedback Quality.xls).

Logbooks

Every student shall use a personal logbook and submit it at the end of the course for assessment. Detailed instructions on the logbook are in Appendix I at the end of this document and the rubric is posted in Module: Rubrics on Canvas (Logbook Marking Rubric.xls).

Your Task On this Project

Your task is to develop a design suitable for addressing the client's proposal based on the resources you have available. You are not expected to address every need if you don't have sufficient resources, but in case you can't fully meet the client's expectations, you are expected to identify what you determine are the priority needs that you can address for the client.

It is generally expected that students in specialization options work on areas relevant to their option. There are several potential areas needing attention. Mechatronics students should generally focus on areas involving actuators and electronic systems and power. Biomed students should focus on biomechanics and kinesiology aspects. Thermo-fluids students should focus on thermal management. General MECH students should take on responsibilities for mechanical design but are expected to overlap other specializations and take on responsibilities in those areas. Everyone is expected to take on project management duties.

Challenges that you face in this project include not only the technical issues but also management issues such as controlling the scope of your activities. Having to plan activities and budget resources to make the best use of available resources to address the needs is part of the exercise.

Getting Started

Take the time to review the deliverables and rubrics associated with the course. It will help you target your work and set an appropriate scope for your project.

Set up your team communications. Decide which utility you will use for storing common files, charts and project information. Use a consistent naming convention for your files which includes your team

number (e.g. *MECH328 2019w T08 – Gantt 1.0*) so that folders automatically sort by version and you won't have to re-title files submitted for the appendices expected in the final report.

Review and reach agreement on iPeer. Note that iPeer scores are normalized and that scores for each person will be averaged to determine the multiplier that will be used on the team grade which makes up nominally 70% of the final mark. A contributor who gets 100% on average on iPeer can expect to get 100% x Team grade. Persons who outperform can achieve more than the team grade and persons who underperform can expect to receive less.

Teams are expected to spend the early part of the project following the design process to further develop their understanding of the problem(s). I.e. teams should assess the importance of various stakeholders and assess their needs too, determine appropriate requirements and criteria for evaluating potential solutions and determine which of the needs are highest priority and within their team's ability to address within the timeframe and other resources available.

Each team is to consider the main problems, explore a range of areas for potential improvement, and plan and then execute a project to develop appropriate new designs. As this is a one term course, there is insufficient time to build a prototype or to fully develop all of the details of each solution (some detailed specifications and drawings are required[1]). Teams are only expected to produce the designs on paper in the form of a comprehensive report and will also present the designs in an oral presentation.

i. One aspect of this project that was not covered explicitly in MECH223 is the determination of scope of a project. While an initial set of requirements and desirable features is proposed, teams are permitted to change the scope. In this project, as in real-world projects, the team is to assess what the main client and possibly other stakeholders want and determine the project priority areas. The team shall then look at the available resources (including team availability and experience, consider the established deadlines for delivery, etc.) and identify which needs can be addressed under these constraints, and then address these needs by developing, evaluating and selecting solutions to be developed in detail for the final deliverable. Produce an appendix that estimates the work required to address the needs. Identify tasks associated with producing the deliverables for this project. Estimate the hours required to carry out each task. Look at your available resources and capabilities and assign resources, beginning with the highest priority tasks. Clearly identify when you will run out of resources and which needs you will not be able to address.

[1] See section Detailed Report Instructions

A difficult task is the determination of the appropriate evaluation criteria. These should be the main drivers of the concept selection. Common errors that are made are: 1, to use inconsistent criteria for different evaluations and 2, to attempt to optimize concept fragments without considering the synergies and compromises that occur due to interdependencies between fragments in a comprehensive concept. For any system, each sub-system is a fragment and you don't know which combination makes for the best overall solution if you don't consider the conflicts, overlaps and need for harmonization between the system components.

As you develop target specifications, don't forget to include team needs – your set of specifications must include project requirements (as was suggested in MECH223) that will guide your team to successful project delivery.

Reporting Meetings and Weekly Reports

Progress reports using the template posted on Canvas are to be submitted to your TA at least 24 hours in advance of your regularly scheduled weekly meeting. Download the report template and follow the template instructions. Also provide the following with each report:

1. an updated copy of your schedule. Note that there is no specific format you are required to follow for showing your weekly schedule so that you are free to use a management application (e.g. MS Project) that fits your team's needs.
2. an updated copy of your project requirements list.

There are 10 reports due over the term. The first report is due before the meetings in the week of September 9th. Note that reports and associated charts are due every week, 24 hours ahead of the regularly scheduled meeting time, regardless of holidays or cases where the weekly meetings are replaced by assessments such as the Concept Selection Reviews. The final weekly reports for the week of November 11th are due to the TA however meetings will be optional as you will likely be busy with the final report and oral presentation preparation.

The rubric used by the TA to assess your report is also posted in Module: Rubrics on Canvas (MECH328 2019w Weekly Reporting Meeting Rubric.xls). Your team's mark for the weekly report component will be the average of the marks achieved on the reports.

Concept Selection Review (interim review)

In the Concept Selection Review (CSR), you are making the work that you have performed to this point available for review. You have 25 minutes (plus 10 minutes Q&A) to convince knowledgeable, senior technical employees of your organization that you understand the project needs, have developed a number of good potential concepts, compared them and selected the appropriate one(s) and have a good plan for delivering the final recommendation report on November 16th.

This review is informal so you are advised not to use your time to make a formatted presentation (e.g. PowerPoint). Your work should be cohesively presented by showing work on-screen or on paper with paper copies for the reviewers (consider this as if you are giving a guided tour of your work). Reviewers may ask to see any aspect of your work, so have an index at hand to find your work and have multiple laptops on hand so that one team member can look up a request while another issue is being examined.

Your CSR will be provided to two people (an instructor and TA from one of the other groups).

The CSR will occur on Wednesday October 9th in place of weekly meeting and classroom time. A schedule will be posted on Canvas when available.

Before the review:

1. As you are working on the project, keep in mind that your teammates need to be able to understand what you are doing and that your work will be reviewed, so from the beginning, get used to making your notes, sketches, calculations, etc. as if you were doing them for someone else to read. If you have a tablet, please consider using it for handwritten work as it will be much easier for you to review, expand, edit and integrate into the report at a later time if needed.
2. Make annotations for any spreadsheet calculations. Any software code should be commented as you write.
3. If you do resort to paper, consider keeping papers in a team project binder, inserting tabs as you go along to make it easier to find items.

At the review:

1. Provide hard copies of key work such as concept images, requirements management spreadsheet, schedule, etc. in an organized handout for the reviewers.
2. Budget your time so that you address each category on the evaluation rubric. You may wish to have a schedule for the 25 minutes available for you to talk about your work. Instructors may cut you off to allow the allotted 10 minutes for questions.
3. Focus on addressing the items in the rubric descriptors for levels of achievement.
4. If there are areas you feel require detailed explanation, wait until the question period and ask the reviewers to allow you to elaborate as necessary.

CSR marking will be reviewed by the entire Teaching Team before being released to students to ensure fairness. Students will have the opportunity to receive clarification on all marking.

Detailed Formal Report and Appendices Instructions:

Note that the rubric is posted in Module: Rubrics on Canvas (MECH 328 Project Report Marking 2019w TXX.xls). You are strongly encouraged to review the rubric before drafting the report as the assessment is based on the rubric. The following is intended to help you fulfill the requirements of the rubric and to reveal what you should typically expect to provide in your project reports and engineering files.

1) The audience for the recommendation report is the client. The body of the report should be written for the client's eyes. The appendices may be written for an engineering audience. For the final report and appendices submission provide the following:

    a) a professionally bound, hard copy of a recommendation report outlining your designs and your recommendations (hard copies of appendices are not necessary).

    b) a USB memory stick containing a PDF copy of the recommendation report and electronic copies of the appendices. Each appendix shall be contained in a single PDF file with the exception of the following: spreadsheets used for management of requirements, evaluations or simulations, technical drawings and project management charts.

    c) a signature page with all team members acknowledging which sections of the report each member was responsible for and to indicate that they have read and approve of the contents of the entire report;

You are strongly advised to follow the report marking rubric as you work on the project so that you do the work that is expected and avoid having to repeat and reformat your work for the final submission. As with all work, the report should include proper referencing. Also, proper attribution (citations, references) should be given to the material that you have not created yourself.

For the main body of the report, keep the language concise, direct, clear and objective and focus on the outcome rather than listing the steps you undertook in the design process. Your target length should be around 3000 words. Marks may be deducted if the body of the report exceeds 3500 words.

ii. Begin with an acknowledgement of the client and a clear statement of the main objectives.

iii. Outline (briefly) the relevant background acknowledging information provided by the client in the proposal and identifying any additional findings that you made.

iv. Refer to important findings from internal and external searches and any research that you performed. Back this up with references to appendices containing details. Appendices should be used to show detailed results of searches. If you performed preliminary tests,

explorations, field trials, etc. to gain an understanding of the design challenge, provide a separate appendix for each one of these that clearly outlines the purpose of the activity, what you hoped to determine, a brief outline of the test in enough detail that it can be replicated, what the test showed and any conclusions that were drawn. Report them here along with research such as results of tests performed by others, related products, patent abstracts, review of relevant standards, etc. Provide a summary in each appendix of areas that were investigated, but do not include detailed information that was reviewed and found to have little relevance.

v. Identify key needs and their order of priority.

vi. Point to an appendix that estimates the work required to address the needs. Identify tasks associated with producing the deliverables for this project. Estimate the hours required to carry out each task. Look at your available resources and capabilities and assign resources, beginning with the highest priority tasks. Clearly identify when you will run out of resources and which needs you will not be able to address.

vii. Outline (briefly) the needs assessment process and present the evaluation criteria used to select the concept. Reference an appendix which captures your detailed needs assessment work. This appendix should contain weekly copies of the needs and requirements list that show the weekly evolution of the needs and requirements through the project.

viii. Reference an appendix in which you clearly reveal how you determined the criteria for comparison of concepts and, in the appendix, justify how you determined the relative importance of the criteria.

ix. In the report, show pictorial descriptions of the various stages of operation of your selected concepts with a concise description of how each works and briefly indicate how the features provide the highest net satisfaction of the various concepts considered.

x. Reference an appendix that details the major prototype tests that will need to be carried out, the pass/fail criteria and estimates for the cost and timeframe. Use the appendix to provide detailed specification and justification of the tests to be performed, identify the threshold value that each test result must meet or exceed for the design to be permitted to be implemented and provide details of your cost and time estimates.

xi. Reference an appendix that shows the other concepts you considered. Concepts shall be clearly described using labeled diagrams (clear sketches are acceptable).

xii. Refer to an appendix detailing the concept selection process used to develop the final concept.

xiii. Refer to detailed analyses, calculations, references and other relevant details located in your appendices to justify the features of your design. All calculations must have:

- clear indication of purpose,
- appropriate diagrams (e.g. Free-body diagram)
- declaration of assumptions
- clear indication of variables
- clear indication of the result
- discussion of the limitations of the validity of the result
- identification of potential source of error
- a re-examination of the assumptions and a discussion on the likelihood that the assumptions are correct
- for critical calculations: an indication that a teammate has independently checked the calculation

Ensure the presentation of your hand calculations follow the posted format of the Sample Calculation. If you used an on-line utility, spreadsheet or other programmable utility for sizing components, you must record the input values used, the output values and for any spreadsheet or code that you have written, clear comments indicating what is being calculated and how (i.e. you must write it so that another engineer can reproduce the spreadsheet and check the calculations for errors).

xiv. Present the cost of producing the device as required in the project description. Reference an appendix with your cost of goods calculation, including cost to set up a production run, material costs, labour, undefineds and contingency;

xv. Reference an appendix detailing safety analyses (e.g. DFMEA, see below). Discuss any significant limitations of your design that the client must be made aware of for safety reasons.

xvi. Reference an appendix outlining Life Cycle Analysis. Details will be provided in class;

xvii. Reference an appendix estimating the cost and duration of the remaining development effort (e.g. building and testing of prototypes, etc.) before product release;

xviii. Reference an appendix with project planning and scheduling information (e.g. an outline of major project risks and a brief explanation of the strategies employed to deal with them, copies of weekly Gantt charts, etc.). Provide a section on project execution in which you discuss how your execution of the project was handled, identify key strategies, how you handled any disruptions and indicate how you would alter your strategy, if at all, if you were to take on a similar project in future.

xix. Provide a section titled Conclusions and draw conclusions based on the information you have presented. Conclusions are to be based only on factors already presented. Don't introduce new information: if you need to introduce information, edit previous sections to incorporate it.

xx. Provide a section titled Recommendations and give a numbered set of specific recommendations on the next steps that the client should pursue. As with Conclusions, do not introduce new information and if necessary edit earlier sections to provide the information necessary to support recommendations. In some cases, your recommendation may be to make drastic changes that could include abandoning the project. Your recommendations should identify steps that are in the best interests of the client. Your recommendations should also reference your list of all the requirements and indicates how each requirement is met as well as reference any appendices indicating outstanding safety issues that remain to be addressed.

(b) Include additional Appendices as follows:

i. An appendix containing a draft list of key user/operator instructions and if needed, installation instructions. No need to provide finished detailed instructions, just alert the client to any key issues that need to be addressed regarding operator training.

ii. An appendix with a select sample of CSA[2] or ANSI/ASME compliant drawings with either an indented drawing list or a drawing tree as follows:

- <u>You do not need to supply a full set of drawings, however, you must show assembly drawings of each system you are specifying and one fully detailed specification drawing of the most complicated custom part from each system.</u>
- Make sure you have discussed the scope of the drawings with your TA and/or instructor prior to investing efforts in the drawings.

[2] Refer to your MECH 220 notes or consult the library for copies of standards.

- Each drawing, including assembly, or subassembly drawing and manufacturing drawings should have a title and a unique drawing number.[3]
- B-size drawings may be included full size as long as they are folded to nest inside the binder.
- Reduce all D and C size drawings to B size and in so doing, ensure the font is large enough to be read when the drawing is reduced and indicate Not To Scale.

iii. Additional appendices as necessary with the details of any software modeling utilities used (versions), copies of input values and settings, summarized copies of output clearly annotated and with the relevance, validity and applicability of the output discussed. An engineer reading your report should be able to check and reproduce your calculations.

iv. An appendix with an early, a mid-project and a final detailed 'Design Failure Modes and Effects Analysis' (including Criticality and Probability)[4] for each of the systems. The DFMEA should contain two additional columns, one indicating how the failure mode should be addressed (e.g. "size the bearing for the worst case load") and the second one indicating how it was actually addressed in this project and where the information is located in the report (e.g. "See worst case load analysis on page 46 in Appendix G and bearing sizing calculation on page 58 in Appendix H"). The second column should contain references as required to analyses, discussions and other evidence that is contained in the report.

v. Include an organized and indexed appendix with technical data you needed for the design (annotated screen shots of e.g. on-line catalog pages, annotated photocopies of hard copy pages, screen shots or PDFs of other online literature are acceptable).

vi. Include an appendix with sequential copies of all your weekly reports.

vii. Include additional appendices as you see fit[5].

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[3] designs using controllers, TTL or PLCs should also include state diagrams or flow charts or pseudo code, schematics and wiring diagrams.

[4] Your completed DFMEA should start with the parts then the sub-assemblies, and finally the general assembly, i.e. the complete machine, or system. (You may add a different type of failure analysis if you found one more suitable to your project.)

[5] These may include such things as an appendix describing your research, descriptions of tests used to obtain data for development of the design, photos, project schedules and schedule revisions, or records of important telephone conversations, letters and e-mails.

Marks related to the Report

Marks for this report make up 40% of the course and count as part of the team grade.

Oral Presentations

Oral presentations will be held on Wednesday November 20th in place of meetings and classes. Meetings normally scheduled for Monday November 18th will be suspended to give your team time to work on this presentation.

In addition to your presentation, you will be assigned to review and assess presentations by some of the other teams. The schedule will be posted on Canvas when available.

There will be two parts to the presentation. In the first part, present as if you were presenting to the client. In the second part, discuss how the project went as if you were presenting to senior engineers within your company. Please provide paper copies of your presentation for the instructor and TA.

Questions will follow Part 2.

The instructor, TA and fellow students will mark your presentation and provide feedback.

Part 1 (10 minutes) Presentation to Client

1. Begin with a concise introduction.
2. Touch upon relevant background.
3. Briefly outline who the major stakeholders are and their major needs.
4. Briefly identify which if any of the client's originally expressed needs were out of scope and why.
5. Present conclusions
6. Clearly present the recommendations
    a. If you are recommending to proceed with developing the designs, showcase your designs and briefly describe how they work and show the client how the features incorporated in your design satisfy the needs.
    b. If you are recommending not to proceed, explain to the client why this is the case.

Part 2 (15 minutes) Presentation to Senior Engineers

1. Assume engineers already understand who the stakeholders are and what their needs are and that they have a general idea of your project.
2. Present how you determined and managed the needs and requirements.
3. Briefly present alternate concepts and explain why they were eliminated.
4. Remaining work: Discuss which aspects of the proposed design are least well determined, outline the risks involved and explain your recommendations regarding these aspects.
5. Discuss how the project was executed and what you learned from this.

6. Present your initial strategy and initial estimates for time and allocation of resources (early draft of schedule) and compare it to what your team actually did and when. Cont'd…
7. Project Risk Management: Discuss how risks were managed. Give the reasons for any unanticipated schedule disruptions.
8. Indicate your conclusions on which if any changes in strategy you would use in future projects.
9. Present the engineering development cost of the project based on a rate of $150 per engineering hour (i.e., add up the total hours from your weekly reports and multiply by $150/hr).

Be prepared to have your justification scrutinized. Have your concept development, selection, detail design and other work supporting your final recommendations at hand so that you can answer questions during Q&A.

Q&A following the presentation: ~10 minutes

Venue: Each venue will have a projector, however teams must bring their own laptop. You are encouraged to visit your venue before the presentation to test your presentation with the AV equipment.

Evaluations and Evaluation Participation:

The format of the oral presentation is formal. This is in contrast to the casual weekly meetings with TA's. You are expected to dress in business dress as appearance will factor into your presentation grade. You should also use language and gestures that are appropriate for a workplace presentation.

1. Please prepare a list of speakers arranged in the order in which they will be speaking and at least 2 hardcopy printouts of your presentation (1 for the instructor and 1 for the TA). You may add important supporting information to the handout.
2. Presentations should be prepared in PowerPoint or similar. Venues will be equipped with LCD projectors; however, you must bring your own laptop.
3. The team must be ready to present at the scheduled time. Any time lost due to team tardiness will be trimmed from the presentation time.
4. The total presentation must be no longer than 25 minutes. There will be 10 minutes for Q&A (you may be cut off to allow time for Q&A if you exceed the 25 minute limit).
5. All members of the design team must speak and deliver some portion of the presentation.
6. One person should take on the introduction and that same person should subsequently monitor and keep the other presenters on track with their allotted time to speak.

Marks related to Oral Presentations

The team-mark for the oral presentation counts for 10% of the final course grade (team portion).

The grade for the oral presentation will be the average of the mark assigned by the instructor, TA and the collective average of the students.

The oral presentation feedback mark counts for 5% of an individual student's final course grade. It is based on the quality and quantity of the feedback the student provides to presenting teams on the 3 oral presentation forms that student submits (i.e. students are being marked on their assessment of and feedback to presenting teams).

Evaluation forms can be filled live, online. Students who prefer to do initial work on paper while attending presentations will be required to upload to the online form within 2 days. Results and comments (anonymized for student evaluators) will be sent to each presenting team.

TAs will assess the quality of feedback on each of the evaluations completed by student evaluators and assign a mark out of 5 for the individual oral presentation feedback mark.

The rubric for this will be posted in Module: Rubrics on Canvas (MECH 328 Oral Presentation Feedback Rubric 2019w.xls).

Final Exam

The final exam is a 60-minute exam that will be based on material delivered and discussed in class, project-specific questions where you have a choice of questions to answer and general questions related to the project that anyone engaged in their project should have little trouble answering correctly.

Additional Project Resources

The following section outlines some of the resources available. Links to most of these resources will be available on Canvas and updates and additional resources will be posted there as well.

Texts and Templates

While there is no specific textbook for MECH328, you should refer to the MECH223 textbook for design project processes and tools as well as the texts from MECH325, MECH326 and texts from your specialization topics. If you need a copy of the MECH223 text, please contact your instructor.

Templates for various design tools (e.g. the Needs and Requirements spreadsheet you used in MECH223) are posted on Canvas for your convenience. You are free to select the tools that are appropriate for concept development and evaluation and are encouraged to try to implement a value equation for comparing concepts.

Client and Other Stakeholder Contact

Interaction with the various project stakeholders, particularly during the needs assessment stage, is heavily encouraged. This is an important element in the process of determining needs and the priority rank of needs.

To facilitate posing questions to the client without a barrage of repeated questions, a Google form and spreadsheet will be set up on Canvas. Google forms collect input information and display entries in a spreadsheet. New questions can be posed using the form. The client will have read and write access to the resulting spreadsheet and can provide answers on a regular basis. Read-only view of the spreadsheet will be made accessible to students so that they can see all posted questions and the corresponding answers.

You are generally free to seek out and consult other stakeholders that you think are important. We ask that you do this in a respectful and considerate manner and honestly represent yourselves as students working on a class project.

Sample Devices

A TrailRider™ will be available on campus for teams to sign out and trial. Details will be announced in class.

Library Resources

UBC Library provides access to a huge variety of information sources ranging from scientific papers to patent search utilities. There are also licenses for many very useful on-line engineering references such as Knovel, EngNetBase and others where you can find information on a wide variety of engineering topics.

The library also maintains on-line subscriptions to some international standards which could be researched for relevant information.

Industrial Literature, databases and On-line forums

Component suppliers often provide excellent technical information online for sizing or otherwise implementing their products. A selection of links will be available on Canvas, but you are expected to find additional information. For this project, you may find the need to reverse engineer some devices to properly verify the sizes of the components. Google is an excellent search-engine, however you may find industry-specific services such as Global Spec and other industry listing services more time-efficient because they exclude non-industry content and include classified lists and links to most of the suppliers operating in North America.

On-line forums and sites such as Eng-Tips and eFunda can be very useful. As always, be wary of the quality and accuracy of information on forums and seek supporting evidence from alternate sources.

Engineering Software

Free educational licensed copies of SolidWorks® Siemens NX® and MatLab® are available for MECH students directly from APSC IT. For Solidworks: http://students.engineering.ubc.ca/success/software/ Further license details are posted on Canvas.

MECH223 Textbook

If you need a copy of the MECH223 textbook, please see your instructor. Students who aren't familiar with the content of this text are strongly encouraged to obtain a copy for their reference.

Guidance

Your Teaching Assistant and supervising instructor are your primary guides, however all members of the instructing team will be available for consultation. Don't overlook help that is close by. Department faculty have expertise in design, vibration, solid mechanics, mechatronics, physiology, heat transfer and other fields that you may wish to apply to develop your solution.

Important Dates

October 9th Concept Selection Reviews

Your first deadline is the Concept Selection Review (see description above). Your team will need to have selected the concept that will be designed in detail. During this review, your team will present the rationale used to make decisions on concepts and will be asked to reveal the process used to develop and compare potential concepts. The reviews will occur in place of the regular weekly meetings or classes. Details will be posted on Canvas.

November 15th – Final Report Due

Printed and electronic copy of report due at the MECH Office before close of business. We will mark and return the reports before the end of classes so that you have an opportunity to discuss marking with your instructor and TA.

November 20th– Oral Presentations

Oral presentations occur. Students present to their instructor, TA and some other teams, as well as assess peer presentations.

November 29th – Logbook Submissions

Logbooks from every team member are due by 4 PM on November 29th at the MECH Office CEME 2054.

Final Notes

Obviously, you will need to use material not yet covered in some courses, a very similar situation many practicing engineers find themselves in. We expect you to use all resources available, starting with your own research, reading ahead in your other courses, and seeking the advice of the teaching assistant assigned to your project and from the instructors. We encourage you to ask questions throughout the course and will do our best to provide appropriate answers. We may not always answer your questions directly however we will point you in the right direction (we won't do your work for you but we do want you to succeed!).

Appendix I – Department of Mechanical Engineering Logbook Requirements

1. Each student to keep a logbook/workbook for the duration of the course and to submit it for assessment upon request and at the end of the project.
2. The book is a chronological record of the project. It serves as a memory aid, a proof of effort in case of an argument, and a valuable record of considerations that may never make their way into more formal deliverables.
3. Use notebook Winnable, 8”x10 ¼”, Composition Book, #WN109 or similar hardcover bound book with pre-numbered pages. Notebooks are available from the UBC Bookstore.
4. On first page: Course, group, your name, & contact information
5. Next 4 pages leave blank for a Table of Contents to be completed at the end of project.
6. To aid photo-copying, avoid writing in page margins.
7. Entries must be in chronological order 8. The date of each entry must be clearly indicated.
9. Start time and end time or a total duration for activities must be noted and totaled daily with an updated total at the bottom of every page.
10. Logbooks/Workbooks must be available for review upon request during weekly meetings and the design review.
11. Do not remove pages, even if the entries are damaged or incorrect. Simply draw a diagonal line across the incorrect entry.
12. Draw a single diagonal line through blank spaces
13. Date and title insertions and permanently affix with a glue stick.

Types of entries:

1. Date and start time of the event (e.g. September 12th 4:25 P.M.)
2. Duration of an event (e.g. 135 minutes or start and end times) 3. Note on a meeting:
    a. Date and start time
    b. Attendance
    c. Purpose
    d. Minutes
    e. Decisions
    f. Assigned Actions
    g. Duration or end time
4. Note on a discussion, conversation or telephone call:
    a. Date and start time

   b. Persons involved
   c. Summaries of key points and who made each point
   d. Decisions
   e. Actions
   f. Duration or end time

5. Note on online information gathering session
   a. Date and start time
   b. Build a list of websites reviewed and key information found. Copy-pasting web addresses and adding notes is one way to do this. Print and paste into logbook.
   c. May include list of websites searched where no information was found, but should not record searching of irrelevant sites (i.e. if you are researching bicycle wheels, you should not record your time spent interrupting your search to look at your personal Instagram site☺)
   d. Duration or end time
6. Key ideas
   a. Date and time of entry
   b. Explanatory sketch with annotations clear enough for someone else to be able to understand the idea by looking at the sketch and reading the description.
   c. Inspiration/ sources – where did you get the idea?
   d. Duration of time spent developing idea
7. Key calculations
   a. Date and time of entry
   b. Clear presentation of the calculation according to the posted guidelines for presentation of calculations. (Someone else must be able to follow and make meaning of the calculation.)
   c. Discussion of the significance. (e.g. “With a maximum tensile stress of 31.2 kpsi as shown by the calculation, the bolt will not fail in tension if the assumptions on p. 67 are maintained. This may not be true if the assumption that maximum transverse load of 4500 N is not maintained and in particular must be re-examined if the coefficient of friction estimate μ falls below 0.23.”)
   d. Duration of time spent doing calculation
8. Software session (e.g. solid modeling, FEA, on-line bearing sizing utility, etc.)
   a. Date and time of entry
   b. Notes on what was done particularly on important trials, summarized record of values and results, etc.
   c. Duration of time spent doing activity
9. Testing session (e.g. estimates of coefficient of friction between two materials.)
   a. Date and time of entry

   b. Notes on what was done, particularly test set-up (annotated digital photos help) important trials, summarized record of values and results, etc.
   c. Duration of time spent doing activity

10. Collaborative Documents (e.g. Google docs)
   a. At end of each collaboration session provide summary notes in logbook outlining major changes in point form
   b. Include date and time for changes

Logbooks/Workbooks may sometimes be used for performing rough work, but they are primarily intended as a summary of work performed and the time spent doing the work,
key decisions, key calculations, contact information. Rough work may also be added by pasting them in and adding notes that explain the sketch.

Best Practices for Logbooks:

- **Keep it where you can see it and keep it open**
- **Jot notes in it continuously**
- **Keep it where you can use it**
- **Must be easy to use and carry**
- **Must be personal**
- **Date all entries**
- **Cross reference when you have the option.**
- **Use a consistent format**
- **Use icons, drawings, colors**
- *Keep it readable but don't spend time being beautiful, rather spend time being informative*.