Assessment Guidance for Final Design Report

Purpose: This document is intended for student teams to prepare the final design report for MECH of DESN2000 in 2023-T3.

Deadline: This final design report is due at 11:59 PM, Friday 24th November (Week 11).

Submission: The report in PDF format is to be submitted by one team member through a Turnitin link (for the purpose of promoting academic integrity) on Moodle. The latest submission on Moodle from your team will be marked. Late penalties will be applied as per the course outline policy (flat -5% penalty per day).

Submission Type: team submission (each team is to submit only **one** submission)

Page Limit: The main body of the final report is limited to 40 pages from Introduction to Conclusion. Note that the length limit excludes the title page, executive summary, team statement, reference, biography, and appendix.

Grade: This assessment counts 40% of your course grade.

Report Content, Format, and Structure

Title Page

- Include an informative title page that specifies the product/project name, the date of submission, as well as every team member's name, student ID, and email address.

Executive summary (5%)

- Provide a short executive summary (no more than 1 page).
- The purposes of an executive summary are: (1) to give a clear indication of the objective, scope, and result of the report; (2) to highlight the most important findings and the most innovative design ideas.

Team Statement

- Summarize the individual contributions of every team member to the report.
- In the extreme case that a particular student fails to make substantial and consistent contribution to the project, the team may choose not to include the student's name in the report. As a result, the student will lose partial, if not all, credits for the report.
- The content of this section is limited to one page.

1. Introduction (5%)

- Reiterate concisely the background and significance of your chosen design problem.
- Reflect the previous progress made for the interim design presentation.
- Describe the organisation of the final report structure.

2. Reflection on Conceptual Design (20%)

- Reflect on how the course-taught design methods are followed in your conceptual design process, their results, and the implications of their outputs. You are expected to reflect how the course-taught methods are followed to generate or improve 2-3

design concepts. The purpose is not to assess the quality of your design concepts, but rather, it is to assess whether the design process is followed correctly.

- Select any **one design method** out of the following: Axiomatic Design Theory – only the Independence Axim (taught in A/Prof. Ang Liu's lecture in Week 3), Biologically Inspired Design (taught in A/Prof. Ang Liu's lecture in Week 4), and TRIZ (taught in A/Prof. Ang Liu's lecture in Week 8).
- If any large language model (e.g., ChatGPT) is used to generate ideas and contents in this section, please include additional evaluation about the quality of AI outputs as well as reflection about the human-AI interactions. The evaluation and reflection must be written by the team. It is important to keep the evaluation and reflection concise (1-2 paragraphs will be sufficient).

3. CAD Model and Mechanical Part Drawing (20%)

- Include a 3D CAD model of the FINAL design concept (only one concept).
- Include an assembly drawing with an exploded view of the entire assembly (i.e., for the final full system). You are not expected to create assembly drawing for sub-systems. Refer to the CAD drawing checklist for more guidance.
- Include a 2D component drawing for the mechanical parts that you have designed. Note that you are not expected to include drawings for standard components (e.g., a standard bolt, nut, or washer) or components that you buy (e.g. electric motors, sensors), but should include such components in the assembly drawing.
- Include the Bill of Materials (BOM) in your assembly drawing that contains all components such as Part Number, Name, Qty, Drawing Number, Description.
- A more detailed, comprehensive BOM should be included as an appendix with the additional information such as Material, Mass, and External source (if the component is not made in-house).
- Make sure to follow the Drawing Checklist Reading Guide - "Engineering Drawing", A. W. Boundy, McGraw Hill (8th Edition)

4. Technical Design and Analysis / Prototyping and Testing (40%)

Section 4 is intended to detail the design of your final design concept. There are two alternative approaches for composing the content of Section 4. A team should choose to pursue only one approach: either <technical design analysis> or <physical prototyping and testing>, but not both. It is entirely up to each team to decide which approach to proceed. The expectations for each approach will be elaborated as follows.

- Technical design and analysis
- Physical prototyping and testing

<u>Alternative Approach (1): Technical Design and Analysis (40%)</u>

- Include the technical analysis of any **two topics** from the following options: material selection, fasteners, power transmission, or sensors.
- Since every solution and team is different, it is entirely up to each team to decide which technical components to analyse in this section of the report.
- Refer to the below dot points and rubric for expectations on technical analysis.

Topic 1: Material Selection (taught in Dr. Patrick Burr's Lecture in Week 5)

- Follow the course-taught design principles to select materials for your design concept.
- Illustrate the material performance using the appropriate metric and/or diagram
- Justify the choice of material(s) in terms of the material index, assumptions, and limitations.

Topic 2: Sensors (taught in Dr. Hoang-Phuong Phan Lecture in Week 7)

- Follow the course-taught principles to select and analyse sensors and their behaviour in your design concept.
- Include high level circuit diagrams, pseudocode algorithms, and any assumptions.

Topic 3: Fasteners (taught in Dr. Daniel Eggler's Lecture Recording)

- Follow the course-taught principles to analyse loading cases and failure modes for fasteners in your design concept.
- Justify selection and placement of fasteners using free body diagrams and relevant equations.
- Include diagrams and/or drawings to illustrate connections (e.g., showing orientation of members and fasteners) and detail assumptions made.

Topic 4: Power Transmission (taught in Dr. Daniel Eggler's lecture recording)

- Follow the course-taught principles to design and analyse your power transmission system, including axial layout and loading, inefficiencies, and losses in your design concept.
- Justify drive selection (e.g., belt, chain, or gear drive) and design of power transmission system using equations, and explain any assumptions made.
- Justify selection of transmission elements (shafts, couplings, bearings, keys/splines/set screws).

<u>Alternative Approach (2): Physical Prototyping and Testing (40%)</u>

As an alternative to the <technical design and analysis>, it is possible to build a physical prototype and test its performance. The alternative approach (2) is newly introduced in 2023.

Prototyping is the process of getting the ideas out of your head and into the physical world. Physical prototypes are tangible representations of a design concept, allowing designers and relevant stakeholders to interact with, test, and refine the design. It is up to each team to decide the specific form of the physical prototype. Some possibilities may include 3D printed models, simulation models, VR and AR models, scale models, functional electronics, user experience prototypes, *etc.* Once a prototype is built, you are expected to conduct relevant testings on the prototype in terms of its functionality, performance, interaction with users, *etc.*

Due to the time restriction in this course, it is expectable that the prototype may not achieve all functions of your final design concept (as specified in Section 3). Additionally, you are not required to conduct a full-scale testing of the prototype. Instead, you may choose to focus on testing the most important features of the prototype. It is up to each team to decide how to prioritize what aspects of the prototyping and testing.

As much as possible, you are encouraged to use the Maker Space facilities (Kirby Makerspace, ELEC Makerspace, Renewable Makerspace) to build your physical prototypes. More details can be found at https://www.making.unsw.edu.au/. Makerspace staff will support you in using tools and technologies (laser cutting, 3D printing, moulding etc.) and accessing spare materials available. Preliminary mock-ups with cardboard and papers are also encouraged in the early stage of concept generation to better plan the prototyping phase.

If you choose the alternative approach of <physical prototyping and testing>, the following contents are expected in Section 4 of the final design report.

- Describe the prototype building process and setting (e.g., machine tools used).
- Provide some high-quality photos (3-5 photos) of the prototype.
- Describe the process of how the prototype is tested.
- Discuss the testing results with respect to concept feasibility, prototype performance, and alignment with the original design intents.

5. Conclusion (5%)

- Draw conclusions on the feasibility and novelty of the final design concept.
- Reflect the design thinking process in terms of challenges faced and lessons learned.
- Outline the future work if any (e.g., further refining the design towards an entry for design competition or patent application).

References (5%)

- List all the references according to the IEEE Citation Style

Biography

- Provide a short biography of every author, preferably with a headshot.
- Each biography should not exceed approximately 100 words.

Appendix

- Include any additional content in the appendix as long as it is referred properly in the main body of the report. For example, you may include collaborative sketches and whiteboard drawings, which are helpful for the reviewers to recreate your design process.
- Technical analysis should be provided in the appendix, never in the main body of the report.

Notes about formatting and language:

- The report should be submitted in English as a PDF document.
- Executive Summary: succinct; no references.
- Layout: single column throughout the paper.
- Margin: 2.54cm for the top, bottom, left, and right (i.e., the normal margin of WORD).
- Font: Calibri or Arial (12 points).
- Sections: all sections should be numbered, except for the sections of “Executive Summary”, “Reference”, “Biography”, and “Appendix”.
- The first section heading: Calibri/Arial (12 points), bold, sentence case.
- The second section heading: Calibri/Arial (12 points), italic, sentence case.

- Spacing: 1.15-line spacing, extra space between adjacent paragraphs.
- All figures and tables should be numbered according to the fashion of, for example, Figure 1, Figure 2, etc. and Table 1, Table 2, etc. All figures and tables should have meaningful and informative captions. The figure/table captions should be centered.
- All figures and tables are labeled correctly: (1) figures and tables and captions centered; (2) figure caption below, table caption above; (3) all figures and tables are mentioned in text (e.g., as shown in Table X, as illustrated by Figure Y).
- References: in the text of the manuscript should be cited as numbers within square brackets and appear in sequential order and follow the style: [1]; [1-3]; [1, 3-7].
- No use of the first person or emotional language (e.g., we feel/think that ...)
- No joined words (e.g., don’t, can’t).
- Use full sentence and correct phrasing.
- It is allowed to use **Latex instead of WORD**. In the case of Latex, some of the above suggestions on formatting may not apply.

Submission of the Report:

All team members are required to contribute to preparing the report. A submission link will become available on Moodle by the end of Week 9.

The submission should comply with multiple requirements as follows:

- Only ONE submission can be made by each team, and multiple submissions by different members are subject to penalties.
- Name your document and "submission title" in the format of "Team Number + Tutorial Session" such as "Team 1 of M09A", "Team 2 of M16A", "Team 5 of T12A".
- Moodle tends to crash from time to time. Please launch the submission at least 30 minutes before the deadline.

Marking Rubric of Final Design Report

Criteria	Marks	Failed (Zero Mark)	Accomplished (Half Mark)	Excelled (Full Mark)
Title Page and Executive Summary	5%	• The title page is missing certain key information. • The executive summary is ill-structured, general, and superficial.	• Somewhere in between failed and excelled outcomes	• The title page is sufficiently informative and presented in a professional manner. • Executive summary is well structured and clearly articulated.
Introduction	5%	• The introduction adds little values or plays no roles in the whole report. • The content of introduction cannot be clearly differentiated from that of Executive Summary or Conclusion. • No reasoning within the content.	• Somewhere in between failed and excelled introductions	• The introduction draws the reader's attention and opens discussions. • The introduction navigates the reader to comprehend the report structure and findings. • A clear flow of reasoning between adjacent sentences and paragraphs.
Reflection of Conceptual Design	20%	• Fail to follow the design method correctly. • The final design concept is infeasible. • No reasoning within the content. • No figure/tables are included.	• Misunderstood certain steps of the design method. • No clear reasoning between adjacent sentences and paragraphs. • Some figure/tables are included, but they are not informative or original.	• Follow the design methods correctly. • The final design concept is both novel and feasible. • A clear flow of reasoning between adjacent sentences and paragraphs. • Original and informative table/figures are included to reinforce arguments.
Technical Analysis – Selection 1	20%	• Fail to follow the course taught methods to perform technical analysis of the chosen topics. • The calculations and/or pseudocode is incorrect. • Fail to comply with the expectations of the technical analysis document. • Fail to articulate the relevant objectives, constraints, assumptions, and justifications.	• In between failed and excelled technical analysis. • The constraints and objectives are well articulated but flawed. • The process was applied correctly, but to inappropriately defined constraint or objectives. • Knowledge of principles is apparent, but choices are not justified by the principles. • Simplistic justifications but are not informed by the course-taught principles.	• Follow the course taught methods to perform technical analysis of the chosen topics. • The calculations and/or pseudocode is correct. • Comply with the expectations of the technical analysis document. • Select the appropriate metrics and evaluate in a convincing manner, supported with the appropriate figures. • Discuss any limitations, assumptions, or approximations in the process performed.

Technical Analysis – Selection 2	20%	• Fail to follow the course taught methods to perform technical analysis of the chosen topics. • The calculations and/or pseudocode is incorrect. • Fail to comply with the expectations of the technical analysis document. • Fail to articulate the relevant objectives, constraints, assumptions, and justifications.	• In between failed and excelled technical analysis. • The constraints and objectives are well articulated but flawed. • The process was applied correctly, but to inappropriately defined constraint or objectives. • Knowledge of principles is apparent, but choices are not justified by the principles. • Simplistic justifications but are not informed by the course-taught principles.	• Follow the course taught methods to perform technical analysis of the chosen topics. • The calculations and/or pseudocode is correct. • Comply with the expectations of the technical analysis document. • Select the appropriate metrics and evaluate in a convincing manner, supported with the appropriate figures. • Discuss any limitations, assumptions, or approximations in the process performed.
Prototyping and Testing	40%	• Fidelity and Detail: Little to no alignment, major details overlooked. • Functionality: None of the major functions are achieved. • Usability and User Interaction: Almost unusable, overwhelmingly negative user feedback. • Testing and Iteration: No evident testing or iteration. No in-depth discussion of the testing results • Documentation: No or inadequate documentation and presentation.	• Fidelity and Detail: Prototype's fidelity somewhat aligns with the design stage, some details missing. • Functionality: Partially functional, with some major flaws. • Usability and User Interaction: some usability issues evident, mixed user feedback. • Testing and Iteration: Limited testing methods, some feedback overlooked, minimal iteration. • Documentation: Basic documentation, some gaps in presentation.	• Fidelity and Detail: Prototype's fidelity matches the stage of design, with attention to detail. • Functionality: Prototype functions flawlessly, demonstrating intended features effectively. • Usability and User Interaction: Intuitive design, easy to interact with, positive user feedback. • Testing and Iteration: Comprehensive testing methods applied, feedback systematically incorporated, evidence of multiple iterations. • Documentation: Thorough documentation of prototyping and testing process, clear presentation, insights well-communicated.
Engineering Drawing	20%	• The CAD model is presented without sufficient details or in an unprofessional fashion. • The CAD model is not rendered effectively nor professionally. • Failed to comply with many requirements of the CAD drawing checklist.	• In between failed and excelled CAD model and drawings.	• The CAD model is presented with sufficient details in a professional manner. • The CAD model is rendered effectively and professionally. • Strictly comply with most requirements of the CAD drawing checklist.

		• The assembly drawing is missing key components or sufficient details. • The cost estimation is flawed if not arbitrary.		• The assembly drawing is holistic, thorough, and detailed.
Conclusion	5%	• Conclusions are general, superficial, and unsupported by evidence. • Reflections of the design process is superficial and general. • No mentioning of future work. • No reasoning within the content.	• In between failed and excelled conclusions	• Conclusions are evidence-based, concrete, and informative. • Reflections of the design process is thoughtful, if not insightful. • The future work is practically achievable.
Reference and Appendix	5%	• Fail to follow a reference format consistently. • The minimum number of references is included. • The references are irrelevant.	• Miss important references • Key propositions are lacking support from relevant references. • Primary data are not included in text nor appendix.	• Primary data and materials are included in the appendix • Follow the reference format correctly and consistently • Key propositions are well supported by references.
Formatting and Language	-10%	There are **more than 10** formatting issues identified, for example: • Presentation is poor to the extent that is impedes reading. • Figures and table are not labelled consistently or correctly, or they are hardly readable. • There are major grammar, punctuation, and spelling issues.	There are **fewer than 10** formatting and language issues, for example: • There are some (but not many) confusing or ill-structured sentences. • Figures and table are not labelled consistently or correctly. • There are minor grammar, punctuation, and spelling issues.	There are **fewer than 3** formatting and language issues, for example: • Professional language with no colloquial phrasing. • Figures and tables are clearly presented and correctly labelled. • There are no grammar, punctuation, and spelling issues.

Note that, if there is concrete evidence that your report is a result of any kind of plagiarism, you may lose all marks for the whole report!