Project Part-2: Detailed and Component Design

Starting date: Nov. 1, 2019 Report due: Dec. 4, 2019

Objectives:

- To learn different power drives including belt, chain, gear, and so on.
- To perform detailed design for power drives, gear sets, shafts, bearings, and accessories
- To go through the design iterations and process
- To apply CAD tools in design and drawing generation
- To develop thorough systematic thinking in practical system design
- To learn to integrate various components into a complete machine
- To design a machine considering costs, safety, manufacturing, installation, maintenance, repair, and other life-cycle issues

Assumptions:

- The design concept is defined as in your Project Part-1
- Detailed electric and control system design is out of the scope of the work
- Detailed description of other complex mechanical systems (e.g. brakes, suspension, fuel system) other than the structure and drive elements, are out of the scope of the work.

Scope of the Work:

- Complete the entire structure including specifications for all related components
- Predicting the amounts of external loads and expected overloads/shocks from relevant resources such as standards, or research papers
- Detailed design the drive system (pedal or motor driven)
- Choosing the structural materials, sections with manufacturing processes in mind
- Stress analysis and design of the components for size and safety
- Detailed drawings of the assembly and parts including tolerances for critical parts and manufacturing/assembly notes where necessary
- Potential use of numerical analysis and validation against theoretical hand-calculations

Relevant Skills to be Gained:

- Simplifying complex problems to more abstract models for applying theoretical calculations of stress and deformations
- Applying material failure theories for practical mechanical design
- Design of standard transmission components such as belt and chain drives, and gears
- Design of bolts and nuts, tolerances, welds, etc.
- Selection of motors if necessary
- CAD tool (e.g. SolidWorks) proficiency
- Engineering Graphics
- Finding off-the-shelf components and soliciting quotes (cost analysis)

Grading

A group written report (60%), oral presentation (10%), and a peer evaluation report (30%) will be used as your project grade. The rubrics of the Project 2 report and peer evaluation form are attached for your reference. The peer evaluation form will be used after each project.

Design Report Guide

The general format and guideline refers to http://writing.colostate.edu/guides/documents/ce-trpt/index.cfm. An article titled "A guide to technical report writing" is also posted in Canvas for your reference.

For this project, in specific,

1. The title page includes
    a. Project Title:
    b. Team No:
    c. Team Name (optional)
    d. Team Members with signatures
2. Executive summary
3. Introduction (a brief overview of requirements and your design goals)
4. Description of the design
    - Major components and their functions (recommended to use an exploded figure with labels for the ease of description)
    - Major technical specifications (refer to Appendices for detailed analyses)
5. Features of your design
    a. Mandatory sections:
        i. A section on machine safety is needed (safety for the users and machine operator). Please highlight all the safety measures that have been designed into the machine.
        ii. A section on cost analysis is needed (including initial costs, and other life cycle costs). Each original cost number needs to be backed up with references, e.g., emails, quotes, books, or calculations.
    b. Optional sections (you may list other features such as manufacturability, ease of maintenance, aesthetics, etc.)
6. Detail design and analysis (only main design decisions or results may be included in the report and leave the detailed calculations in the appendix)
    - Structural design and analysis
    - Machine Element selections
    - CAD drawings for the assembly and key components
7. Final Recommendations and Conclusions
8. References
9. Appendices

Note:

1. As a general guide, the length of the report (excluding Appendix, title page, executive summary, table of contents, and list of figures/tables) should be no more than 10 pages (1.5 line space, minimum 12 pt font size for the body text).
2. Your audience is other professionals who do not know your specific project (think about your fellow classmates.)

RUBRIC for PROJECT PART-2 REPORT

Team #:

Elements (% of marks)	Marks	Comments
Cover Page (2%) - including: Project Title, Team # [required] & team Name [optional], names of team members with *signatures*		
Executive Summary (5%)		
Introduction (3%)		
Description of the design (10%) Exploded view of the vehicle; description of main components, mechanisms, etc.; list of main technical specifications		
Features of machine (20%) - **Safety** - **Cost** - **Others** How your design satisfy customer needs; why your design is excellent		
Detail Design and Analysis (40%) - **Structural Design and Analysis** - **Machine Element Design** - **Engineering Drawings**		
Recommendations (3%)		
References and Appendices (2%)		
Overall technical writing quality (10%)		
Overall professionalism (5%)		
Total Mark		

Peer Evaluation Form (confidential)

Team No. _____

Please give your assessment of the performance of each team member **(including yourself)** in the design project. For each of the stated attributes, assess the performance according to the following scale, and total each column. If you have any comments or suggestions for any colleague(s), write them overleaf.

Unacceptable (0-5, reasons to be given)
Poor 5
Fair 7.5
Good 10

Attributes \ Names of team members					
Respect team goal and pursues it wholeheartedly					
Attends all meetings punctually					
Participates openly in team discussion and planning					
Accepts critical comments objectively					
Shows respect for other team members					
Accepts a fair share of the required work					
Carries out assigned tasks promptly					
Shows interests in the work of other team members					
Has a positive and motivating effect on team morale					
Overall (out of 10)					
Comments					

Your name (print):_____

Signature _____ Date: _____