Eastern **M**editerranean **U**niversity
Faculty of Engineering
Department of **M**echanical **E**ngineering
PRINCIPLES OF COMPUTER AIDED ENGINEERING – MENG303
Spring-2018

Instructor: **Assoc. Prof. Dr. Qasim Zeeshan**

Assistant/ Lab Instructor: Mr. Mustafa Glaissa

STUDENT'S

Name, Surname: ……

Student Number: ……

DESIGN PROJECT

Due Date: 25 May 2018

Summary

Students are required to design a complete System. This project requires the students to apply the theoretical principles studied in the Dynamics, Materials Science, Machine Elements, Strength of Materials, Systems Control and other related courses to design a system by utilizing the ***Design Process*** taught in the theoretical part of the course. The design of the product with the aid of theoretical predictions provides the student for the opportunity to implement the ***Design Process***.

Scope:

Various design concepts are being explored. In this project the students will focus on a cost effective concept and by designing a prototype of a human powered manned vehicle. The work will cover several key areas of mechanical, mechatronics & automotive engineering:

1. Introduction: Detailed definition of the project, Significance of the project, Detailed project objectives, Detailed project constraints, Report Organization
2. Background study and literature research: Background information, Concurrent solutions, Comparison of the concurrent solutions. Review and categorize various design concepts. Discuss various available designs, and Proposed a design based upon Objectives and Constraints.
3. Conceptual design: Performance estimation & Preliminary design on major parameters. Develop the preliminary design and assess its performance. Apply mathematics or science in design calculations. Solutions of the related equations with reference to the project. Detailed Design: Design the main structural elements and assess suitable materials needs.
4. Manufacturing Plan: Apply science and engineering standards to select suitable materials and components subject to the Constraints.
5. Testing Plan: Perform tests for design validation.

Constraints:

Economic: The design should be economical viable.
Availability: The product should be designed by employing materials and components available in the local market.
Manufacturability: The product should be manufacture-able in the ME workshop.
Sustainability: The design should be robust and sustainable.
Environment: Hazardous materials should NOT be used. Recyclable materials should be preferred.
Health and Safety: Safety standards should be adhered to while manufacturing. The final product should be safe to operate.
Ethical: The design should be original and the references should be cited in the design report.

Standards

The relevant standards for Materials, Components, Drawings (Tolerance, Dimensions etc), Manufacturing Process, Product Design and Operations should be identified and followed. The reason must be provided if any particular standard is not followed. (Relevant Standards for Materials/Components used/Procured, Product Design and Development Standards (if applicable), Standards etc like ASTM, ASHRAE, ANSI, TS-EN Drawing Standard, NACA Airfoil Standard, AWEA Standards, Others)

Design Process. The student must follow a logical process in accomplishing the design as taught in the theoretical part of the course. This design process must be reflected in the design report submitted. The students are encouraged to use the templates available online. WEB RESOURCE (http://www.davidullman.com/2-uncategorised/15-mechanical-design-process)

Design Report. The student must develop documentation on the design. The design report will reflect the steps taken in the design process used in solving the problem. Fundamental calculations and drawings must coincide. **3D model & drawings** must be drawn in **SolidWorks** ® software and copied to a **CD** and submitted alongside the **report**. Drawings must include part and assembly drawings. Grade evaluation will be equally weighted to the design concept generated in the report and the CAD Models & drawings. The design report should be as the **MENG410 CAPSTONE DESIGN REPORT FORMAT** available on http://me1.emu.edu.tr/en/students/capstone-design-and-projects
Submission of the report **on-time** is stressed. ***Late submissions will not be accepted.***

Reference Sources:

https://www.asme.org/events/competitions/human-powered-vehicle-challenge-(hpvc)
https://community.asme.org/hpvc/w/wiki/12638.report-archive.aspx
https://www.obvibase.com/p/MiwdF2D3fkHh#table/MiwdF2D3fkHh/*
https://www.youtube.com/user/ASMEHPVC
https://www.facebook.com/ASMEHPVC
http://www.ihpva.org/
http://www.velomobiles.co.uk/

Project Guidelines

Design the ***system*** and explore the engineering principles involved. The project consists of the following major activities:

a. **Literature Review** of the existing Designs
   –Survey existing concepts
   –Categorize the existing concepts
   –Collect data
b. Generate **Customer Requirements** and relate to **Engineering Specifications** (QFD).
c. Define **Design Criteria** (Design Objectives, Design Variables & Constraints).
d. Generate & Evaluate **Design Concepts** (Generate at least 3 concepts, based on the literature reviewed).
e. Select a **Design Concept** (Pugh's Matrix).
f. Define **Systems & Sub-systems** (Product Breakdown Structure (PBS)).
g. **Select** the **Systems & Sub-systems (**Selection Design Process**).**
h. Identify **ALL Design Activities** and assign timelines, resources and responsibilities (Gantt Chart and Work Break Down Structure (WBS)).
i. **Design** and **CAD Modelling** of the Mechanical Subsystems (SOLIDWORKS), include your rationale for why you designed it as you did.
j. **Detailed Drawings** according to **Drawing Standards** with **Dimensions** and **Tolerances of Key Dimensions.**
k. **Material Selection**: Select the Materials required using Ashby Charts, (Bill of Materials).
l. **Manufacturing Process Selection**: Select the Manufacturing Processes involved and specify using a flow chart, (Design for Manufacturability)
m. **Verification and Validation Plan**: Testing Plan. How do you intend to verify and validate your design.
n. **Cost Estimation** of the **Proof of Concept Prototype**. Including Direct, Indirect, Material and Manufacturing Costs etc.
o. Identification of **Failure Modes & their Effects Analysis** (FMEA).
p. **Conclusions and Recommendations** for Further Work (also include what you might have done differently knowing what you know now). Summarize the work done, what was learned, and the outcomes of the project, such as how well it worked or didn't work.
q. **References** (At least 20 references). Any references listed should be cited in your report. Examples of how to cite references can be found in the MENG410 CAPSTONE DESIGN REPORT FORMAT available on me.emu.edu.tr. Note that the reference list must be alphabetized. Remember that any material you include in your report that you did not create by yourself or that is common knowledge, **must be** cited as **reference**, or else you are committing the ethical violation of plagiarism.
r. **Annexures.** Provide any other information that, in your judgment, might be a big help to someone trying to do a similar project (Standards, Brochures, data sheets, catalogue pages, etc.).
s. **Fabrication** of a **physical prototype**/model of your design.

Project Report Guidelines (One report per group)

The design report should be as the MENG410 CAPSTONE DESIGN REPORT FORMAT available on
http://me1.emu.edu.tr/en/students/capstone-design-and-projects

Abstract

Succinctly and specifically state: **The objective(s) of the project**, **the outcome/results** (as per project guideline requirements), **summary of all the "performance data."** This section should consist of three to five paragraphs, and be about one page long. The Project Summary gives the **key aspects** of the project in a concise form. It must include a summary of the performance data (weight, height, maximum power, stiffness, costs etc.) and should include the outcome of your project (Did it successfully achieve the design objectives? Were there significant failures?) The rest of the report will elaborate on what you did, how you did it, and what happened.

Table of Contents

Number report pages starting with page 1 as the Introduction page. Title page has no number and other pages before Introduction can be numbered i, ii, iii, etc. The **Table of Contents** should include all the sections / subsections headings with the starting page number for each. It comes after the Abstract.

Introduction

This section describes relevant background information. (4 pages). It describes what the project was about, first in general, but then *specifically*, presenting the *specific* objectives that your design addresses. Identify goals and specifications. This section should be at least 4 pages. Make sure that you include sufficient sketches, drawings, and/or photographs and verbiage to clearly explain to someone unfamiliar with this project what it is all about. A figure (or a photograph) that provides a good visual summary of your project is appropriate for this section, but no more than one. Remember, each figure should be numbered and have a caption. Talk about and refer to figures in the text.

Theory: Describe briefly the theory(ies) that apply to your project, including any applicable formulas. Provide equation numbers.

Design: Provide the *Semantic, Analytical* and *Graphical* design. Give a brief description of your turbine blade and structure design including:

a) Relevant **sketches, drawings, pictures.**

b) **Type**, **shape** and **dimensions** (and possibly cost if known) of the materials used

c) Name/describe the **major tools** used during the "Design" cycle

d) Briefly describe the **type of analysis** performed on the project, the **purpose of each analysis** and its **outcome.**

e) Include data plots for the parameters and briefly discuss the performance.

Consider putting performance results in tables. Create a graph of your calculations. You will have achieved success in writing this section if a peer in the class could take what you have written, and referring to it alone, be able to reproduce your device.

Conclusions SUMMARIZE the work done, what was learned, and the outcomes of the project, such as how well it worked or didn't work. How did the efficiency of your turbine compare with the efficiency of typical turbines in use today?

Recommendations for Future Work: Include some recommendations of what you would do if you had more time to improve the design or what you might have done differently knowing what you know now. Here you want to make sure to give *specific* recommendations for improvements or further work. For example, a poorly written recommendation might say something like, "… we would make the turbine blade go faster." A better one might read, "… we would use four blades instead of three to develop more power, since power is related to blade area."

References. Any references listed should be cited in your report. Examples of how to cite references can be found in the MENG410 CAPSTONE DESIGN REPORT FORMAT available on me.emu.edu.tr
Note that the reference list must be alphabetized. Remember that any material you include in your report that you did not create by yourself or that is common knowledge, ***must be*** cited as **reference**, or else you are committing the ethical violation of plagiarism.

Appendices contain any other information that, in your judgment, might be a big help to someone trying to do a similar project (Standards, data sheets, catalogue pages, etc.).

Helpful Hints

1. Do not plagiarize
2. Have someone other than the author, proofread the report
3. All tables, charts, pictures, drawings etc. must have a number and a title/caption as per the format
4. Do not split tables, charts etc. across pages
5. Use short paragraphs
6. Number all the pages of the report
7. Use the same font throughout the report (except headings, titles etc.)
8. Use past tense

Project Evaluation Guidelines

SECTIONS	Available and Very Good	Available and Good	Available and Insufficient	Available and Poor	Partly Available	Not Available	Score
	5	4	3	2	1	0	
ABSTRACT							
Summary of the problem							
Summary of significance of the project							
Summary of project objectives							
Summary of project constraints							
Summary of the conclusions							
CHAPTER 1 - INTRODUCTION							
Detailed definition of the project							
Significance of the project							
Detailed project objectives							
Detailed project constraints							
Report Organization							
CHAPTER 2 - LITERATURE REVIEW							
Background information							
Concurrent solutions							
Comparisons of the concurrent solutions							
Engineering standards of the concurrent solutions							
CHAPTER 3 -DESIGN and ANALYSIS							
Proposed/Selected design							
Engineering standards							
Design calculations							
Cost analysis							
CHAPTER 4 - MANUFACTURING PLAN							
Manufacturing process selection							
Details of selected manufacturing process							
CHAPTER 5 - TESTING PLAN							
Verification of the objectives of the project							
Verification of the applied engineering standards							
CHAPTER 6 - RESULTS and DISCUSSIONS							
The results							
The engineering standards							
The constraints							
CHAPTER 7 - CONCLUSIONS and FUTURE WORKS							
The conclusions: Lessons Learned							
The future works							
REFERENCES							
Reference list							
APPENDIX- PROJECT PLAN							
Gantt Chart explaining major milestones of the project with their timelines, responsibilities and resource allocation							
APPENDIX- ENGINEERING DRAWINGS							
Complete assembly drawing and detailed drawings of each part/ component (according to the technical drawing standards)							
APPENDIX- CONSTRAINTS							
Economic, Environmental, Sustainability, Availability, Manufacturability, Ethical, Social, Political, Health and Safety, Constraints etc							
Note: Check if any of above is listed and explained.							
APPENDIX- STANDARDS							
Relevant Standards for Materials/Components used/Procured, Product Design and Development Standards (if applicable), Standards etc like ASTM, ASHRAE, ANSI, TS-EN Drawing Standard, NACA Airfoil Standard, AWEA Standards, Others							