ECOR 1010 – Introduction to Engineering (2016)

Project: Reverse Engineering and Redesign

Assigned at the first lecture: Final Design Report due no later than 16:30, Friday, December 2, 2016; to be deposited in the ECOR 1010 slot in the cabinet outside room 3135ME. Late submissions of the Final Design Report will NOT be accepted. Other Project Deliverables are due as indicated below; read this document carefully!

I — Overview:

Reverse engineering is the process of understanding the reasons for the underlying technological features of existing products, which could include devices, objects and systems. Reverse engineering usually involves making measurements of properties and relating these to how the product operates in-service. In essence, reverse engineering tries to understand and to re-create the original series of design decisions that led to the form and function of the product. These product properties and features are often incorporated into a computer-aided design, CAD, database to create a virtual 3D model.

Redesign is the process of modifying existing products to improve their performance, extend their life or lower their cost. CAD virtual models are often used in the redesign process. It is often straightforward to make a virtual simulation of how the product will work given a new design choice. For instance, a CAD program can be used to calculate stress and strain under load of a component made from a new low-cost alloy to see if it will be fit for service.

The 2016 ECOR 1010 Project will incorporate reverse engineering and redesign into one full-scale engineering activity. While this project is open-ended and limited only by your imagination, your grade will be based on the fulfillment of the requirements in a reasonable way. You are encouraged to strive for excellence, but keep the notion of diminishing returns in mind.

II — Project Requirements:

Find a simple object that consists of only one part that you can hold in your hand and which is used in common engineering applications. The part must have some simple features such as a hole, flange, boss, etc. Examples include a screwdriver, a shelf bracket, a part found in hardware stores, etc. A simple solid (a cube, rectangle, etc.) that has no features is not acceptable. First, reverse engineer the part, then redesign and improve it! This can be done by adding an extra feature, reshaping, or even reinventing something new.

Project Groups: You must find partners to form a group of three. YOUR PARTNERS MUST BE IN THE SAME LABORATORY SECTION AS YOU. The Project is a test of your ability to work as a member of a group: you cannot do the Project by yourself, you must be part of a group. Tell your TA who your partners are, and you will be assigned a group number that will start with your Lab Section number. For example B2-3, which is Group 3 in Section B2. You must do the following:

1. Determine (and indicate in your report) the purpose of the part. What is it called?
2. Measure all of the important dimensions;

3. Determine the material the part is made from;
4. Describe the manufacturing process required to go from raw material to finished part;
5. Identify one failure mode for your part;
6. Describe the value and benefit of your redesign in approximately 200 words, considering creativity, usefulness, part integrity, and aesthetics;
7. Using IntelliCAD, AutoCAD or CREO Pro/ENGINEER, generate an engineering drawing of the part, including all relevant dimensions;
8. Using CREO Pro/ENGINEER generate a rendered solid model of the part to include in the Design Report, and a scaled model converted to STL file format;
9. Submit the STL file for printing on one of two 3D printers.

III — Project Deliverables:

	Project Deliverable	*Due Date*	*Grade Weight*
1	.STL file	Submit according to Mr. Biljan's instructions by 16:30 Friday November 4, 2016	See item 2 below
2	3D Printed Part	Submit to your TA in your scheduled Lab during the week of November 21, 2016	25% of project grade
3	Design Report	16:30 Friday December 2, 2016: deposit in the cabinet outside room 3135ME.	75% of project grade

IV – 3D Print Requirements:

1. Your reverse engineered and redesigned part will be printed using one of the Dimension BST 3D printers. Given the large number of designs to be printed and the machine capability, the following limits must be satisfied:
    - Maximum volume of printed component is 1 in^3 (16 387 mm^3) and
    - Minimum wall thickness is 0.0625 in (1/16 in) (1.59 mm).
    - The length, height and depth must each be less than 5 in (127 mm).

2. Using PTC CREO Parametric (previously called Pro/E), generate a rendered solid model of your part, and save it in the STL file format. This solid model of your part will be different from the one used in your report, because it will have to be scaled to conform to the 1 in^3 volume limit imposed by the large number of students in ECOR 1010 and the fact that there are only two 3D printers.

2. It is absolutely necessary that you submit your STL file according to instructions to be specified by Mr. Stephan Biljan in advance of the deadline of 16:30 Friday November 4, 2016.

IMPORTANT: Make sure that your project group number has been included as a text protrusion on any convenient, but visible surface on your part (see "To create text in sketcher" in the CREO help page). This is necessary for part identification: as many as 50 items will be created at the same time in each batch print job.

V — Report Requirements:

A formal engineering design report is required. Use the outline described in class and the Design Project template on cuLearn. You must include a title page and table of contents, but the remaining sections in the report can be arranged, included, or excluded as you see fit.

Please, remember that the entire written report is to be limited to seven pages. **THE SEVEN PAGES INCLUDE ONE TITLE PAGE, ONE PAGE FOR A TABLE OF CONTENTS, ONE PAGE FOR THE ABSTRACT, ONE PAGE FOR YOUR ENGINEERING DRAWING, AND ONE PAGE FOR YOUR CREO (PRO/E) RENDERED SOLID MODEL.**

Printing Your IntelliCAD Drawing: To send your drawing to the printer, follow the steps below.

1. From the menu, select File > Print...
2. The Print dialogue box will pop up. Click the Print Setup... button. In the Print Setup window that pops up select either "Portrait", or "Landscape", whichever best suits the orientation of your drawing and click on OK.
3. Back in the Print window, click on Window in the "Print Area" options. Additionally, select the "Print only area within specified window" option. Next, click on the Select Print Area button.
4. Enclose the entire drawing, including the title block, in the window: move the magnifying-glass cursor to the lower left corner of the drawing and left click; drag the window to the upper right corner and left click again.
5. Click the Print Preview... button. If you like what you see, click Print in the previewer window, otherwise click Print Settings and reset the print window.

VI — Submission:

STL file and 3D Print: Due by 16:30 on Friday November 4, 2016. Submit your STL file according to instructions to be specified by Mr. Stephan Biljan BEFORE the deadline. The 3D print will be graded by your head TA in your laboratory period during the week of November 21.

Design Report: Your report (hardcopy) is to be submitted through the ECOR 1010 slot in the steel cabinet outside the Mechanical and Aerospace Engineering general office (3135ME). It is to be stapled with only one staple in the upper left corner. No other binding is to be used. The names and student numbers of all group members are to be inserted on the lower left corner (within the margins) of the title page. The reports will be collected at 16:30, Friday December 2, 2016. **NO LATE REPORTS WILL BE ACCEPTED.**

VII — Marking:

Both the 3D print and the design report will be marked out of 10. The marking scheme is as follows: 9-10 (excellent), 7-8 (good), 5-6 (satisfactory), and less than 5 (poor) will be used. To receive credit for the project, all requirements must be submitted; all deliverables shall conform to the PEO Code of Ethics as described in the course outline available on the cuLearn website. It is the responsibility of all Project Group members to ensure the project is submitted on time: all group members will receive FND if the project in not submitted on time.