ENGR 2330

Introduction to Mechanical Prototyping

Course Syllabus

2013 Spring Semester

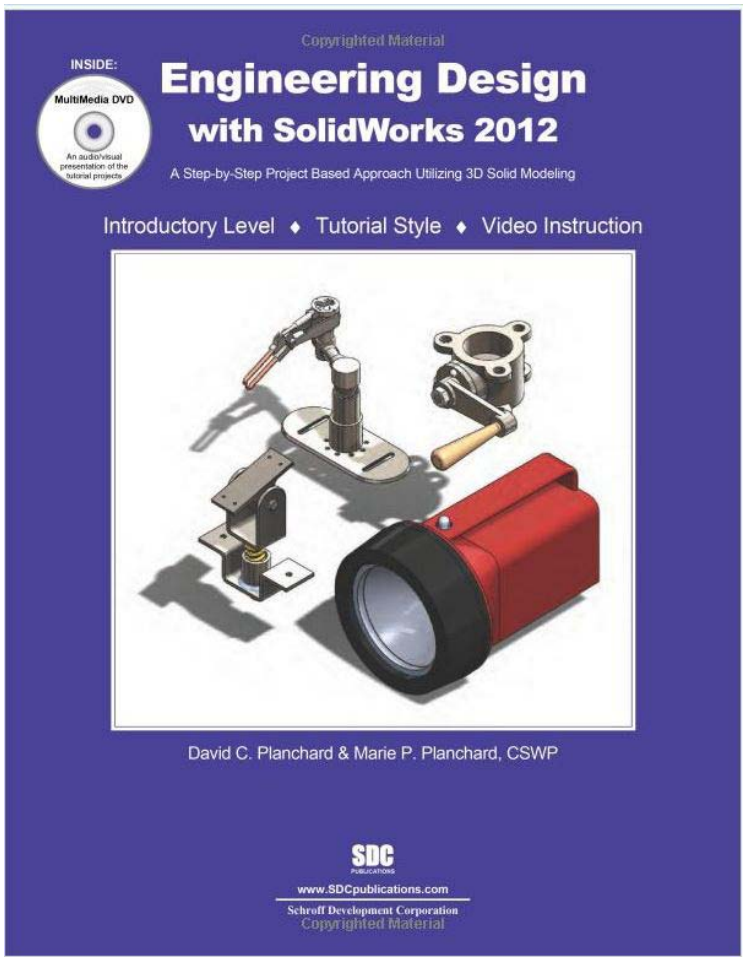
Franklin W. Olin College of Engineering

1/15/2013

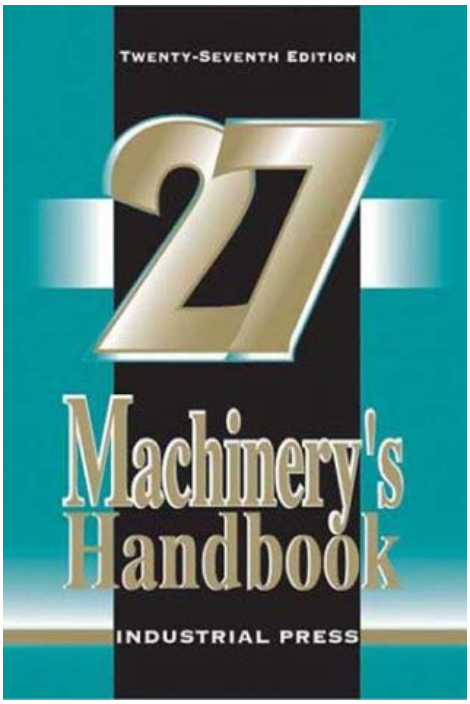
ENGR 2330 Mechanical Design (Monday and Thursday 9-11 in AC309)
Instructor: Barrett (david.barrett@olin.edu)
Credits: 4. Course Folder: P:\+Courses\ENGR2330
Prerequisites: a desire to build complex machines well
Satisfies subject requirements: ME Mechanical Design Core

Through project experiences, students will learn the techniques needed to both master the technical communication of mechanical designs and the fabrication skills needed to rapidly build them. Students will practice professional drafting techniques to describe a full range of fabricated components, including milled, lathed, sheet metal, water jet, injection molded, 3d printed and composite components. This course will include a significant machine shop component, where each student will gain exposure to advanced fabrication techniques. The final project will be the design and fabrication of a fully operational, complex mechanical system.

Suggested Reference Text 1:



Suggested Reference Text 2:



Recommended Hardware (Amazon.com):

Avenger MC0006 6" Digital Caliper with Large Display

List Price: ~~$44.00~~
Price: $39.99

General Tools 616 Flexible Industrial Straight Edge Ruler

Price: $4.99

DewalDPG54-1C Protector Clear High Performance Lightweight Protective Safety Glasses

Price: $6.36

A brief overview of the semester:

The purpose of this course is to teach you the fundamentals of Mechanical Prototyping. It is intended to familiarize you with the basic mechanical components that make up most mechanical systems and to train you to both design them and combine them into simple useful machines. The course will consist of developing professional skills in Solidworks and the physical fabrication of illustrative examples of prototypes in the Olin shop and Large Project Building Composites Lab. The course will include multiple team design projects and will conclude with a final independent design project of significant complexity. A working knowledge of simple machine shop fabrication techniques and the ability to generate Part, Assembly and Detailed drawings in SolidWorks is highly recommended.

Course Objectives:

At the end of this course, students will be able to generate a professional grade mechanical documentation package, choose appropriate manufacturing techniques and be able to efficiently build rapid prototypes of simple mechanical systems.

Measurable Outcomes:

At the end of this course, students will be proficient in the creation of professional part, drawing and assembly documents in Solidworks™ and will be able to rapidly build simple mechanical prototypes using a wide range of fabrication techniques.

Deliverables:

Mechanical Design Packages: Professional grade mechanical documentation package will consist of a written report including a SolidWorks drawing package of all of a designs components and a digital picture of the fabricated component (if one is generated). Please use the following format for all design packages:

1) Title Page
2) Table of Contents and list of Figures
3) Executive summary
4) Detailed description of “Structure” used in design. What structures, what joints, what fasteners and why?
5) Detailed description of “Power” used in design. Where does power come from? How does it work?
6) Detailed description of “Transmission” used in design. What types of transmissions are used? Where are they used? And why are they used?
7) Full professional SolidWorks assembly drawing package for design.
8) Full professional SolidWorks detailed drawing package for design.
9) Full Bill of Materials of all hardware used.

Successful Robot Demos: Each Design package will be paired with an in-class demonstration of your team’s fully assembled, tested, working robot.

Class Involvement: Includes attendance and participation in both project team based design activities, in class design reviews and in advanced fabrication technique seminars in the Olin Shop.

In-Class Design Studies: Each design lecture will be followed by a short, in class design study that will allow student hands-on experience with new design concept..

Please turn in one paper copies of all work for grading purposes and place one archival .pdf copy for ABET accreditation records in the course folder.

Grading:

Although a much of the work done in this course will be done in a team format, students will generate and be graded on unique individual reports. Final course grades will be determined by the following work breakdown.

Team Mechanical Design Packages: 35%
Successful Robot Demos: 30%
Instructor Appraisal of Class Involvement: 15%
Individual In-Class Design Studies: 20%

All work graded on a scale of 100 points. In that the ability to deliver before fixed deadlines is critical to a successful engineering enterprise, work submitted late (without prior approval) will be penalized on the following scale: Late 1 day -10 points, Late 2 days -20, Late 3 days –submission refused, Grade=0. Please note that any un-submitted report will generate a zero grade and will significantly affect your final course grade.

Grading Metric:
>95 = (A); >90 = (A-); >85 = (B+); >80 = (B); >75 = (B-); >70 = (C+); >65 = (C); >60 = (C-); >55 = Please Don't!

Time Expectations:

ENGR2330 is a 4 credit course. Please plan on spending an average of 12 hours a week on this material, ~4 of which will be in class. A significant portion of the remaining 8 hours will involve designing components in SolidWorks or fabricating components in the machine shop. Course assignments will involve significant out of class team work. The Olin Mini-Shop and Project building composites fabrication bay are configured to support this work.

Honor Code Issues:

Collaboration on all deliverables is expected and encouraged; many assignments will be done in design teams of 4 to 5 students. However it is expected each individual on a team will both do their fair share of the team work and will turn in his or her own unique reports and design packages. In practice, if a team of 5 produces 20 drawings, I will expect to see ~4 "individually signed" drawings from each team member.

Spring 2013 Schedule*:

Date	Class Description	Deliverable (student work due this day)
1/24 Th	Course Orientation and Fundamentals of Rapid Mechanical Prototyping.	Take clean legible notes on lectures. (Place all notes and parts generated in your personal course digital design folder at: \\FSv01\Courses\ENGR2330\firstname_lastname Sign up for Mill and Lath Training in Main Shop
1/28 M	***Lecture Structure;*** Design of the 7 most common mechanical structures. Design of joints with fasteners, adhesive and welds. ***Class Project:*** "Your name Structure Design Study"	Complete SolidWorks Embedded Tutorials. Open SolidWorks, Got to >Help>SolidWorks Tutorials, Do: 1. Intro to SolidWorks 2. Lesson 1: Parts 3. Lesson2: Assemblies 4. Lesson3: Drawings Place all of your tutorial parts in your digital design folder.
1/31 Th	***Lecture Transmission;*** Overview of transmissions. ***Class Project:*** "Your name Structure Design Study"	Complete SolidWorks Embedded Tutorials Open SolidWorks, Got to >Help>SolidWorks Tutorials, Do: 1. 3D Sketching 2. Fillets 3. Lofts 4. Revolves and Sweeps 5. Assembly Mates 6. Advanced Drawings Place all of your tutorial parts in your digital design folder.
2/4 M	***Lecture Transmission;*** Design of 4 bar linkages. ***Class Project:*** 4 bar linkage Design Study	***"Your Name Structure" Design Study Due.*** Complete SolidWorks Embedded Tutorials Open SolidWorks, Got to >Help>SolidWorks Tutorials, Do: 1. Toolbox 2. SolidWorks Motion 3. PhotoView 360 and Appearances Place all of your tutorial parts in your digital design folder.
2/7 Th	***Lecture Transmission;*** Design of Cams. ***Class Project:*** Cam Design Study	See and do "Cam Design Help Tutorial Using SolidWorks:" http://www.youtube.com/watch?v=yhZ3N_cJLM0&feature=relmfu See "Cam Mating and Analysis Help Using SolidWorks:" http://www.youtube.com/watch?v=Wn7CW9y42Pg

		See on-line cam help: http://help.solidworks.com/2012/English/SolidWorks/sldworks/Cam_Follower_Mates.htm?id=90955495603d4c3fac01d15f6cdb1a05#Pg0
2/11 M	***Lecture Transmission;*** Design of gear transmissions. ***Class Project:*** Gearbox Design Study	See "Solidworks Tutorial: Mechanical Mates: http://www.youtube.com/watch?v=Oupme_s5uZg See following for design help with gears: http://help.solidworks.com/2012/English/SolidWorks/sldworks/Gear_Mates.htm http://help.solidworks.com/2012/English/SolidWorks/sldworks/Rack_and_Pinion_Mates.htm?id=150393bebc7f4101bb0bc3797a43796f#Pg0
2/14 Th	***Lecture Transmission;*** Design of belt and chain transmissions. ***Class Project:*** Belt Design Study	See "Belts and Chains in SolidWorks:" http://www.youtube.com/watch?v=Xmyryo9kVlc&feature=related See link for designing belts in Blocks: Using Traction and Belts for Layout Sketches http://help.solidworks.com/2012/English/solidworks/sldworks/using_traction_and_belts_for_layout_sketches.htm
2/19 M	***Lecture Power;*** Motors, Actuators, Springs, Flywheels, Brakes, Shocks, Dampers. ***Class Project:*** Power Design Study	***Transmission Design Package Due*** See SolidWorks Motion Simulation: http://www.youtube.com/watch?v=rMeyaO1Kqe0 See SolidWorks Engine Animation: http://www.youtube.com/watch?v=ilMxChYGq0Q See 3HP Motor Animation: http://www.youtube.com/watch?v=5a4KasNwLk0 See spring animation at: http://www.youtube.com/watch?v=OYlJT7rhq_g&feature=fvwrel See: http://help.solidworks.com/2012/English/SolidWorks/motionstudies/c_Introduction_to_Motion_Studies.htm?id=d951ad4645444174be782c4314d50ea4#Pg0

2/21 Th	***Lecture: Traditional Fabrication*** Saw+Sand+Drill+Tap Review. Team Project: Traditional Machine Shop Built Robot	Hands on fabrication training using saws, sanders, drill presses and threading tools in shop. Start team design of robot.
2/25 M	Team Project: Traditional Machine Shop Built Robot	Top Level design finalized, team work on individual components
2/28 Th	*No Class*	No scheduled activities
3/4 M	Team Project: Traditional Machine Shop Built Robot	***In Class Design Review 1***
3/7/Th	Team Project: Traditional Machine Shop Built Robot	Team work on detailed design and fabrication
3/11 M	Team Project: Traditional Machine Shop Built Robot	Team work on assembly.
3/14 Th	Team Project: Traditional Machine Shop Built Robot	In Class Project Demo ***Design Package 1: TMSBR Due***
3/18 M	Spring Break	No course work
3/21 Th	Spring Break	No course work
3/25M	***Lecture: Sheet Metal Fabrication*** Team Project: Sheet Metal Built Robot	Do embedded sheet metal tutorials within SolidWorks, See: Sheet Metal in SolidWorks http://www.youtube.com/watch?v=am-EKmxZTws See: Sheet Metal Box http://www.youtube.com/watch?v=m38VqL0t9sk See: Solidworks Tutorial (Sheet Metal and Forming Tools I) http://www.youtube.com/watch?v=24qTQR7oLtQ Start team design or robot.
3/28 Th	Team Project: Sheet Metal Built Robot	Top Level design finalized, team work on individual components
4/1 M	Team Project: Sheet Metal Built Robot	***In Class Design Review 2***

4/4 Th	Team Project: Sheet Metal Built Robot	Team work on detailed design and fabrication
4/8 M	Team Project: Sheet Metal Built Robot	Team work on assembly.
4/11 Th	Team Project: Sheet Metal Built Robot	In Class Project Demo ***Design Package 2: SMBR Due***
4/17 W	***Lecture: Composite Fabrication*** Team Project: RP-Composite Built Robot	Do mold and surface tutorials within SolidWorks. See: Intro to Surface Modeling http://www.youtube.com/watch?v=fA2-i34UVUo See: SolidWorks Complex shapes http://www.youtube.com/watch?v=3MoowmIKwYQ See: SolidWorks Surfacing to Create FSAE Body Work - Part 1 http://www.youtube.com/watch?v=-8dKweEt1OQ See: SolidWorks Surfacing to Create FSAE Body Work - Part 2 http://www.youtube.com/watch?v=-MFFjb6ul4A
4/18 Th	Team Project: RP-Composite Built Robot	Top Level design finalized, team work on individual components
4/22 M	Team Project: RP-Composite Built Robot	***In Class Design Review 3***
4/ 25 Th	Team Project: RP-Composite Built Robot	Team work on detailed design and fabrication
4/ 29 M	Team Project: RP-Composite Built Robot	Team work on assembly.
5/2 Th	Team Project: RP-Composite Built Robot	In Class Project Demo ***Design Package 3: RP-Composite Robot Due***

*Schedule subject to review and revision at any time.

Deliverables denoted in RED will turned in to instructor for course grade. 1 paper copies and 1 .pdf copy in course folder please.