BE 3320 MECHANICAL DESIGN FOR BIOLOGICAL ENGINEERING

Fall 2015 Class Syllabus

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TA: No formal TA is assigned to this course; RA's may assist: Daniel Smith dsmi112@lsu.edu; Charles Malveaux cmalve2@lsu.edu; Gabe Rivera griver3@lsu.edu; Melody Thomas mtho135@lsu.edu ; Marlon Greensword mgree15@lsu.edu ; **Departmental TA**: Anna Charron Dugas acharron@lsu.edu

Location: Lectures 12:30--1:30 T/Th 2218 Taylor

Moodle site: http://moodle2.lsu.edu/course (look for BE3320)

Labs 1:40-4:30 W/Th 138 Ag. Metals or shopTh; 106 AgMetals or shop

Description: BE 3320 Mechanical Design for Biological Engineering (3 credits)

Prerequisites: CE 3400; ME 3133 or CE 2460. Philosophy of machine design for power machinery, materials of construction, frame designs, biological engineering, selection of machine elements, and guided projects in machine design and analysis.

Textbook: Shigley's Mechanical Engineering Design, Budynas and Nisbett, 9th Edition, (SI) McGraw Hill, 2010. Fundamentals of Engineering (FE) Reference Handout. www.ncees.com.

References: ASABE Standards; Commercial literature, Statics, Dynamics, Strength of Materials and Properties texts; Autodesk; Autodesk Inventor (available on machines in computer lab)

Class goals: To learn and apply techniques of machine design to relevant mechanical and biological engineering challenges, and to use these creative skills to effectively communicate technical, written and oral aspects of this work.

Communication Intensive Course: This has been certified Communication-Intensive (C-I) course which meets the requirements set forth by LSU's Communication across the Curriculum program, including

•instruction and assignments emphasizing informal and formal [writing] and [visual];
•teaching of discipline-specific communication techniques;
•use of draft-feedback-revision process for learning (on two formal projects);
•practice of ethical and professional work standards;
•40% of the course grade rooted in communication-based work; and
•a student/faculty ratio no greater than 35:1.

Students interested in pursuing the LSU Distinguished Communicators certification may use this C-I course for credit. For more information about this student recognition program, visit www.cxc.lsu.edu.

CxC studio contacts: David 'Boz' Bowles dbowles@lsu.edu; Warren Hull whull1@lsu.edu

ABET class: 2 hours engineering design, 1 hour engineering sciences.

ABET Objectives: a) apply knowledge of math, science, engineering; b) analyze and interpret data; c) design a system/component; e) identify, formulate and solve engineering problems; f) understand professional and ethical responsibility; g) communicate effectively; k) use techniques, skills and modern engineering tools necessary for engineering practice.

Prerequisites: Statics; Dynamics; Strengths of Materials; word processing; spreadsheet; AutoCAD; Inventor.

21	Nov 5	Design Project Draft Due at 4:30
22	Nov 10	

Laboratory Schedule

Note: All Laboratory Reports are due by the beginning of lab 1 week later.

Class period	Date	Subject
01	Aug 26/27	No labs (Review Autodesk Inventor independently)
02	Sept 2/3	Shop Safety and Lab Introduction, Visit CxC lab (Hull, Bowles)
03	Sept 9/10	AutoCAD and Inventor Review
04	Sept 16/17	Project Design/Drawing Day: Work on Project 1
05	Sept 23/24	Springs, Hinges, and Fasteners
Project 1 due Sept 25 by 4:30 PM		
06	Sept 30/Oct 1	Autonomous Vehicle Analysis and Design Improvement
07	Oct 7/8	Work on Design
Project Proposal II Due Oct 9 by 4:30 PM		
08	Oct 14/15	Welding and Soldering A: Permanent Joints/DW
10	Oct 21/22	Design work/W&S B
11	Oct 28/29	**Fall Break**
12	Nov 4/5	Small Engines A: Analysis and Assembly/DW
	Final Project Report Due: Nov 13, by 4:30	
12	Nov 11/12	Design Work/SE B
13	Nov 18/19	Project Presentations
(Thanksgiving: Give Thanks!) No Labs Nov 25/26		
14	Dec 2/3	Final Lab: Final Design Presentations; Debrief
Final Exam:	**Dec 10**	**12:30-2:30**

Communication Intensive Philosophy for BE 3320 Design Course

As professionals in service to the world, engineers need not only solid competence in technical skills, but excellent communication skills to both understand and convey ideas to a variety of audiences. Some specific examples include both conceptual development of designs for particular products and the presentation of those designs to potential clients, to other engineers, and to more general public audiences. At the same time, engineers need not only competence but excellence in their technical field. In this case, that means learning how to design three dimensional components, analyze these components with appropriate technical software, including stress analysis, dynamic simulations and related areas.

We view the inclusion of the communication intensive designation in this course as not being in competition with technical excellence, but enhancing it. These components of learning are intended to be synergistic. For example, learning is often enhanced by the opportunity to share, teach or present one's work. Additionally, critical feedback from class members as well as instructor can enhance clarity in both learning and communication. Practical examples of this include the additional organization required to provide a top quality presentation of technical work. Other ways that communication can enhance technical acitivty is by focusing functionality and clarity of the technical information. By comparison, the technical work, especially the simulations and analyses are ways that figures and videos can help convey needed information.

In summary, the concept is that communication components of this course will enhance engineering skills and vice versa: development of skills in engineering design software allow better presentations that will prepare students for excellent professional work in industry, classroom, and government. In addition, coverage of professional, technical, communication and ethical issues will be included and the synergistic interaction between these should enhance each aspect.

In practice, you will be provided with in-class time to review technical writing, and you will have a chance to visit the CxC Engineering Lab with Warren Hull. I also recommend you to avail yourselves of the services of these labs for practicing presentations, putting videos together and other communication related work, as you will have technical, written and oral components as a significant part of the course.

Practical Aspects of Communication Intensive BE 3320, and Schedule

Fall 2015

Homeworks and exams include written components which allow students to express their ideas in written and graphical format. An early INDIVIDUAL design project will be due in late September (see syllabus for details on dates), and will help familiarize students with the software (Inventor and related technologies) we will be using to assist with numerical stress analysis of mechanical components. A short presentation by each student will allow the opportunity to share in verbal format with other students. A standard feedback form will allow other students to provide critical constructive feedback to presenters which can be used in later projects. A final design project due in November focuses on graphical, verbal, written techniques, as well as interpersonal skills.

One example of a homework that is expected in written format is a review of a professional and/or standards organization related to engineering design. Specific examples of such organizations include ASABE, AES, SAE, or any organization that addresses an engineering profession, organization or other group.

The midterm and final exams will each include written components and/or essay type questions. However, as appropriate for a technical course, significant technical and numerical content will also be evaluated on exams and homeworks.

Writing assignment 1, BE 3320

Choose from the list provided on Moodle,one standard or professional organization related to this course. Go to their website and/or write/call the organization. Write a 1 page summary of the organization including the following:

1) Name of organization
2) Address (web and physical if available)
3) Mission or purpose
4) History
5) Audience
6) Specific services provided
7) Conferences or events
8) Publications
9) Standards if appropriate
10) Current or future activities
11) Additional information as appropriate
12) Be prepared to give a 1-2 minute summary of your organization
13) Submissions will be collated and posted on Moodle for your review

Write in text format, using Chicago style guide. Include references in author/date style per CxC website.

Grading Rubric for Writing Assignment in BE 3320	Possible Points	Points

BE 3320: Mechanical Design for Biological Engineering

Project 1, Fall 2015

Objectives: To refresh memory of the basic drawing functions of Autodesk Inventor.
To learn and practice the tools in Autodesk Inventor that will assist in mechanical design, such as Stress Analysis, Dynamic Simulation, and Drawings.
To explore the effects of stress on simple mechanical tools

Problem: Find a purely mechanical, easy-to-dimension item to draw and analyze via Autodesk Inventor tools. The device should have at least one moving part (when a "small" force is applied to the part it will move). Some example items are a potato peeler, paint roller, rotary cutter, scissors, vernier caliper, retractable pen, a locking door with frame, etc.

You will need to:

- draw the parts of your item,
- assemble the parts,
- run a dynamic simulation using the forces you assume to most likely impact the normal motion of the item, and
- run a simulation using the forces that you assume will most likely cause your device to fail. (dulling of blades, fracture of support structure, etc)

Constraint: You cannot use a pre-drawn part from the Autodesk Inventor Tutorial files or from the web.

For Help: Go to: Inventor Help (F1 while in program) and select the "Try It Tutorials" and go through:

- "Creating a Part" - for making **Standard.ipt** part files
- "Creating Assemblies" – for assembling the parts into an the item in **Standard.iam** files
- "Preparing Final Drawings" – for setting up the Orthographic and Assembly drawings, **Standard.idw** files

Orthographic Drawings of each mechanically important part
Isometric Drawing of the assembly

And posted to (Moodle forum),
A video of each of the dynamic simulations (*.avi may work**; .wmv or other ñcompressedò format preferred****), using the appropriate force loads and constraints

Project due as stated in syllabus

Partial list of grading components:

Device choice
Description of device (written complementing drawings)
Drawing of device (orthographic and isometric drawings)
Dimensioning
Qualitative description of actual forces, likely stress and failure points
Assumptions made to simplify analysis (written)
Stress analysis report of each important component (especially those likely to fail, and assumptions made to decide on these parts)
Qualitative description of actual dynamics of system
Assumptions made to simplify dynamic simulation
Calculations used to simplify dynamics
Video of dynamic simulations
Qualitative description of biological interface(s), including biomechanical forces, viscous and elastic forces and other forces expected
Qualitative description of expected (and creative) failure modes
Analysis of safety constraints of device, possible injuries to human or other biological or mechanical components, as well as safety aspects built into device
Comments on possible redesign to enhance functionality, manufacturability (draw-