DEPARTMENT OF BIOMEDICAL ENGINEERING
INSTRUCTIONAL INCUBATOR
UNIVERSITY OF MICHIGAN

BME Course Summary

Introduction

1. Course Information

Course Name	Introduction to Biomedical Engineering Design
Institution	University of Michigan
Course Number	BIOMEDE 350
# credits	3
Meeting times	11:30 am-1:00 pm, Monday and Wednesday
Is this a required course?	yes
Pre-requisites	advised BIOMEDE 211, 221, 231; co-requisite BIOMEDE 241
Target audience (e.g. 1st, 2nd year):	3rd year
Textbook	There are no required textbooks. Some lecture content will be based on materials in Biodesign: The Process of Innovating Medical Technologies by Yock, Zenios, and Makower (Cambridge University Press, 2009).
Course Website (if it exists)	http://bme.umich.edu/course/biomede-350/

2. Course Description

In the space below, "paste" the description of the course. This can be the actual description listed in the syllabus from the course.

This course uses problem-based learning to introduce students to biomedical engineering design concepts, tools, and methodologies. Students will work in groups and use virtual design and computational tools to propose and validate feasible solutions to real-world biomedical engineering problems with industrial and/or clinical relevance.

3. Course Learning Objectives

In the space below, "paste" the course learning objectives if explicitly stated.

1. Define and solve design-oriented problems to gain familiarity with state-of-the-art software packages that are commonly used in engineering design.

2. Formulate feasible design strategies based on model algorithms.
3. Document the problem identification and algorithmic design.
4. Translate algorithms into computational tools.
5. Use computational tools for virtual design, including development, validation, and optimization of prototypes.

4. Fundamental Tools and Skills

In the space below, describe the fundamental tools and skills that are addressed in the class. For example, labvview, arduino's, the design process etc.

In this course the students are introduced and provided tutorials on MATLAB, SolidWorks, and COMSOL. The students are provided a tutorial on MATLAB and are expected to complete a homework on using MATLAB for image processing. The students also work through a tutorial on SolidWorks and COMSOL and have two homework assignments on each. These assignments are meant to be an introduction into the programs for the students to prepare them for their design project due at the end of the semester.

The students are also introduced to the design process. Their final project is constructed in a way that forces them to work through the process.

5. Exercises or Experiential Projects of Interest

Exercise/Project	**Project Overview**	**Learning Activities and Assessments**	**Required Resources for Project Completion**
EXAMPLE	Students make pulse oximeters.	**Learning Activities** • Students will use resistors and a bread board to … • In a short essay assignment, students explain… **Assessment** • Students complete a laboratory report that explains …	Function generator, resistors, oscilloscope….
MATLAB Tutorial and Homework	Students analyze images using MATLAB	**Learning Activities** • Students complete a tutorial on MATLAB • Students create short codes to analyze images based on color • Students learn how to use Image Segmenter App **Assessment** • Students provide step-by-step details for solving each homework	MATLAB

Exercise/Project	Project Overview	Learning Activities and Assessments	Required Resources for Project Completion
		question • Students submit results in the form of images and explanation • MATLAB code is also submitted as appropriate.	
COMSOL Tutorial and Homework	Students learn about mesh independence and how to run CFD simulations	**Learning Activities** • Students compete a COMSOL tutorial • Students analyze steady incompressible flow in a cylinder using COMSOL • Students complete mesh adaptivity analysis • Students also study the effect of a stenosis on velocity and pressure **Assessment** • Students summarize your results in a short report which includes plots from their simulations • Students also submit all generated files from COMSOL	COMSOL
SolidWorks Tutorial and Homework	Student learn how to design and print a generic part	**Learning Activities** • Students complete a SolidWorks Tutorial • Students work individually and then in groups to learn design SolidWorks part and assembly files • Students also learn how use a 3D printer to print their part • After printing, the students check the accuracy of their parts by measuring dimensions **Assessment** • Students submit the SolidWorks CAD files and drawing • Also submit the printed part • Complete a brief engineering test report that include the results from measuring the printed part	SolidWorks, 3D Printer
Design Project	Students create a final design project and report.	**Learning Activities** • Each groups is responsible for creating a design idea and porotype to one of four possible problems. • Students must use a combination of SolidWorks and COMSOL to describe their solution and simulate its physiologic performance • In the case of COMSOL, groups should simulate at least two physics (i.e., diffusion and convection).	SolidWorks, COMSOL

Exercise/Project	Project Overview	Learning Activities and Assessments	Required Resources for Project Completion
		Assessment • Students must submit a final report that explains their design process and findings/results.	

6. Additional thoughts

If you have any other thoughts about this course, but have not been able to reflect it elsewhere in the document, please feel free to do so here.

Until recently this class was not mandatory which led to a few growing pains the first year it was required for students. Last year the first half of the semester was quite slow because it mostly involved tutorials. During the second half of the semester when the design project took precedence the students did not transition to a higher workload well and became overwhelmed. This year the professors are trying to fix this by assigning more work earlier on and setting clearer expectations.

Although the student learn about three different software's (MATLAB, SolidWorks, and COMSOL) this is not a software course. The students only receive an introduction to these programs and do not teach them in-depth through the lectures of homework assignments. This course is more focused on integrating knowledge from previous classes and giving students an introduction to the design process.

One of the biggest struggles that the instructors had was that students often use the software without actually understanding which equations they're solving or what it means physically. For example, they would often run CFD simulations with COMSOL without having a general idea of the PDEs they were solving. This is something the instructors tried to fix. The students did come into the course with very strong presentation skills. In general, the instructors noticed that the students did not use engineering problem solving when working on their final design project. They would often jump into coding or using software without breaking down their problem and doing the necessary preparation work. Overall, the instructors feel like this is a useful course for students because it introduces them to the design process and better prepares the students for their senior design course.