BIOMEDE 350: INTRODUCTION TO BIOMEDICAL ENGINEERING DESIGN  
WINTER 2023

Bulletin Description: 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.

Instructors:  
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GSI:  
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IA:  
Mary Kritikos  
E-mail: marykrit@umich.edu

Time & Location:  
Mondays & Wednesdays 3:00-5:00PM, 1620 BBB

Office Hours:  
For software assignments, assistance will be provided during scheduled work times (see course schedule). Additional office hours will also be arranged based on need. For design projects, multiple meetings with the technical advisors will be arranged.

Credits:  
4

Prerequisites:  
BIOMEDE 211 (Circuits and Systems for BME),  
BIOMEDE 221 (Biophysical Chemistry and Thermodynamics)  
BIOMEDE 231 (Intro to Biomechanics)

Efforts toward an inclusive classroom:
1) We strive to create a culture of transparency, empathy, and flexibility by using intentionally designed and clearly communicated classroom norms. These norms can be adapted to changing student needs and can include accommodations to ensure equitable learning. If you would like to discuss any accommodations, please reach out to the instructional team.

2) The teaching team is committed to creating a safe and encouraging space for students to learn and grow. It is vital for our future as a society that our future engineers (yes, you!) are both proud of themselves and their identities, as well as develop an identity as an engineer that they can be proud of. It is also important for current engineers (teaching team included) to realize that that is not always the case right now. If at any point myself, a member of the teaching team, or your fellow students act in a way that feels exclusive (or otherwise puts you on guard or increases your anxiety), please use this anonymous, Microaggression Reporting Form. **Please note** that if you choose to leave your name and indicate any possible instances of sexual or gender-based misconduct, that faculty are Individuals with Reporting Obligations (IRO). This involves filing with the Office for Institutional Equity, where an adviser will contact you directly to determine a course of action, which can include remaining anonymous or seeking legal action.
**Course Description:**
This course, intended for 3rd-year undergraduates majoring in biomedical engineering, will expose students to key aspects of the process of designing a biomedical device or biotechnology product, and provide them with the technical fundamentals to perform design.

The primary focus of this class will be the solution of design projects intended to provide students with practical experience through “virtual” solutions of biomedical engineering problems and design of biomedical devices and technologies (paper design). Students will pose feasible solutions to real-world biomedical problems and perform engineering analyses to substantiate their proposed solutions. Design projects will be open-ended problems with no single correct answer, but more constrained than typical design problems to reflect the more introductory nature of this course.

The course will rely more on active, experiential learning than on traditional didactic lectures and passive learning. Lecture time will be designed to impart some general knowledge of problem solving and design, present the engineering and physiology background relevant for design projects and assignments, and provide tutorials for relevant software packages commonly used in biomedical engineering. Students will also have dedicated time during the lecture periods to actively use the relevant software packages. Through the assignments and the design projects, students will gain familiarity with three different software packages: SolidWorks, COMSOL, and MATLAB. Mastery of these packages will only be attained through extensive self-study, and therefore ample time is allocated for independent study.

**Design Projects:**
Students will work in small groups on constrained design problems related to medical products. Projects will require the use of SolidWorks and COMSOL (and Matlab if needed) for virtual design and simulation. Further details will be provided on the content of your assignments and these design projects (i.e., what you have to hand in and when) as we move along.

**Required Textbooks:**
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, 2015). The U-M Library offers free online access to this book.

**Software Requirements:**
We will use three major software packages in this course: Matlab, COMSOL, and SolidWorks.

*SolidWorks* is a computer-aided design software package widely used in engineering in general, and biomedical industry in particular. [http://www.solidworks.com/](http://www.solidworks.com/)

*COMSOL* is a modeling package for the simulation of any physical process you can describe with partial differential equations (PDEs). It features state-of-the-art solvers that address complex problems quickly and accurately, while its intuitive structure is designed to provide ease of use and flexibility. [http://www.comsol.com/](http://www.comsol.com/)

*MATLAB* is a mathematics package that provides a high-level programming language, an interactive computing environment, and functions for algorithm development, data analysis/visualization and numeric computation. [http://www.mathworks.com/](http://www.mathworks.com/)

If you have no experience or familiarity with these software packages, do not fear – the point of this class is to teach you how to use them and give you the opportunity to practice. All 3 packages are available on CAEN computers and the CAEN Remote Desktop Service.
Course Management
All course content will be coordinated through Canvas. Additionally, this class utilizes Piazza for communication. See Communication Policy below on best practices for communication in the course.

Course Outcomes:
Upon completion of this course, students should be able to:
1. Apply the Design Process to future problems
2. Translate real life items and ideas into 2D and 3D models accurately
3. Apply computational tools to test 3D models with physical phenomena
4. Effectively work on a project team while using inclusive practices
5. Understand the big picture of design in the engineering field

Grading Criteria:

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<thead>
<tr>
<th>In-Class activities = 4%</th>
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<tr>
<td>Leadership Quiz &amp; CATME</td>
<td>1%</td>
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<tr>
<td>Team Contract</td>
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<td>Reference Hunt</td>
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<td>3D Visual Activity</td>
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<td>Expected Results graph</td>
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<tr>
<th>Design Assignments = 12%</th>
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<tr>
<td>User Needs &amp; Problem Definition</td>
<td>4%</td>
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<tr>
<td>Design Inputs: Requirements &amp; Specifications</td>
<td>4%</td>
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<td>Validation &amp; Verification Plan</td>
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<th>Computational Assignments = 34%</th>
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<tr>
<td>Solidworks 1</td>
<td>6%</td>
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<td>Solidworks 2</td>
<td>6%</td>
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<td>Solidworks 3</td>
<td>6%</td>
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<td>COMSOL 1 (tutorial 2)</td>
<td>8%</td>
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<td>COMSOL 2 (tutorial 3)</td>
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<th>Design Deliverables = 40%</th>
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<td>Preliminary Design Review (PDR)</td>
<td>10%</td>
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<td>Final Design Review (FDR)</td>
<td>15%</td>
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<td>Final Design History File (Report)</td>
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<th>Peer Evaluation = 10%</th>
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<td>PDR Peer Eval</td>
<td>5%</td>
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<tr>
<td>FDR Peer Eval</td>
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Policies and Statements

Communication
For questions relating to general course material or assignments, please post on Piazza – you will achieve the fastest answer in this manner, and your classmates will benefit as well. We reserve the right to ask that questions sent over email be posted first on Piazza before a response is given such that the whole class can benefit. Exceptions to this policy include questions pertaining to the design projects (communicated individually with the project advisor) and matters that are private or individual, relating to course progress, advising, any difficulties or challenges, etc. (communicated individually with the instructors).
Deadlines and Regrades
Deadlines for all deliverables are available in the provided Course Schedule and also on Canvas. There will be a 15-minute grace period for late assignment submissions, after which a 20% deduction per day late will be in effect. If you have a foreseeable conflict with a deadline, or a deadline conflicts with a religious observance (please see university policy here), please reach out to the instructors at least two weeks in advance for alternate arrangements. Emergency matters will be handled on an individual basis.

Questions about grading or requests for a re-grade are permitted but must be submitted no more than one week after the release of grades.

Academic Integrity
Students in this course are bound by the College of Engineering Honor Code. Details of the Honor Code can be found here, and particular applications to assignments in this course are listed below. Any suspected violations of the Honor Code will be sent to the Honor Council.

- For individual (software) assignments: You may discuss approaches, concepts, and strategies with other students, but the code, inputs, and outputs must be your own work.
- For group assignments: These are to be done collaboratively within your group, receiving help or advice only from the instructional team as needed.

Accommodations for Students with Disabilities
As of this semester, the Services for Students with Disabilities Office has changed the process by which accommodations are processed and reported. Within the first week of the term, the teaching team will confirm with you via email any accommodations that we have on file for you; if you do not get this email but require an accommodation, please let us know immediately. Any information that you provide is confidential and will be treated as such.

Mental Health and Well-Being
It is critical to acknowledge and address the many stressors that can affect not only your performance in a class but also your general well-being. Maintaining your health is of paramount importance, far superseding the academic content of this course, and we encourage any student who is struggling to seek support with these matters rather than trying to navigate them alone. Please let us know if we can discuss any academic matters contributing to or resulting from such challenges or help connect you with relevant resources, such as the C.A.R.E. Center or CAPS, which stand ready to offer help and support.

Flexibility
All statements and policies in this syllabus and otherwise present (e.g. on the course Canvas) are subject to change; such changes will be communicated class-wide and updated documentation will be made available as needed.

Religious Observances
The University of Michigan, as an institution, does not observe religious holidays. However, every reasonable effort will be made to help students avoid negative academic consequences when their religious obligations conflict with academic requirements. If you find that a presentation or assignment due date conflicts with a religious observance, it is your obligation to let the instructors know at least 2 weeks in advance of the conflict. You will be given every opportunity to make up the work without penalty unless it interferes unreasonably with course delivery. Read the University's full policy here:

https://www.provost.umich.edu/calendar/religious_holidays20-21.html