

BME 590: FUNDAMENTALS OF ENGINEERING DESIGN

Course Objectives, Grading Policy and Course Syllabus

Fall 2017

Lecture: Tues/Thurs 11:45am-1:00pm
Hudson Hall 208

Lab M, 4:40-7:40pm Hudson Hall 212

Professors: Chelsea Salinas, Ph.D.
1153 CIEMAS
Chelsea.salinas@duke.edu

Robert Malkin, Ph.D.
201 North Building
robert.malkin@duke.edu

Mark Palmeri, Ph.D., M.D.
Hudson Hall Annex Rm 258
mark.palmeri@duke.edu

TAs: Muath Bishawi (muath.bishawi@duke.edu), Zachary Steelman
(Zachary.steelman@duke.edu), Garren Angacian (garren.angacian@duke.edu)

Course Goal: The introduction of formal engineering design principles will be emphasized; overview of assistive technologies, patent issues, engineering ethics. Students are expected to identify and research a need drawn from Duke hospital/medical personnel, local companies and organizations around Duke University. Students will develop and determine design feasibility for a device, system, material, or process, subject to real-world constraints such as time, money, and resources. Students should also be able to communicate objectives in writing and presentations. **Co-reqs:** BME354L

Course Outcomes: Upon completion of the course, students should be able to:

1. Successfully develop a prototype to solve a client-based design challenge through following engineering design steps: a) define client's need/space, b) investigate current designs/challenges and solutions, c) generate design criteria, d) brainstorm solutions for your client, e) evaluate and prioritize ideas via matrix selection, f) prototype and build physical solution
2. Work collaboratively on an engineering team to complete design project.
3. Work collaboratively on an engineering team to write technical documents and present oral/visual technical reports.
4. Work safely in space allotted.

Course Organization: Students are organized into teams of 3-4 persons to design a device, system, material, process, or method. Class time will be used in a variety of ways including short lectures, in-class exercises, team meetings, writer's workshops and team presentations. Active engagement is expected of all students. Day-to-day design team work is carried out in the classroom, approved lab space or undergrad machine shop, under the supervision of the instructors and selected TAs where required. There are project deadlines, with documents to

be submitted and presentations to be made, in order for planning, monitoring, trouble-shooting and/or reporting purposes. By the end of the fall semester, a Gantt chart or gitlab will be updated every week in order to track your progress and milestones. Periodically throughout the semester, student groups will also present to the professors and their classmates.

Student Design Teams: Student teams will be formed based upon student interest and skills. Students will work in their design teams for the entire year (Fall and Spring semesters), therefore completion of the project preference form is expected to show student commitment to the class for the entire academic year. Active, productive engagement is expected of all students. Design team meetings will occur during class, and as such, attendance at each class period is highly recommended. *Design teams are also required to meet outside of class.* Each member of the design team is to contribute equally to the project. Contributions may vary from week to week, but effort should be comparable. Team responsibilities should be shared. Peer evaluations will be conducted three times over the course of the Fall semester using the online CATME system.

Textbooks & Website:

- No textbook. Relevant readings assigned by professors and/or identified by students.
- Sakai site for the course contains: documents, templates, slides, resources.
- Sakai site is also where documents & assignments will be submitted by each team.

Course Meetings:

- Lectures and in-class activities: as per schedule attached
- Course Modules will couple the lecture portion of the course to provide hands-on training in each major design areas:
 - Machined materials (machine shop training required)
 - CAD design (SolidWorks) and 3D printing
 - Microcontroller Design
 - Electronic Design Automation (EDA) (Altium Designer) for PCB layout and fabrication
 - Version control software (git)
- Students will generally be working on projects in the classroom, BME approved lab space or offsite. If need be, students can also work in the Pratt machine shop, under supervision of the authorized personnel for that facility. **Note that in order to work in the machine shop, all students MUST undergo proper training. All training must be completed and proof of training submitted to the professors on or before 9/22.**
- Meeting of student groups with professor is required outside of class time.
- One mid semester and one end of semester presentation to peers, TAs and professors

Requirements:

- Each student must follow announcements and documents posted on Sakai.
- Each student is expected to work 10 hours per week on the project and related activities.
- All documents must be submitted on time; assignments are due as outlined in schedule.
- All students are required to take part in student machine shop safety training and IRB safety training Proof of training must be submitted to professors by **9/22**.
- All students are to adhere to the lab/shop policies laid out in the training. If it is determined that any one student does not follow the guidelines, he/she may receive up to a 15% deduction in the final grade.
- Any and all lab materials borrowed from the BME approved lab that are not returned by the end of semester will result in a grade of incomplete until said items are returned.
- Design teams are required to meet with Dr. Salinas for briefing once a week.
- Design teams are required to meet with faculty mentors **4x/** semester
- It is highly recommended that **all** group members participate in meetings with professors.
- All group members must be present at the end of semester presentation session.
- Student teams must maintain an active Group Site within gitlab and Sakai, with the required and any additional team documents.

Grading: Grading is based upon the quality of the work put forth by each student, the degree to which the student works toward development of a feasible design, and the completion of a final prototype/mock design. It is also based on the quality of assignments, presentations, the level of communication with the professor, and the professors' evaluation of project satisfaction and each student's contribution to the team. Finally, timely posting of assignments and reports will be considered in the grade. A breakdown is provided below:

Assignments	% of Final Grade
Written reports	30%
First prototype demo/project pitch (Oral I)	10%
Final design & prototype demonstration (Oral II)	15%
Team participation (CATME evals)	10%
Completion of videos and quizzes	5%
Faculty mentor and team briefings	5%
Completion of modules	15%
Quality of final prototype and report	10%

Written reports are submitted individually (unless otherwise noted), and graded as such, with the exception of the final paper (to be delivered with your final presentation). The final paper is a group document and compilation of the individual written reports over the semester.

Oral presentations will occur twice during the semester. While not every member may need to speak, team members can participate in the presentation through demonstration of prototype. Presentations will be graded as 10 and 15% respectively. Quality of the final prototype will be graded upon the meeting of design criteria and proper evaluation (10%).

Team participation evaluations are conducted three times per semester. Individual team participation grades will be based upon contribution, peer evaluation, instructor evaluation, self-evaluation, attendance, etc. The instructor will determine the overall individual team participation grade.

Videos and quizzes will be assigned throughout the semester. Students are expected to complete these assignments, individually to receive full credit.

Teams are expected to meet with their instructor 10 times (i.e. weekly) during the semester for team briefings. In addition, teams are required to meet with their faculty mentors **4 times** during the semester. Not all members need be present at each meeting, but each member must attend 1/2 of the required meetings.

Module assignments will be presented during weekly lab periods. Students are given TA and instructor support during scheduled lab time. Students are welcome to work on modules outside of lab time to ensure completion of the assignment. Modules are individual assignments created to improve technical skills needed for a broad range of design projects.

Course Deliverables:

- Statement of project goals
- Introduction and background research
- Clinical/FDA, ethical and IP project research
- Standards
- Safety analysis
- Project Illustration
- Proof of feasibility (identification of evaluative testing)
- First round prototype

Class policies:

- If you cannot turn in an assignment on time, because of ***illness only***, you need to notify the instructor and the TA prior to the deadline via the web-based short-term illness notification form, posted at <http://www.aas.duke.edu/trinity/t-reqs/illness/>. The online form will automatically send emails to the instructor and the academic dean. If you are extremely sick and cannot fill the form prior to the deadline, you must submit a letter from your doctor within a week. We can then discuss the options for postponement.
- If you think that there are mistakes in grading your quizzes, reports, or other materials, you need to contact me within 10 days after you receive the grades. **No corrections** will be made after this period.
- You can discuss the module assignments, writing components and quiz material, but should finish all assignments independently, unless otherwise noted.
- Any cheating discovered during the semester will be reported to the Dean's office; and sanctions to be imposed range from zero credit for the cheated work, failing the

course, to being suspended from the University, depending on the severity of the problem.

- Duke Community Standard Pledge:

1. I will not lie, cheat, or steal in my academic endeavors, nor will I accept the actions of those who do.
2. I will conduct myself responsibly and honorably in all my activities as a Duke student.

COURSE SUPPORT

Faculty and TA Support:

Instructors for the course will serve to support teams in and out of the classroom. TAs for this course were specifically chosen for their design skillset. All the instructor/faculty mentors and TAs are experienced with engineering design and serve as a great resource for any challenge. They are dedicated to helping your team generate a good design solution.

Writing Support:

Two in-class writing workshops are included on the course schedule. Writing effectively will be a large component of the course, therefore, individual writing support will be available through the Writing Studio throughout the entire course. Students will be required to schedule writing appointments with a mentor at least twice during the semester.