MEC ENG 102B

Mechatronics Design

Fall 2019 (4 units)

Course Objectives: This class introduces students to design techniques for mechatronics systems; provides guidelines to and experience with design of variety of sensors and actuators; provides experience in programming microcomputers and various IO devices; exposes students to the synthesis of mechanical power transfer components; develops an understanding of dynamics and kinematics in robotic systems; exposes students to design experiences in synthesis of feedback systems; provides experience in working in a team to design a prototype mechatronics device.

Prerequisites:
E 25/26/27 (junior transfers students are exempt from this requirement), as well as EE 16A or EE 40

We will be using bCourses for the course website, *https://bcourses.berkeley.edu/*. All technical questions should be asked in person in office hours or on bcourses discussion boards. Emails are for logistical and emergency correspondence only.

Instructor Professor Hannah Stuart (hstuart@berkeley.edu)
Office Hours: Wed 10-11:30am, 5138 Etcheverry Hall

GSI Sareum Kim (sareum@berkeley.edu), Office Hours: Tue 11-2, Mon 3:30-5
Wilson Torres (wilson_torres@berkeley.edu), Office Hours: Mon 11-3:30

Staff Tom Clark (510-435-0357, tomclark@berkeley.edu)
9a-4p daily (as available), in 31 Hesse (shop)
Student Machine Shop staff (e.g., Scott McCormick)
See shop hours, in 1166 Etcheverry Hall

Schedule

Lecture:	Mon, Wed 9:00-9:59a	Kroeber 160
Labs:	101, M 11:00a-1:59p	Hesse 50A
	102, M 2:00p-4:59p	Hesse 50A
	103, Tu 11:00a-1:59p	Hesse 50A

Availability for lectures, laboratories, exams and project presentations is required. Please see the teaching team for accommodation of religious beliefs, disabilities, and other special circumstances before the end of the second week of classes for any foreseeable issues. Otherwise, your absence may affect your grade.

Course Materials:

- C.R. Mischke and J.E. Shigley, "Mechanical Engineering Design," 11th edition. (Recommended)
- Carryer, Ohline and Kenny, "Introduction to Mechatronic Design." (Recommended)

Scoring:

15%	HOMEWORK & LABS	55%	GROUP PROJECT
3%	Homework #1	3%	Early project progress
4%	Homework #2	10%	Project Design Review I
3%	Homework #3	10%	Project Design Review II
4%	Labs	10%	Functionality check-in
1%	Shop safety training	12%	Demo Day score
30%	EXAM	10%	Report

Homework: Homework must be submitted online via bourses by the deadline specified. Submit a single file in PDF format. Your solutions can be hand-written (pen recommended) as long as they're legible once scanned. If your solutions are illegible, you may lose points on the assignment that cannot be made-up. Late assignments will have the graded score multiplied by a factor of 0.9 (24 hours late), 0.75 (24 to 72 hours late). Assignments will not be accepted after 72 hours (3 days) from the original deadline time.

Labs: There are no lab reports. Labs must be checked-off by a GSI during lab hours to get credit. Only the lab team members present will receive credit. If the teaching staff has reason to believe that you did not participate in the lab assignment, you may lose credit. You may take the hardware home to finish any lab on your own time, in which case you must demonstrate the lab working at the next lab section. Labs can only be checked-off for credit by the end of lab sections during the 8th week of the semester.

Exam: The exam can include questions that cover all materials from the course up until the time of the exam. Students will have the option to re-take the exam during the final week of classes:
(1) your re-take score will replace your prior score, even if it is lower that the results of the first exam.
(2) the questions will be new, and can cover all materials from the course (it is more comprehensive).

Project: There will be one hands-on project illustrating various aspects of mechanical engineering design and integration. These projects help you gain a deeper understanding of mechanical design, develop critical thinking and practice working in a team. Ideally, this provides invaluable experiences to prepare you for a changing industrial world. Modern mechanical design may have electronics or computer as part of the control mechanism. Therefore, students must have a project that involves both electronics and mechanical design. More detailed requirements will be published later in the semester.

You will self-organize into groups of 4-5 students. Choose a team from your lab section, or ensure that all teammates can attend one section for design reviews. We provide a forum on bcourses to facilitate team-making, and encourage everyone to participate. The teaching staff reserves the right to add students to existing teams, or move students to another team. Recommended: have a mix of skills represented in your group. *Participation and Peer-evaluations:* Participation is central to this class. Therefore, you may receive a 0% for a Project Design Review or Laboratory that you miss without prior instructor approval. Peer-evaluations will be performed for each project. You will evaluate yourself, as well as peers in your team and other groups. These evaluations will be factored into your grade. No display of activity on your project can result in individual project grade reductions of up to 100%, in the most extreme cases.

Machine Shop and Jacobs Maker Space access: This class requires training in the machine shop (1166 Etcheverry Hall), even if you do not plan to use this resource for your project. To receive this training, you must sign-up at the machine shop. It is your responsibility to ensure that you are trained before available sessions end mid-way through the semester to receive credit. Do this early, as sessions fill quickly, and requires a full day of time commitment. You can also get a Jacobs Hall Makers Pass to gain access to the equipment within Jacobs Hall. In order to use this equipment you will need to take (and pass) the safety requirements. http://jacobsinstitute.berkeley.edu/our-space/makerpass/get-maker-pass/

Academic Honesty and Integrity: The student community at UC Berkeley has adopted the following Honor Code: "As a member of the UC Berkeley community, I act with honesty, integrity, and respect for others." For homework assignments in this class, you are allowed (and encouraged!) to *discuss* the problems and techniques with other students currently in this course, but each student must do his or her own version of the solution *from scratch.* Cheating on the exam may result in a failing grade for the entire course. In all cases, your actions will be reported to the Center for Student Conduct.

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WEEKLY AGENDA:

Week	Lecture schedule	Lab schedule / Due Dates
Week 1 8/26/19	~~M: No class~~ W: Logistics, Project introduction	N/A
Week 2 9/2/19	~~M: No class~~ W: Review of circuits and semiconductors	GSI office hours (W only) **Due: Team formation (W)**
Week 3 9/9/19	M: Intro to microprocessors W: Electromechanical motors I	**Lab1: Setting up** **Due: Project ideation (W)** **HW1: Circuits refresher (Sun)**
Week 4 9/16/19	M: Feedback control of a DC motor W: Switches & software design	**Lab2: Input and output with the Teensy** **Due: Design specs / concept selection (W)** **HW2: DC motor selection and control (Sun)**
Week 5 9/23/19	M: Shafts & bearings W: Linkages, prismatic joints	**Lab3: DC Motor Control**
Week 6 9/30/19	M: Gear transmissions W: Transmission efficiency	**Design Review I** (lab slots)
Week 7 10/7/19	M: Electromechanical motors II W: Flexible transmissions	**Lab 4: RC Servos and Stepper Motors** **HW3: Transmissions (Sun)**
Week 8 10/14/19	M: Holes, fasteners and locating features W*: Guest Lecture	GSI office hours
Week 9 10/21/19	M: Springs and living hinges W: Sensors, A/D Converters	**Design Review II** (lab slots)
Week 10 10/28/19	M: Power supplies and noise W: Interrupts and timers	GSI office hours
Week 11 11/4/19	M*: Guest Lecture W*: **Exam**	GSI office hours
Week 12 11/11/19	~~M: No class~~ W: Friction drives, clutches and brakes	GSI office hours (W only)
Week 13 11/18/19	M: Adhesives and lubricants W: Pneumatics and hydraulics	**Functionality check-in** (lab slots)
Week 14 11/25/19	M: Communication for inventors ~~W: No class~~	GSI office hours (M only)
Week 15 12/2/19	M: **Exam makeup (optional)** W: Project assistance **FRIDAY 12/6, DEMO DAY** **3p-6p in 310 Jacobs** **Setup at 2:30p, teardown until 6:30p**	GSI office hours

* Professor Stuart is traveling for a robotics conference.

This syllabus is a guide and every attempt is made to provide an accurate overview of the course. However, circumstances and events may make it necessary for the instructors to modify the syllabus during the semester and may depend, in part, on the progress, needs, and experiences of the students. Changes to the syllabus will be made with notice to the students in the course.