

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 correspondences only.

**Instructor**                      Professor Hannah Stuart ([hstuart@berkeley.edu](mailto:hstuart@berkeley.edu) )  
Office Hours:  
Wed 10:00-10:15 at classroom, 10:30-11:30am, 5138 Etcheverry Hall

**GSI**                                      Sareum Kim ([sareum@berkeley.edu](mailto:sareum@berkeley.edu) ), Office Hours: M 11-12:30, Tu 11-2  
Wilson Torres ([wilson\\_torres@berkeley.edu](mailto:wilson_torres@berkeley.edu) ), Office Hours: M 12:30-5

**Staff**                                      Tom Clark (510-435-0357, [tomclark@berkeley.edu](mailto: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

<b><u>Schedule</u></b>	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:** Lecture notes will be provided.

- 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

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**WEEKLY AGENDA:**

Week	Lecture schedule	Lab schedule / Due Dates
Week 1 8/26/19	<del>M: No class</del> W: Logistics, Project introduction	N/A
Week 2 9/2/19	<del>M: No class</del> W: Circuits refresher, Semiconductors	GSI office hours (T only) <b>Due: Team formation (W)</b>
Week 3 9/9/19	M: MOSFETS, Microprocessors W: Electromechanical motors I	<b>Lab1: Setting up</b> <b>Due: Project ideation (W)</b> <b>HW1: Circuits refresher (Sun)</b>
Week 4 9/16/19	M: Feedback control of a DC motor W: Microcontroller peripherals	<b>Lab2: Input and output with the Teensy</b> <b>Project check-in (F)</b> <b>Due: Concept selection (Sun)</b> <b>HW2: DC motor selection and control (Sun)</b>
Week 5 9/23/19	M: Shafts & bearings I W: Shafts & bearings II	<b>Lab3: DC Motor Control</b>
Week 6 9/30/19	M: Gear I transmissions W: Gears II, linear motion	<b>Design Review I</b> (lab slots)
Week 7 10/7/19	M: Motors II, Power Screws <del>W: Class canceled (PG&amp;E Power Outage)</del>	<b>Lab 4: Stepper Motors</b> <b>HW3: Transmissions (Sun)</b>
Week 8 10/14/19	M: Linkages, living hinges W*: Guest Lecture: Liwei Lin, Fasteners	GSI office hours
Week 9 10/21/19	M: Flexible transmissions I W: Flexible transmissions II	<b>Design Review II</b> (lab slots)
Week 10 10/28/19	<del>M: Class canceled (PG&amp;E Power Outage)</del> W: Embed. Sys. Prog., Review for exam	<b>Lab 5 (optional): DC motor control, RC Servos</b> <b>HW4 (optional): Practice problems (Sun)</b>
Week 11 11/4/19	M*: Guest Lecture W*: <b>Exam</b>	GSI office hours
Week 12 11/11/19	<del>M: No class</del> W: Sensors	GSI office hours (T and F only)
Week 13 11/18/19	M: Power supplies, noise & efficiency Pneumatics and hydraulics W: Communication for inventors	<b>Functionality check-in</b> (lab slots)
Week 14 11/25/19	M: Clutches and brakes, Adhesives <del>W: No class</del>	GSI office hours (M and T only)
Week 15 12/2/19	M: <b>Exam makeup (optional)</b> W: Project assistance <b>FRIDAY 12/6, DEMO DAY</b> <b>3p-6p in 310 Jacobs</b> <b>Setup at 2:30p, teardown until 6:30p</b>	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.*

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**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.

**Homework:** Homework must be submitted online via bCourses 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) or 0.75 (24 to 72 hours late). Assignments may be submitted more than 72 hours after the original deadline time for 50% credit. No homework assignments will be accepted after the first exam of the semester.

**Labs:** SAFETY GLASSES REQUIRED. There are no lab reports. Labs must be checked-off by a GSI during lab hours to get credit. If the teaching staff has reason to believe that you did not participate in the lab assignment (e.g. you are not attending lab), you may lose credit. We will not allow you to take laboratory hardware home with you. Instead, once you get key-card access, you can enter Hesse 50A to complete the lab on your own time after the lab sections are done. In this case, you must demonstrate the lab working at the following lab section (within one week).

**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 than the results of the first exam.
- (2) the questions will be new, and can cover all materials from the course (it is 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. *Participation and Peer-evaluations:* Participation is central to this class. Therefore, you may receive a 0% for a Project Design Review 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. *Project costs:* project costs are typically paid by students out-of-pocket – this allows them to keep their project after the semester is done. If project expenditures are a financial hardship, please communicate with Prof. Stuart early to explore alternative options.

**Machine Shop access and Jacobs Makerpass:** 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 via the link: <https://me.berkeley.edu/resources/student-machine-shop/shop->

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[training/training-request-form/](#). You will first need to complete an online training, then an in-person training session. 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. We will use the Student Machine Shop trainee data to assign grades, so make sure you are recorded correctly in their system. If you already have access to the Student Machine Shop (e.g. you have already completed safety training) you do not need to take it again.

You can also get a Jacobs Hall Makerpass to gain access to the equipment, like 3d printers, 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/>. The cost for an individual, non-research Maker Pass is \$100 per semester (regardless of whether students are getting the Maker Pass through their affiliated class, or through general registration). Both full and partial fee waivers available for students with financial need, based on their financial aid packages.

**Software access:** Students in this class can access CAD software (Solidworks or Autodesk) via CAD Labs: 1171 Etcheverry Hall and 10 Jacobs Hall. The CAD Labs are open during Monday - Friday: 7am-7pm in 1171 Etcheverry Hall, 8:30am - 7pm in 10 Jacobs Hall. You can request cardkey access to enabled for off hours at <http://apps.me.berkeley.edu/accounttool> with a \$5 activation fee. Remember that scheduled classes have priority during open hours. You can alternatively download this software to your personal computer. See <https://software.berkeley.edu/home> for Autodesk downloads or visit [https://www.solidworks.com/sw/education/SDL\\_form.html](https://www.solidworks.com/sw/education/SDL_form.html) for Solidworks (information regarding the version and activation serial number will be provided in class or via a class announcement).

**Student support resources:** Safety and well-being are a priority for all students. If you ever have a mental health crises, or just a concern, please reach out to the Berkeley [Counseling and Psychological Services \(CAPS\)](#) immediately in the Tang Center (2222 Bancroft Way #4300). Please note that **responsible employees** are individuals who must report incidents of sexual violence and/or harassment to the Office for the Prevention of Harassment and Discrimination (OPHD). If you confide in a responsible employee, such as the teaching team, they *must* notify OPHD and may reveal details about you and/or the perpetrator. Many university officials are considered responsible employees including academic advisers, administrators, athletic coaches, GSIs, professors, resident advisors, supervisors, managers, and more. If you are concerned about maintaining confidentiality, please use confidential resources, such as [PATH to Care Center](#) or [UHS Social Services](#).