MEC ENG 102B V.2
Class #: 28998 Published
Mechatronics Design
Spring 2025 (4 units)

Course Objectives

This class introduces students to design techniques for mechatronics systems; provides guidelines to and experience with design of a variety of actuators; provides experience in programming microcomputers for smart products; exposes students to the synthesis of mechanical power transfer components with relevant engineering standards; develops an understanding of dynamics and kinematics in robotic systems; exposes students to design experiences in synthesis of feedback systems; provides experience prototyping mechatronics devices collaboratively.

Teaching team

Email questions and requests to the instruction team at: me102b@lists.berkeley.edu

Professor Lining Yao Office Hours: Friday 10:00-11:00a, Etcheverry 5128 or Zoom (To schedule for both in person or online: https://calendly.com/liningy/me102b) liningy@berkeley.edu	**GSI Kathy Min** (20 hr) **Lab 101 & 104** Office hours: Wed, 10-11am, Hesse 50A songheemin@berkeley.edu
Tom Clark, Staff Cell: 510-435-0357 tomclark@berkeley.edu *See Tom about missing or broken kit parts.*	**GSI Evan Daniel Kaplan** (20 hr) **Lab 102 & 103** Office hours: Thursday 1-2pm, Hesse 50A evankaplan02@berkeley.edu
	GSI Pierre-Louis Soulie (10 hr) **Lab 105** Office hours: Thursday, 10-11am, Hesse 50A pierrelouis.soulie@berkeley.edu
ME Machine Shop staff! meshops-me@berkeley.edu Shop access strongly recommended for all.	

Prerequisites

E 25/26/27 OR E 29 (except junior transfers), as well as ME100 (in the past EE 16A or EE 40).

Schedule

Lectures: Hearst Mining 390

MW 9:00 am-9:59 am

All lectures will be delivered synchronously and in-person – live attendance is expected. Lectures will be recorded for later review.

Lab sections: *Hesse 50A*

(#101 **M 11:00 am-1:59 pm,** #102 **M 2:00 pm-4:59 pm,** #103 **Tu 11:00 am-1:59 pm,** #104 **Tu 2:00 pm-4:59 pm,** #105 **W 11:00 am-1:59 pm)**

In-person attendance at your assigned laboratory session is required.

Communications

We will be using bCourses for the course website: *https://bcourses.berkeley.edu/* We encourage you to use bcourses discussion boards for both technical and general course questions, so other classmates can receive the same information. If you email about technical or general questions, you will likely be reminded to participate through bcourses discussion boards. For individual matters, please email instruction team at me102b@lists.berkeley.edu

Course Materials

Lecture slides will be provided. Highly recommended supplementary reading (optional):

- Keith Nisbett and Richard Budynas, "Shigley's Mechanical Engineering Design, 2024 Release or 11th edition.
- Carryer, Ohline and Kenny, "Introduction to Mechatronic Design."

A required lab kit will enable you to perform hands-on assignments in the lab. You should have received it in a prior semester in ME100 and/or ME103. See Tom Clark in the first week of class if you have not received this kit. Specific broken parts needed for lab activities can be replaced as needed throughout the semester. More information about the lab kit can be found at *https://microkit.berkeley.edu/.*

You will need to use the Arduino IDE as well as a CAD software package. See *https://software.berkeley.edu/home* and *https://microkit.berkeley.edu/* for more information. Download software to your personal computer or use departmental computers. (There are computers in Hesse 50A!) If you are unable to access these resources, notify the teaching team within the first week of class.

Assessment & scoring

This semester, we are basing 32% of your grade on laboratory assignments. These are designed to dovetail directly into project requirements. 68% is based on the term project itself.

32% Laboratory assignments. These are designed for the median student to complete in ~3 hours while working intensely with GSI and peer support in the lab section. You can take additional time outside of the assigned laboratory time (see Deadlines). You will need to perform in-person checkoffs during your scheduled lab period. Lab assignments 2-8 should be conducted and submitted in student teams (three students in one team). These teams will be assigned during the first lab session by the GSIs. Note, Lab 1 is an individual assignment. In-person attendance of your assigned laboratory section is required and will be recorded. You can miss up to 2 lab sections without it impacting your grade. However, any additional absences will result in that lab's grade being docked 20%.

4% Lab 1: Microcontroller I/O setup (only individual lab)
4% Lab 2: Driving a DC motor
4% Lab 3: Mechanical Transmissions I
4% Lab 4: Mechanical Transmissions II
4% Lab 5: DC motor feedback control I
4% Lab 6: DC motor feedback control II
4% Lab 7: Embedded Design I
4% Lab 8: Embedded Design II

68% Projects will be performed in groups with 5 people. Teammates have to be in the same lab section. Teams with 6 or 4 people will be considered on a case-by-case basis. You are welcome to form your own teams, and the teaching team will additionally help facilitate teaming between classmates.

You will be *assessed on the demonstration of advanced mechatronics skills developed in this course* and you are expected to produce a high-quality physical prototype. Requirements and assessment will be published in a separate document. Peer- and self-evaluations will be performed for each project at the end of the semester. These evaluations may be factored into your grade; little or no display of activity on your project can result in individual project grade reductions of up to 100%.

18% Project Assignments: P1 (5%); P2 (20%); P3 (15%); P4 (20%); P5 (20%); P6 (20%)
20% End-of-term deliverables (e.g. report, video, showcase)
30% Does your machine work? Final *live* functionality demonstration with the teaching team.

Deadlines and submitting work

Lab assignments are due prior to the start of your next registered lab section that is often in the following week. i.e. if your section starts at 11a M, your assignment is due at 10:59a M the following week. Project deadlines vary. When submitting work, it must be in the format specified in the instructions. We will be using bcourses for submitting work this semester, and other hard/soft copies will not be accepted. We seek to give you feedback on assignments quickly, however a solution manual will not be provided. It is your

responsibility to follow- up on misunderstandings with the teaching team to grasp the underlying concepts more deeply.

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<u>TENTATIVE</u> WEEKLY AGENDA (subject to change):

Week	Monday 9:10-10a	Wednesday 9:10-10a	Lab activity	Project
Week 1 1/20	No class	What is mechatronics design?	--	--
Week 2 1/27	2. Motors I	3. Motors II	Lab 1: I/O setup	**P1** Team
Week 3 2/3	4. Motors III	5. Project Ideation	Lab 2: DC motor setup	**P2** Pitch
Week 4 2/10	6. Motors IV	7. Bearings	Project idea critic on **P2** Pitch	
Week 5 2/17	No class (holiday)	8. Gears I	--	--
Week 6 2/24	9. Gears II	10. Flexible Drives I	Lab 3: Transmission System	--
Week 7 3/3	11. Flexible Drives II + Lead Screws	12. Linkages	Lab 4: Transmission Design	**P3** CAD
Week 8 3/10	13. Motor control I	14. Other Actuators I	Lab 5: Motor feedback control I	
Week 9 3/17	Shop consultations	15. Other Actuators II	Shop consultations	**P4** Consult
Week 10 3/24	No Class (recess)	No Class (recess)	--	--
Week 11 3/31	16. Motor control II	17. Fasteners & Compliant Mechanisms	Lab 6: Motor feedback control II	**P5** Specs
Week 12 4/7	18. Embedded Prog. I	19. Embedded Prog. II	Lab 7: Embedded Programming I	--
Week 13 4/14	20. Embedded Prog. III	21. Safety & Ethics (+ Maker Grant Q&A)	Lab 8: Embedded Programming II	**P6** Software
Week 14 4/21	Project assistance (or guest lecture)	Project assistance (or guest lecture)	Project assistance	--
Week 15 4/28	Project assistance	Project assistance	Functionality Evaluations (30% of your overall grade)	**Function Tests**
Week 16 5/5	RRR week **Project Showcase!** 5/8 Thu: 4-5:30 pm in Jacobs Hall Room 310		--	
Week 17 5/12	Finals week		Final project deliverables due 5/16 @ 11:59pm Self/Peer Assessment due 5/16 @ 11:59pm	

This schedule 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 depending on the progress, needs, and experiences of students. Changes to the syllabus will be made with notice to the students in the course, and bcourse assignment details will be made to match new deadlines.

Accommodations

Late policy When an assignment allows for late submission, the policy will typically be: minus 10% for up to 24 hours late, minus another 10% (80% max grade) for 24 to 72 hours late, and 0% after 72 hours. Some assignments, like presentations are not eligible for this late policy. In this case, or if over 72 hours, you can request the *Makeup policy*. *Project deliverables cannot be submitted late.*

Makeup policy (including extension requests) For you to be eligible, *the Makeup policy must be requested as soon as it is known that it will be needed*. For example, if you are unable to complete an assignment by 72 hours after the initial deadline, you must request the makeup policy before or immediately as the 72 hours passes.

- Do NOT request the Makeup policy (including short term extension requests) via email! The notification must instead be submitted at this link: https://forms.gle/iNwEtqnRneBmFob86 to generate a record of notification with a time stamp that the who teaching team can access.
- If approved for a Makeup assignment, you will be subject to new deadlines, after which your work will no longer be accepted. Makeup or extended assignments are not eligible for late policy.
- The goal of this Makeup policy is to evaluate your demonstrated skill in the course. Therefore, an alternative assessment may include new or expanded requirements, substituted or modified from the original assignment, or even new requirements on future assignments to demonstrate a particular skillset. This is at the discretion of the instructor.
- The use of the Makeup policy means that your assignment grade, or even your overall grade in the class in extreme cases, may be assessed holistically and no longer adhere to the same points- based system as your peers. It is therefore critical to speak openly with the instructor to fully understand what is expected of you, how you are performing, and whether you are making adequate progress.

Special Accommodations The purpose of academic accommodations is to ensure that all students have a fair chance at academic success. If you have Letters of Accommodations from the Disabled Students' Program or another authorized office, please share them with me as soon as possible, and we will work out the necessary arrangements. While individual circumstances can vary, requests for accommodations often fall into the categories listed on the Academic Calendar and Accommodations website. The campus has well-developed processes in place for students to request accommodations, and you are encouraged to contact the relevant campus offices listed on the Academic Accommodations Hub. These offices, some of which are confidential, can offer support, answer questions about your eligibility and rights, and request accommodations on your behalf, while maintaining your privacy.

Disability, or hardships such as basic needs insecurity, uncertain documentation and immigration status, medical and mental health concerns, significant familial distress, and experiencing sexual violence or harassment, can affect a student's ability to satisfy particular course requirements. Students have the right to accommodations and supportive measures and to resources, without having to disclose personal information to instructors.

For any foreseeable conflicts with the class, you must request special accommodation before the end of the second week of classes. Note that DSP accommodations will be applied as the need arises, and the student should request accommodation as it is needed. In the case of unforeseeable conflicts with the class, you should notify the teaching team within 1 week of when the issue first arises.

All lectures will be recorded and captioned. Instructors may insert short video or animation clips inside the lecture slides, and those embedded videos do not have any sound, and instead they will be used as tools to describe or augment the teaching contents.

COVID-19 considerations We will follow all campus guidelines throughout the semester. Masking is encouraged, both in lectures and labs. If you have COVID, you will qualify for Special Accommodation but you must still notify the teaching team as soon as you know you will need special accommodation.

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 assignments in this class:

- You are allowed (and encouraged!) to discuss the problems and techniques with other students currently in this course.
- Each student or laboratory group must perform their own version of the solution from scratch using their own hardware. We will specify in assignments whether you must perform a task alone or if it's ok to submit shared work within a group.
- Do not send your solution files to other students or give someone else your working circuit or mechanism. You can borrow a single part (e.g. the microcontroller) from a peer if yours is broken, but do not borrow fully assembled/working circuits or hardware.
- Posting or accessing solutions online is considered academic misconduct.

For infractions, your actions will affect your assignment and/or course grade and may also be reported to the Center for Student Conduct for administrative review.

Project realization resources

There are several resources available to help you realize your project vision:

1) The ASME student chapter at UC Berkeley runs a Maker Grant program. Their aim is to allow students to request funding to support projects. We will provide you with more information in the class as available.
2) You will have access to the ME student machine shop this semester for the class project. This is highly encouraged for all students. You must follow all safety trainings to be eligible. You can also use the Jacobs Institute MakerPass system for realizing projects (fee waivers available upon application).
3) Speak to Tom and the GSIs about your project vision to see if Tom has any parts you can borrow from our stockpile, such as motors (that tend to be expensive). This can also be a learning process in which you can consult and get critical feedback on your ideas – do this early!
4) This class will help you develop your skills and knowledge to design machine prototypes *without* purchasing the most expensive components. This is a skill useful when designing for scale. You will learn in this class why *cost is often not correlated with component suitability or even quality!* Please ask the teaching team if there is a more economical way to achieve your vision.

Class values

Inclusion We are committed to creating a learning environment welcoming of all students that supports a diversity of thoughts, perspectives and experiences, and respects your identities and backgrounds (including race/ethnicity, nationality, gender identity, socioeconomic class, sexual orientation, language, religion, ability, etc.). To help accomplish this:

- If you have a name and/or set of pronouns that differ from those that appear in your official records, please let us know.
- We, like many people, are still in the process of learning about diverse perspectives and identities. If something was said in class, by *anyone*, that made you feel uncomfortable, please talk to us about it. If you would like support from outside the class, you may also contact the ME department's Staff Student Services for Equity, Diversity, and Inclusion, Patrick Civello (civello@berkeley.edu). For ME specific resources for Equity & Inclusion please visit our website: *https://me.berkeley.edu/about/equity-and-inclusion/*
- As a participant in this class, recognize that you should be proactive about making other students feel included and respected.

OTHER RESOURCES

Center for Access to Engineering Excellence (CAEE) The Center for Access to Engineering Excellence (227 Bechtel Engineering Center; *https://engineering.berkeley.edu/student-services/academic- support*) is an inclusive center that offers study spaces, tutoring in >50 courses for Berkeley engineers and other majors across campus, and a wide range of professional development, leadership, and wellness programs, and technology loans.

Disabled Students' Program (DSP) The Disabled Student's Program (260 César Chávez Student Center #4250; 510-642-0518; *http://dsp.berkeley.edu*) serves students with disabilities of all kinds. Services are individually designed and based on the specific needs of each student as identified by DSP's Specialists.

Mental Health and Wellness: All students — regardless of background or identity — may experience a range of issues that can become barriers to learning. These issues include, but are not limited to, strained relationships, anxiety, depression, alcohol and other drug problems, difficulties with concentration, sleep, and eating, and/or lack of motivation. Such mental health concerns can diminish both academic performance and the capacity to participate in daily activities. In the event that you need mental health support, or are concerned about a friend, UC Berkeley offers many services, such as free short-term counseling at University Health Services. A campus website has links to many resources is: *http://recalibrate.berkeley.edu/.* Another website addressing mental health services. The University Health Services Counseling and Psychological Services staff is located at the Tang Center (*https://uhs.berkeley.edu/counseling/resources:* 2222 Bancroft Way; 642-9494) and provides confidential assistance to students managing mental health. To improve access for engineering students, a licensed psychologist from the Tang Center also holds walk-in appointments in 241 Bechtel Engineering Center (schedule: *https://engineering.berkeley.edu/student-services/advising-counseling*).

The Care Line (PATH to Care Center) The Care Line (510-643-2005; *https://care.berkeley.edu/care-line/*) is a 24/7, confidential, free, campus-based resource for urgent support around sexual assault, sexual harassment, interpersonal violence, stalking, and invasion of sexual privacy. The Care Line will connect you with a confidential advocate.

Ombudsperson for Students The Ombudsperson for Students (102 Sproul Hall; 642-5754; *http://students.berkeley.edu/Ombuds*) provides a confidential service for students involved in a University-related problem (academic or administrative), acting as a neutral complaint resolver and not as an advocate for any of the parties involved in a dispute. This is a great place to start if you are unsure how to proceed with a dispute or delicate matter.

UC Berkeley Food Pantry The UC Berkeley Food Pantry (#68 Martin Luther King Student Union; *https://pantry.berkeley.edu*) aims to reduce food insecurity among students and staff at UC Berkeley. The pantry operates on a self-assessed need basis; there are no eligibility requirements. The pantry is for students and staff who need core food support.