Berkeley MAS-E
COLLEGE OF ENGINEERING

Degree Planner

Plan Your Journey

Our degree planner allows you to explore our courses, create an individual plan, and share that plan with an academic advisor. Start by selecting your concentration, and the eight required courses will populate. Round out your degree with 14 electives from any of the remaining courses offered within the MAS-E degree course catalog. All MAS-E degrees include our two-unit capstone project, where students integrate cutting-edge knowledge and technical skills to address an interdisciplinary engineering challenge.

Concentration

8 of 8 Units Selected

Concentration Selected

Select your concentration

Robotics and controls

Each concentration includes 8 required units

ENGIN 202A	**Human Centered Design Methods I** This course provides an introduction to design methods used in the development of innovative and realistic customer-driven engineered products, services, and systems. Design methods and tools are introduced and the student's design ability is developed via a series of short design process modules: design research, analysis and synthesis, concept generation and creativity. Students will be expected to use tools and methods of professional practice to consider the social, economic and environmental implications of their products, services, or systems. There is an emphasis on hands-on innovative thinking and professional practice.
ENGIN 204A	**The digital transformation in industry** The purpose of this course is to make the student fluent with the context, concepts and key content of the technologies that are driving what is collectively known as "Digital Transformation" (DT), and more specifically, focus on the industrial impact of DT, as captured under the term "Industry 4.0" (I4.0). This topic is

	quite important: for millennia we have improved our circumstances by managing our material surroundings: tools, shelter, supplies, land. Access to information is meant to enhance our efficiency in doing so, and dwindling resources, impeding climate change, and geopolitical strife are now stressing our planet. But this will not be a course in sociology, economics or geopolitics. Rather, it will be an engineering course, taught in these contexts.
ENGIN 236A	**Applied Data Science for Engineers** This course aims at providing basics of Data Science to students and professionals who need to work with and analyze a large volume of data. The base programming language is Matlab, but techniques taught, and topics covered can be coded in any programming language (examples from Python and Fortran will be discussed). The course is aimed at graduate students in engineering, and therefore examples, assignments and the course project are from real life scenarios and engineering problems.
ENGIN 238C	**Optimization of engineering systems** Optimization is a fascinating topic that finds applications across a wide array of disciplines, including finance, energy, data science, physical sciences, public policy, social science, and more. After completing the course, students will have an entirely new perspective on designing systems using mathematical optimization. Specifically, this course provides students with an introduction to mathematical optimization from the point-of-view of data science applications, e.g. mobility, energy, finance. Foundational concepts include optimization formulations, linear programming, quadratic programming, convex optimization, and machine learning.
ENGIN 250A	**Analysis and Control of Nonlinear Systems** This course provides a basic introduction to nonlinear dynamical systems and their control. The first module begins with an overview of nonlinear system models, and types of behaviors that can only arise in nonlinear systems. It then introduces phase portraits for systems with two state variables, states basic existence and uniqueness results for solutions of ordinary differential equations, and concludes with sensitivity equations that allow one to evaluate the sensitivity of the solutions with respect to parameters and initial conditions. The second module introduces Lyapunov stability theory and Lyapunov functions. It proceeds to linearization as a method for determining local stability properties around operating points, and defines the notion of a region of attraction. The third module focuses on feedback control design for nonlinear systems, starting with backstepping as an example of Lyapunov-based feedback design to stabilize an operating point. It continues

	backstepping as an example of Lyapunov-based feedback design to stabilize an operating point. It continues with input/output linearization for trajectory tracking, by first introducing requisite concepts such as relative degree. The fourth module introduces feedback linearization for stabilization, then proceeds to sliding mode control for stabilization in the presence of model uncertainty. The course will illustrate all concepts with physically-motivated examples, and will point to resources for further study.
ENGIN 252	**Legged Robots: How to make Robots Walk and Run** Bipedal robot locomotion is a challenging problem. This course will introduce students to the math behind bipedal legged robots. We will cover modeling and dynamics of legged robots, trajectory planning for designing walking and running gaits, and common control strategies to achieve the planned motions. The course will also include applied techniques of programming up a simulator with a dynamical model of a bipedal robot as well as a controller that stabilizes a walking gait. This short course will take students through every step of the process, including: • Mathematical modeling of walking gaits in planar robots. • Analysis of periodic orbits representing walking gaits. • Algorithms for synthesizing feedback controllers for walking. • Algorithms for optimizing energy-efficient walking gaits. • Detailed simulation examples.
ENGIN 253	**Flying Robots: from Small Drones to Aerial Taxis** Aerial robots are increasingly becoming part of our daily lives. This course is aimed at a broad audience, and intends to give an introduction to the main considerations made when designing aerial robots. We will consider sizes ranging from less than 1 kilogram to vehicles that can carry multiple passengers. Using simple physics, we will derive some fundamental constraints and trade-offs. We will also discuss autonomy of such systems, and specifically different components used in the sense-decide-act feedback control loop.
ENGIN 272	**Python for Engineers** In recent years Python has emerged as an indispensable programming language for engineers, both practicing and academic, as well as data scientists, web developers, and many others. However the language is vast and

	includes many features that are not immediately relevant to most engineers. The goal of this course is to help students to quickly gain a foothold with the parts of the language that they are most likely to use. We will begin with a high-level description of Python and how it differs (both in syntax and in philosophy) from other popular programming languages. We will learn about Python's extensive offering of libraries, starting with the standard library, and including Numpy and Pandas. We will set up our programming environment with Anaconda, Jupyter, and Spyder. We will then delve into the basic constructs of the language (data types, program flow, etc). We will also cover code organization and object-oriented programming. As well, we will begin using numerical libraries such as Numpy and Pandas to solve more advanced problems. The course will be suffused with demonstrations of the concepts, and sample visualizations created with Matplotlib.

Electives

14 of 14 Units Selected

ENGIN 202B	**Human Centered Design Methods II**
ENGIN 202B	**Designing for the Human Body** Students will learn how the body transfers loads during daily activities and how external or internal device design can have a long-term impact on body biomechanical function. Some examples include the impact of phone use and forward flexion of the neck and asymmetrical spinal loading due to shoulder bags (e.g., impact on factory workers or military personnel). The role of human-centered design on internal and external devices will be presented through case studies. Lastly, the impact of data from novel portable measurement tools that can be incorporated into wearable devices will be discussed, with a specific focus on disease monitoring, prevention, and early detection.
ENGIN 222	**Molecular Imaging Methods for R&D and Clinical Trials** This course is designed as an introduction to the growing world of molecular imaging in medicine and research. The current confluence of increased understanding of how genetic differences mitigate drug response, alongside substantial innovation in targeted molecular therapeutics including gene editing approaches, represents an inflection point for the use of molecular imaging

	including gene editing approaches, represents an inflection point for the use of molecular imaging. This course will provide individuals with fundamental understandings of medical imaging modalities that are used in both R&D and clinical settings. Building upon this framework, corresponding methods for targeted molecular imaging including contrast mechanisms and probe design will provide direct relevance to current needs for high throughput in vivo efficacy measurements. Quantitative methods for image analysis will be taught in the context of real world disease targeted applications using published data from recent clinical trials.
ENGIN 234	**Introduction to Data Structures and Software Engineering** The Introduction to Data Structures and Software Engineering course provides important principles and techniques that you can use to minimize overall development and maintenance time when writing computer programs. To that end, we introduce the Java programming language, a widely used programming language that supports these best practices, though these practices can be applied in other languages as well. The course assumes familiarity with at least one programming language, not necessarily Java.
ENGIN 236B	**Data Science and Machine Learning Fundamentals** The Data Science and Machine Learning Fundamentals course provides an introduction to machine learning in the context of data science. By the end of the course, students will know how to clean, visualize, and model real world datasets using basic machine learning techniques. The course assumes a familiarity with the Python programming language.
ENGIN 238A	**Renewable Energy Systems**
ENGIN 264	**Applied Continuum Mechanics** Continuum mechanics is a powerful method of modeling physical systems of a very large variety. In this course students will learn the basic elements for describing system state and how balance laws are formulated to ensure correct system response. The developed methodology will first be applied to basic problems in elasticity, followed by application to poroelastic systems, batteries, and piezoelectric material systems.

	piezoelectric material systems. The foundations gained from this course will allow students to understand how continua, both simple and complex, are properly modeled. It will set them up to be able to formulate continuum mechanical problems and it will allow them to more fully understand numerical solutions that are arrived at via modern computational methods, such as the finite element method. This course sets students up for the ability to contribute a sophisticated perspective on modeling questions that arise in a wide variety of engineering problem classes.	
ENGIN 270	**Quantum physics for semiconductor engineers**	
ENGIN 271	**Photovoltaic Device Technology**	
ENGIN 273	**Statistics for Engineers**	
ENGIN 280A	**Electronic properties of materials** Introduction to the physical principles underlying the electronic properties of solids from macroscopic to nano dimensions. General solid state physics will be taught in the context of technological applications, including the structure of solids, behavior of electrons and atomic vibration in periodic lattice, and interaction of light with solids. Emphasis will be on semiconductors and the materials physics of electronic and optoelectronic devices.	
ENGIN 281	**Development of Modern Materials for the Microelectronics Industry** This course covers the materials science and processing of thin film coatings that incorporates fundamental knowledge of materials transport, accumulation, defects and epitaxy. Through this course, an understanding of the fundamental physical and chemical processes which are involved in crystal growth and thin film fabrication will be gained. Important synthesis and processing techniques used for the fabrication of electronic and photonic devices will be discussed. Finally, this course will provide an understanding of how material characteristics are influenced by processing and deposition conditions. This course is designed to directly address current challenges and future	

	and deposition conditions. This course is designed to directly address current challenges and future needs of the semiconductor and coating industries.
ENGIN 282	**Next-generation electronic device design and fabrication** This course is designed to give an introduction, and overview of, the techniques used in fabrication of electronic devices. Topics such as materials deposition, patterning, laboratory safety and best practices will be covered. The students will learn basic processes used in the fabrication of silicon-based devices and novel semiconducting materials. After covering the fundamental processes and technologies needed to form an electronic device, the fabrication flow of NMOS devices will be studied in detail.
ENGIN 291A	**Introspective and Authentic Leadership** This course provides the framework for personal leadership development. The class comprises three parts: (I) Exploration of your leadership journey; (II) Discovery of your personal leadership style; and (III) Development of a personal leadership plan. Topics include identification of personal crucibles, moral compass, ethical decision-making, conflict resolution, navigation of difficult conversations, positive psychology, growth mind-set, teamwork and development of personal leadership plans. Students engage in weekly reflections and introspective exercises.

Capstone Project

Final two units via Capstone course

ENGIN 296MS	**Capstone**