STANFORD UNIVERSITY
MECHANICAL ENGINEERING DEPARTMENT

GRADUATE STUDENT HANDBOOK
Academic Year
2019 – 2020

Mechanical Engineering Student Services
Building 530, Room 125
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1/2020

MECHANICAL ENGINEERING GRADUATE STUDENT HANDBOOK
2019 – 2020

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September 2019

Hello!

Welcome to Stanford University. We are pleased that you have chosen Stanford for your graduate study. This guide will familiarize you with the department, academic policies, and procedures. In addition to this guide, you are expected to stay informed of policies governing financial aid, degree, and course requirements by consulting university web sites such as the Stanford Bulletin and Graduate Academic Policies. If uncertain about a policy, please consult with the Student Services Office staff located in building 530, room 125. You may stop by, or give us a call; our numbers are listed on the next page. Generally speaking, our office hours are from 8:30am - 5:00pm, Monday through Friday. Office hours may be limited during the Summer Quarter.

Students enrolled in the MS and Ph.D. programs have been assigned to an academic advisor. The assignments were based on availability of the faculty and your academic interests. However, please know that you may seek the advice of any of our faculty throughout the department regardless of who your assigned advisor is. If you wish to submit a formal change of advisor, please let us know.

The Student Services team is available to answer any questions that you may have, academic or otherwise. We know of many on- and off-campus resources available to you in addition to those listed in this handbook. Please feel free to stop by our office, even if just to say hello! My staff and I would appreciate the opportunity to get to know you.

Sincerely,

Michelle Lucas Rice
Director, Student and Academic Services
(650) 725-2075
malucas@stanford.edu

MECHANICAL ENGINEERING ADMINISTRATIVE OFFICES
Building 530

The Department of Mechanical Engineering is organized into five groups: Biomechanical Engineering, Design, Flow Physics and Computational Engineering, Mechanics & Computation, and Thermosciences. These groups are housed in separate buildings and have laboratories and centers located throughout the campus. Although each group has its own administrative office and staff, the heart of the department is located in Building 530.

STUDENT SERVICES AND GRADUATE ADMISSIONS OFFICE
Building 530, Room 125 & 126

Student Services Specialist (Curriculum, Course/Classroom Scheduling):
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Chair of the Committee for Undergraduate Curriculum:
Professor Sheri Sheppard, sheppard@stanford.edu

Director of Graduate Studies Committee:
Professor Allison Okamura, aokamura@stanford.edu

Chair of the Committee for Graduate Admissions:
Professor Marc Levenston, levenston@stanford.edu

Please come to the Student Services Office with all of your student services questions, issues and concerns. The office processes assistantships and Stanford fellowships, program proposals, leave of absence petitions, academic petitions, and degree conferral applications and performs many more duties. In addition, we organize various events including orientation and the annual graduation ceremony. It is not possible to obtain a degree from the department without visiting this office at least once!

OFFICE OF THE CHAIR
Building 530, Room 113
(650) 723-4023

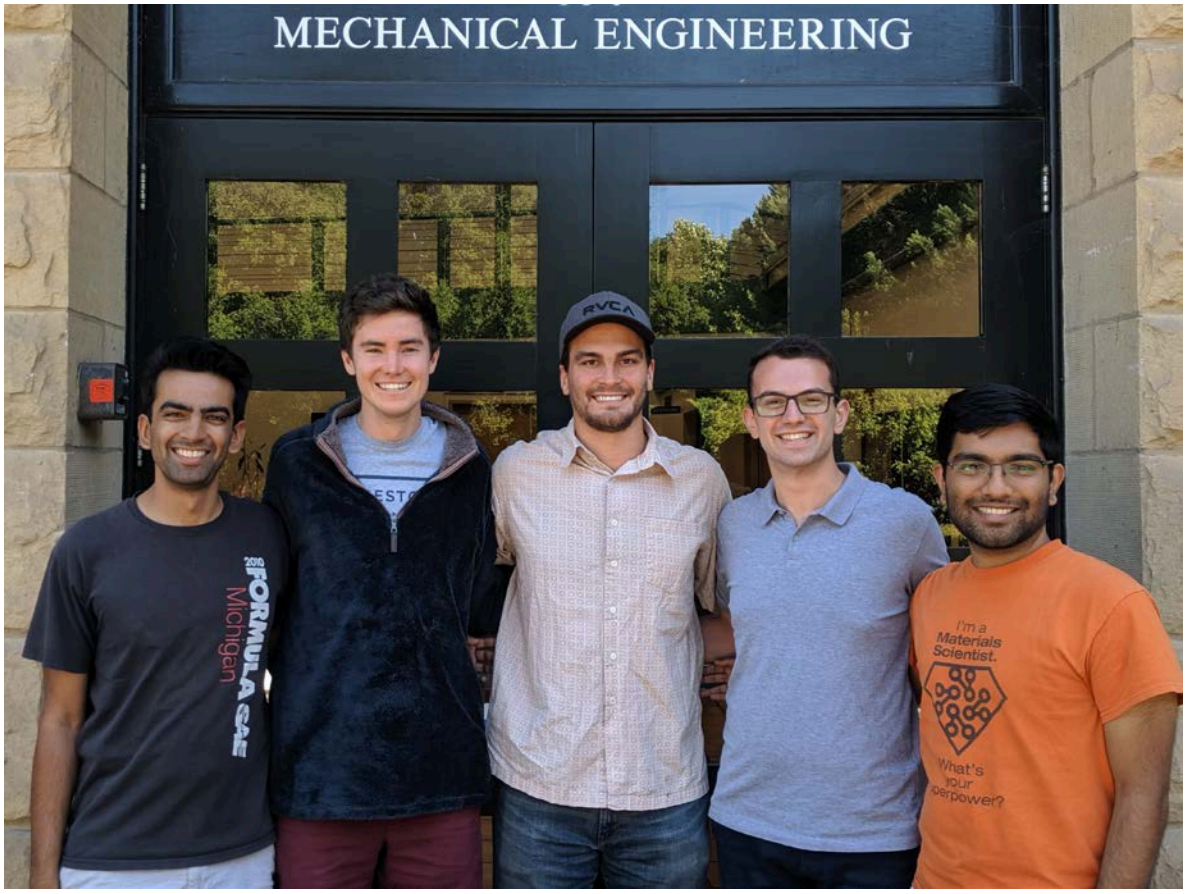
Professor Ellen Kuhl, Department Chair
Giselle Martin, Director of Finance and Operations
Hong Clark, Department Administrator
Jessica Kubo, Faculty Affairs Administrator

The Chair's Office handles issues related to faculty, staff and the operating budget. They cannot answer any admission or student services questions or sign academic petitions. However, Professor Kuhl is very open to discussing Department or University issues with students, so if you feel that you have a problem or want to bring something to her attention, please feel free to do so.

ME GRADUATE STUDENT COMMITTEE:

The ME Graduate Student Committee is a student-run group which organizes social, academic and community events for the graduate student population in the ME Department. The flagship events of the ME Graduate Student Committee are monthly happy hours, which are very popular among the ME graduate students. In addition to these, we host bi-annual Quals Panels, a mid-summer BBQ and an annual town hall meeting. We less regularly hold smaller events to help building a sense of community among ME grad students. To keep up to date with our events or get involved, join our Facebook group at www.facebook.com/groups/StanfordMEGAFun or our listserv at https://mailman.stanford.edu/mailman/listinfo/me-grad-fun

2019-20 COMMITTEE MEMBERS:



Wai Tong Chung (not pictured), Seth Cordts, Tushar Goel, Kevin Griffin, Omkar Shende, and Filip Simeski

BIOMECHANICAL ENGINEERING GROUP
Building 520, Room 232
(650) 723-4133

David Camarillo, Assistant Professor, by courtesy, and Assistant Professor of Bioengineering
Dennis Carter, Professor (Emeritus)
Ovijit Chaudhuri, Assistant Professor
Steve Collins, Associate Professor
Scott Delp, Professor and Professor of Bioengineering
Nicholas Giori, Associate Professor, by courtesy, and Associate Professor of Orthopaedic Surgery
Miriam Goodman, Professor, by courtesy, and Professor of Molecular and Cellular Physiology
Ellen Kuhl, Professor and Department Chair
Marc Levenston, Associate Professor, Group Chair, and Chair of the Committee for Graduate Admissions
Allison Marsden, Associate Professor, by courtesy, and Associate Professor of Pediatrics and Bioengineering
Allison Okamura, Professor and Professor, by courtesy, of Computer Science, and Director of Graduate Studies Committee
Peter Pinsky, Professor (Emeritus)
Sindy Tang, Associate Professor
Paul Yock, Professor, by courtesy, and Professor of Bioengineering

Kelly Chu – Group Administrative Lead

Biomechanical Engineering (BME) at Stanford embodies teaching and research in which principles of mechanics and design are used to examine fundamental questions in biology and to advance human health. Research in Biomechanical Engineering involves multidisciplinary approaches that includes strong interactions with the School of Medicine as well as other engineering disciplines. The faculty, research staff, and current and former students are widely known for their leadership in developing new ideas in biotechnology, biomedical design, scientific analysis, and medical applications. Research in BME is both experimental and theoretical, traversing many domains: biodesign, biofluidics, molecular/cell/tissue mechanics, movement biomechanics, biorobotics, mechanobiology, orthopaedic biomechanics, cardiovascular biomechanics, neuroscience, cancer, and mechanics of vision.

Facilities

The BME Laboratories include experimental techniques from fundamental biology to clinical studies (including patient studies). The BME laboratories house state-of-the-art wet laboratories with cell and tissue culture, mechanical testing, cell and tissue preparation and microscopy. The Computational Biomechanics Laboratory supports graduate research in computer modeling of the human body. The Soft Tissue Biomechanics Laboratory supports investigation of tissue mechanics, mechanobiology and tissue engineering. The Neuromuscular Biomechanics Laboratory has extensive imaging facilities, a motion capture laboratory, and computational facilities. The Chaudhuri Lab for Biomechanics and Mechanobiology develops force measurement instruments and engineered biomaterials to investigate mechanical properties of cells and extracellular matrices. The Collaborative Haptics and Robotics in Medicine Lab develops principles and tools needed to realize advanced robotic and human-machine systems capable of haptic interaction for application to biomedical systems. In collaboration with Medical School colleagues, biologically and clinically oriented work is conducted in various facilities throughout the Stanford Medical Center and the VA Palo Alto Health Care System.

DESIGN GROUP
Building 550, Room 114
(650) 725-9131

John Armstrong, Lecturer
Michael Barry, Adjunct Professor
David Beach, Professor (Teaching)
William R. Burnett, Adjunct Professor
J. Edward Carryer, Adjunct Professor
Steve Collins, Associate Professor
Mark Cutkosky, Professor
Kathleen Hannon Davies, Lecturer
John Edmark, Lecturer
Rainer Fasching, Adjunct Professor
Sean Follmer, Assistant Professor
J. Christian Gerdes, Professor
Shannon Gilmartin, Adjunct Professor
John Howard, Adjunct Professor
Barry Katz, Adjunct Professor
David Kelley, Professor
Monroe Kennedy, Assistant Professor
Thomas Kenny, Professor and Senior Associate Dean of Engineering for Student Affairs
Marlo Kohn, Lecturer
Larry Leifer, Professor
David Lentink, Assistant Professor
Erin MacDonald, Assistant Professor
J. Craig Milroy, Senior Lecturer and Director of Undergraduate Teaching Labs
Paul Mitiguy, Adjunct Professor
Drew Nelson, Professor
Gary O'Brien, Adjunct Professor
Allison Okamura, Professor and Professor, by courtesy, of Computer Science
Dev Patnaik, Adjunct Professor
Friedrich Prinz, Professor, (joint with Materials Science and Engineering)
Bernard Roth, Professor
Paul Saffo III, Adjunct Professor
Gabrielle Santa-Donato, Lecturer
Sheri Sheppard, Professor and Chair of the Committee for Undergraduate Curriculum
Dan Somen, Lecturer
Joseph Towles, Lecturer
George Toye, Adjunct Professor
Emily Tsiang, Lecturer
Kenneth Waldron, Professor (Research)(Emeritus)
Douglas Wilde, Professor (Emeritus)
David B. Camarillo, Assistant Professor, by courtesy and Assistant Professor of Bioengineering
Oussama Khatib, Professor, by courtesy, and Professor of Computer Science

Kristin Burns – Group Manager

The Design Group is devoted to the imaginative application of science, technology, and art to the conception, visualization, creation, analysis and realization of useful devices, products, and objects. Courses and research focus on topics such as assistive technology, bio-inspired design, biofluid dynamics, controls, kinematics, applied finite elements, microprocessors, medical devices, fatigue and fracture mechanics, experimental mechanics and stress analysis, dynamics and simulation, micro-electromechnical systems (MEMS), rehabilitation, optimization, high-speed devices, product design, scientific instrument design, vehicle dynamics, experimental mechanics,

robotics, haptics, human-computer interaction, creativity, idea visualization, computer-aided design, manufacturing, rapid prototyping, design analysis, design theory & methodology, organizational innovation, and engineering education.

Facilities

The Design Group offers a rich and diverse set of facilities in support of its academic and research efforts. Faculty and administrative offices are in Building 550, also known as Peterson Laboratory.

The **Alex Tung Memorial Assistive Technology Laboratory at Stanford (ATLAS)** (Professor Drew Nelson, Director; David L. Jaffe, MS, Associate Director) houses the research of Drew Nelson and students plus the teaching of ME348 and **ENGR110/210**. It is in Building 550, Room 134

The **Assistive Robotics and Manipulation Laboratory (ARM Lab)** (Assistant Professor Monroe Kennedy III, PI), develops robotic, assistive technology to complete complex task objectives with considerations for reliability. We use a combination of tools in control theory (classical, non-linear and robust control), dynamical system analysis, state estimation and prediction, motion planning, vision for robotic autonomy and machine learning. Our lab focuses heavily on both the analytical and experimental components of assistive technology design. While our application areas are broadly all autonomous assistive technology, our focus is robotic assistants (mobile manipulators and humanoids) with the goal of deployment for service tasks that may be highly dynamic and require dexterity, situational awareness and human-robot collaboration.

The **Automotive Innovation Facility (AIF)** houses the **Volkswagen Automotive Innovation Lab (VAIL)**, a state-of-the-art vehicle research facility where interdisciplinary teams work on projects that move vehicle technology forward. Stanford projects which reside at the AIF include vehicle dynamics control at the limits of handling by the Dynamic Design Lab of Chris Gerdes; interaction-aware decision making and planning by the Autonomous Systems Lab of Marco Pavone, research on the interaction of drivers with vehicles in a driving simulator by the Center for Interdisciplinary Brain Sciences Research of Allan Reiss; and the Stanford Solar Car Project, which designs, builds and races the solar vehicle which competes in the World Solar Challenge in Australia. To improve safety, sustainability, performance and enjoyment of automobiles, the Automotive Innovation Facility provides a space for researchers to build and test new ideas in real vehicles. The AIF provides project, fabrication, classroom and meeting spaces for students and researchers to prototype the cars of the future.

The **Bio-inspired Research and Design Lab** (BIRD Lab) (Assistant Professor David Lentink, Director) integrates three areas of research in Mechanical Engineering:
comparative *Biomechanics*, biological *Fluids* and robot *Design*. The lab's mission is to improve our understanding of how birds fly to develop better flying robots. Together, lab members bridge a diverse set of complementary disciplines (dynamics, controls, fluids, physiology, neuroscience and biomechanics) to advance both science and engineering, a process that traditionally required multiple labs. Multidisciplinary collaboration between students and postdocs in the lab is therefore central to the culture of the BIRD/Lentink Lab.

The **Biomechatronics Laboratory** (Associate Professor Steve Collins, PI) develops wearable robots to improve human mobility. We use a combination of theory, design, and experiment to improve stability and energy efficiency for individuals whose strength and coordination have been affected by amputation, stroke, or aging. Our primary focus is to speed and systematize the design and prescription of prostheses and exoskeletons using versatile device emulator hardware and human-in-the-loop optimizer algorithms (Zhang et al. 2017, Science). Another focus is efficient autonomous devices, such as highly energy-efficient walking robots (Collins et al. 2005, Science) and exoskeletons that use no energy yet reduce the metabolic energy cost of human

walking (Collins et al. 2015, Nature). We believe that appropriate mechanical assistance can not only restore function, but can enhance performance beyond typical human limits.

The **Biomimetics and Dextrous Manipulation Laboratory** (Professor Mark Cutkosky, PI) is affiliated with the Center for Design Research. BDML research activities include modeling and control of dextrous manipulation with robotic and teleoperated hands; force and tactile feedback in telemanipulation and virtual environments; and design and control of compliant "biomimetic" robots with embedded sensors and actuators.

The **Center for Automotive Research at Stanford (CARS)** (Professor Chris Gerdes, Director; Stephen Zoepf, PhD, Executive Director) operates an interdisciplinary automotive research lab, the **Volkswagen Automotive Innovation Lab (VAIL)**. By creating a community of faculty and students from a range of disciplines at Stanford with leading industry researchers and policymakers, CARS strives to radically re-envision the automobile for unprecedented levels of safety, performance and enjoyment. CARS' mission is to discover, build and deploy the critical ideas and innovations for the next generation of cars and drivers.

The **Center for Design Research** (Professor Larry Leifer, Director) is a community of scholars focused on understanding and augmenting engineering design innovation and education. We are dedicated to facilitating individual creativity, understanding interdisciplinary, multi-cultural, design team dynamics. We strive to instrument the team's activity to predict breakthrough innovation performance and coach teams in real time. We develop advanced tools and methods to promote superior design and delivery of products, services, and businesses. We research the problem space before offering solutions through design thinking, concurrent engineering, systems engineering, global teams-of-teams. We focus on design knowlege capture, indexing, and reuse. Our instruments are deployed in academic and industry contexts. Understanding human/machine (autonomous car) relationships is a hot topic of the times. CDR's team-interaction-observatory is in Building 560. Several research projects use VAIL.

The **Collaborative Haptics and Robotics in Medicine Lab (CHARM Lab)** (Professor Allison Okamura, PI) develops principles and tools needed to realize advanced robotic and human-machine systems capable of haptic (touch) interaction. Systems for teleoperation, virtual environments and robotic manipulation are designed and studied using analytical and experimental approaches. Application areas include surgery, simulation and training, rehabilitation, prosthetics, neuromechanics, exploration of hazardous and remote environments, design and education. The lab is in the Mechanical Engineering Research Laboratory (MERL, Building 660), Room 126.

The **Design Observatory (DO)** (Professor Larry Leifer, PI) is a research environment for studying engineering design team activity through real-time observation, recording, analyzing, and coaching. Activities include idea generation, prototyping and globally distributed design team meetings. Through observation, video and audio analysis, the researchers have discovered patterns of behavior that correlate with effective team performance. The DO environment is flexible enough to allow researchers to set up different design experiments quickly and easily. It also allows researchers to investigate various aspects of design behavior in a detailed manner (second by second). The end results of the research carried out in the DO are new metrics of effective design behaviors, new research instruments and new design practices that yield innovation eco-systems. The DO is in the Center for Design Research, Building 560.

The **Designing Education Lab (DEL)** (Professor Sheri Sheppard, PI) investigates a broad range of engineering education topics, from the persistence of students and alumni in engineering fields to the impact of exposure to entrepreneurship on engineering students' career interests. DEL researchers are engaged in national and international collaborations with colleagues within and outside of engineering. Our activities and projects emphasize the relationship of research to academic and professional practice by informing the redesign of engineering course pedagogy and curriculum and the dissemination of findings in conference papers, workshops, webinars, online resources and publications. The DEL is in the Center for Design Research, Building 560.

Chris Gerdes is director of the Center for Automotive Research at Stanford (CARS) and directs his own laboratory, the **Dynamic Design Lab (DDL)**. Research interests in the DDL include vehicle dynamics, design of x-by-wire systems, driver assistance systems and control of homogeneous charge compression ignition engines. A good example is the current development of autonomous racing and drifting algorithms to enable Shelley, an Audi TT-S, to race up Pikes Peak without a driver.

The **designX Lab** (Professor Larry Leifer, PI) is focused on graduate-level research in the larger subjects of design innovation, design methodology, and design education. Our designX community is comprised of fulltime members who arrive from a diverse range of disciplines including sociology, product design, neuroscience, mechanical engineering, electrical engineering, economics, business and architecture. While our lab reflects a range of interests across multiple disciplines, we share an interest and commitment to better understanding Design Thinking: a research and design paradigm which is user-centered and is proving to yield superior outcomes in the face of contemporary problems. We are actively developing understandings of design as a research topic, as a research method, and as a philosophical approach.

The **Innovation Acceleration Lab**, part of the Center for Design Research, aims to develop feedback methods and technology to accelerate the effectiveness of engineering product innovation teams. Researchers at the Innovation Acceleration Lab use video interaction analysis and visual representations to measure, analyze and give process feedback to engineering product innovation teams.

Research projects in the **IRIS Design Lab: Interdisicplinary Research in Sustainable Design** (Assistant Professor Erin MacDonald, PI) have three foci: (1) Modeling the role of the public's decisions in effective large-scale sustainability implementation; (2) Improving engineering designers' abilities to address complex customer preference for sustainability; and (3) Using data on how consumers perceive products, especially visually, to understand how products are evaluated and subsequently improve those evaluations. These foci represent three corresponding design vantage points: (1) system-level; (2) human-scale or product-level, and (3) single-decision-level, as shown in the Figure. The exploration of these different vantage points is fundamental to performing insightful design research on complex design issues, such as sustainability.

The **Loft** (in Building 610) is a unique facility that represents the culture of innovation at Stanford. It is a space in which students of the **Design Impact Program** (Assistant Professor Erin MacDonald, Director) carry out graduate-level design work.

The **ME310 Design Team Development Loft** (Professor Larry Leifer, PI) provides space and technical support for globally distributed product development teams working on corporate partner projects. Teams are assigned a desktop design station with internet video studio support. The facility is in Building 550.

The **Micro-Structures and Sensors Laboratory** (Professor Thomas Kenny, PI) is the setting for efforts to develop and fabricate novel mechanical structures. Basic research on the non-classical phenomena exhibited by micro structures is emphasized as well.

The **Nanoscale Prototyping Laboratory** (Professor Fritz Prinz, PI) focuses on the design and fabrication of micro and nanoscale devices for energy and biology. Examples include fuel cells and bioreactors. Interest is in mass-transport phenomena across thin membranes such as oxide films and lipid bi-layers. This research group studies electro-chemical phenomena with the help of atomic force microscopy, impedance spectroscopy and quantum Modeling. The lab is in Building 530.

The guiding spirit of the **Product Realization Lab (PRL)** is to transform our world by preparing Stanford students to be self-confident change agents. Each year, more than 1000 students come to the PRL to create objects of lasting value. Nearly half of these students are women, and an ever-increasing percentage are non-engineers. The pathbreaking PRL curriculum and award-winning

teaching team, directed by Professor David Beach and Senior Lecturer Craig Milroy, continue to inspire and support students who are solving the greatest challenges of our time. The PRL is open to Stanford undergraduate, graduate, and professional school students. For a list of courses and to learn more about the lab, please visit the **Product Realization Lab website**.

SHAPE Lab (Assistant Professor Sean Follmer, PI) develops advanced technologies in robotics, mechatronics, and sensing to create interactive, dynamic physical 3D displays and haptic interfaces that allow 3D information to be touched as well as seen. We are specifically interested in using these novel interfaces to support richer remote collaboration, computer-aided design, education, and interfaces for people with visual impairments. In pursuit of these goals, we use a design process grounded in interative prototyping and human-centered design and look to create new understanding about human perception and interaction through controlled studies. Our research in Human Computer Interaction and Human Robot Interaction are currently directed in five areas: Dynamic Physical Shape Displays, Wearable Haptics for Grasping in VR, Ubiquitous Robotic Interfaces, Mobile Haptics and Soft Actuation and Sensing.

The **Smart Product Design Laboratory** (Adjunct Professor Ed Carryer, Director) supports the Smart Product Design sequences (ME210 and ME218 A,B,C & D) at Stanford University. Smart Products are products whose functionality is increased through the use of an embedded microcontroller. It is a super-set of the field that has become known as Mechatronics. Embedded microcontrollers can already be found in everything from dishwashers to automobiles - and more Smart Products appear every day. The ME218abc lab is located on the second floor of the Thornton Annex, next to the Terman Pond. The ME210/218d lab is located in the Peterson Laboratory Building in rooms 106 & 108. These labs are the site of the hands-on learning which characterizes the Smart Product Design / Mechatronics courses at Stanford. Each lab is supported by an array of PC-based workstations that include the tools to develop the mechanical and electrical systems and the software for the 8- and 32-bit microcontrollers which are embedded into student projects.

FLOW PHYSICS and COMPUTATIONAL ENGINEERING GROUP
Building 500, Room 500B
(650) 736-0766

Andreas Acrivos, Emeritus Professor (Joint with Chemical Engineering)
John Dabiri, Professor (Joint with Civil and Environmental Engineering)
Eric Darve, Associate Professor
John Eaton, Professor
Gianluca Iaccarino, Professor and Director, Institute for Computational and Mathematical Engineering (ICME)
Matthias Ihme, Associate Professor
Vadim Khayms, Senior Lecturer
Sanjiva Lele, Professor (Joint with Aeronautics and Astronautics)
Ali Mani, Associate Professor
Parviz Moin, Professor, Group Chair and Director, Center for Turbulence Research
Lester Su, Lecturer

Pamela Nelson Foster – Group Manager

http://fpc.stanford.edu
http://ctr.stanford.edu
http://psaap.stanford.edu
http://exascale.stanford.edu
http://tfsa.stanford.edu/tfsa_contact.html

Fluid mechanics is an important part of engineering. Many devices and systems involve liquids and gases or are manufactured or recycled using fluid processes. Fluid mechanics plays a major role in such diverse areas as blood flow in our bodies, flow over aircraft wings, injection, mixing, and combustion of fuel and oxidizer in the combustor of propulsion engines, noise-emission from aircraft, dispersion of pollutants in the atmosphere, solar energy harvesting systems, and plasma processing in semi-conductor equipment manufacturing.

With the rapid development in computer technology, the future offers great opportunities for computational engineering analysis and design. The Flow Physics and Computational Engineering Group (FPCE) blends research on flow physics and modeling with algorithm development, scientific computing, and numerical database construction. FPCE is contributing new theories, models and computational tools for accurate engineering design analysis and control of complex flows (including multiphase flows, chemical reactions, acoustics, plasmas, interactions with electromagnetic waves, and other phenomena) in aerodynamics, energy production, propulsion and power systems, materials processing, electronics cooling, environmental engineering, and other areas. A significant emphasis of research is on modeling and analysis of physical phenomena in engineering systems. In addition, FPCE students and research staff are developing new methods and tools for generation, access, display, interpretation, and post-processing of large databases resulting from numerical simulations of physical systems. Research in FPCE ranges from the development of advanced numerical algorithms for simulation of turbulent flows to active flow and combustion control using control theory for distributed systems. The FPCE faculty teaches graduate and undergraduate courses in engineering, computational mathematics, fluid mechanics, turbulence, heat transfer, solid mechanics, thermodynamics and propulsion, combustion, acoustics, aerodynamics, and computational fluid mechanics.

The Flow Physics and Computational Engineering Group is strongly allied with the Center for Turbulence Research (CTR), a research consortium between Stanford and NASA, the Predictive Science Academic Alliance Program II (PSAAP II), one of the U.S. Department of Energy centers of excellence in computational science, and the Institute for Computational and Mathematical Engineering (ICME). CTR conducts fundamental research aimed at understanding the mechanics of

turbulent flows leading to prediction methods and algorithms for turbulence control. PSAAP research thrust is the development of computational algorithms and physical models to study the interaction between air turbulence, particle transport and radiation as it occurs is solar-thermal energy devices. The program is built over a strong collaboration between FPCE and the Computer Science department at Stanford to harness the power of next-generation exascale computers in simulating complex multiphysics problems at an unprecedented fidelity. The FPCE Group has direct access to major national computing facilities located at the various DOE and facilities NASA, including massively parallel super computers and hybrid multiprocessor GPU/CPU systems. The intellectual atmosphere of the Flow Physics and Computational Engineering Group is greatly enhanced by interactions with CTR and PSAAP staff of postdoctoral researchers and distinguished visiting scientists. Group facilities include several parallel supercomputers (with up to 7000 CPUs), advanced workstations and reproduction facilities and experimental and flow and heat transfer measurement facilities.

MECHANICS AND COMPUTATION GROUP
Building 520, Room 232
(650) 723 4133

Thomas P. Andriacchi, Professor (joint with Orthopaedic Surgery) (Emeritus)
David Barnett, Professor (joint with Materials Science and Engineering) (Emeritus)
Wei Cai, Associate Professor and Group Chair
Eric Darve, Professor
Charbel Farhat, Professor (joint with Aeronautics & Astronautics)
Wendy Gu, Assistant Professor
Ellen Kuhl, Professor and Department Chair
Adrian Lew, Associate Professor
Christian Linder, Associate Professor, by courtesy, and Associate Professor of Civil and Environmental Engineering
Peter Pinsky, Professor (Emeritus)
Charles Steele, Professor (Emeritus)

Kelly Chu – Group Administrative Lead

Teaching and research in the Mechanics and Computation Group is devoted to the study of a broad range of mechanical phenomena including the behavior of solids, fluids, biological tissue and complex materials under the actions of loads. The ultimate goals of this effort are to discover new scientific knowledge relevant to engineering problems of the future, to enhance technological development in a broad range of industries, to improve health in society and to advance national security and defense.

Much of the research conducted within the Group is interdisciplinary in nature, reflecting a combination of concepts, methods, and principles that often span several areas of mechanics, mathematics, computer sciences, materials science, biology and numerous other scientific disciplines. Our approach often combines experimental or clinical studies with theoretical modeling and numerical simulation to create tools that both explain phenomena and predict behavior and that may be used to advance concepts and designs in industry.

To achieve our educational objectives our teaching and research encompasses computational mechanics, multiphysics modeling, computational bioengineering, and micro-scale devices.

Computational mechanics is concerned with the development and application of computational methods based on the principles of mechanics and the field has had a profound impact on science and technology over the past three decades. It has effectively transformed much of classical Newtonian theory into practical and powerful tools for prediction and understanding of complex systems and for creating optimal designs. Active research topics within our Group include development of new finite element methods (e.g. discontinuous Galerkin method), computational acoustics and fluid-structure interaction, algorithms for dynamical and transient transport phenomena, adaptive solution schemes using configurational forces, modeling the behavior of complex materials and biological tissue. The group is actively engaged in methods and algorithm development for high-performance computing including massively parallel computing. A recent emphasis is concerned with the coupling of techniques for analysis at the quantum, atomistic and continuum levels to achieve multi-scale modeling.

Multiphysics modeling arises from the need to model complex mechanical, physical and/or biological systems with functionalities dependent on interactions among chemical, mechanical and/or electronic phenomena. These systems are often characterized by wide ranges in time and length scales which requires the development of technologies to describe and model, using numerical and mathematical techniques, the coupling between those scales with the goal of designing and/or optimizing new engineering devices. Myriad different applications exist ranging

from novel molecular scale devices based on nanotubes and proteins, to sensors and motors that operate under principles unique to the nanoscale. Computer simulation is playing an increasingly important role in nano-science research to identify the fundamental atomistic mechanisms that control the unique properties of nano-scale systems.

Computational bioengineering is a quickly advancing field of research and is providing opportunities for major discoveries of both fundamental and technological importance in the coming years. The interface between biology and computational engineering will be one of the most fruitful research areas as the ongoing transformation of biology to a quantitative discipline promises an exciting phase of the biological revolution in which engineers, and especially those employing computation, will play a central role. As physical models improve and greater computational power becomes available, simulation of complex biological processes, such as the biochemical signaling behavior of healthy and diseased cells, will become increasingly tractable. A particular challenge along these lines lies in the multiscale modeling of biomechanical phenomena bridging the gap between the discrete cell level and the continuous tissue level. The potential scientific and technological impact of computational bioengineering can hardly be overstated. The group is playing an active part in this research effort at Stanford with current collaborative projects with the School of Medicine in areas such as the modeling of the mechanics of the ear and hearing, the eye and vision, growth and remodeling, simulation of proteins and mechanically gated ion channels, tissue engineering and stem cell differentiation.

Machine Learning has had tremendous success in computer science for image, video, and speech processing, among other applications. We are investigating how we can apply these novel approaches in computational mechanics where the requirements, such as accuracy, stability, and uncertainty quantification, are much more stringent than in many computer science applications. Example areas of applications include inverse modeling, uncertainty estimation, multi-fidelity models, and optimal control.

Experimental nano-mechanics is the measurement of the mechanical response of nanostructured materials. We study the strength, deformation and failure of nanoscale metals, oxides and semiconductors in order to design strong and lightweight structural materials, damage tolerant composites, and mechanically actuated nano-sensors. Active projects include compression testing of core-shell nanocrystals, development of high strain rate testing techniques for microscale samples.

Metal additive manufacturing is a new research direction that the group is actively pursuing both through experiments and computation. A metal 3D printer based on powder-bed fusion (PBF) technology provides the platform for fundamental research on the physical processes in metal printing, as well as for the manufacturing of metal parts with complex shapes for novel applications. Computational modeling is used for geometry design and optimization, for the design of experiments, and to control of the printing strategy so as to ensure the quality of printed parts.

To deal with such complex and often multidisciplinary problems, the engineer must have a thorough knowledge of analytical, computational, and experimental methods and a deep understanding of underlying physical principles. To achieve this level of understanding, graduate curricula in Mechanics and Computation are offered which include core work in solids, fluids and computational mechanics, dynamics, fracture and biomechanics. Course work is supplemented with research in the student's specialized area of interest.

The Mechanics and Computation Group is located in the Building 520. The building provides offices, computer facilities, research laboratories, and seminar rooms for faculty, research associates, and graduate students of the Group. MS candidates planning to proceed to a Ph.D. program are encouraged to consider arranging three or more units of directed study (ME391/392) during their MS program.

THERMOSCIENCES GROUP
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Juan Santiago, Professor
Sindy Tang, Associate Professor
Hai Wang, Professor
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Mary Hanrahan – Group Administrative Lead

The Thermosciences Group conducts experimental and analytical research on both fundamental and applied topics in the general area of thermal and fluid systems. Research strengths include high Reynolds number flows, microfluidics, combustion and reacting flows, multiphase flow and combustion, plasma sciences, gas physics and chemistry, laser diagnostics, microscale heat transfer, convective heat transfer, and energy systems. Research motivation comes from applications including air breathing and space propulsion, bioanalytical systems, combustion and pollution control, electronics fabrication and cooling, stationary and mobile energy systems, biomedical systems, and materials processing. Emphasis is on fundamental experiments leading towards advances in modeling, optimization, and control of complex systems.

Facilities

The Thermosciences Group has three major laboratory facilities. The High Temperature Gasdynamics Laboratory includes research on laser diagnostics and sensors, plasma sciences, coal and biomass combustion and gasification, combustion and fuel conversion kinetics, pollutant formation during combustion, and reactive and non-reactive gas dynamics. Research facilities include diagnostic devices for combustion gases, a spray combustion facility, laboratory combustors including a coal combustion facility, a supercritical water combustion and gasification facility, supersonic combustion facilities, several advanced laser diagnostics systems, a variety of plasma facilities, a pulsed detonation facility, and five shock tubes and tunnels.

The Thermosciences Group and the Design Group share the Microscale Thermal and Mechanical Characterization laboratory (MTMC). MTMC is dedicated to the measurement of thermal and mechanical properties in thin-film systems, including micro fabricated sensors and actuators and integrated circuits, and features a nanosecond scanning laser thermometry facility, a laser interferometer, a near-field optical microscope, and an atomic force microscope. The activities at MTMC are closely linked to those at the Heat Transfer Teaching Laboratory (HTTL), where undergraduate and master's students use high-resolution probe stations to study thermal phenomena in integrated circuits and thermally actuated micro valves. HTTL also provides macroscopic experiments in convection and radiative exchange.

The Energy Systems Laboratory is a teaching and research facility dedicated to the study of energy conversion systems. The lab includes three dynamometers for engine testing, a computer-controlled variable engine valve controller, a fuel-cell experimental station, a small rocket testing facility, and a small jet engine thrust stand

GRADUATE POLICY
Please note, all university deadlines and policies are detailed in the Stanford Bulletin and Academic Calendar, the official documents of the University.

Enrollment

To retain your student status, you must be enrolled full time (8-10 units) during Autumn, Winter and Spring Quarters. Exceptions to this rule:

- Honors Coop (SCPD students) are part time
- In the final quarter of your degree program, if your requirements will be fulfilled by taking less than 8 units, you may petition to take 3-7 units via the department and registrar's office, with the Tuition Adjustment petition.
- TGR students must enroll in the 0 unit TGR course*
- PhD students on a Graduation Quarter should be enrolling in the 0-unit TGR course. Approval for Graduation Quarter Status is via the department and registrar's office. Graduation Quarter status is for those that are completely finished with graduation requirements and are not enrolling in classes the final quarter. Students who do the Tuition Adjustment petition to take 3-7 units should only enroll in the 3-7 units they need to graduate.
- Students with documented disabilities through the Office of Accessible Education may petition to take less than 8 units via the registrar's office

* TGR is a special status that Ph.D. students may attain once they have completed all their formal course work. While enrolled as a TGR student, you may take up to three units in addition to the TGR course without increasing your tuition bill. By definition, TGR students have completed all course requirements, so any courses taken during TGR status must not be necessary for degree conferral. For example, taking 1 course per quarter to complete a Ph.D. Minor while on TGR status is not allowed. Many students take advantage of this opportunity to take "fun" classes like athletics or art.

Although Summer Quarter enrollment is optional for most, if you are working as a summer TA, CA or RA, or you are receiving a fellowship during summer, you must enroll in the appropriate number of units depending upon your specific assistantship or fellowship. For questions about how many units you should enroll in, please contact the Student Services Office.

Enrollment is completed via Axess and must be done by the first day of each quarter. The registration (study list) deadlines are published in the University Academic Calendar. **Failure to register on time will cost you a late fee of at least $200, assessed by the registrar's office.** If an International student misses the enrollment deadline, they will not be in good standing with regards to their visa.

Follow the on-line directions in Axess to register. If a course allows you to choose a grading option (letter grade or S/NC), be sure to select the correct grading option to meet your degree requirements. See the section on degree requirements (p. 30) for more details. There is a quarterly deadline to change the grading option. Once this deadline has passed, you will not be able to change it. Please read the policy on grading option carefully so you do not enroll in the wrong option for a given course. If there is a choice between letter grade and credit/no credit, and the course is a required course (Math, Depth, Breadth or Approved Electives), you must choose a letter grade. Required courses taken for credit/no credit will not be counted towards graduation requirements.

Units

Graduate students in the School of Engineering must enroll for a minimum of 8 units per quarter (except in Summer Quarter) with some exceptions listed above. A typical academic load for students is 9-10 units, although students who are not restricted by a fellowship or assistantship may choose to do 11-18 units. Students who seek exception to the 8-unit minimum policy must meet one of the following criteria:

- You will finish all degree requirements and complete the program during the quarter for which 3-7 units is requested, and you will not be enrolled the following quarter. Request for Tuition Adjustment must be approved by the Student Services Office and the Registrar.

- You have received approval from the Office of Accessible Education for special accommodation. Request for Tuition Adjustment must be approved by the Student Services Office and the Registrar.

- You are a Ph.D. or ENG student and have completed all requirements and milestones except for the oral defense and thesis. You must enroll in the 0 unit TGR course. Petition for Terminal Graduate Registration (TGR) status must be approved by the Student Services Office and the Registrar.

- All degree requirements have already been completed. Since students must enroll during the quarter of degree conferral, you may petition for a one-time $150 tuition quarter for the purpose of graduating. In this case, you must enroll in the 0 unit TGR course. Petition for Graduation Quarter must be approved by the Student Services Office and the Registrar. Important note: If a Ph.D. student takes a graduation quarter but does not complete the degree requirements during that quarter, the tuition rate will revert back to full tuition rate for the following quarter. A new TGR petition must be filed to regain TGR status.

All petitions can be submitted via eForms or downloaded from the University Registrar's Office Graduate Forms page.

2019 – 20 Graduate Engineering Tuition Schedule

Units	Cost Per Quarter
11-18*	$18, 635
8-10	$12, 110
TGR**	$3, 411

*Tuition continues to increase by the per-unit rate for each unit taken above 18

**TGR: Applicable only to post-MS students who have completed all University and Department requirements except for oral exam and dissertation submission.

Fall Quarter Preliminary Study List Deadline (September 23): Failure to enroll in at least 8 units (or the TGR course if applicable) by this date will result in at least a $200 late charge.

Fall Quarter Final Study List Deadline (October 11): Last day to add, drop or adjust units.

Fall Quarter Withdraw: You may withdraw from a course after the Final Study List Deadline until November 4th. A "W" will be recorded on your transcript for that course. Students who do not officially withdraw from a class by November 4 will be assigned a grade by the instructor. **"W" grades cannot be changed by retaking the course.**

Fall Quarter Incomplete: If you need to take an incomplete or "I" for a course, you must make arrangements with the instructor by the last day of class on December 6. All coursework must be completed, and the incomplete must be changed to a credit or grade within one academic year. Failure to do so will automatically result in a failed grade that cannot be changed under any circumstances.

Course Retakes: Generally speaking, completed courses may be retaken one time. When retaking a course, you must register for the same number of units as when you originally took the course. The units for the first attempt will change to zero, and the grade or notation will change to "RP". The grade for the second attempt will include an indication that it is a repeated course. You may only retake a course for a third time if an "NC" (no credit) or an "NP" (not passed) was received for the second attempt.

University Unit Requirement

Each type of degree has a specific total unit requirement, set by the University (please see the Stanford Bulletin for details). This should not be confused with department degree unit requirements, which may differ. Students in doctoral programs are eligible for the TGR tuition rate when they have completed the unit requirement as well as all other requirements established by the University and the Department.

Students Completing More than One Graduate Degree Program

If you are pursuing more than one graduate degree, you may not double-count units towards the different degrees. The major exception to the policy is that the 45 units required for the Master's degree are included in the 135 units required for the doctoral degree. It is also possible for a student who did an MS degree at another university to transfer *up to* 45 units towards their Ph.D. degree. The number of eligible transfer units is reviewed and approved via the registrar's office.

Unit Requirement Chart

Note: In addition to meeting University requirements, students must also meet department unit degree requirements (see degree section).

Degree Requirement	Units	Maximum Transfer	TGR Requirement
Masters	45	0	N/A
Engineer	90	45	90
Doctorate	135	45	135

To Change or Add a Degree Program

To change or add a degree program, you must complete the Graduate Authorization Petition process (a paper form, and a petition online). The Graduate Authorization Petition is on-line, via Axess. MS students interested in staying for a Ph.D. must complete the paper petition BEFORE submitting the on-line petition. Be sure to complete this petition process no later than the quarter before conferring your MS degree. Failure to do so will force you to apply for the Ph.D. program as an outside applicant. Ph.D. students who wish to add the MS to their program also need to submit a Graduate Authorization Petition. Submitting the on-line petition via Axess will incur a fee regardless of the outcome, so please be certain of your intentions before completing the on-line form. The petition should be used in the following situations:

1. A matriculated ME Ph.D. student who would like to add the MS program must submit the Graduate Authorization Petition to the Student Services Office no later than the quarter before conferring your Ph.D. After the form is filed with the Student Services Office, the student must submit the on-line petition via Axess. No funding form is required. Note that the M.S. program should be conferred at the same time or before the Ph.D. is conferred to avoid administrative delays and additional fees.
2. A matriculated MS-ME student who would like to continue with a Ph.D. must submit the Graduate Authorization Petition to the Student Services Office no later than the quarter before the final MS quarter, although it can be earlier than this. The student must secure funding and advising for the Ph.D. program through a faculty sponsored assistantship (or have proof of fellowship support), and have the faculty member sign the form. If the faculty member is from a department other than Mechanical Engineering, is appointed by courtesy, or is emeritus, the student must secure a co-advisor in Mechanical Engineering before the petition will be approved. In order to add the Ph.D., the student must have a minimum 3.5

GPA. (The Graduate Admissions Committee will consider forms from new students with no Stanford GPA or students with <3.5 GPA, with an explanation/rationale from the advisor.) Faculty who sign the petition are committing to support and advising for the duration of the Ph.D. program pending satisfactory degree progress. After the form is filed with the Student Services Office, the student must submit the on-line petition via Axess. If the MS degree is conferred prior to the addition of the Ph.D. degree, the student will be required to apply for the Ph.D. program as an "external" applicant and adhere to application deadlines, pay application fees, etc.

3. New students interested in adding the MS or Ph.D. must complete their first quarter with a minimum 3.5 GPA in order to be eligible for the Graduate Authorization Petition review.
4. A matriculated graduate student changing departments (on-line petition only). Please talk to the Admissions and Financial Aid Specialist before submitting the online petition because the fee will apply whether the transfer is successful or not
5. A matriculated graduate student in the ME Department changing fields (e.g., from MS-ME to MS-ENGR in Biomechanical Engineering). No funding forms required.

Note: International students are required to submit proof of adequate financial support prior to obtaining departmental approval. Contact the Bechtel International Center for details.

Academic Progress Requirement

Graduate students enrolling at full tuition (11-18 units per quarter) must enroll for at least 11 units per quarter and pass at least 8 units each quarter; those registering at 8-10 units per quarter must enroll for at least 8 units per quarter and pass at least 6 units per quarter. Please note: students appointed as 50% (20 hours per week) teaching or research assistants may only enroll in 8-10 units. Enrolling in more than 10 units is not permitted under any circumstances.

Leave of Absence for Graduate Students

Graduate students may find themselves in need of a Leave of Absence. Common reasons for interrupting school temporarily are family emergencies, illness, financial difficulties, or even employment or internship opportunities that could further progress in research.

Procedure to File a Leave of Absence: A leave of absence for an MS student must be approved in the department (no advisor signature required). Ph.D. students must also have their primary advisor sign the form before submitting to the student services office. Although there is no signature line for the graduate student's advisor, an irrelevant signature line (i.e. a line for undergraduate students) can be used for this purpose. If you cannot get your advisor's signature, an e-mail from the advisor to Michelle Rice at malucas@stanford.edu will suffice. Evidence of good academic progress is a requirement to obtain approval. The leave form must be approved by the Student Services Office and submitted to the Registrar's Office for final approval and processing.

International students must also obtain approval from the Bechtel Center to ensure visa requirements are met. Failure to enroll without first obtaining approval for a Leave of Absence will cause discontinuation of your student status.

Once a leave of absence is granted, the right to use University facilities (i.e. housing, libraries, athletic facilities, etc.) is revoked as student status will not be active during the leave. This also applies to any Stanford funding (e.g., fellowships, assistantships and loans). Therefore, a student is advised to think carefully before requesting a leave. Should one be necessary, please consult with the Student Services Office.

FINANCIAL AID

What is an Assistantship: Assistantships are **contracts** for students to do research, teach, or provide course support in exchange for salary and tuition benefits.

***Research Assistant**: A matriculated **and** registered graduate student who participates in a research project under the supervision of a faculty member*. For the most part, research assistants are selected by individual faculty with available research funding. Continuation of a research assistantship depends on the quality of the work performed and the availability of research funds. An assistantship that spans multiple years requires a new RA form at the beginning of each year.

***Teaching Assistant**: A matriculated **and** registered graduate student who assists a faculty member to teach his or her course.* Duties vary and may include: preparing for class sections and/or labs, grading exams or papers and holding regular office hours. Teaching assistants are not expected to independently assign final grades.

***Course Assistant**: A matriculated **and** registered graduate student who assists a faculty member to teach his or her course.* Duties vary and may include assisting to prepare lecture materials, conducting review sessions, holding office hours and grading exams. Course Assistants have less independence than Teaching Assistants.*

*All Teaching Assistants and Course Assistants regardless of what courses are being taught, are required to fulfill the Mechanical Engineering CA/TA training program.

POLICIES: STUDENTS WITH TEACHING/COURSE/RESEARCH ASSISTANTSHIPS

Note: All individuals who serve as Course or Teaching Assistants for courses offered by Mechanical Engineering must participate in the TA Orientation program offered by the Vice Provost for Teaching and Learning (VPTL), as well as the department specific training. Sessions are given each quarter throughout the year. More information can be found on the VPTL website:

Enrollment*:* All students holding assistantships **must** be enrolled for courses (minimum 8 units) during the quarter for which the assistantship appointment is held (**including Summer Quarter**). Although summer enrollment is optional for students who are not holding assistantships, it is mandatory for research, teaching and course assistants. Students holding 50% assistantships are prohibited from taking more than 10 units.

Tuition: The tuition grant that is part of the compensation package can be used only for tuition charges. It is not transferable for cash, cannot be used by another student, and cannot be used for other charges, such as ASSU fees or health insurance. The tuition credit will appear on the student bill **after** the student has enrolled for a minimum of 8 units, or 3-7 units if a petition has been approved for a disability or Part-Time Enrollment registration. Students with approved TGR status must enroll for the TGR course. Students who have been approved for Graduation Quarter must enroll in the TGR course (Ph.D.).

Tuition payment: The amount of tuition paid is based on the total percentage of time employed in any given quarter, as shown below. The student must be appointed for the entire quarter or the tuition charges will be billed back to the student. Engineer and Ph.D. students who are eligible for TGR will receive **only** the TGR tuition rate regardless of the percentage of the appointment. Students in their final quarter with an approved "reduced tuition" rate will only receive a tuition grant for the number of units taken. Students in their "graduation quarter" will receive a tuition grant in the amount of $150.

Important note: If a Ph.D. student takes a graduation quarter but does not complete the degree requirements during that quarter, the tuition rate will revert back to full tuition rate for the following quarter. Please email the ME Degree Progress Officer if you need to return to TGR status.

Use of all credit – With the exception of students with TGR status, students on assistantships must enroll for a minimum of 8 units (with some exceptions, listed earlier). Students with half-time assistantships (50% time or 20 hours per week) are entitled to receive tuition credit for 8-10 units per quarter. Students with 25% assistantships (10 hours per week) receive 5 units of tuition credit and are required to pay the remaining tuition due.

Students with 50% appointments are expected to work a maximum of 20 hours per week in addition to carrying an 8-10 unit load per quarter, and are prohibited from taking more than 10 units. Students with 25% appointments work 10 hours per week in addition to carrying an 8-10 unit load (or more) per quarter. An academic quarter lasts 12 working weeks, including the exam week. Some assignments will require the assistant to start one week before the quarter begins.

The assistantship salary and tuition credit begins and ends each quarter as follows:

Autumn Quarter: October 1 - December 31 (first pay check available 10/22 and last check 1/7)
Winter Quarter: January 1 - March 31 (first pay check available 1/22 and last check 4/7)
Spring Quarter: April 1 - June 30 (first pay check available 4/22 and last check 7/7)
Summer Quarter: July 1 – September 30 (first pay check available 7/22 and last check 10/7)

The check cut on the 22nd of the month covers work completed from the 1st through the 15th. The check cut on the 7th of the month covers work completed from the 16th through the 31st of the prior month. For example, if you start working on October 1st, your first paycheck on October 22 will cover your pay period October 1 - 15. Your second paycheck, for the pay period October 16 – 31, will be cut on November 7th. These are the formal periods used for delivery of salary payments. Students who are required to start work before the quarter begins receive no extra allowance, but the research or teaching supervisor should adjust the schedule so it does not exceed the norm. We highly recommend setting up direct deposit to avoid lost checks in the U.S. mail.

Assistantship appointments are for a full quarter; there are no partial quarter assistantships available. Students on assistantships who leave the University for any reason must contact the Student Services Office to ensure that the appointment is canceled. In this case, if an assistantship is not canceled and payment continues, the student will be responsible for repayment of salary, **plus any fees incurred.** If you know in advance that you will not be able to work for the whole quarter, you may be able to work as an hourly employee instead. However, tuition benefits are not part of hourly employment agreements.

Summer Quarter RA appointments: During Summer Quarter, it may be possible for you to work more than 50% time if your research supervisor has adequate funding and allows for it. It is quite common for summer RA appointments to be increased to 75% or even 90% time. A 90% appointment is the maximum allowable for enrolled students. Please note that you must enroll if you are going to work as an assistant during Summer Quarter. Failure to enroll will result in payments being withheld. During Summer Quarter, the tuition benefit is in reverse proportion to the number of hours worked. For example, 50% appointments pay for 8-10 units, but 75% appointments pay for only 5 units and 90% appointments pay for 3 units. You should enroll in the correct number of units according to how much your tuition grant will be. If you enroll in the wrong number of units, you may receive a tuition bill for anything your assistantship does not

cover. You will have to contact the Student Services Center on the 2nd Floor of Tresidder Union should this occur.

NOTE: TGR students must enroll in the TGR course. TGR students who are Research Assistants may take up to three units in addition to the TGR course and the tuition will be paid. However, if you take more than 3 units during a TGR quarter, you will be responsible for paying any extra tuition. (This applies to all TGR quarters, not just Summer Quarter.) Please note that you may not take courses necessary for a degree requirement (including a Ph.D. minor) while on TGR status.

Work in Addition to an Appointment or Stanford Fellowship: Employment in addition to a 50% assistantship or full fellowship **cannot exceed 8 hours per week**. This policy is monitored very closely by the School of Engineering Student Affairs Office. Students on the Graduate Engineering Fellowship, Stanford Graduate Fellowship and NSF should consult the ME Student Services Office prior to accepting employment. Ph.D. students working as Research Assistants must get permission from the faculty advisor. Immigration regulations prohibit International students on F and J visas to work in addition to a 50% assistantship while enrolled full time. International students must be aware of visa restrictions. Information on visas should be obtained from the Bechtel International Center.

Benefits: Students on assistantships do not accrue sick leave or vacation. Time off is subject to the approval of the faculty supervisor and must be requested well in advance.

Health Subsidy: Students who have RA/TA/CA appointments of at least 25% time for any given quarter are eligible for the university health subsidy, which will pay one half of the Cardinal Care health premium, should you choose to enroll in Cardinal Care. You are responsible for paying the other half. In order to receive the subsidy, your appointment must be fully approved by the supervisor, all paperwork must be signed and submitted on time, and you must be enrolled in courses by the Study List Deadline. If you fail to meet any of these requirements during any given quarter, you will forfeit your health subsidy for that quarter.

Fellowships: Stanford fellowships and outside fellowships that are processed by Stanford are paid on a quarterly basis. The tuition (if applicable) is credited to the student's account directly and the Student Financial Services office will deduct fees such as health insurance from the stipend. The remainder will be deposited directly to your bank account if you have requested direct deposit, or mailed to your mailing address. We highly recommend direct deposit for the most convenient and timely receipt of stipend payments. If you receive a fellowship that is paid directly to you, please contact the Mechanical Engineering Director of Student and Academic Services and include documentation detailing the funding package. You must provide this information prior to the start of each academic year that you hold the outside fellowship

Note: If you are appointed to an assistantship when your fellowship ends, keep in mind that there will be a two-week delay before your first assistantship paycheck is issued. You also must file employment paperwork at the onset of your assistantship. Please stop by the Student Services Office for more information.

Fellowship Health Subsidy: Students who receive a non-tuition stipend at or above the minimum salary for a 25% assistantship (CA or RA) for any given quarter are eligible for the university health subsidy, which will pay one half of the Cardinal Care health premium. You are responsible for paying the other half. In order to receive the subsidy, your fellowship must be fully approved on time, and you must be enrolled in courses by the Study List Deadline. If you fail to meet any of these requirements during any given quarter, you will forfeit your health subsidy for that quarter. If you receive an outside (non-Stanford) fellowship that pays you directly, you *may* be eligible for the health subsidy if the student services office receives official

details (copy of the award letter) by the health subsidy deadline. The amount of the external fellowship dictates whether the health subsidy will be paid or not. Please contact the Student Services Office for more information. Questions about health insurance coverage and payments of premiums should be directed to Vaden Health Center.

HOW TO OBTAIN PAYMENT

Responsibility of Processing Payment: Students paid by mechanical engineering accounts must ensure that all necessary documentation is completed and submitted appropriately. Delays will not only delay payment, but may result in the loss of the University's student health subsidy. It is strongly advised that students be proactive to make sure that the assistantship is processed well in advance of the anticipated start date. Students who need help should contact the Mechanical Engineering Student Services Office and/or their group administrator. If you are expecting a credit for your tuition because you are on fellowship or have an assistantship, please be sure to check your bill a couple days before it is due. If you do not see a credit, please come to the Student Services Office immediately.

Social Security Number: Students receiving research or teaching assistantships must obtain a social security number. International students on Stanford based fellowships are to obtain an Individual Tax Identification Number (ITIN) from the Bechtel International Student Center in order to receive their fellowship funds.

International students who do not have a social security number must apply for one through the Social Security Administration Office. As national security concerns have increased over the last decade, federal regulations evolve rapidly. In order to ensure that you have the most updated information on how to apply for and obtain a social security card, please see the Bechtel International Student Center website.

Note: In a response to "national security and fraud concerns," the Social Security Administration has implemented policy that requires verification of certain information in an Immigration and Naturalization Services (INS) database. The Social Security Administration strongly suggests that a student wait 10-12 days after arriving to the United States before applying for the Social Security Number. This will allow adequate time for information verification.

The closest Social Security Administration office is located at:

701 N. Shoreline Blvd., First Floor, Mountain View, CA 94043
Office Hours: M, T, Th, F 9:00 am to 4:00 pm and W 9:00am-12:00pm
Phone: 1-800-772-1213

Note: You must apply in person.

Once you have applied for the social security number, bring your receipt to the ME Student Services Office. We can use a copy of the receipt for payroll purposes, but you must provide a copy of your social security card once you receive it.

Taxes and Tax Reporting:

a) The tuition portion of fellowships and assistantships is exempt from tax.
b) All stipends and salaries are subject to tax. The amount of tax varies according to total income, dependency status, treaty status for International students, and individual circumstances.
c) Assistantship salaries are subject to tax withholding.

d) Fellowship stipends paid to U.S. citizens and permanent resident are not subject to withholding, but are still taxable income. **Students may be responsible for making estimate tax payments during the year**, if appropriate.
e) Fellowship stipends paid to non-US citizens or permanent residents are subject to 14% tax withholding.

The Student Services Office is unable provide advice or assistance with taxes. Students are encouraged to seek the advice of tax consultants or accountants. You may also find helpful information on the Student Financial Services website.

Eligibility to Work Requirement: Per federal regulations, individuals who are paid on the Stanford payroll (assistantships, hourly appointments, etc.) must have an I-9 (identification and work eligibility form) on file prior to commencement of employment. The I-9 form requires the individual to provide appropriate documentation to prove eligibility for work (social security card, birth certificate, current driver's license). Students on visas must show a current passport and the current visa. The I-9 must be renewed when the visa is extended. Expired visas will cause the I-9 to expire and the student's appointment will automatically be canceled. Please stop by the Student Services Office to file your I-9 form, if required.

Curricular Practical Training (CPT) and Optional Practical Training (OPT): These are options for international students to obtain employment while still on a student visa. Since the degree program does not require internships or practical training, ***we allow students to do no more than one quarter each of CPT and OPT (a total of two quarters)*** during the graduate program. For more information on CPT and OPT, please speak with the ME Student Services Office and the Bechtel International Center.

Patent Agreement: The patent agreement form is required for **all** students. If you did not receive a form, please contact the Office of Technology Licensing.

English Placement Exam: International students from non-English speaking countries are required to take and pass the English Placement Examination prior to the start of their Teaching or Course Assistantship appointment. Contact the English for Foreign Students Program for details.

Part-Time Employment: Graders

Graders are hired directly by the instructor of a course, if the instructor has secured a budget for a grader. Graders are paid on an hourly basis and there is no tuition benefit. The student must obtain information about the job expectations and limitations on hours from the hiring instructor directly. Students who accept an ME grader position should work with their group administrator for payroll processing. On-line time sheets should be submitted twice a month (by noon on the 15th and the last day of the month) and require approval by the appropriate Group Administrator. **Note**: The group that the instructor is affiliated with determines who the Group Administrator is. Please see the Group descriptions at the beginning of this handbook.

A CA or TA cannot also be a grader for the same course. In addition, a student cannot enroll in a course that they are hired to CA/TA.

Note: Students on F or J visas are not authorized (per INS regulations) to perform hourly work for additional pay if they also hold a 50% assistantship appointment. International students should consult with Bechtel International Student Center for visa and employment related questions.

HOW TO OBTAIN YOUR MS DEGREE

Program Proposal

In accordance with University academic policy, MS students are required to file a program proposal by the end of the first quarter of matriculation (Honor's Coop Students have until the 4th quarter). The departmental deadline to submit the proposal for students starting their first quarter in September 2019 is the final study list deadline of **OCTOBER 11, 2019.** This applies to **all** MS students including those pursuing the MS in Design Impact and MS in Biomechanical Engineering*.

Instructions

1. Obtain the appropriate form from the ME Website or the ME Student Services Office.
2. Type or print neatly. Course titles and units must be included. Illegible forms will not be reviewed or processed.
3. Consult your advisor to obtain his/her signature.
4. Submit the form to the ME Student Services Office for review and approval. Keep a copy for your own records.
5. Proposals can take up to 14 working days to be reviewed and processed. Axess will indicate the approval of your proposals under "milestones". Proposals that are not approved will be returned to the student for revision.
6. Although your academic advisor may sign your form, the student services office, as representative of the department, has authority for final approval.

*Please note: Students interested in the MS-ENGR-BME program must fill out an on-line Axess petition to transfer programs from MS-ME to MS-ENGR-BME Please make sure to visit the Student Services Office BEFORE submitting the on-line petition.

All programs are subject to the approval of the student's advisor **and** the Director of Graduate Studies (via the Director of Student and Academic Services).

Program Proposal Revision

Students who alter their MS program during their course of study must submit a new program proposal by the **third week of their final quarter**. This is a firm deadline and there are no exceptions. Students who fail to submit a revised program sheet by the third week of the final quarter may be forced to delay graduation.

All program revisions are subject the approval of the student's advisor **and** the Director of Graduate Studies. It is important that you keep your advisor apprised of any changes to your program so that there are no problems when you submit your final program proposal.

Degree Conferral

Students must apply to graduate via Axess. Due dates are listed on the academic calendar posted by the Registrar's Office. These deadlines are firm and the University does not make exceptions. If you miss the deadline, you may be able to petition with the Registrar's Office to file your application to graduate past the deadline, but late fees will apply.

Registration is required during the degree conferral quarter; you cannot graduate during a quarter in which you are not enrolled. No exceptions.

The Student Services staff will make every effort to contact a student whose degree requirements (i.e. missing forms, missing grades) are not met prior to submitting the lists of graduating students to the University Registrar. However, due to time constraints and other demands imposed on the staff, you are responsible to ensure you meet all graduation requirements. If you have questions about graduation and degree requirements, please contact the ME Student Services Office.

Commencement

Commencement is held annually each June. There are two ceremonies: the University ceremony (main event) and the Departmental Diploma Distribution Ceremony. Information about commencement is typically available around mid to late April.

Degree Fields

Students admitted to the MS in Mechanical Engineering will not have a field listed on the diploma (i.e. Thermosciences, Design, Flow Physics, Mechanics & Computation etc.). However, students admitted to the MS in Design Impact or MS in Biomechanical Engineering will have a field listed on the diploma.

Time Limits

The University has set the following time limits for the MS degree:

1) HCP (honors cooperative students): Five years from the first quarter of enrollment in the MS program.
2) Coterminal students: Three years after the quarter in which 180 units are completed.
3) All other students: Three years from the first quarter of enrollment in the MS program.

The Department has set the following, additional, time limit for the MS degree:
1) Three years from the first quarter of enrollment in the MS program, **or 60 units completed**.

Extensions of time limits are subject to the approval of the Department and the School of Engineering. Students having difficulty meeting the above time limits should consult their advisor and/or the Director of Student and Academic Services.

MASTER OF SCIENCE IN MECHANICAL ENGINEERING

The following requirements must be met for the MS Degree in Mechanical Engineering:

1. ***Mathematical Fundamentals (6 units)***: Two math courses from the following list are required for the MS degree: ME300A, ME300B, ME300C, CME302, ME408, EE261, EE263, ENGR155C/CME106, MATH courses with catalog numbers greater than 200, and CME courses with catalog numbers greater than 200 (excluding CME 285). In addition, courses must cover two different areas out of: partial differential equations, linear algebra, numerical analysis and statistics. This excludes programming classes such as CS106A/B/X, CME211, CME212, CME213, CME214* and CME292. Those classes can be placed in the approved electives category. Students with questions about their math curriculum covering two different areas should consult with their advisor. Courses taken for the math requirement must be taken for a letter grade.

2. ***Depth in Mechanical Engineering:*** "Depth" refers to a cluster of courses with thematic and/or technical continuity that enables a student to study a part of mechanical engineering in more depth, with more focus, and over a period of time. A depth cluster or area typically is made up of 10-12 units (2-3 courses). The depth areas described on the following pages have been approved by the faculty as providing depth in specific areas as well as a significant component of applications of the material in the context of engineering synthesis. Courses taken in the depth area must be taken for a letter grade.

3. ***Breadth in Mechanical Engineering:*** "Breadth" refers to graduate level ME courses outside of the student's depth area. The intent is for students to engage in course work in areas of mechanical engineering outside of the depth to broaden understanding and competency in a wider range of topics. Two courses are required from the list of eligible breadth courses described under each depth area. Courses taken in the breadth area must be taken for a letter grade.

4. ***Sufficient Mechanical Engineering Coursework:*** Students must take a minimum of 24 units of coursework in mechanical engineering topics. For the purposes of determining mechanical engineering topics, any course on approved lists for the math requirement, depth requirement and breadth requirement counts towards these units. In addition, any *graduate level* course with a ME course number is considered a mechanical engineering topic. Research (independent study) units cannot count towards the 24 units of ME coursework.

5. ***Approved Electives:*** Additional graduate (numbered 200+) engineering, math and science courses will bring the total number of units to at least 39. All of these units must be approved by the student's advisor. Graduate engineering, math and science courses are normally approved. Of these 39 units, no more than 6 units may come from independent study (ME391 and 392) and no more than 3 units may come from seminars. A student planning to continue for a Ph.D. should have a discussion with the academic advisor about taking ME391 or ME392 during the master's program. Approved electives must be taken for a letter grade unless grades are not an option (e.g. seminars and ME391 and 392). ME491 and ME492 may not be included in approved electives. Students may use one of the following courses as an approved elective, without petition: CS106A, CS106B, CS106X, CS107.

Note: Students participating in ME391 or ME392 should make the necessary arrangements with a member of the faculty. In addition, the faculty member and the student should determine the number of units for the course. ME391 and ME392 may only be taken on a credit / no credit basis. If a student takes an independent study in a different department, the grading option should be credit/no credit.

6. ***Unrestricted Electives:*** These courses will bring the total number of units submitted for the MS degree to 45. Students are strongly encouraged to take these units **outside** of engineering, mathematics or the sciences. Students should consult their advisor for recommendations on course loads and on ways to use the unrestricted electives to make a manageable program. Unrestricted electives must be level 100+ and may be taken credit/no credit.

7. ***Laboratory Requirement***: Within the courses satisfying the requirements above, there must be at least one graduate-level course with a laboratory component. Courses which satisfy this requirement are ME203, ME210, ME218ABCD, ME220, ME250*, ME287, ME310ABC, ME318, ME323*, ME324, ME348, ME354, or ME367.

   ME391, ME392, and ME398 will satisfy this requirement if 3 units are taken for work involving laboratory experiments.

Candidates for the MSME degree are expected to have a minimum GPA of 3.0 in the 45 units counted towards the degree.

Students considering a Ph.D. in Mechanical Engineering should review the permitted qualifying examination courses when making their course selections (p. 47-48)

*Course not offered in 2019-2020.

DEPTH AND BREADTH AREAS FOR THE MSME DEGREE

Note: Course descriptions and availability should be checked using the Stanford Bulletin, Explore Courses, and the Quarterly Time Schedules as course offerings are subject to change.

Instructions

Depth – Select **one** area as your specialty
Breadth – Select two courses (6 units) from area(s) outside your depth, as noted in each depth area description. They can come from two different areas.
Courses marked with * indicate that they are not offered in 2019-2020

1. **Automatic Controls** (any three of the following):

ENGR105	Feedback Control Design	3 Units
ENGR205	Introduction to Control Design Techniques	3 Units
ENGR209A	Analysis and Control of Nonlinear Systems	3 Units
AA203	Optimal and Learning-Based Control	3 Units
AA212*	Advanced Feedback Control Design	3 Units
EE266*	Introduction to Stochastic Control with Applications	3 Units

Breadth: If depth is **Automatic Controls** (Area 1), select any **two** courses (6 units) from one or two of areas: 2-14.

2. Biomechanical Engineering

Depth: Three courses totaling at least 9 units are required, and must include at least two Foundational Courses.

Foundational Courses		
ME239*	Mechanics of the Cell	3 units
ME244	Mechanotransduction in Cells and Tissues	3 Units
ME281	Biomechanics of Movement	3 Units
ME283	Introduction to Biomechanics and Mechanobiology	3 Units
ME287	Mechanics of Biological Tissues	4 Units
ME337*	Mechanics of Growth	3 Units
System-Specific Courses		
ME234	Introduction to Neuromechanics	3 Units
ME285*	Computational Modeling in the Cardiovascular System	3 Units
ME303*	Biomechanics of Flight	3 Units
ME328*	Medical Robotics	3 Units
ME381*	Orthopaedic Bioengineering	3 Units
ME485	Modeling and Simulation of Human Movement	3 Units

Breadth: If depth is **Biomechanical Engineering** (Area 2), select any **two** courses (6 units) from one or two of areas 1, 3-14. If depth is other than Biomechanical Engineering (Area 2), select any course from the list above.

3. Mechatronics (any two of the following):

ME218A	Smart Product Design Fundamentals	4-5 Units
ME218B	Smart Product Design Applications	4-5 Units
ME218C	Smart Product Design Practice	4-5 Units

Breadth: If depth is **Mechatronics** (Area 3), select any **two** courses from one or two of the following areas: 1-2, 4-14. If depth is in an area other than Mechatronics, ME210 may be taken as a breadth course in Mechatronics.

4. **Design Methodology** (all three must be taken)

ME310A	Engineering Design Entrepreneurship and Innovation	4 Units
ME310B	Engineering Design Entrepreneurship and Innovation	4 Units
ME310C	Engineering Design Entrepreneurship and Innovation	4 Units

Breadth: If depth is **Design Methodology** (Area 4), select any **two** courses (6 units) from one or two of the following areas: 1-3, 5-14. If depth is in an area other than Design Methodology, ME318 and ME324 may be taken as breadth courses in Design Methodology.

5. **Manufacturing and Product Realization**

Take two of the following*:

ME203	Design and Manufacturing	4 Units
ME219	The Magic of Materials and Manufacturing	3 Units
ME318	Computer-Aided Product Creation	4 Units

*Students who were Stanford undergraduates and used ME203 towards their BS degree may not use ME203 towards their Product Realization Depth Sequence.

PLUS ONE OF THE FOLLOWING

ME225	Scaling Your Vision	3 Units
ME324	Precision Engineering	4 Units
ME325	Making Multiples, Injection Molding	3 Units

Breadth: If depth is **Manufacturing and Product Realization** (Area 5), select any **two** courses from one or two of the following areas: 1 - 4, 6 -14.

6. Fluid Mechanics (both must be taken)

ME351A	Fluid Mechanics	3 Units
ME351B	Fluid Mechanics	3 Units

PLUS ONE OF THE FOLLOWING

ME355*	Compressible Flow	3 Units
ME361	Turbulence	3 Units
ME451A/B/C*	Advanced Fluid Mechanics	3 Units Each
ME457*	Fluid Flow in Microdevices	3 Units
ME461	Advanced Topics in Turbulence	3 Units

Students with exceptionally strong backgrounds in Fluid Mechanics may substitute ME351A and/or ME351B with other courses listed in this depth area (with advisor's consent).

Breadth: If depth is **Fluid Mechanics** (Area 6), select any **two** courses from one or two of the following areas: 1-5, 7, 8 (excluding 352C), 9-14.

7. **Energy Systems** (both must be taken)

ME370A	Energy Systems I: Thermodynamics	3 Units
ME370B	Energy Systems II: Modeling and Advanced Concepts	4 Units

PLUS ONE OF THE FOLLOWING:

ME362A	Physical Gas Dynamics	3 Units
CHEMENG242	Basic Principles of Heterogenoeous Catalysis with Applications in Energy Transformations	3 Units
MATSCI303	Principles, Materials and Devices of Batteries	3 Units

Breadth: If depth is **Energy Systems** (Area 7), select any **two** courses from one or two of the following areas: 1-6, 8-14.

8. **Heat Transfer** (any three of the following)

ME131	Heat Transfer	4 Units
ME352B	Fundamentals of Heat Conduction	3 Units
ME352C	Convective Heat Transfer	3 Units

Breadth: If depth is **Heat Transfer** (Area 8), select any **two** courses from one or two of the following areas: 1-6, 7, 9-14.

9. Reactive Gas Dynamics

ME362A	Physical Gas Dynamics	3 Units

PLUS TWO OF THE FOLLOWING

ME362B*	Nonequilibrium Processes in High-Temperature Gases	3 Units
ME364	Optical Diagnostics and Spectroscopy	3 Units
ME371	Combustion Fundamentals	3 Units
ME372	Combustion Applications	3 Units

Breadth: If depth is **Reactive Gas Dynamics** (Area 9), select any **two** courses from one or two of the following areas: 1-8, 10-14.

10. Solid Mechanics (Any three of the following):

ME333*	Mechanics – Fundamentals and Variational Methods	3 Units
ME340	Mechanics – Elasticity and Inelasticity	3 Units
ME338	Continuum Mechanics	3 Units
ME335A	Finite Element Analysis	3 Units
ME335B*	Finite Element Analysis	3 Units
ME335C*	Finite Element Analysis	3 Units

Breadth: If depth is **Solid Mechanics** (Area 10), select any **two** courses from one or two of the following areas: 1-9, 11-14. If depth is in an area other than Solid Mechanics, ME337*, ME339 and ME346A/B* may be taken as breadth courses in Solid Mechanics.

11. Dynamics: (Any three of the following):

ME331A*	Advanced Dynamics and Computation	3 Units
ME331B*	Advanced Dynamics, Simulation and Control	3 Units
AA242A	Classical Dynamics	3 Units
ME227	Vehicle Dynamics and Control (limited enrollment)	3 Units
CS225A	Experimental Robotics	3 Units
ME334	Advanced Dynamics, Controls and System Identification	3 Units

Breadth: If depth is **Dynamics** (Area 11), select any two courses from one or two of the following areas: 1-10, 12-14.

12. MEMS (Three courses required. Two or three of the following):

ENGR240	Intro to Micro and Nano Electromechanical Systems	3 Units
ENGR241	Advanced Micro and Nano Fabrication Laboratory	3 Units
ME321	Optofluidics: Interplay of Light and Fluids at the Micro and Nanoscale	3 Units
ME358*	Heat Transfer in Microdevices	3 Units
ME373	Nanomaterials Synthesis and Applications for Mechanical Engineers	3 Units
ME414	Solid State Physics for ME Experiments	3 Units
ME457*	Fluid Flow in Microdevices	3 Units

Plus (if only two were taken from above)

MATSCI316	Nanoscale Science, Engineering and Technology	3 Units

Breadth: If depth is **MEMS** (Area 12), select any two courses from one or two of the following areas: 1-11, 13, 14

13. Robotics and Kinematics (any three of the following)

ME271E*	Aerial Robot Design	4 Units
ME320	Introduction to Robotics	3 Units
CS225A	Experimental Robotics	3 Units
CS327A	Advanced Robotic Manipulation	3 Units
ME322*	Kinematic Synthesis of Mechanisms	3 Units
ME327	Design and Control of Haptic Systems	4 Units
ME328*	Medical Robotics	3 Units
ME330*	Advanced Kinematics	3 Units

Breadth: If depth is **Robotics and Kinematics** (Area 13), select any two courses from one or two of the following areas: 1-12,14.

14. Materials and Stress Analysis (any three of the following)

ME219	The Magic of Materials and Manufacturing	3 Units
ME241*	Mechanical Behavior of Nanomaterials	3 Units
ME309*	Finite Element Analysis in Mechanical Design	3 Units

ME345	Fatigue Design and Analysis	3 Units
ME348	Experimental Stress Analysis	3 Units

Breadth: If depth is **Materials and Stress Analysis** (Area 14), select any two courses from one or two of the following areas: 1-13.

MASTER OF SCIENCE IN ENGINEERING
Field Designation: Biomechanical Engineering

The Master of Science in Engineering: Biomechanical Engineering (MSE:BME) promotes the integration of engineering mechanics and design with the life sciences. The eligibility requirements for this degree program are the same as for the Master of Science in Mechanical Engineering. Applicants are expected to have an additional exposure to biology and/or bioengineering in their undergraduate studies. Students planning for subsequent medical school studies are advised to contact Stanford's Premedical Advising Office in Sweet Hall.

In addition to the above eligibility requirements, students wishing to pursue this program must get approval from the Student Services Office and then complete the on-line Graduate Authorization Petition.

Degree Requirements:

1. Mathematical competence (min 6 units) in two of the following areas: partial differential equations, linear algebra, complex variables, or numerical analysis, as demonstrated by completion of two appropriate courses from the following list: ME300A, B, C; MATH106, MATH109, MATH113, MATH131P; STATS110, or ENGR155C; CME108, CME302.

   Students who have completed comparable graduate-level courses as an undergraduate, and who can demonstrate their competence to the satisfaction of the instructors of the Stanford courses, may be waived via petition from this requirement by their advisor and the Student Services Office. The approved equivalent courses should be placed in the "approved electives" category of the program proposal.

2. Graduate Level Engineering Courses (minimum 21 units), consisting of

   a) Biomechanical engineering restricted electives (9 units) to be selected from: ME239*, ME244, ME281, ME283, ME287, ME328*, ME337*, ME381*.
   b) Specialty in engineering (9-12 units): A set of three or four graduate level courses in engineering mechanics, materials, controls, or design (excluding bioengineering courses) selected to provide depth in one area. Comparable specialty sets composed of graduate engineering courses outside the Mechanical Engineering Department can be used with the approval of the student's advisor.
   c) Graduate engineering electives (to bring the total number of graduate level engineering units to at least 21). These electives must contribute to a cohesive degree program, and be approved by the student's advisor. No units may come from bioengineering courses, mathematics courses, or seminars.

3. Life science approved electives (minimum 6 units): Undergraduate or graduate biological/medical science/chemistry courses which contribute to a cohesive program.

4. Biomechanical Research Symposium ME389.

5. General approved electives (to bring the total number of units to 39): These courses must be approved by the student's advisor. Graduate level engineering, math, physical science courses and upper division undergraduate or graduate life science courses are normally approved.

6. Unrestricted electives (to bring the total number of units to 45): Students without undergraduate biology are encouraged to use some of these unrestricted units to strengthen

their biology background. Students should consult their advisor for recommendations on course loads and on ways to use the unrestricted electives to create a manageable program.

All courses except unrestricted electives must be taken for a letter grade unless letter grades are not an option.

MASTER OF SCIENCE IN ENGINEERING
Field Designation: Design Impact

The Master's Program in Design Impact is project-driven, highly immersive, and based on design thinking, the human-centered design process pioneered at Stanford. We teach the process, mindsets and skills needed to lead high-impact design teams. In our work on products, services, systems, and experiences, empathy is our guiding principle. Students completing the two-year program will earn a Master's of Science in Engineering degree with a concentration in Design Impact (MSE-Design Impact).

MSE-Design Impact Degree Requirements

In the first year, students take all their classes together as a cohort. In the second year, students will continue to work together in the year-long "Design Impact" course (ME316A, B, C: Design Master's Project), each selecting to work on a project related to one of the two Impact themes. This sequence of classes will be the culmination of their educational experience and launch them into their individual careers as designers.

The student will select electives in the second year with their advisor. The elective will be one of two types: focused on building a deep learning in the student's chosen Impact theme area and expanding the student's skill set and design toolkit. Appropriate electives are described below (5).

Candidates for the Design Impact Engineering Master's Degree are expected to have the approval to graduate from the faculty and a minimum GPA of 3.0 on the 56 units completed in the program.

Course Number	Course Title	Units	Grade
ME 313	Human Values and Innovation in Design	3	
ME 203(1)	Design and Manufacturing	4	
ME 277	Graduate Research Methods in Design	3	
CS 106A(1)(2) Or higher-numbered CS course	Programing Methodology	3	
ME341	Design Experiments	3	
ME311(3)	Leading Design Teams	3	
ME216M	Introduction to the Design of Smart Products	4	
DESINST215 Or CS448B	Design of Data Information Visualization	3	
ME or MS&E (40	Business considerations in design course (4):	3	
ME 316A(5)	Design Master's Project	4	
ME 316B(5)	Design Master's Project	4	
ME 316C(5)	Design Master's Project	4	
ME 391	Engineering Problems	1-2	
Approved elective units (6) (12 units total)			
Total Units	**(52 Minimum)**		

The above program, when completed, will fulfill the requirements for the MS Degree.

(1) ME 203 and CS 106A (or see (2)) should be completed in the first quarter (Autumn) of the degree program.

(2) CS106A is for students who have had limited exposure to computer programming and want to start at the introductory level. Students who have already had an introduction to computer science, or who have professional programming experience, should consult with their advisor on the best-fit computer science class; it must have a higher number than 106. In this case, it is recommended that the course be completed by Spring of the first year, in order to prepare for ME216M. Taking a higher level CS course does not require a petition.

(3) May substitute ME 368 d.Leadership: Design Leadership in Context

(4) A course that teaches Business Considerations in Design will be selected by the student in consultation with their advisor. Options include: ME215C: Consumer Analytical Product Design; MS&E 140X: Financial Accounting Concepts and Analysis and ACCT 317: Managerial Accounting: Performance Measurement, Compensation, and Governance.

(5) ME 316A, B & C are taken sequentially for three quarters during the second year. Students may take ONE of ME316 A, B, or C at reduced units of 2 or 3 in order to allow for a larger-unit elective. Only one quarter may be taken at reduced units, and total units for the quarter must remain above 9. This does not require a petition.

(6) Students may choose elective courses at the 100 level or higher, in consultation with their advisor, from any of the Schools at the University to fulfill their elective requirement. Electives must be selected to fulfill education and career objectives and be related to their selected theme area within the Design Impact program. **The advisor must sign-off on a program sheet containing proposed electives prior to the students committing to taking them.**

Candidates for the Design Impact Engineering Master's Degree are expected to have the approval to graduate from the faculty, and a minimum GPA of 3.0 in the 52 units completed in the program.

Note: All required classes and electives must be taken for a letter grade unless:

1) The class is not offered for a letter grade. OR
2) **Prior approval** has been granted to take a class CR/NC in the form of a signed petition filed and approved **before the class begins**.

MASTER OF SCIENCE IN ENGINEERING (no field designation)

As described in the School of Engineering section of the Bulletin, each department in the School of Engineering may sponsor students in a more general degree, the Master of Science in Engineering. Sponsorship by the Department of Mechanical Engineering requires that the student submit a petition for admission to this program and that the "center of gravity" of the proposed program lie in Mechanical Engineering. The petition must be submitted no later than the 2nd quarter of the MS program, along with a statement explaining the objectives of the program, how it is coherent, contains depth, and fulfills well-defined career objectives. The proposed program must include a minimum of 9 units of graduate level work in the Department of Mechanical Engineering and must meet the standards of rigor of the MS in Mechanical Engineering Degree Program. The graduation requirements are the same as for the Master of Science in Mechanical Engineering. Once the ME advisor and the department approve the proposal, it will be reviewed by the School of Engineering Dean's Office for final approval.

If you choose to go this route, please be sure that you are included in the e-mail lists that are managed by the Student Services Office in the Mechanical Engineering Department. Since students following this path are considered students of the School of Engineering (as opposed to the Department of Mechanical Engineering) important communications originated from the Mechanical Engineering Department may not reach you if you are not proactive in this regard.

DEGREE OF ENGINEER

The basic University requirements for the degree of Engineer are described in the "Degree" section of the Stanford Bulletin. The program is designed for students who desire to engage in more specialized study than the MS students, and who plan to take up professional engineering work upon graduation.

The admission standards for this program are substantially the same as for the Master's degree. However, since thesis supervision is required, the department cannot admit a student to the program until the student has personally arranged for a faculty member to supervise their research project. This will frequently involve a paid research assistantship awarded by an individual faculty member (usually on a sponsored research project). Students studying for their Master's degree at Stanford who wish to continue for the Engineer's degree ordinarily make such arrangements during their MS program.

The department requirements for the degree include a thesis, for which up to 18 units of credit will be allowed (ME400). In addition to the thesis, 27 units of approved course work in mathematics, science and engineering are required beyond the requirements for the Master of Science degree. The choice of courses is subject to the approval of the advisor. Students who have not fulfilled the Stanford MS degree requirements will be required to do so (up to 45 units may be transferred via petition for an MS degree received from another institution). A total of 90 units is required for the program.

All candidates for the degree of Engineer will be expected to have the approval of the faculty and to have a minimum grade point average of 3.0 for all courses (exclusive of thesis credit) taken beyond those required for the Master's degree.

DOCTOR OF PHILOSOPHY

The basic University requirements are discussed in the "Degrees" section of the Stanford Bulletin. The Ph.D. degree is intended primarily for students who plan for a career in research or teaching. For these endeavors a broad background in mathematics and engineering, along with intensive study and research experience, is necessary.

Students entering the ME Ph.D. program in Autumn 2018 or later are admitted either with or without prior arrangements for funding and supervision by specific faculty member (who serves as the research and dissertation advisor). Students admitted without a research advisor have up to four quarters to rotate in different research groups and find their best fit with a faculty member who will ultimately serve as the dissertation advisor. Until a Ph.D. research advisor is identified, new Ph.D. students remain in good standing by performing a documented "research rotation" each quarter. Research rotations are tracked by the student enrolling in *ME 398: Ph.D. Research Rotation* for at least 1 unit, and signing up for the section associated with a faculty member who has agreed to sponsor the research rotation. To facilitate introduction to the ME Ph.D. program, the first research rotation must be with a faculty member whose primary appointment is in the ME department. In addition, a new sponsor is required for each research rotation until the Ph.D. research advisor is identified. Before enrollment in a rotation, the student should come to an agreement with the faculty sponsor about the activities expected in order for the rotation to have the level of depth and interaction required to explore the fitness for a potential PhD advising relationship. Once the Ph.D. research advisor is identified (by the end of the 4th quarter), no further rotations are required and the student should obtain the advisor's signature on the "Ph.D. Advising Commitment Form" that indicates a commitment to supervise the dissertation and ensure the student's financial support for the duration of the Ph.D. The research advisor also becomes the student's academic advisor. Students who have identified a Ph.D. advisor will sign up for ME392 in their advisor's section for the remainder of their research.

The Mechanical Engineering Department encourages all Ph.D. students to make early and steady progress towards completion of the Ph.D. The primary responsibilities for monitoring the progress of these Ph.D. students lie with the Ph.D. research advisor. Until the Ph.D. research advisor is identified, the student's academic advisor can provide guidance on completing the MS and/or Ph.D. programs and finding a Ph.D. advisor. The department's Student Services Office and the Graduate Curriculum Committee also has some broad oversight responsibility. In addition to finding a Ph.D. research advisor and completing the Ph.D. qualifying exam, students are required to provide periodic progress reports as described below. Some aspects of these requirements had been informally encouraged in the past; these are now **requirements that must be met for TA and RA Appointments to be approved**, and all Ph.D. students are strongly encouraged to meet quickly with their advisors and make plans to come into compliance.

Important note: If the primary research supervisor is emeritus or not from the ME department (Courtesy appointments do not count as ME faculty), the student **must** secure an agreement with an ME faculty member to serve as co-advisor. This co-advisor must be a member of the student's Reading Committee and Oral Exam Committee.

MS Students interested in continuing towards a Ph.D. degree must secure funding and faculty supervision. If the faculty advisor is emeritus, appointed by courtesy, or from another department, a co-advisor from ME is required. Once accomplished, a "Graduate Authorization Petition" (this is two parts: a paper form, then on-line via Axess) must be completed and submitted to the ME Student Services Office no later than the quarter before the MS degree conferral. Please get approval before filing petition online. Failure to submit this petition on

time will force the MS student to apply for the Ph.D. program through the regular admissions process, pay application fees, etc. Please contact the ME Student Services Office with questions.
Ph.D. students wishing to also receive an MS degree can add the MS program using a "Graduate Authorization Petition" (this is two parts: a paper form, then on-line via Axess), which must be completed and submitted to the ME Student Services Office well in advance of the Ph.D. degree conferral.

Steps to Obtain the Ph.D. Degree

1. Preliminary PhD Program Proposal: PhD students are required to file a preliminary PhD program proposal, covering planned coursework for the first two years of their program, to the Student Services office by the end of the third week of classes of the first quarter of matriculation. The departmental deadline to submit the proposal for students starting their first quarter in September 2019 is OCTOBER 11, 2019. If the PhD student is adding the MS program, the MS program proposal is accepted in lieu of the preliminary PhD program proposal (see instructions in the section "HOW TO OBTAIN YOUR MS DEGREE").

   Instructions for submitting the preliminary PhD program proposal (to be submitted only if you are not submitting an MS program proposal) are as follows:

   1. Obtain the appropriate form from the ME dept. website or ME Student Services Office.
   2. Type or print neatly. Course titles and units must be included. Illegible forms will not be reviewed or processed. Consider courses toward satisfying the PhD requirements, preparing you for the qualifying exam topics you plan to take (see next step), and giving appropriate background your desired area of research. There is no specific number of courses/units to be listed, but it should be a realistic plan for your first two years at Stanford. Your course plan can be revised later when you advance to candidacy.
   3. Consult your academic advisor (or dissertation advisor, if you have one), update the plan if needed, and then obtain his/her signature.
   4. Submit the form to the ME Student Services Office for review and approval. Keep a copy for your own records.
   5. Proposals can take up to 14 working days to be reviewed and processed. Proposals that are not approved will be returned to the student for revision.
   6. Although your advisor may sign your form, the Student Services office and Graduate Curriculum Committee have authority for final approval.

2. Ph.D. Qualifying Examination: Ph.D. Students who entered the program at Stanford without having completed an MS elsewhere are required to take the Ph.D. Qualifying exam at or before the start of the 3rd year of graduate school. For students beginning their graduate work after completing a MS elsewhere, the exam must take place at or before the start of their second year at Stanford. Exams are given during the 3rd and 4th week of the Fall and Spring academic quarters. Exams will be based on 3 topics from an approved list that is based on the Depth topic list for the MS degree.

   At the completion of the first attempt at the exam, students who have passed all three topics are considered to have passed the exam. Students who did not pass one or more topics on the first attempt may re-take the exam one time, during the next offering of the exam, subject to support of their advisor. Students may re-take the failed subjects, or select new subjects. Those who select new topics will have one opportunity to pass. If the student passes the remaining subjects during the re-take, the student is considered to have passed the exam. Outcomes for students who do not pass one or more subjects during the retake will be determined by the Graduate Curriculum Committee. Details of the

Qualifying Exam process are outlined later in this Handbook.

3. Ph.D. Candidacy: To achieve Ph.D. candidacy status, the student must file the Ph.D. candidacy form (University policy expects that this form will be filed by the end of the 6th quarter of the student's Ph.D. registration; for students starting without an MS and taking the Qualifying Exam at the beginning of the third year, this may be delayed by one quarter). This usually takes place immediately following successful completion of the Qualifying Exam. Stanford funding and future registration will be placed on hold until the student complies with the policy. The candidacy form is to be approved and signed by the advisor and the Chair of Graduate Curriculum (via the ME Student Services Office). Students are expected to complete their program within five years from the date that candidacy is granted.

4. Reading Committee: After attaining Ph.D. Candidacy, in consultation with the advisor, the student must form a Reading Committee. The Reading Committee approves the program of advanced course work beyond the MS, including the technical breadth requirement. A formal Reading Committee form must be completed and filed with the Student Services Office prior to the approval of TGR status. University policy requires appointment of a principal dissertation advisor currently on the Academic Council, while former Academic Council members, emeritus Academic Council members, or non-Academic Council members can to serve as co-advisor. A co-advisor is also needed if the principal dissertation advisor is from outside the ME department. In these cases, a Mechanical Engineering Faculty member must serve as co-advisor. The co-advisor must be included as a member of the Reading Committee and Oral Exam Committee.

   Please consult the Graduate Academic Policy for guidelines on how to form your Reading Committee.

5. Green Light Meeting: No less than 6 months prior to the planned Ph.D. Defense, the Student and the Reading Committee are required to meet in a "Green Light Meeting". In this meeting, a Final Dissertation Proposal will be reviewed and discussed, and the student will present a "Draft Ph.D. Thesis outline" indicating status of prior work and plans for additional work. The presentation should not be a "practice thesis defense presentation", but rather should be a chapter-by-chapter review of the status of completion of each part of the expected Ph.D. thesis. A month-by-month schedule for the time remaining until the Ph.D. Defense should be presented at this meeting. The purpose of this Green Light Meeting is to make sure that the entire Reading Committee is familiar with the plans for the completed Ph.D. thesis, and is comfortable with the proposed content and the schedule. At the conclusion of the meeting, a Student Services form is used for a brief report. The form must be submitted to the Student Services office as soon as possible after the meeting. This report should indicate the target dates for the Ph.D. Defense and completion of the Ph.D. dissertation as agreed to by the Reading Committee, and is signed by the Ph.D. advisor.

   Ph.D. students who are in their Ph.D. program for more than 6 years are required to organize annual "Green Light Meetings" with their Reading Committee and submit meeting reports to the Student Services Office until completion of the Ph.D. Dissertation Defense.

6. Teaching Requirement: An important aspect of a Ph.D. from Stanford is the demonstrated ability to communicate fundamental concepts and unique ideas to a diverse audience. Excellent preparation for communication in industry or academia is through teaching

experience. To that end, Ph.D. students must 1) complete the department Teaching Assistant Training Program, and 2) obtain teaching experience equivalent to at least one 25% course assistantship. Students may enroll in ME491 for up to 3 units while they are working as a TA or CA. Students are encouraged to enroll in ME492 for 1 unit for notation on their transcript. "Ph.D. Teaching Experience" or similar teaching experience may include equivalent teaching preparation, lecturing, leading sessions, tutoring, or scientific or engineering outreach. Definition of the nature and scope of the teaching experience and fulfillment of this requirement will be certified by the Ph.D. advisor. This policy will apply to all Ph.D. students who start their Ph.D. program in fall 2007 or later. Students must submit a Student Services form to verify completion of this milestone.

7. Coursework: Ph.D. candidates must complete a minimum of 135 units. (Ph.D. candidates who received their MS from Stanford may count up to 45 units towards the 135 total). Out of the 135 units, a student must complete a minimum of 21 units of approved courses in advanced study in engineering, science and mathematics (excluding research, directed study, seminars and ME491/492) beyond the MS degree. **These courses must be numbered 200+ and must be taken for a letter grade.** In addition, all Ph.D. candidates should participate in their area's research seminar each quarter. An advisor approved Ph.D. course proposal must be submitted when applying for Ph.D. candidacy. Students who received an MS degree at another institution may petition (through the Registrar's office) to transfer up to 45 units towards the 135 unit requirement.

   If choosing to take a Ph.D. minor at another department, the 20 units required for the minor program may be included with the 135 units required for the Ph.D. Up to 9 units of the Ph.D. minor may be included in the 21 units of coursework required.

   The Mechanical Engineering department has a breadth requirement for the Ph.D. program. This may be satisfied either by a minor in another department or by at least 9 units of course work covering physical principles or methodologies outside the student's primary area of research. Candidates with primarily experimental projects should include at least three units on experimental techniques. If choosing to take a Ph.D. minor in another department, the 20 units required for the minor program may be included within the 135 units required for the Ph.D. Up to 9 of the units used for the Ph.D. minor may be included in the 21 units of coursework required.

8. University Oral Examination: Any time after completing an acceptable draft of the dissertation, with the approval of the advisor and Reading Committee, the student may schedule the University Oral Examination (Dissertation Defense). To do so requires completion of the university Oral Exam Schedule form (available from the University Registrar's website). The form must be submitted for approval at least **two weeks prior** to the day of the exam. It is the student's responsibility to schedule the time and day of the exam and ensure that all examiners are available to attend. If the student is required to have a co-advisor (see step 3), the co-advisor must serve on the Oral Exam Committee.

   For information on forming your Oral Exam Committee, please see the Graduate Academic Policy.

   Once the Oral Exam Schedule has been approved by the Director of Student and Academic Services, the student should pick up the approved petition and accompanying information to give to the Chair of the committee at least **two** days in advance of the exam date. If the Chair of the exam does not have the approved petition prior to the start of the exam, the exam will be invalid.

The Orals Chair should submit the results of the examination to the Student Services Office immediately following the exam. The student's advisor will notify the student of the outcome.

Note: Students **must** have an active student status during the quarter in which the examination is taken.

9. Dissertation Preparation and Submission: Please consult the Dissertation Information Website for rules governing format of dissertation, fees, forms and deadlines. Students must have a minimum cumulative GPA of 3.0 to graduate.

Ph.D. Qualifying Exam

Exam Structure

Ph.D. Students who do not already have an MS when they started at Stanford are **required** to take the qualifying exam at or before the start of the 3rd year of graduate school. For students beginning their graduate work after completing a MS elsewhere, the exam must take place at or before the start of their second year at Stanford.

Exams are given during the 3rd and 4th week of the Fall and Spring academic quarters. Exams will be based on 3 topics from the list below. The exam will usually consist of **30-minute topical exams in three subjects** chosen by the student in consultation with their advisor from the list below. Please note that if one of your topics is customized, you should plan for one hour for the custom exam.

Examiners for exams for the standard topics will be selected by the Graduate Curriculum Committee. The selections will be made on the basis of the faculty expertise and experiences with the courses that are the basis of the topical exams, and with a goal of distributing workload evenly where possible. It is possible that the advisor for a Ph.D. student will be one of the examiners on a single topical exam on occasion. The Curriculum Committee will ensure that the advisor is not the examiner for more than one topic for one of their own Ph.D. students, and that they are not the examiner for the custom topic exams.

Research or Custom Subject Exams- Students may choose exams consisting of a research exam with a presentation or a topical exam in a topic not represented above (Note: custom topical exams must be based on courses listed in the ME depth areas, beginning on p. 29). Detailed proposals for a Custom Exam topic are to be prepared with and signed by the research advisor, and will be approved or rejected by the Graduate Curriculum Committee. **It is important for the Custom Subject Proposal to describe how the content of the Custom Exam is distinct from the content of the 2 topical exams already being selected.**

Custom exams are **private events**, and may be attended by other faculty, but not by students, family and friends. If the examination consists of a presentation followed by Q&A, the advisor may attend the entire session as a "silent observer". Other faculty are excused after completion of the presentation portion of the examination.

The recommended format for custom research exams is based on a 20-minute presentation related to the Ph.D. research that the student is working on, followed by up to 40 minutes of questions by the two examiners. Below is some additional guidance on the format and execution of these custom exams:

1. The goal of the presentation is to demonstrate that the student can explain some specific key issue in their proposed research, and describe the work that they are doing to resolve this issue. The content of the presentation should be accessible to faculty with modest expertise in the Ph.D. research topic. Therefore, it is the responsibility of the student to prepare a presentation that is clear and informative, and which can serve as the basis for rigorous questions by many faculty in our department.
2. It is the responsibility of the Student and Advisor to define a custom examination specification that is clearly distinct from the content of the 2 topical examinations. Specifications that do not address this distinction in detail will be rejected.

Administrative Procedures

1. Obtain the Nomination of a Faculty Sponsor. An Academic Council Member of Stanford University must be willing to supervise and support your Ph.D. program and dissertation. The decision by the faculty member to supervise the program and dissertation is based on your potential to become an independent scholar, as well as many other factors, including your undergraduate and graduate course record, research, teaching, and professional experience. The most important factor in this nomination is the direct knowledge the faculty sponsor has of your research capabilities, and their belief that you are qualified to pursue a Ph.D. at Stanford University on the basis of this knowledge.

If the Research Advisor is from outside of the Mechanical Engineering Department (or is a faculty in M.E. by courtesy, or an emeritus faculty), an ME Department faculty member must be willing to serve as Academic Co-Advisor throughout the Ph.D.. In this case, the nomination is still provided by your research advisor, and is signed by your academic advisor.

2. Prepare Application Materials. Electronic applications will be sent out by the Student Services Office approximately six weeks before the exams begin. The application folder includes:
a) Updated transcripts of all non-Stanford graduate course and Stanford graduate coursework. A GPA of 3.5 or higher is required. The GPA calculation must be based entirely on letter grades in Math, Science and Engineering classes at the graduate level. Grades from independent study or dissertation research are not to be included in this calculation. (Exceptions to the GPA requirement must be requested by petition written and signed by the research advisor.)
b) Preliminary Dissertation Proposal (two to three pages) providing a rationale and methodology for the proposed research. Examiners will have access to this proposal, and may use it as a basis for exam questions.
c) The nomination form signed by your research advisor.

NOTE: All exceptions to all eligibility and timing requirements are subject to petitions to be signed by the Research Advisor, and reviewed by the Chair of the Graduate Curriculum Committee.

3. Choose Three Subjects. Together with your faculty sponsor, choose any three subjects from the list below. For each topic, the student will list the 2 or more course numbers within that topic area that they will prepare to be examined on. For each of the subjects, descriptions of the materials to be used as a basis for the exam will be provided. Individual topic descriptions are being drafted by the GCC with support of the faculty likely to be involved in those topics.

Math: Exam is based on ME300A/ME300B/ME300C (Linear Algebra/PDEs/Numerical Methods) – Please select 2 out of 3 of these classes.

Automatic Controls: This exam will be based on the content normally offered in ENGR105 + ENGR205.

Biomechanical Engineering: BME exams are based on any 2 of these courses: ME239, ME244, ME281, ME283, ME287, ME337

Mechatronics: This exam will be based on ME218AB or ME210+ME220.

Design Methodology: This exam will be based on ME310AB

Design for Manufacturing: This exam will be based on ME203 and ME219

Fluid Mechanics: This exam will be based on two of ME351A, ME351B, and ME355

Energy Systems: This exam is based on ME 370A-C. Taking ME 370A and either ME370B or C should prepare the student for this exam.

Reactive Gas Dynamics (formerly HT Gas Dynamics): This exam is based on ME362A, ME362B, ME364, ME371 and ME372. The student will be examined on material covered in any two courses selected from this sequence.

Heat Transfer: This exam is based on ME 131, ME 352 A, B, C and ME 358. The student will be examined on material covered in any two courses selected from this sequence.

Solid Mechanics: This exam is based on {ME333 and ME340 or ME338}, or {ME335A and ME335B or C}.

Dynamics: This exam is based on two of ME331A, ME331B, and ME334

MEMS and Devices: This exam is based on content in ENGR240, ENGR241, ENGR341, ME414 and ME457.

Robotics and Kinematics: This exam is based on ME320 (CS223A) + one of CS225A, ME322, ME326, or ME327.

Materials and Stress Analysis: This exam is based on any two courses selected from ME241, ME345, ME309, and ME348.

4. Submit the Examination Application. The research advisor is required to sign the qualifying exam application. The application deadline is set by the department, generally 4 weeks prior to the exams. Time and location of exams will be provided by the Student Services Office (commonly the Wednesday before exams begin).

HONOR CODE

Stanford examinations are not proctored. We expect students to behave as mature adults, and to be judged on the basis of knowledge that they alone possess.

This is not the tradition at many other universities. We live by the honor code, and to do so we must support it. This means that students should report observed honor code violations, and the faculty is committed to a quick and just resolution of each case of suspected violation through established administrative practices.

We **do** deal firmly with honor code violations. Students have been suspended, and have had degree conferral delayed, following convictions for honor code violations.

Stanford University Honor Code

A. The Honor Code is an undertaking of the students, individually and collectively;

    1. that they will not give or receive aid in examinations; that they will not give or receive un-permitted aid in class work, in the preparation of reports, or in any other work that is to be used by the instructor as the basis of grading;
    2. that they will do their share and take an active part in seeing to it that others as well as themselves uphold the spirit and letter of the Honor Code.

B. The faculty on its part manifests its confidence in the honor of its students by refraining from proctoring examinations and from taking unusual and unreasonable precautions to prevent the forms of dishonesty mentioned above. The faculty will also avoid, as far as practicable, academic procedures that create temptations to violate the Honor Code.

C. While the faculty alone has the right and obligation to set academic requirements, the students and faculty will work together to establish optimal conditions for honorable academic work.

Please visit the Office of Community Standards for more information on the Honor Code.

PLACES TO GET HELP

If you find yourself in an overwhelming situation, rather than letting things build up until you can no longer handle it, there are several individuals and offices that can help. Here is just a sample of places you can turn. They are not listed in any particular order, so feel free to contact whomever you feel most comfortable with.

- The Wellness Network at Stanford: https://wellness.stanford.edu/graduate
- CAPS - Counseling Services (CONFIDENTIAL unless a mandated reporting issue): 2ND floor, Vaden Health Center: Crisis Center, stress management center, support groups, individual counseling
- Graduate Life Office: 2nd floor of the Graduate Community Center: offers support and assists with connecting students to necessary resources for personal and academic issues.
- Your academic advisor or another faculty member that you feel comfortable with.
- Michelle Lucas Rice, Director of Student and Academic Services, Mechanical Engineering Department, Building 530, Room 126
- Professor Allison Okamura, Director of Graduate Studies Committee, aokamura@stanford.edu
- Sally Gressens, Assistant Dean of Student Affairs, School of Engineering, Huang Building Room 135
- Stanford Office of the Ombuds: located at Kingscote Gardens, Room 302 https://ombuds/stanford.edu

FOR ADDITIONAL ASSISTANCE

Vice Provost for Teaching and Learning – 408 Panama Mall
Services to students:

- Courses to Improve Learning Effectiveness
- One-on-one Study Skills Counseling
- Tutoring and Tutor Training

Bechtel International Center
583 Lagunita Drive (behind Tresidder Union)
For assistance with cultural and language problems as well as visas/passport issues
Excellent resource for spouses/families too!

REFERENCE GUIDES

Graduate Academic Policies and Procedures: http://gap.stanford.edu/
This Handbook is a collection of information about University policies, requirements, and resources relevant to all Stanford graduate students

Stanford Bulletin: http://www.stanford.edu/dept/registrar/bulletin/
Course descriptions, as well as University and School policies

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