STANFORD UNIVERSITY
MECHANICAL ENGINEERING DEPARTMENT

GRADUATE STUDENT HANDBOOK
Academic Year
2006-2007

Mechanical Engineering Student Services
Building 530, Room 125
(650) 725-7695
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Revised 9/06

MECHANICAL ENGINEERING GRADUATE STUDENT HANDBOOK
2006-2007

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Hello!

Welcome to Stanford University. We are pleased that you have chosen Stanford for your graduate study. This booklet will acquaint you with the department, academic policies and procedures. In addition to this booklet, you are expected to stay informed of the regulations and policies governing financial aid, degree, and course requirements by consulting the Stanford Bulletin, time schedules and university websites. If uncertain about the precise meaning or application of a regulation or policy, you should seek clarification from the Student Services Office staff located in building 530, room 125. You may stop by, or give us a call at
(650)725-7695.

Students enrolled in the MS program have been assigned to an academic advisor. The assignment was based on availability of the faculty, their research interests and your 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 a formal change of advisor, please let me know.

I am also available to answer any questions that you may have. The issue does not necessarily have to be of an academic nature. I know of many on and off campus resources available to you in addition to those listed in this booklet. Please feel free to stop by the office even if just to say hello! My staff and I would appreciate the opportunity to get to know you.

Sincerely,

Indrani Gardella
Student Services Manager
(650) 725-2075
indrani@stanford.edu

MECHANICAL ENGINEERING ADMINISTRATIVE OFFICE
Building 530

The Department of Mechanical Engineering is organized into five groups: Biomechanical Engineering, Design, Flow Physics, 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
(650) 725-7695

Indrani Gardella, Student Services Manager
Patrick Ferguson, Student Services Administrator
Sue Emory, Graduate Admissions Administrator
Professor Mark Cappelli, Co-Associate Chairman of Student Services (Building 520)
Professor Drew Nelson, Co-Associate Chairman of Student Services (Terman)
Professor Kenneth Goodson, Associate Chair of Graduate Curriculum (Building 530)
Professor Thomas Kenny, Associate Chair of Admissions Committee (Building 530)

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, leaves 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 probably is not possible to obtain a degree from the department without visiting this office at least once!

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

Professor Friedrich Prinz, Department Chairman
Professor John Eaton, Vice-Chairman
Gail Stein, Department Manager
Laura Walch, Administrative Associate

The Chairman'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, Professors Prinz and Eaton are very open to discussing Stanford issues with students, so if you feel that you have a problem or want to bring something to their attention, please feel free to do so.

BIOMECHANICAL ENGINEERING GROUP
Durand, Room 223
(650) 723-3610

Thomas P. Andriacchi, Professor and Group Chairman
Gary S. Beaupre, Consulting Professor
Dennis R. Carter, Professor
Scott L. Delp, Professor and Chairman Bioengineering Department
Christopher Jacobs, Associate Professor (Research) and of Orthopedic Surgery
R. Lane Smith, Professor (Research), by courtesy and Associate Professor (Research) of Orthopedic Surgery
Charles A. Taylor, (By Courtesy, Associate Professor of BioEngineering)
Felix E. Zajac, Professor (Emeritus)

Phoebe Abt, Group Administrator

The Biomechanical Engineering (BME) Group offers research and teaching programs that focus primarily on neuromuscular, musculoskeletal, and cardiovascular biomechanics. Research in other areas including hearing, vision, ocean and plant biomechanics, biomaterials, biosensors, and imaging informatics, are conducted in collaboration with associated faculty in medicine, biology, and engineering. The BME Group has particularly strong research interactions with the Mechanics and Computation Group and the Design Group in the Mechanical Engineering Department as well as the Departments of Orthopedics, Surgery, and Radiology in the School of Medicine.

Research in the BME Group is based upon the integration of biology and clinical medicine with engineering mechanics and design. Clinical and biological observations and data provide the basis of inquiry. Mathematical modeling and computer simulation are major tools for better organizing these findings and developing a theoretical framework to provide further insights. Experimental biological, mechanical, and clinical studies are conducted to answer key research questions and to validate theoretical models. Design and evaluation of medical implants, devices, and procedures are important aspects of much of this research. Student research projects reflect the overall research program of the BME Group.

<u>Facilities</u>

The Computational Biomechanics Laboratory supports graduate research in computer modeling of the human body. The Cardiovascular Biomechanics Research Laboratory supports computational and experimental graduate research in cardiovascular biomechanics. The Research Biomotion Laboratory supports experimental research on human movement. The Tissue Engineering, Surgical Simulation, and Cell Culture facilities are state-of-the-art.

Many BME Group activities and resources are associated with the Rehabilitation Research and Development (RR&D) Center of the VA Palo Alto Health Care System. This major national research center houses the Experimental Mechanics, Skeletal Biomechanics, Human Motor Control, and Rehabilitation Device Design Laboratories. In addition, the RR&D Center has computational and prototyping facilities. These facilities support graduate course work as well as student research activities.

Research is also conducted in various facilities throughout the School of Engineering and School of Medicine. Particularly well used facilities are the Advanced Biomaterials Testing Laboratory of the Materials Science and Engineering Department, and the Orthopedic Research Laboratory in the Department of Functional Restoration. In collaboration with our 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.

Student Offices

There are a limited number of student office spaces available in the Mechanical Engineering Research Laboratory (MERL), the Durand Building and at the VA Rehabilitation Center. Priority is given to post-masters students and students holding assistantships. Additional office information can be obtained from the Group Administrator, Phoebe Abt, at pabt@stanford.edu.

DESIGN GROUP
Terman Engineering Center, Room 551
(650) 725-9131

James Adams, Professor (joint with Management Science & Engineering) (Emeritus)
David Beach, Professor (Teaching)
J. Edward Carryer, Consulting Associate Professor
Mark Cutkosky, Professor
Daniel DeBra, Professor (joint with Aero & Astro) (Emeritus)
Chris Gerdes, Associate Professor
Kosuke Ishii, Professor
David Kelley, Professor
George Kembel, Lecturer
Thomas Kenny, Professor and Associate Chair of Admissions Committee
Larry Leifer, Professor
Craig Milroy, Senior Lecturer
Drew Nelson, Professor and Co-Associate Chair of Student Services
Gunter Niemeyer, Assistant Professor
R. Matthew Ohline, Lecturer
Friedrich Prinz, Professor and Department Chairman
Bernard Roth, Professor
Sheri Sheppard, Professor
Kenneth Waldron, Professor (Research)
Douglas Wilde, Professor (Emeritus)

Kristin Burns, Group Administrator

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. It is governed by the consensus of faculty and staff through weekly meetings which students are welcome to attend. Courses and research focus on topics such as kinematics, applied finite elements, microprocessors, fatigue and fracture mechanics, rehabilitation, optimization, high-speed devices, product design, experimental mechanics, robotics, creativity, idea visualization, computer-aided design, design analysis, manufacturing, and engineering education.

Facilities

The Design Group is located on the fifth floor of the Terman Engineering Center. Information about facilities can be found at http://design.stanford.edu/facilities.html. Design Group facilities and laboratories available to Mechanical Engineering students include:

The Product Realization Laboratory (PRL) offers design oriented prototype creation facilities to students engaged in course work or research. Design reaches fruition in the testing of hardware. The creation of physical artifacts often leads to design solutions that would otherwise not occur. Hands-on experience engenders tacit knowledge regarding devices, materials and processes. Relationships between design and manufacturing are clarified through prototype creation. The PRL is located in building 610 at the corner of Santa Teresa and Duena streets and is open during the academic year. Visit their website at http://prl.stanford.edu.

The Smart Product Design Laboratory (SPDL) supports microprocessor application projects related to the course series ME218A/B/C/D. The SPDL is located in the Thornton Center on Santa Teresa Street.

The Dynamic Design Lab (DDL) focuses on the use of dynamic modeling as a means of integrating mechanical design with automatic control and diagnostics. Many of the sponsored projects have an automotive application and the lab has a small fleet of full-scale and 1:4 scale vehicles for experimentation. The DDL is located in the **Mechanical Engineering Research Laboratory (MERL)**, on Panama Mall, Room 130.

The Telerobotics Lab is located in room 129 of MERL. The lab examines the interaction between humans and robots. In particular, it seeks to improve the control of robots operating under human command, with applications ranging from in-orbit assembly to minimally invasive surgery.

The Center for Design Research (CDR) provides an excellent facility for CAE/CAD/CAM research development and education. Resources include high-performance graphics workstations, high bandwidth networking and advanced internet-mediated design exploration and design collaboration technologies. CDR is located in Building 560 on Panama Mall.

The Manufacturing Modeling Laboratory (MML) addresses various models and methods that lead to competitive manufacturing. The lab serves as the repository for world-class manufacturing models and develops key technologies in life-cycle design, concurrent engineering, and supply chain management. The MML is located in the Thornton Center on Santa Teresa Street.

The Microscale Engineering Laboratory is located in (MERL), and is shared by Professors Goodson, Kenny and Santiago affiliated with the Thermosciences and Design Groups. This lab features facilities for thermal, mechanical, and fluid measurements with a unifying emphasis on microscale aspects. In addition to the individual research activities of these faculty members, there are also several shared Ph.D. projects, involving a mixture of thermal, mechanical and fluids issues in single projects.

The Product Design Loft is a unique facility in which students in the Product Design program develop their graduate design projects. It is located in Building 610 at the corner of Santa Teresa and Duena Streets.

The Rapid Prototyping Laboratory (RPL) consists of seven processing stations including CNC milling, plasma deposition, laser deposition, low temperature deposition, shot peening, grit blasting, and cleaning. Students use ACIS and Pro/Engineer solid modeling software on six Hewlett-Packard workstations for process software development. The RPL is located in Building 530 on Panama Mall.

The Design Team Development Loft provides space and technical support for globally distributed product development teams working on corporate partner projects. Teams are assigned a desktop design station and laptop computers. The Loft is located in the Terman Engineering Center on the fifth floor.

Student Offices

There are a limited number of student offices. Priority is given to post-master's students and students holding assistantships. Additional office information can be obtained from Kristin Burns in Terman 559 (kristin.burns@stanford.edu).

FLOW PHYSICS AND COMPUTATION AND ENGINEERING GROUP
Building 500, Room 500A
(650) 725-2077

Eric Darve, Assistant Professor (jointly with ICME)
Paul Durbin, Visiting Professor
Sanjiva Lele, Professor (jointly with Aeronautics and Astronautics)
John Eaton, Professor and Department Vice Chairman
Charbel Farhat Professor (jointly with ICME)
Vadim Khyams, Consulting Assistant Professor
Parviz Moin, Professor (joint with ICME) and Group Chairman
Heinz Pitsch, Assistant Professor
Eric Shaqfeh, Professor (jointly with Chemical Engineering and ICME)

Deb Michael, Group Administrator

http://fpc.stanford.edu
http://ctr.stanford.edu
http://cits.stanford.edu
http://icme.stanford.edu

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 dispersion of pollutants in the atmosphere, blood flow in our bodies, flow over aircraft wings, mixing of fluids and oxidizers in combustion chambers of engines, and plasma processing in semi-conductor equipment manufacturing.

With rapid development in computer technology, the future offers great opportunities for computational engineering analysis and design. The Flow Physics and Computation Group (FPC) blends research on flow physics and modeling with algorithm development, scientific computing, and numerical database construction. FPC is contributing new theories, models and computational tools for accurate engineering design analysis and control of complex flows (including multi phase flows, chemical reactions, acoustics, plasmas, interactions with electromagnetic waves and other phenomena) in aerodynamics, 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, FPC 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 FPC ranges from development of advanced numerical methods for simulation of turbulent flows to active flow and combustion control using control theory for distributed systems. The FPC faculty teach graduate and undergraduate courses in engineering, computational mathematics, fluid mechanics, heat transfer, thermodynamics and propulsion, combustion, acoustics, aerodynamics and computational fluid mechanics.

The Flow Physics and Computation Group is strongly allied with the Center for Turbulence Research (CTR), a research consortium between Stanford and NASA, the Center for Integrated Turbulence Simulations (CITS) (which is supported by the Department of Energy (DOE) under its Accelerated Strategic Computing Initiative), 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. The objective of CITS is to develop advanced computational tools and models necessary for simulation of the major components of a gas turbine engine. The Center for Turbulence Research has direct advanced access to major national computing facilities located at the nearby NASA-Ames Research Center, including massively parallel super computers. The Center for Integrated Turbulence Simulations has access to DOE's vast supercomputer resources. The intellectual atmosphere of the Flow Physics and Computation Group is greatly enhanced by interactions with CTR and CITS staff of postdoctoral researchers and distinguished visiting scientists. Group facilities include several parallel supercomputers, advanced workstations with color display and reproduction facilities and experimental and flow and heat transfer measurement facilities.

Students interested in doctoral research with FPC faculty are advised to arrange for directed study (ME391/392) with one or more of the affiliated faculty during their master's year.

MECHANICS AND COMPUTATION GROUP
Durand Building, Room 262
(650) 723-4133

Holt Ashley, Professor (joint with Aero & Astro) – (Emeritus)
David Barnett, Professor (joint with Materials Science and Engineering)
Wei Cai, Assistant Professor
Eric Darve, Assistant Professor (joint with ICME)
Adrian Lew, Assistant Professor
Peter Pinsky, Professor and Group Chairman
Beth Pruitt, Assistant Professor
Sunil Puria, Consulting Associate Professor
Charles Steele, Professor (Emeritus)

Doreen Wood, Group Administrator

Historically, the study of mechanics has made significant and fundamental contributions to the growth of science and technology. Its role is even more vital today in view of the rapid technological and societal intricacy. For instance, the modern mechanician may be called upon to design safer vehicles, to model human hearing mechanisms, to determine the cause of a mechanical failure, or to develop models for simulating vascular surgery. 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.

Facilities

The Mechanics and Computation Group is located in the north wing of the William F. Durand Building. The building is centrally located and provides offices, computer facilities, research laboratories, and seminar rooms for faculty, research associates, and graduate students of the Group.

Student Offices

There are a limited number of student office spaces available. Priority is given to course assistants and students working with faculty on specific research projects. Contact Doreen Wood in Durand for additional information.

THERMOSCIENCES GROUP
Buildings 500, 520 and 570
Group Office, Building 530-Room 520F
(650) 723-1745

Tom Bowman, Professor and Thermosciences Group Chairman
Peter Bradshaw, Professor (Emeritus)
Mark Cappelli, Professor and co-Associate Chair of Student Services
Chris Edwards, Associate Professor
David Golden, Consulting Professor
Kenneth Goodson, Associate Professor and Associate Chair of Graduate Curriculum Committee
Ronald Hanson, Professor
James Johnston, Professor (Emeritus)
William Kayes, Professor (Emeritus)
Charles Kruger, Professor
Reginald Mitchell, Associate Professor
Robert Moffat, Professor (Emeritus)
Godfrey Mungal, Professor
J. David Powell, Professor (joint with Aero Astro) (Emeritus)
Juan Santiago, Associate Professor

Cita Levita, Group Administrator

Thermosciences deals primarily with the engineering sciences associated with advanced energy systems, materials processing and manufacturing systems. The course work and research cover a broad spectrum of experimental and theoretical studies, including heat transfer, fluid mechanics, applied thermodynamics, plasmadynamics, combustion, diagnostics and sensors, and the physics/chemistry of gases.

The Group philosophy is to combine aspects of molecular, solid-state, and fluid physics, lasers and electro-optics, physical chemistry and electromagnetic phenomena, together with the traditional mechanical engineering disciplines of fluid mechanics, heat transfer, and thermodynamics. The interdisciplinary character of this program is of major importance to the mechanical engineer of the future in adapting to new technologies and will greatly expand professional options, whether involved in research, teaching, engineering applications, or technical management. Thus, the program is intended to be broadening in nature rather than aimed at a single discipline.

To achieve these educational objectives, we have focused our research program on the following high-technology areas: plasma sciences, combustion and propulsion sciences, pollution sciences, high temperature materials processing, spray dynamics, particle-laden flows, turbulent flows, heat transfer in turbulent flow, micro-scale fluidics and heat transfer, and advanced optical diagnostics. Plasma science deals with fundamental plasma processes, including studies of plasma chemistry, plasma diagnostics, and plasma propulsion. Our current research on combustion and propulsion is distributed over several areas, including: reaction kinetics of hydrocarbon pyrolysis and oxidation, combustion and gasification of cool and biomass, non-equilibrium hypersonic flows, turbulent reacting flows, and programs on supersonic reacting flows and active control of combustion, and pulse detonation engines. Our work on pollution sciences is concerned primarily with fundamental studies of high temperature reaction kinetics associated with formation and removal of nitrogen

oxides (NOx) during the combustion of hydrocarbon fuels. Aspects of materials processing at high temperature include studies of the synthesis of advanced materials such as diamond and cubic boron nitride in plasma environments. Spray dynamics focuses on understanding the temporal and spatial structure of two-phase spray flows with applications to combustion, heat transfer, and spray coatings. Particle-laden flow includes the study of how particles interact with and affect the properties of turbulent flows. Studies in turbulent flows include heat transfer, turbulent flow control, and turbulent flow in complex geometries. Aspects of microscale heat transfer include studies of the scattering of heat carriers in sub-micrometer semiconductor films, as well as studies of the thermal properties and thermal failure of microelectronic devices. Microfluidics research is aimed at providing fundamental understanding and improved design of transport processes in micro chemical/bio analytical systems. The area of advanced diagnostics is concerned primarily with the development of laser-based methods for studying many of the processes described above, providing spatially-resolved and/or temporally resolved measurements of fluid properties, as well developing methods for non-intrusive sensing and control of industrial processes. Advanced laser diagnostics are also being used for the study of temperature fields in microfabricated transistors, sensors, and actuators with unprecedented spatial and temporal resolution. A third area for which advanced laser diagnostics are being developed is the study of the fluid mechanics phenomena associated with micron-scale bioanalytical devices.

Our approach is to combine experimental and theoretical investigations of fundamental problems that we perceive to be relevant to new engineering applications, and to provide a continuously improving state-of-the-art for industry. A further common emphasis in the research is on the development and use of modern experimental methods. Depending on the particular topics, the work involves high-temperature fluid mechanics and heat transfer, applications of electricity and magnetism, various aspects of physics, including spectroscopy, lasers, and electro-optics, aspects of physical chemistry, design of experimental equipment and instrumentation, and analytical and numerical calculations.

Thermosciences Group faculty and students are also involved in collaborative efforts with other departments and research groups at Stanford, such as the Stanford-NASA Center for Turbulence Research, the Flow Physics and Computation Group, the Electrical Engineering Department, the Chemistry Department, and the Materials Science Department.

The faculty and students of the Thermosciences Group are housed in buildings 500, 520, 570 and the Mechanical Engineering Research Laboratory (MERL). MS candidates planning to proceed to a Ph.D. program are encouraged to consider arrangements for three or more units of directed study (ME391/392) during their MS program.

GRADUATE POLICY

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.
- TGR students must enroll in the 0 unit TGR course*
- Students in "Graduation Quarter" must also enroll in the 0 unit TGR course

Although Summer Quarter enrollment is optional for most, there are some exceptions:

- If you are working as a summer TA or RA, or you are receiving a fellowship during summer, you must enroll
- If you plan to petition for your Graduation Quarter for Autumn Quarter, enrollment is required for the prior Summer Quarter.

Enrollment is completed via Axess http://axess.stanford.edu and must be done by the 2nd week of each quarter. The registration (study list) deadlines are published in the University Academic Calendar. If you miss the deadline, late fees will apply. If International students miss the enrollment deadline, the Department of Homeland Security may get involved.

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 elect the correct grading type required for your degree requirements. See the section on degree requirements for more details.

* TGR is a special status that Ph.D. students can attain once they have completed all their formal course work. Since TGR tuition is a little more than the 1-3 unit rate, you may take up to three units in addition to the TGR course and the TGR tuition will cover them. However, if you take more than 3 units during a TGR quarter, you will be responsible for paying any extra tuition. By definition, TGR students have completed all course requirements, so any courses taken during TGR status must not be necessary for the degree conferral. Many students take advantage of this opportunity to take "fun" classes like athletics or art.

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 to enroll for a minimum of 3 units:

- ❑ You will finish all degree requirements and complete the program during the quarter for which 3-7 units is requested and 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 Disability Resource Center 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 except for the oral defense and dissertation. 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 be enrolled in the quarter of degree conferral, you may petition for a one time $100 tuition quarter for the purpose of graduating. In this case, you must enroll in the 0 unit TGR course. You must have been enrolled in the quarter immediately prior to the requested graduation quarter. If graduation quarter will be Autumn Quarter, summer enrollment is required.

All petitions can be downloaded from the University Registrar's Office:
http://registrar.stanford.edu/shared/forms.htm

2006-2007 Graduate Engineering Tuition Schedule

Units	Cost Per Quarter
11-18*	$11,728
8-10	$ 7,620
7	$ 5,334
6	$ 4,572
5	$ 3,810
4	$ 3,048
1-3	$ 2,286
TGR**	$ 2,760

*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. Enrollment in TGR is required to complete the dissertation.

Add Courses: You may add courses through the end of the third week of classes. Check the Academic Calendar for specific deadlines:
http://registrar.stanford.edu/academic_calendar/index.htm

Drop Courses: You may drop courses through the end of the fourth week of classes, without any record of the course appearing on your transcript. No drops are permitted after this point, regardless of the grade or progress in the course. Check the Academic Calendar for specific deadlines.

Withdraw: You may withdraw from a course after the drop deadline through the end of the eighth week. If this is done, the notation "W" will be recorded on your transcript for that course. Students who do not officially withdraw from a class by the end of the eighth week will be assigned a grade by the instructor. **"W" grades cannot be changed by retaking the course.**

Incomplete: If you would like to take an incomplete or "I" for a course, you must make arrangements with the instructor by the last day of class. 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.

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 is 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. Therefore it is possible for a student who did an MS degree at another university to transfer up to 45 units towards their Ph.D. degree.

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. This petition should be used in the following situations:

1. A matriculated MS-ME student who would like to continue with a Ph.D. must submit the completed petition and departmental cover sheet to the Student Services Office by the beginning of the final MS quarter. The student must secure funding for the Ph.D program through a faculty sponsored assistantship. The petition must be fully processed by both the department and the University Registrar before the conferral of the MS degree. 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.

2. A matriculated graduate student changing departments.

3. A matriculated graduate student in the ME Department changing fields (e.g., MS in Biomechanical Engineering or Product Design)

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.

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 opportunities that could further progress in research.

Procedure to File a Leave of Absence: A leave of absence must be approved in advance by the student's advisor and the department. Although there is no signature line for the graduate student's advisor, an irrelevant signature line (i.e. the line for undergraduate students) can be used for this purpose. Evidence of good academic progress is a requirement to obtain approval. The leave form must be approved by the Student Services Manager 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.
http://registrar.stanford.edu/pdf/leaveofabsence.pdf

Once a leave of absence is granted, the right to use University facilities (i.e. libraries, athletic facilities, etc.) is halted 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 Manager.

FINANCIAL AID

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

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.

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.

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 Center for Teaching and Learning. Sessions are given each quarter throughout the year. More information can be found on the CTL website: http://ctl.stanford.edu/

Enrollment*:* All students holding assistantships **must** be enrolled for courses 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.

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 (students with approved TGR status must enroll for the TGR course).

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 will be charged 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.

Use of all credit – With the exception of TGR status students, students on assistantships must enroll for a minimum of 8 units. 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 typically expected to work a maximum of 20 hours per week in addition to carrying an 8-10 unit load per quarter. Students with 25% appointments work 10 hours per week in addition to carrying a unit load of 8-10 or more 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 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.

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 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 the 8-10 unit rate, but 75% appointments pay 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 decide that you do not want to enroll during Summer Quarter, you may ask your research supervisor about the option to work hourly. However, no tuition benefit is included for hourly work.

NOTE: TGR students must enroll in the TGR course. Since TGR tuition is a little more than the 1-3 unit rate, you 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.).

An infrequent but not unusual situation arises when a student who is working as a 90% RA during the summer is also planning to go TGR during that Summer Quarter. You should be aware that it would save your research supervisor some money if you delay going TGR until Autumn Quarter, since the tuition grant for a 90% RA appointment will cover either the TGR rate or the 3 unit rate. The 3 unit rate is actually a few hundred dollars less than the TGR rate. So the best solution is to enroll in 3 units for Summer Quarter, and then apply for TGR status in autumn.

Work in Addition to an Appointment or Stanford Fellowship: Employment in addition to a 50% assistantship must be formally approved by the faculty supervisor and **cannot exceed more than 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. 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 as they have the expertise on these regulations.

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. 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 is credited to the student's account directly and the Student Financial Services office will deduct fees such as housing and 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.

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.

Health Subsidy: Students who receive at least $2,000 in fellowship stipends (non-tuition) 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.

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.

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 Administrative Office. As national security concerns have increased over the last few years, federal regulations, policies and procedures 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:

http://www.stanford.edu/dept/icenter/new/orientation/SOCIAL_SECURITY_NUMBER.htm

Note: In a response to "national security and fraud concerns," the Social Security Administration has implemented policy that requires verification of certain information on 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:

700 East El Camino, Suite 350, Mountain View, CA 94040
Office Hours: M-F 9:00 am to 4:30 pm
Phone: 1-800-772-1213

You can find a map and other information here: https://s044a90.ssa.gov/apps6z/FOLO/fo001.jsp

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 are responsible for making estimate tax payments during the year**.
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. Please check the phone book if you need to meet with one.

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 current passport and the current visa. The I-9 is to 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.

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

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 ME Student Services 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.

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 2006 is **NOVEMBER 3, 2006.** This applies to **all** non-HCP MS students including those pursuing the MS in Product Design and MS in Biomechanical Engineering.

Instructions

1. Obtain the appropriate form from 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 final 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.

Please do not rely on your advisor to deliver the proposal to the ME Student Services Office.

All programs are subject the approval of the student's advisor **and** the Associate Chair of Graduate Curriculum (via the Student Services Manager).

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 Associate Chair of Graduate Curriculum.

Petitions

In some instances, you may want to substitute a course for your program that is not on the approved list. Also, some students may want to waive the math requirement because they have already taken extensive graduate level math courses elsewhere. In such cases, it may be appropriate to file a petition. Please stop by the Student Services Office for more information on the petitions process. Note: a successful petition to waive math courses does not reduce the total number of required units.

Degree Conferral

Students must apply to graduate via Axess. Due dates are listed on the front of the time schedule and in Axess. 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. Late fees will apply.

Registration is required during the degree conferral quarter.

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 Product Design 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.

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 Manager of Student Services.

MASTER OF SCIENCE IN MECHANICAL ENGINEERING

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

1. ***Mathematical competence in <u>two</u> of the following areas (6 units)***: partial differential equations, linear algebra, complex variables, numerical analysis or statistics, as demonstrated by completion of two appropriate courses from the following list: ME300A, ME300B, ME300C, MATH106, MATH109, CS205, CME302, EE263, EE261, STATS110 or ENGR155C. Courses taken for the math requirement must be taken for a 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 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 breadth courses are required and are generally graduate level ME courses listed in a depth area outside of the student's depth area. Eligible breadth courses are described under each depth area. Furthermore, the combination of depth and breadth courses must bring the total number of ME units to at least 24 (including the math requirement). Courses taken in the breadth area must be taken for a grade.

4. ***Approved Electives:*** Additional graduate 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 392 during the master's program. Approved electives must be taken for a grade unless grades are not an option (e.g. seminars).

Note: Students participating in ME391 or 392 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 and the grading type for the course.

5. ***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 may be taken credit/no credit.

6. ***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 ENGR206, ENGR207B, ME218A, ME310ABC, ME317AB, ME318, ME324, ME348, ME354, ME367, or ME382AB. ME391/392 will satisfy this requirement if 3 units are taken for work involving laboratory experiments. A student who has had substantial laboratory experience in industry or a government research institute may be waived from this requirement by his or her advisor and the Associate Chair for Graduate Curriculum (via the Student Services Office).

Courses used to fulfill math, depth, breadth, laboratory requirement and approved electives requirements must be taken for a letter grade except for courses where a pass/no credit is given to all students. Up to 3 units of approved electives may be taken as seminars.

Candidates for the MSME degree are expected to have a minimum GPA of 2.75 in the 45 units counted towards the degree.

DEPTH AND BREADTH AREAS FOR THE MSME DEGREE

Note: Course descriptions and availability should be checked using the Stanford Course bulletin 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.

1. **Automatic Controls** (one of the following sets):

Set A (all three must be taken)

ENGR205	Introduction to Control Design Techniques (Formerly ME305)	3 Units
ENGR207A	Modern Control Design I (Formerly ME307A)	3 Units
ENGR207B	Modern Control Design II (Formerly ME307B)	3 Units

OR

Set B (all three must be taken)

ENGR105	Feedback Control Design, 3 units, (Formerly ME105)	3 Units
ENGR206	Control System Design (Formerly ME306A)	4 Units
ENGR209A	Analysis & Control of Nonlinear Systems (Formerly ME306B)	3 Units

OR

Set C (all three must be taken)

ENGR205	Intro to Control Design Techniques (Formerly ME305)	3 Units
ENGR206	Control System Design (Formerly ME306A)	4 Units
ENGR209A	Analysis & Control of Nonlinear Systems (Formerly ME306B)	3 Units

OR

Set D (all three must be taken)

ENGR205	Intro to Control Design Techniques (Formerly ME305)	3 Units
ENGR207A	Modern Control Design I (Formerly ME307A)	3 Units
ENGR206	Control System Design (Formerly ME306A)	4 Units

Breadth: If depth is **Automatic Controls** (Area 1), select any **two** courses (6 units) from one or two of areas: 2, 3 (excluding ENGR206) or areas 4-12

2. **Biomechanical Engineering**

Set A: BioDesign

ME382A	Biomedical Device Design & Evaluation I	4 Units
ME382B	Biomedical Device Design & Evaluation II	4 Units

PLUS ONE OF THE FOLLOWING

ME381	Orthopaedic Bioengineering	3 Units
ME294	Medical Device Design	3 Units
ME310A	Tools for Team-Based Design	3-4 Units

OR

Set B: BioFluid Mechanics

ME284A	Cardiovascular BioEngineering	3 Units
ME284B	Cardiovascular BioEngineering	3 Units

PLUS ONE OF THE FOLLOWING

ME484	Computational Methods in Cardio. Bioengineering	3 Units
ME351A	Fluid Mechanics	3 Units
ME351B	Fluid Mechanics	3 Units

OR

Set C: BioDynamics (any three of the following)

ME281	Biomechanics of Movement	3 Units
ME331A	Classical Dynamics	3 Units
ME331B	Advanced Dynamics	3 Units
ME386*	Neuromuscular Biomechanics	3 Units
ME485*	Modeling & Simulation of Human Movement	3 Units

* ME386 and ME485 Not offered in 2006-2007

OR

Set D: Musculoskeletal Mechanics (one of the following)

ME338	Continuum Mechanics	3 Units
ME340	Elasticity in Microscopic Structures	3 Units

PLUS TWO OF THE FOLLOWING

ME280	Skeletal Development and Evolution	3 Units
ME381	Orthopaedic Bioengineering	3 Units

ME385	Tissue Engineering Lab	1-2 Units

Breadth: If depth is **Biomechanical Engineering** (Area 2), select any **two** courses (6 units) from one or two of areas 1, 3-12.

3. Design Analysis and Technology (one of the following sets)

Set A (any of two of the following):

ME218A	Smart Product Design Fundamentals 4 - 5 units	4-5 Units
ME218B	Smart Product Design Applications, 4 - 5 units	4-5 Units
ME218C	Smart Product Design Practice, 4 - 5 units	4-5 Units
ENGR206	Control System Design (Formerly ME306A)	4 Units

Set B (any three of the following)

CS223A	Introduction to Robotics (Formerly ME320)	3 Units
CS327A	Advanced Robotics (Formerly ME327A)	3 Units
ME322	Kinematic Synthesis of Mechanisms	3 Units
ENGR206	Control System Design (Formerly ME306A)	4 Units
ME330	Advanced Kinematics	3 Units

Set C (any three of the following)

MATSCI270*	Materials Selection in Design (Formerly ME321)	3 Units
ME345	Fatigue Design and Analysis	3 Units
ME348	Experimental Stress Analysis	3 Units
ME309	Finite Element Analysis in Mechanical Design	3 Units

* MATSCI 270 Not Offered in 2006-2007

Breadth: If depth is **Design Analysis & Technology** (Area 3), select any **two** courses (6 units) from one or two of the following areas: 1 (excluding ENGR206 if depth is 3A or 3B), 2, 4 (excluding ME210 if depth is 3A), or 5-12.

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

ME310A	Tools for Team-Based Design	3-4 Units
ME310B	Design Project Experience with Corporate Partners	3-5 Units
ME310C	Design Project Experience with Corporate Partners	3-4 Units

OR

ME318	Computer-Aided Product Creation	4 Units
MS&E264	Manufacturing Systems Design (Formerly ME317C)	4 Units
ME210*	Introduction to Mechatronics	4 Units

* ME210 and ENGR207B should not be taken concurrently

Breadth: If depth is **Design Methodology** (Area 4), select any **two** courses (6 units) from one or two of the following areas: 1-3, 5-12.

5. **Design for Manufacturability** (both must be taken)

ME317A	Design for Manufacturability: Product Definition	4 Units
ME317B	Design for Manufacturability: Quality by Design	4 Units

PLUS ONE OF THE FOLLOWING

MS&E264	Manufacturing Systems Design (Formerly ME317C)	4 Units
ME310A	Tools for Team-Based Design	3-4 Units
ME417	Total Product Integration Engineering	4 Units

Breadth: If depth is **Design for Manufacturability** (Area 5), select any **two** courses from one or two of the following areas: 1 - 4, 6-12.

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
ME457	Fluid Flow in Microdevices	3 Units
ME453	Intro to Modeling and Simulation of Fluid Flow	3 Units

Breadth: If depth is **Fluid Mechanics** (Area 6), select any **two** courses from one or two of the following areas: 1-5, 7 (excluding 352C), 8-12.

7. **Energy Systems** (all three of the following)

ME370A	Energy Systems I: Thermodynamics	3 Units
ME370B	Energy Systems II: Modeling and Advanced Concepts	4 Units
ME370C	Energy Systems III: Projects	4 Units

Breadth: If depth is **Energy Systems** (Area 7), select any **two** courses from one or two of the following areas: 1-6, 8-12.

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

ME352A	Radiative Heat Transfer	3 Units
ME352B	Fundamentals of Heat Conduction	3 Units
ME352C	Convective Heat Transfer	3 Units
ME358	Heat Transfer in Microdevices	3 Units

Breadth: If depth is **Heat Transfer** (Area 8), select any **two** courses from one or two of the following areas: 1-5, 6 (okay if depth does not include 352C), 7, 9-12.

9. **High Temperature Gas Dynamics**

ME362A	Physical Gas Dynamics	3 Units

PLUS TWO OF THE FOLLOWING

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

*ME364 not offered in 2006-2007

Breadth: If depth is **High Temperature Gas Dynamics** (Area 9), select any **two** courses from one or two of the following areas: 1-8, 10-12.

10. **Solid Mechanics**

Any three of the following

ME333	Mechanics	3 Units
ME335A	Finite Element Analysis	3 Units
ME335B	Finite Element Analysis	3 Units
ME335C*	Finite Element Analysis	3 Units
ME338A	Continuum Mechanics	3 Units
ME338B	Continuum Mechanics, 3 units	3 Units
ME340	Elasticity in Microstructures, 3 units	3 Units

*ME335C Not offered in 2006-2007

Breadth: If depth is **Solid Mechanics** (Area 10), select any **two** courses from one or two of the following areas: 1-9, 11-12.

11. Dynamics (Both must be taken), plus one more course approved by the advisor

ME331A	Classical Dynamics	3 Units
ME331B	Advanced Dynamics	3 Units

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

12. **MEMS**

Three courses required.

Two or three of the following:

ENGR240	Intro to M/NEMS	3 Units
ENGR341	Micro/Nano Systems Design & Fabrication Lab	3-5 Units
ME342	MEMS Lab II	3-4 Units
ME358	Heat Transfer in Microdevices	3 Units
ME414	Solid State Physics Issues for ME Experiments	3 Units
ME457	Fluid Flow in Microdevices	3 Units

Plus one of the following (if only two were taken from above)

EE312	Micromachined Sensors and Actuators	3 Units
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.

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 complete the "Graduate Program Authorization" and get approval from the Student Services Office. This form serves to officially add the field to the student's record. You may download the form from the University Registrar's website.

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, MATH131, MATH132; 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: ME280, ME281, ME284A, ME381 (not offered in 06-07), ME382AB, or ME385.
   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. Such sets have been approved by the Mechanical Engineering faculty. Comparable specialty sets composed of graduate engineering courses outside the Mechanical Engineering Department can be used with the approval of the student's advisor. Examples can be obtained from the Biomechanical Engineering Group Office (Durand 223).
   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, courses ME389, 390, 394, 395, 396, 397 or other 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 engineering seminar ME289.

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.

MASTER OF SCIENCE IN ENGINEERING
Field Designation: Product Design

The Joint Program in Design focuses on the synthesis of technology with human needs and values to create innovative product experiences. This program is offered jointly by the Mechanical Engineering Department and the Art Department. It provides a design education that integrates technical, human, aesthetic, and business concerns. Students entering the program from the engineering side earn a Master of Science in Engineering with a concentration in Product Design, and those from the art side a Master of Fine Arts. Students complete the core product design courses in their first year of graduate study at Stanford before undertaking the Master's project in their second year.

Degree Requirements

ME313	Human Values & Innovation in Design	3 Units
ME203	Manufacturing and Design	4 Units
ARTSTUDI 60	Design I: Fundamental Visual Language	3 Units
ME216A	Advanced Product Design: Need Finding	4 Units
ME312	Advanced Product Design: Form Giving	4 Units
ARTSTUDI 160	Design II: The Bridge	3 Units
ME216B	Advanced Product Design: Implementation	4 Units
ME316ABC*	Master's Design Project	12 Units Total
ARTSTUDI360ABC*	Master's Design Project	6 Units
	Approved Electives**	17 Units

*ME316 ABC and Art Studio360 ABC are taken **concurrently** for three quarters during the **second year.**

**Approved electives fulfill career objectives. Students may focus their energy in engineering, business, psychology, or other areas relevant to design. Most students elect a broad-based approach that spans these domains and increases their cultural awareness. Approved electives must be discussed with the student's advisor.

Note: A least 21 units must have School of Engineering course numbers of 200 or above, and be taken for a letter grade.

Candidates for the MS in Product Design will be expected to have the approval of the faculty, and a minimum GPA of 2.75 in the **60 units** presented in the program.

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. The graduation requirements are the same as for the Master of Science in Mechanical Engineering.

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).

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.

S*ince thesis supervision is required, admission is not granted until the student has personally arranged for funding and supervision by a faculty member.*

MS Students interested in continuing towards a Ph.D. degree must secure funding and faculty supervision. Once accomplished, a "Graduate Authorization Petition" and departmental cover sheet must be completed and submitted to the ME Student Services Office well in advance of the MS degree conferral. 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.

Steps to Obtain the Ph.D. Degree

1. Ph.D. Qualifying Examination: During the first year of post-master's study, a student is expected to take and pass the Ph.D. qualifying examination. **Note**: on occasion, an outstanding MS student is encouraged by faculty to pursue the Ph.D. program and is recommended to take the qualifying exam. Please be aware that passing the qualifying exam alone will not gain you admission to the Ph.D. program. After passing the qualifying exam, securing funding and program supervision, you must also complete the Graduate Authorization Petition and departmental cover sheet, and submit them prior to conferral of your MS degree. Details for the procedures of the qualifying exam follow this section in the handbook.

2. Ph.D. candidacy: To achieve Ph.D. candidacy status, the student must file the Ph.D. candidacy form (University policy requires that this form be filed by the end of the 6th quarter of the student's post-master's registration). 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 Associate 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.

3. 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 dissertation proposal presentation (Step 5). Most students submit the Reading Committee Form at the same time the candidacy paperwork is filed.

   Reading committee selection: The dissertation reading committee consists of three members: the principal dissertation advisor and two other readers. At least two members must be Stanford Academic Council members.

   On occasion, permission for the appointment of one non-Academic Council reader may be approved by the department if the proposed reader is particularly well qualified to consult on the dissertation project. Approval is requested on a Petition for Doctoral Committee Member

form (found on the University Registrar's website). The reader **must** have a Ph.D. or the foreign equivalent and the petition must be accompanied by a curriculum vitae.

4. Course work: 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 27 units of approved courses in advanced study (excluding research, directed study, and seminars) beyond the MS degree. The courses should consist of graduate courses in engineering and sciences. In addition, all Ph.D. candidates must participate in their area's research seminar each quarter. Students who received an MS degree at another institution may petition to transfer up to 45 units towards the 135 unit requirement.

   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 nine 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 (this requirement can be waived if suitable courses have already been taken at the MS level). 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.

5. Dissertation proposal presentation: At least one year before anticipated completion of the dissertation, a written proposal must be submitted to the reading committee. The committee will review the proposal with regard to the quality of the technical content and the written exposition. If the proposal is acceptable, the committee will ask the candidate to make an oral presentation. The purpose of this presentation is to ensure the reading committee that the candidate has an adequate understanding of the subject area, and it affords the student the opportunity to seek guidance for the dissertation work.

6. 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.

   The University Oral Examination Committee must consist of a Chair and four examiners including the principal dissertation advisor. The Chair **must** be a Stanford Academic Council member and **may not have a full or joint appointment in the same department as the candidate or the principal advisor**. The purpose of this regulation is to ensure that there is at least one unbiased committee member who can make sure that all rules and policies are followed during the exam. The Chair need not be familiar with the student's field of specialization and emeriti faculty members are eligible to serve. At least three of the four remaining committee members must be on the Stanford Academic Council.

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

The Oral 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** be registered during the quarter in which the examination is taken

7. Dissertation Preparation and Submission: Rules governing format of dissertation, fees, forms and dates of submission can be found at:
   http://registrar.stanford.edu/publications/#Dissertations