1. FOR FRESHMEN AND SOPHOMORES

Just as it is for students at any university at the beginning of the year, your first weeks here will certainly be exciting, and may be overwhelming. For freshmen everything is new, and during orientation and as the school year begins you will be immersed in a constant stream of academic information together with many bits and pieces of Stanford culture. For sophomores, as you begin to move toward study that is more specialized, there will still be much for you to discover. This Handbook can help to inform your academic choices and provide some perspective on the School of Engineering within Stanford University.

GETTING STARTED AT STANFORD

One of the great advantages of Stanford as an undergraduate institution is the tremendous breadth of excellence that the university offers. Some universities are strong in particular disciplines, while less so in others. The faculty and students we have been able to attract over the years have placed Stanford in the wonderful and exceptional position of being strong across the board. In engineering, as well as in the sciences, humanities, and social sciences, surveys conducted by the National Academies and other professional organizations that seek to assess the strength of academic programs all attest to the eminence of Stanford in education and research.

As an undergraduate, you should take the time to explore that wealth of academic excellence. Committing yourself prematurely to one discipline or coming in with too-firmly fixed ideas of exactly where you are going can take away from your chances to discover what Stanford has to offer, and to take advantage of all its diversity. Stanford encourages academic exploration by not requiring you to make a commitment up front; at many universities, students are asked to declare their intended major as part of the application process, particularly if they are interested in engineering. Not so at Stanford. Here, you need not declare a major until the beginning of your junior year. You have the time to explore different possibilities before settling on a major.

At the same time, the flexibility that Stanford offers does not mean that you, as a prospective student of engineering, can afford to spend your first two years completely away from the techie side of things. Engineering majors typically require more courses and units than majors in other parts of the university. Technical courses, moreover, tend to be cumulative, in the sense that more advanced courses draw heavily on the material presented in the introductory courses that precede

them. In engineering, you need to strike a balance between taking advantage of the freedom to explore and making sure that you are getting a reasonable start on an engineering curriculum.

PLANNING YOUR FIRST (AND SECOND) YEAR

The best strategy is to avoid the extremes. A first-year schedule that includes *no* mathematics, science, or engineering will make it very difficult to complete an engineering major in four years. Conversely, it is surely a recipe for disaster to insist on packing your first year with three quarters each of calculus, physics, and chemistry along with the mandatory Introduction to the Humanities and Program in Writing and Rhetoric classes. There is too much work in each of those courses to take them all at the same time, particularly before you've had a chance to acclimate to Stanford's intensity and rapid pace. You should seek an appropriate balance for your studies.

EXPLORING ENGINEERING

There are several ways for students to explore the various engineering majors. One is through the freshman/sophomore seminar program and departmental seminars, and another is through the "Engineering Fundamentals." The freshman/sophomore seminar program is described in detail in a separate publication from the Office of the Vice Provost for Undergraduate Education (VPUE), which you should receive as part of your orientation material. These seminars provide excellent opportunities for students to work with faculty in small settings, often on topics that aren't otherwise part of the curriculum for a particular major. You should ***definitely*** try to find a seminar that interests you, whether or not it's in engineering, and make that a part of your academic plans in your first or second year.

For 2006-2007, the seminars in engineering are listed in the table on the following page. For course descriptions, see the VPUE publication or consult the web pages at http://fsp.stanford.edu.

FRESHMAN/SOPHOMORE SEMINARS 2006-2007

Preference to Freshmen	Dept	Course
The Global Positioning System: Where on Earth Are We, and What Time Is It?	AA	115N
The Art of Structural Engineering	CEE	80N
The Role of Information Technology in Global Conflict Resolution	CS	020N
Motion Planning for Robots, Digital Actors, and Other Moving Objects	CS	26N
The Science of Art	CS	48N
Business on the Information Highways	CS	73N
Digital Dilemmas	CS	74N
The Magic of Pi and Other Mathematical and Physical Constants	EE	018N
How the Internet Works	EE	019N
Hacking Stuff	EE	020N
What is Nanotechnology?	EE	021N
How Musical Instruments Work	EE	10N
Building the Future: Invention and Innovation with Engineering Materials	MATSCI	70N
Form and Function of Animal Skeletons	ME	010N
Re-Designing the Human Experience	ME	013N
The Art of Experimentation	ME	022N
The Jet Engine	ME	12N
Renaissance Machine Design	ME	21N
Preference to Sophomores		
Structures: Why Things Don't (and Sometimes Do) Fall Down	AA	113N
Designing Organizations to Execute Global Projects	CEE	048Q
Accessing Architecture through Drawing	CEE	31Q
Fail Your Way to Success	CEE	46Q
Art, Chemistry, and Madness: The Science of Art Materials	CHEMENG	080Q
Environmental Regulation and Policy	CHEMENG	60Q
Masters of Disaster	CHEMENG	70Q
Japanese Companies and Japanese Society	MATSCI	159Q
Creative Teams and Individual Development	ME	18Q
The Public Use and Misuse of Mathematics: How to Interpret Numbers as Used by the Media and Politicians	MS&E	094Q
International Environmental Policy	MS&E	92Q
Nuclear Weapons, Terrorism, and Energy	MS&E	93Q

In addition to the seminars listed above (check **http://introsems.stanford.edu** for current information), that offer the opportunity to work closely with faculty, many programs within the School of Engineering offer less intense one-unit seminars that provide exposure to key issues and current research within their disciplines. Generally, these seminars feature invited speakers, and meet once a week for an hour or an hour and a half. They often require attendance only or attendance and modest participation, such as asking questions or writing brief responses to presentations. Some seminars (such as ChemEng 10 and EE 100) are specifically designed to introduce new students to the field, while others (such as CS 547) are designed for upper-level undergraduates or graduate students, but are generally accessible to the interested non-expert. These seminars can provide a low-key way to explore different majors and research areas, and we encourage you to check out the ones in areas of interest to you. The following table lists some of the more popular seminars that have been offered in the past, but offerings do change from year to year: be sure to look in Axess each quarter for other such seminars in departments of interest to you.

Course	**Department**
The Chemical Engineering Profession	Chemical Engineering CHEMENG 10, Autumn
Human-Computer Interaction Seminar	Computer Science CS 547, Autumn, Winter, Spring http://hci.stanford.edu/cs547/
The Electrical Engineering Profession	Electrical Engineering EE 100, Autumn
Entrepreneurial Thought Leaders Seminar	Management Science & Engineering MS&E 472, Autumn, Winter

The "Engineering Fundamentals" courses are an integral part of the undergraduate engineering curriculum and play a different role than the seminars. There are twelve such courses and each serves as an introduction to one of the various engineering disciplines, endeavoring to build a foundation for more advanced work. Each major requires a minimum of three fundamentals chosen from the list, one goal being to ensure that our students obtain some breadth in engineering outside of their major. Details on the Fundamentals are provided later in this handbook. If, as a freshman, you are fairly certain which field of engineering you want to pursue, you might consider taking one of the Fundamentals in that area.

MATHEMATICS COURSES

As a general rule, students interested in an engineering major should take a calculus sequence in their first year. Choosing which calculus sequence to take, however, requires careful thought and

the assistance of your advisor. Stanford offers several different entry points into the study of calculus:

- MATH 41 and 42 present single variable calculus, with an emphasis on differential calculus in the first quarter and integral calculus in the second.
- MATH 19, 20, and 21 cover the same material as MATH 41 and 42, but do so in three quarters instead of two.
- MATH 51, 52, and 53 are taken by students who enter Stanford with 10 units of AP credit, or who have completed either Math 42 or Math 21. They cover differential and integral calculus in several variables, linear algebra, and ordinary differential equations. These courses are taught in an integrated fashion, with differential calculus of several variables and linear algebra being taught in MATH 51, integral calculus with linear algebra in MATH 52, and differential equations, including matrix methods for solving systems, in MATH 53. Students who are unsure of their mathematics preparation should consult with an advisor in the mathematics department before registering for this sequence.
- MATH 51H, 52H, and 53H cover the same material as in 51, 52, and 53, but with more emphasis on theory and rigor. These courses are designed for students who have a strong interest in majoring in mathematics with an inclination toward pure mathematics.
- CME 100, 102, and 104 or 106 (same as ENGR 154, 155A, 155B, and 155C) cover material that is similar to that in the MATH 51-52-53 series, but do so in a different order and with a more explicit engineering focus. The Computational and Mathematical Engineering (CME) courses were developed for undergraduates interested in Engineering. CME 100 presents multivariable calculus with engineering applications. It also introduces MATLAB, a computer program that integrates mathematical computing and visualization, providing a deeper, more visual understanding of the basic principles of multivariable calculus. CME 100 can replace MATH 51 in an engineering undergraduate's course requirements. Students can continue on with the CME 102/104/106 sequence, which covers the rest of the introductory mathematics curriculum with an emphasis on engineering applications. CME 102/104/106 require either MATH 51 or CME 100 as a prerequisite.

PHYSICS COURSES

The decision of whether to take a physics course in your first year is not nearly as simple as your decision about mathematics. Given the fact that you will also be taking required courses in writing and the humanities, taking both mathematics and physics in your first year pretty much fills your schedule, leaving little room for seminars or other courses that spark your interest. Furthermore, although all engineering majors require physics, it is often unnecessary to take physics so early in your undergraduate program. For students interested in engineering majors that depend heavily on

physics, such as Mechanical Engineering and Electrical Engineering, taking physics in your first year makes a great deal of sense because physics is a prerequisite for many of the advanced courses. For most other engineering majors, however, it probably makes sense to delay physics until your sophomore year, giving you more flexibility in your course schedule.

As with mathematics, there are several possible sequences that are appropriate for first-year students:

- **PHYSICS 41, 43, and 45** constitute the standard introductory sequence in physics and cover mechanics, electricity and magnetism, and light and heat, respectively. These courses are calculus-based and are generally far more intensive than typical high-school offerings, even at the advanced placement level. Even students who have taken AP physics—and therefore do not in fact need the credits for these courses—find them challenging. Because the Stanford courses cover so much more material and do so with greater depth and rigor, it often makes sense to give up the advanced placement credits and take these courses. Talk with your advisor for guidance in this area.
- **PHYSICS 61, 63, and 65** offer a more advanced sequence designed for prospective physics majors and those interested in a more rigorous introduction to the field.
- **PHYSICS 21, 23, and 25** provide a lower-level introduction to basic physics primarily intended for premedical students. Most departments in the School of Engineering do not accept these courses and require students to take the 40 series or a more advanced offering. However, if you are intending to major in a discipline that *allows* students to take these courses, such as Computer Science or many of the degree options in Management Science and Engineering, these courses may represent an attractive option.

CHEMISTRY COURSES

For some engineering majors, such as Chemical Engineering and the Individually Designed Majors associated with the Department of Bioengineering, taking a chemistry course in your first year is far more important than taking physics largely because Stanford requires students to take a year of introductory chemistry before enrolling in biology. In order to get any advanced biology courses into a four-year degree, it is critical to begin the chemistry sequence early.

The Chemistry Department has recently revised its undergraduate offerings, starting with the freshman year. The following information has been provided by the department. Returning students will recognize the changes from previous years, and freshmen will receive additional information through their advisors.

Chemistry 30, 31, and 32 are no longer offered. Instead, they are replaced by two tracks, the two-quarter sequence Chemistry 31A and 31B, which is offered in the Autumn and Winter quarters respectively, and the one-quarter course, Chemistry 31X, which is offered in the Autumn quarter only. Additionally, students with a score of 4 or 5 on the Chemistry Advanced Placement Exam may continue to start in Chemistry 33, which is offered Winter and Spring quarters, but see the last paragraph in this section, below, about consequences for those preparing to apply to medical school.

Chemistry 31A and Chemistry 31B cover all the essential topics in general chemistry that are required to prepare students for the subsequent courses in the curriculum. Only the more advanced portions of these same topics are covered in Chemistry 31X. Both tracks use the same textbook and will arrive at the same endpoint. Thus, Chemistry 31X is an accelerated course for students with a strong background in high school chemistry. Chemistry 31A and 31B is for students with moderate or no background in high school chemistry. Chemistry 31A is a prerequisite for taking Chemistry 31B. Students must decide before Autumn quarter whether or not they will take the two-quarter track because it will not be offered again until the following year.

In addition to the courses offered by the Chemistry Department, the School of Engineering offers the course ENGR 31, "Introduction to Solid State Chemistry with Application to Materials Technology." ENGR 31 provides a one-quarter freshman-level chemistry option that emphasizes topics and approaches that are of interest to engineers. The course will provide preparation in chemistry that is equivalent in rigor and scope to the new Chemistry 31 A&B, or Chemistry 31X. The applications of chemistry in materials technology will be discussed, including: relationships among the optical properties and electronic structures of molecules and solids; thermodynamics governing the reduction of oxide ores to produce high purity metals; kinetics of the chemical vapor deposition of silicon; the analogy between the pH of an aqueous solution and the Fermi Energy of electrons in a solid.

The chemistry placement exam is required for students who are interested in taking Chemistry 31X in Autumn quarter 2006 but who do not have a 4 or 5 on the AP exam. Students with a limited background in chemistry should sign up for Chemistry 31A, Autumn quarter, and may continue with 31B, Winter quarter (there is no need for this latter group to take the placement exam). New students will take the test on Wednesday morning of Orientation week. Returning students have an opportunity to take the placement test on Sunday evening.

Chemistry 33 is the next course in the chemistry sequence after Chemistry 31A and 31B, Chemistry 31X, or ENGR 31. It is offered in Winter and Spring Quarters. Students in Chemistry 31 A and B should plan to take Chemistry 33 in Spring Quarter. The laboratory course Chemistry 36 can be taken in the Spring quarter with Chemistry 33 as a pre- or co-requisite. The laboratory course Chemistry 130 can be taken in the Autumn quarter of a student's second year with Chemistry 36 as a pre-requisite and Chemistry 35 as a pre- or co-requisite.

Students with AP credit in chemistry forfeit this credit if they complete Chemistry 31X or Chemistry 31A and Chemistry 31B. Students who are planning to apply to medical school should be forewarned that not all medical schools accept AP credit. Therefore, it is recommended that pre-med students with a 4 or 5 on the Chemistry AP exam enroll in Chemistry 31X and not proceed directly to Chemistry 33. Questions concerning pre-med requirements should be directed to the Undergraduate Advising Programs office in Sweet Hall.

SUMMING UP

Here is some general advice that comes from the collective experience of the SoE advisors:

- *Get to know your advisor*. Every entering student at Stanford is assigned an advisor, usually in a discipline in which the student has expressed an interest. Many advisors are faculty, while some others are members of the staff or recent graduates. All advisors certainly have a good general sense of Stanford and its resources. Even if your advisor doesn't know the answer to one of your questions, it is almost certain that the advisor knows where to find that answer. Your job is to make sure that you establish a good relationship with your advisor so that you can draw on that wealth of knowledge and experience.
- *Take a course that provides real engineering experience.* Too many students spend their entire first year taking nothing beyond mathematics, physics, and the required writing and humanities courses. Such schedules make it hard to feel the excitement that comes from the quintessentially engineering activity of making something work. There are many courses—particularly in the Freshman Seminar program—that will give you an opportunity to engage in problem solving within an engineering domain.
- *Maintain flexibility.* Each year, some of you arrive at Stanford absolutely convinced about your major and career plans; many more of you, however, will not be quite so certain by the end of your first year. Rather than commit early to a particular major or course of study, it makes sense to explore more broadly and to keep an open mind about the possibilities.
- *Get help when you need it.* As at most universities, many students who start out with an interest in engineering end up leaving the field after running into problems in their introductory courses. For some, this decision is presumably the right one. Almost all of you, however, have what it takes to succeed in engineering. The same talent and drive that got you into Stanford should enable you to pursue your passion for engineering and go out into the world with a solid foundation in your chosen discipline. But you might need a little help along the way. Make sure you get that assistance when you need it, and not when it seems too late.
- *Plan ahead for an Overseas Program.* With careful planning, many engineering students can fit study at one of Stanford's overseas centers into their academic plans. Talk to your advisor as early as freshman year about planning for one or more quarters abroad (see "Engineers and Overseas Studies" section in Chapter 8).
- *Plan ahead for Coterm Degrees.* In the School of Engineering, all graduate programs allow students to study for a master's degree while completing their bachelor's degree. Because admission requirements and optimal application times vary, students are encouraged to talk early to the department in which they are interested (as early as end of sophomore year) to understand options, deadlines, etc. See chapter on "Other Degree Programs" or the ***Bulletin*** for more information.

Have a wonderful year, and a successful time at Stanford.