Princeton University

Department of Chemical and Biological Engineering
Graduate Handbook

September 2010

FIRST-SEMESTER ORIENTATION

WELCOME!

We're happy that you've chosen Princeton for your graduate work, and we're glad to welcome you here. We think you'll enjoy your stay here for the next few years. Princeton has a lot to offer, both inside and outside the department, and we encourage you to explore the full range of opportunities offered by the University and the surrounding area (New York, Philadelphia, the Pocono's…). By design, we run a medium-sized graduate program, with a small student-to-faculty ratio; this promotes a close working relationship between advisors and students, and camaraderie among the student body, which we all value. Don't pass up the opportunity to get to know as many students and faculty here as you can; besides making your stay here more enjoyable, contacts made in graduate school can form the basis for friendships and professional relationships which could last your whole life.

Besides other students and faculty, during the course of your stay at Princeton you'll interact with a range of University staff (in the department, the School of Engineering and Applied Science, at the Graduate School…). Many of these people have more years of experience at Princeton than the faculty, and all of them are happy to assist graduate students in their research or in negotiating the maze of University administration. If you have questions about University procedures and don't know whom to contact, start with our Graduate Coordinator Karen Oliver, A209 EQuad, 8-4619, koliver@princeton.edu.

We value the spirit of community we have here in the department and at Princeton, and when new situations arise, we try hard to find a mutually agreeable arrangement. If you have any concerns about the department or about the University in general, convey these to your Graduate Student Committee (GSC) representatives so that they can be brought to the full GSC for discussion and brainstorming. If you have any concerns that apply specifically to you (personal or professional), feel free to contact the Director of Graduate Studies (DGS, Professor Stanislav Y. Shvartsman, A421 Equad, 8-4694, stas@princeton.edu).

INTRODUCTION

Many rules and procedures at Princeton are common to graduate students in all departments. The *Graduate School Announcement* (which contains, among other things, the descriptions of all courses currently "on the books") details these common procedures in the section entitled "The Graduate School." Please be sure to read this section sometime during your first semester here at Princeton. There is now only an on-line version available, which is located at: http://gradschool.princeton.edu/about/catalog/. The principal purpose of the *Handbook* you are reading is to provide you information regarding additional rules and procedures of the Department of Chemical and Biological Engineering and the School of Engineering and Applied Science (SEAS). Contained herein are detailed descriptions of the requirements for the PhD degree, and correspondingly shorter descriptions for the MSE and MEng degrees. It also contains "orientation" material for students new to Princeton, such as descriptions of normal office, shop, and laboratory safety procedures. Please read this *Handbook* through at your earliest convenience, and keep a copy where you can easily refer to it. While you may receive reminders about some points described herein (such as certain degree requirements), each student is expected to be familiar with the material contained in this *Handbook*. If you have questions regarding any of the material herein, please contact our Graduate Coordinator Karen Oliver, A209 EQuad, 8-4619, koliver@princeton.edu. She may, in turn, refer you to the Director of Graduate Studies (DGS), or another knowledgeable individual inside or outside the

department. Also, if you have suggestions for corrections, clarifications, or additions to this *Handbook*, they would be welcome; please pass these on to the DGS (Professor Stanislav Y. Shvartsman, A421 EQuad, 8-4694, stas@princeton.edu).

The main departmental office is located in A217 EQuad (staffed by Heather Yaccone, 8-8620, hyacone@princeton.edu). Adjacent (and connected) to A217 are the offices of the Department Chair (Professor Richard A. Register, 8-4691, register@princeton.edu), and the Department Manager (Sharon Malley, 8-4650, smalley@princeton.edu).

We have a spacious lounge for graduate students, the Lapidus Lounge, in A214 EQuad, with several facilities installed for graduate students: a sink, a microwave, a toaster oven, and a coffee/tea/cocoa machine (used by faculty also, 25¢ per cup, bring your own mug if you're a frequent drinker). You are most welcome to eat lunch in the Lapidus Lounge, but please keep the area neat (the custodial staff does not clean this room). Each enrolled graduate student has a mailbox (cubbyhole) in the Lapidus Lounge; mail which arrives in the department is sorted and deposited in the appropriate mailbox daily. Also, any packages that arrive for you (including equipment or supplies which you will order from outside vendors in the course of your research) will be deposited on the table next to the mailbox rack. Please check both your mailbox and especially the package table daily to avoid excessive accumulation of materials and consequent overflow. Outgoing mail (both US and campus mail) may be left in the appropriate boxes (wire baskets) in A220. Interdepartmental (manila) envelopes for campus mail are available in A220. For personal US Mail, you are responsible for putting postage on the letter; for posting mail related to your research, see Karen.

The bulletin board in the hallway across from the departmental office (labeled "CBE Graduate Program Information") contains announcements and syllabi for graduate courses and other official notices. Notices of permanent and postdoctoral positions are posted on the board outside the Elgin Room (A220). The "white board" across from the Lapidus Lounge will show any departmental-wide events (such as seminars) occurring that day. Check these boards frequently!

BUILDING ACCESS, OFFICE SPACE, AND KEYS

All exterior doors to the EQuad are unlocked Monday thru Friday from 7:00 am to 7:00 pm, excluding University holidays. When these doors are locked, most of them can be opened with a building access card (most, but not quite all, of the doors are equipped with card readers—black rectangular items mounted on the right side of the door frame at about hip level, with an LED in the upper left corner). Access cards are now an integral part of the University ID for new students. Handicapped access to the EQuad is available at the entrance to the G-Wing near the tall liquid nitrogen tanks and also at the main EQuad entrance on Olden Street.

As described below, new students select their thesis topics in January, at which time they will move into an office or lab overseen by their advisor. For the first semester here, students will be assigned a temporary desk in an office or lab. These temporary desk assignments may be obtained from Karen. Please make use of your temporary desk—it'll give you a chance to meet upper-year graduate students and find out what life in the department is *really* like (at least according to them—poll a *broad* cross-section of students!). Keys to all the offices and laboratories are located in Karen's office (A209), who will provide you with a key to your temporary office when you arrive, and to your (more) "permanent" office in January. The offices and laboratories are keyed such that one key will open all rooms overseen by a particular faculty member, so most students will need to carry only one key.

LIBRARY FACILITIES

The University's library now has a fairly extensive electronic component, accessible at: http://libweb.princeton.edu. From this site, you can access the University's on-line catalog, many databases (such as the *Science Citation Index*), and the electronic forms of many key journals (including those published by the American Chemical Society and the American Institute of Physics). Since these resources are available from any University computer, take some time at your earliest convenience to acquaint yourself with what's available. The University also has an electronic document delivery service, where you can request articles from journals not held by the Library, or in older (non-electronic) volumes in branch libraries, all without ever leaving your desk! Of course, there are still the "non-virtual" branches of the library, some of which are listed below:

Engineering Library -- The Engineering Library is located in the Friend Center, ground and upper floors. Books and periodicals covering all branches of engineering are located here. The library is quite nice, so it'd be worth your time to pay a visit soon.

Firestone Library -- Firestone is the University's main library, though engineering students have relatively little need for its collections. Firestone Library also contains a copy center which has self-service color photocopiers (closer than Kinko's, maybe a bit cheaper).

Chemistry Library -- This is located in the Frick Chemical Laboratory and contains most of the reference books and periodicals relating to chemistry and biochemistry.

Mathematics and Physics Library -- This combined library is located in Fine Hall. It is essentially a reference library.

Lewis Library – Located on the corner of Washington Road and Ivy Lane, this is the University's newest library. It combines the outstanding collections and knowledgeable staff of the Astrophysics, Biology, Chemistry, Geosciences, Mathematics and Physics Libraries, the Map Collection, and the Digital Map and Geospatial Information (GIS) Center.

Fine Annex -- Located in the basement of Fine Hall, this is where many older periodicals (including many from the Engineering Library) are archived. The Annex is open 8:00 a.m. – 11:45 p.m., Monday through Friday, and 9:00 a.m. – 11:45 p.m., Saturday and Sunday.

PHOTOCOPYING

During your first semester here, you may have (very) occasional need to photocopy something related to your coursework, or to your investigation of potential thesis projects. The department is prepared to pay for such modest copying needs; see Karen, who will provide you with an access code for the photocopier in A220 and instruct you how to work it. Bound library journals, which are not normally permitted to circulate, can be checked out of the Engineering Library for an hour to photocopy pages from their contents. Alternatively, you may use the copiers in the library, but these do not accept our access codes; you will have to pay for the photocopies.

Once you join a research group in January, you should request from your advisor an account number to use for future photocopying. You may also use this account number to purchase a library copy card, a sort of debit card which comes prepaid in various denominations (1,000 copies per card is the most economical). Give Karen an account number and ask her to order a copy card for you from OIT (Office of Information Technology); she will let you know when the card is ready for pick up.

TELEPHONES

Campus and local calls can be made from almost any campus phone, including those in your temporary offices. To place long-distance personal calls, you may use one of these phones if you have a calling card, or place a collect call; alternatively, there is a pay phone booth on the second floor of the C Wing.

Once you join a research group, you may need to make long-distance telephone calls for your research. To do so, you need a five-digit access code (to dial after you dial the telephone number; a second, different dial tone will sound prior to your entering the access code). Our Financial Assistant, Mary Beth Friedfeld (A213, 8-4690) will obtain an access code for you once you provide her with an account number. If you make a personal long-distance call using this access code, you are expected to reimburse the department; Mary Beth will periodically distribute telephone logs, which show each card and the associated charges.

Also, once you obtain your "permanent" office, you can set up your telephone voice mail account. The procedures to obtain a voice mail account are detailed in the Campus Directory.

CLERICAL MATTERS

At the present time, computers and printers for general use are available in clusters in the Friend Center. You may be able to use computers and printers in your temporary office; contact the faculty member or student in charge of the lab's computers to discuss.

Departmental assistants should not be asked to type a student's work. Assistant's desks, typewriters, computers, printers, and supplies may not be used by students, within or outside of office hours without explicit permission from the appropriate assistant. Department letterhead, envelopes, and other stationery may not be used by students except in very special instances (such as mailings for the Graduate Student Symposium) and with approval from the appropriate assistant or faculty member.

WASTE DISPOSAL

The University participates in a state-mandated recycling program. On each floor of the EQuad you will find bins for cans and bottles. In each office and laboratory there are two kinds of trash cans: one labeled for recyclable paper items, the other for trash which cannot be recycled. Please read the labels and sort your trash. If recyclable paper is commingled with other trash, the janitors have been instructed not to empty your cans.

TAX AND RESIDENCY ISSUES

NJ vs. "Home State" Residency

For the usual residency matters (voting, taxation, auto registration and insurance), you can retain your home-state residency if you choose (which would probably make auto insurance cheaper). However, the part about auto insurance only holds if you're single and are covered under your parents' policy (*i.e.*, you can still claim to be a dependent on your parents for this purpose). If you get married, you can no longer claim to be your parents' dependent and will need to switch your residency.

Stipend Taxability

For federal taxes, all types of awards (fellowship; Assistant in Research, AR; Assistant in Instruction, AI) are taxable. Those who are receiving external awards (*e.g.*, NSF Fellowships) may need to make quarterly anticipated tax payments, since there is no withholding. For NJ state taxes, fellowships are nontaxable, while AR and AI stipends are taxable. So for the first year,

your stipends will be NJ tax-free. If you are receiving funds from an external fellowship (*e.g.*, NSF Fellowship), this portion will be NJ tax-free for the duration of the fellowship.

If you're an out-of-NJ resident and you receive any taxable income (*e.g.*, AR or AI stipend), you will in general have to pay taxes to both NJ and your state of residence, according to the appropriate tax laws. Note that individual states may not conform to NJ's policies (*i.e.*, they may tax fellowship income as well as AR and AI income), so you'll need to check the tax laws in the relevant state. Also, Pennsylvania and NJ have a reciprocity arrangement for state taxes, such that one pays according to the state of residency (so, if you're a PA resident, you pay PA state taxes on your stipend just as if the money was earned there, and nothing to NJ).

Fortunately, the Graduate School does hold a tax workshop for graduate students each February or March. You should expect to receive a general email with the details sometime before then.

PhD IN CHEMICAL AND BIOLOGICAL ENGINEERING: DEGREE REQUIREMENTS

The PhD program aims to prepare students for positions as independent researchers, whether in industry or in academia. Many of these students will eventually go on to assume managerial or administrative positions; we believe that the close mentorship which characterizes our program and our strong emphasis on written and oral communication, benefits students who follow such career paths. The central feature of the program is original research leading to the student's PhD dissertation. In addition, students must exhibit a firm and broad grasp of modern chemical engineering and allied fields through coursework and the General Examination, and demonstrate the ability to conceive and plan original research outside of their dissertation area through the preparation of the Second Proposition. A checklist of PhD program requirements is given on the following page.

PhD RESEARCH TOPIC SELECTION

In your first year, at the end of September, you will receive a packet of short descriptions of the PhD thesis topics being offered this year. Each faculty member offering a project will make a 20-minute presentation to you and your classmates (schedule to be distributed). After reviewing the packet and identifying a few topics of particular interest, you should make appointments with the faculty members offering these topics to discuss them in greater depth. To ensure that you've investigated a broad range of topics, we ask that you meet with a minimum of six faculty members during this process. In many cases, you may wish to meet more than once with faculty in whose research you are particularly interested (*e.g.*, scheduling a second meeting after reading articles or proposals relevant to the topic being offered). Use the fall semester to gather whatever information you think will help you make the best decision possible: after all, this will be *your* project for the next four years, so make sure it's one you will enjoy! Besides the faculty members, upper-year graduate students are often a good source of information about the work going on in various groups. Students who arrive at Princeton with their own funding (*e.g.*, full support for three or more years from a source outside the University; this does not include Wu, Upton Fellows) should feel free to discuss with faculty whether there are potential projects not listed in the packet which might be available to such an externally-funded student.

Your project choice will be due in early January. Conflicts in project selection (*e.g.*, two or more students choosing a project which can accommodate only one) are infrequent but do occur. In the event of such a conflict, the faculty will make the final project assignments, relying largely on the input of the faculty member(s) offering the project in question.

CHEMICAL AND BIOLOGICAL ENGINEERING PH.D. PROGRAM CHECKLIST

Coursework
___ CBE 501 or MAE 552, semester grade for General Examination _____
___ CBE 502, semester_____ , grade for General Examination _____
___ CBE 503, semester_____ , grade for General Examination _____
___ CBE 504, semester_____ grade for General Examination _____
___ CBE 505, semester_____ , grade for General Examination _____

___ Technical 5xx elective, course number and semester_____
___ Technical 5xx elective, course number and semester_____
___ Technical 5xx elective, course number and semester_____
___ Technical 5xx elective, course number and semester_____
___ Free elective, course number and semester_____
___ Free elective, course number and semester_____
___ Free elective, course number and semester_____

First Proposition
___ submitted, date: _____
Advisor: _____
Second Reader (or Co-Advisor): _____
Third Reader: _____
___ approved, date:_____

AI Service
___ course number, semester, instructor _____

Second Proposition
___ topic approved, date:_____
___ submitted, date:_____
Reader: _____
if returned to student for revision, date(s) of return and resubmission:

___ approved, date:_____

Final Public Oral Examination
Advisor:_____
Second Reader:_____
Member:_____
Member:_____ (indicate chair of committee)
___ sustained, date:_____

COURSE REQUIREMENTS

PhD students must pass a total of twelve courses, divided as follows:

5 ChemE "core" courses:

CBE 501 or	Incompressible Fluid Mechanics
MAE 552	Viscous Flows and Boundary Layers
CBE 502	Mathematical Methods of Engineering Analysis II
CBE 503	Advanced Thermodynamics
CBE 504	Chemical Reactor Engineering
CBE 505	Advanced Heat and Mass Transfer

4 graduate-level (500-level) technical courses

3 unrestricted electives (any level, any subject)

The "unrestricted elective" courses can be used, for example, to learn a foreign language, take introductory Molecular Biology, policy courses in the Woodrow Wilson School, or any other course in any department. There is no foreign language requirement for the PhD in Chemical and Biological Engineering. Technical graduate-level "technical" courses need to have their primary (first) listing in an engineering or physical science department (e.g. Chemical Engineering, Chemistry, Physics, Molecular Biology).

Students, particularly those entering with Master's degrees, who have previously taken a graduate-level course comparable in scope to one of our "core" courses, may request exemption from this required course from the Director of Graduate Studies. Completion of the five core courses is a prerequisite to advancing to post-generals status, so that written testing (e.g. taking the course final exam) would normally be required before an exemption from a ChE core course is granted. Each exemption approved will count in lieu of the course requirement, *i.e.*, the student does not have to take another course in place of the one approved for exemption (or in other words, the total requirement of 12 courses is reduced). The request should describe for which course(s) exemption is sought, and should provide some information on the course taken elsewhere (school, course name and number, instructor, textbook used, and if at all possible, a syllabus for the course). Such exemptions should be sought during a student's first semester of residence. Exemptions from the other seven requirements on the basis of prior work elsewhere will not be granted.

Core graduate courses in chemical engineering are graded with a letter grade. Graduate electives are graded pass/fail (P/F) for chemical engineering PhD candidates, though we do retain an internal record of letter grades (which some students have requested later, such as for admission to business school). Courses taken outside the department, or undergraduate chemical engineering courses taken to fulfill the "unrestricted elective" requirement, may be taken either P/F or for a letter grade, according to the preferences of the student and the policies of the instructor and offering department. Courses which are audited, or which are not completed, do not satisfy any of the above requirements.

GENERAL EXAMINATION

The General Examination consists of two components: 1) mastery of graduate-level chemical engineering material in the five departmental core courses (501-505), and 2) a written First Proposition (thesis research proposal) and its oral defense. There is no oral examination other than the First Proposition defense.

Students are required to have a grade of B- or above in each of the five departmental core courses. A grade of C+ and lower means that the doctoral candidate will have to retake the corresponding course (not for credit), possibly after auditing a relevant undergraduate course. Course materials for students repeating a core course will be made available by the course instructor to a committee of faculty, who will make a recommendation to the faculty as a whole.

The First proposition examination committee (described in the following section) is augmented for purposes of deciding the outcome of the general examination by two or one additional faculty, depending on whether a student is individually or jointly advised, respectively. The advisor(s) participate in the exam but do not vote on whether the student passes or fails. The First proposition oral defense is open to all chemical engineering faculty, who can participate by asking questions; however, only the three committee members (excluding the advisor(s)) have voting rights.

As noted above, passing the General Examination requires passing (or being exempted from) all five core courses and satisfactorily defending the First Proposition. Upon passing the General Examination, the student advances to "post-generals" candidacy, and receives a modest enhancement in stipend. In addition, passing the General Examination entitles the student to receive a Master of Arts (MA) degree.

FIRST PROPOSITION AND THESIS COMMITTEE

The First Proposition serves to initiate a student's dissertation research, and provides the faculty with an opportunity to assess the student's creativity and aptitude for research. It comprises a critical, written study in the proposed area of the dissertation, embodying the results of the first year's research activity, including a clear definition of the specific problem to be addressed. In addition, it must contain a substantial, original effort toward the solution of some aspect of that problem. The written document should be prefaced by an Abstract and a Table of Contents, and the date of submission should appear on the cover page. The First Proposition is due by 4:30 pm on the first Friday in November of the second year of residence; four velo-bound copies should be submitted to the Graduate Coordinator, along with suggestions for Second and Third Readers (described below).

The First proposition should address the following questions: Why is the proposed work interesting? How does it relate to previous work? Is the proposed work doable? Providing an answer to the first two questions involves explaining what makes the proposed topic interesting from the standpoint of engineering and applied science. Addressing the third question is best done by providing some preliminary data, either experimental or computational/analytical.

The length of the First Proposition document should not exceed 15 pages, font size 11. This page limit includes figures and tables. There is no page limit on the references. Proposals exceeding this size will be returned for reformatting.

Second and Third Readers may be drawn from Chemical and Biological Engineering associated faculty as well as other departments within or outside of Princeton. The department encourages the addition of external thesis committee members, but any travel and other costs associated with such committee members are the responsibility of the project advisor or the external committee member. If you would like to have a faculty member who is not a regular or associated CBE faculty member serve as your Second or Third Reader, discuss this matter first with your advisor and then with the DGS *prior* to submitting your First Proposition.

The First Proposition is read and evaluated by the student's advisor and two other faculty members, the Second and Third Readers. For jointly-advised thesis projects, one faculty member will be designated as the advisor and the other as the Second Reader. Students' suggestions for readers will be honored insofar as possible within the constraint of an equitable readership and

advising load across the faculty; final assignments of readers will be made by the DGS. Students will be informed of the reader assignments within two weeks of submitting their proposition. The defense of the First Proposition takes place the following January, during the General Examination period specified by the university (Jan. 3 – 23, 2010 for the coming year) and is scheduled by the student with their committee members. The oral defense committee consists of the advisor(s), reader(s), and one or two additional faculty members, as explained in the previous section on the "General Examination." The oral defense is open to departmental faculty.

The oral exam consists of a presentation by the student, and questions by the oral defense committee members and by any other participating departmental faculty members. The student should prepare a short, 15-20 minute presentation of the proposed work. It is strongly recommended to practice this presentation in advance, to make sure that the main goals of the proposed work are presented in a clear and succinct manner. In addition to assessing the student's creativity and aptitude for research, the questions are intended to evaluate the student's understanding of his/her proposed research area, and of chemical engineering fundamentals as they pertain to his/her dissertation topic.

In addition to passing, other outcomes of the oral defense are possible. Students may be asked to make revisions to the written document, to re-defend the proposition orally, or both. The committee must approve the First Proposition before a student can advance to post-generals candidacy. There is no limit to the number of times which a student may revise and/or re-defend the First Proposition, though a student who is unsuccessful on his/her second attempt may be counseled to request a switch to the MSE degree track. In any case, the First Proposition must be approved by Commencement Day (June) of the student's second year in residence, or PhD degree candidacy is automatically terminated by the Graduate School.

As noted below, the advisor, Second Reader, and Third Reader form the nucleus of the student's thesis committee; this group of three will later be augmented by the reader of the Second Proposition to make up the full committee which will be present at the thesis defense (the Final Public Oral examination). It thus behooves the student (you) to build relationships with the members of this committee, and to keep them informed of your progress throughout your time at Princeton. When you write up an article for a journal or a conference volume, provide your committee members with a copy for their perusal. When you give an on-campus seminar or poster presentation on your research, let your committee members know so that they may attend. Furthermore, there is now a required committee meeting with you once per year, normally before the middle of the Spring semester, to review your progress. (Contacting your committee members and arranging for such a meeting is your responsibility; if you encounter any difficulties, please contact the DGS.) These faculty members may be able to provide useful information or guidance as you progress in your research. In any event, building a relationship with these committee members will make the steps leading up to the Final Public Oral faster and more enjoyable for all concerned.

In some cases, it is necessary to make substitutions in the membership of a student's thesis committee after the time of a First Proposition. Faculty who retire or otherwise leave the employ of the University will be replaced on students' thesis committees as necessary by the DGS as soon as it is apparent that the faculty member will have departed by the time of the student's FPO. Faculty who are away from the department for an extended period (personal leave, serving as Dean, *etc.*) will also be replaced on students' committees as needed.

SECOND PROPOSITION

The Second Proposition is either a proposal for original research, or an actual piece of original research, on a topic within the chemical and biological engineering field, broadly

construed. The subject of the Second Proposition must be *distinct* from that of the student's dissertation, and must be conceived and written without assistance from the student's advisor(s). The purpose of the Second Proposition is to assist students in developing original research ideas in new areas, and in presenting these in such a way as to persuade a critical reviewer of both the merit of the research and the soundness of the method. Such skills are essential for any research career, whether academic or industrial, and similar skills (though different subject matter) would be required even for most non-research careers (*e.g.*, developing a business plan).

The key aspect of the Second Proposition is the identification of a novel area for research, or an original solution to a long-standing problem. The Second Proposition may not be a summary of work performed elsewhere by the student (*e.g.*, at a university previously attended, or at a previous industrial position) or by anyone else, though problems or research areas suggested by a student's previous experience are certainly appropriate. Since the Second Proposition is a distinctive feature of our PhD program, it is unlikely that an acceptable Second Proposition would correspond to a piece of required work in another course (where the assignments are typically not to propose or execute *original* research, but merely to describe previously-reported research). However, such a multiple submission may be acceptable provided the student follows the procedures for "Multiple Submission" described in *Rights, Rules, Responsibilities* (p. 62 of 2008-2009 edition), where the "instructor" for the Second Proposition is the Director of Graduate Studies (DGS). Many students have found inspiration for their Second Proposition from seminars given on campus, either within Chemical Engineering or elsewhere.

Simply put, the idea for the Second Proposition should be that of the student, not anyone else's. In developing plans for the execution of the research, it is permissible to consult with faculty other than the student's advisor(s), as well as other individuals within or outside the University, regarding *specific* points relevant to the detailed research plan (*e.g.*, capabilities or limitations of a particular analytical technique). In such cases, however, an acknowledgment or citation (to "personal communication") should be included in the proposition (as is typical for research papers).

As noted above, the Second Proposition must be written on a topic distinct from the student's thesis area. One measure of distinctness is that the literature cited for the Second Proposition should be wholly different from that cited in the student's dissertation. To ensure this distinctness (and to avoid possible later rejection of the Second Proposition on the grounds that it was too similar to the thesis work), students should submit their topics to the Director of Graduate Studies for approval prior to embarking on the actual writing of the Second Proposition. The student should submit to the DGS a draft abstract of the Second Proposition (including a brief list of the most relevant references you have consulted) and a draft abstract of the dissertation. In some cases, the DGS may request additional information, or may solicit the opinions of faculty more knowledgeable in the subject areas, before approving the Second Proposition topic. Note that topical approval does not imply automatic approval of the Second Proposition itself; it serves merely to certify that the topical area is distinct from the thesis. Eventual approval of the Second Proposition will hinge on the reviewer's assessment of the originality of the proposed research and (for proposed research) the feasibility of the approach or (for completed research) the correctness of the conclusions. To allow adequate time for writing the Second Proposition, it is strongly recommended that students secure the DGS's approval of their topic by the last day of classes in their third year of residence, at the very latest. In practice, this means that students should start thinking about their Second Propositions early in their third year, since good ideas generally require some time to incubate. Along with the topic, please submit the names of three faculty members (possibly including CBE associated faculty) who

were not part of your First Proposition committee as potential readers for your Second Proposition.

The great majority of Second Propositions describe *proposed* research, and for such propositions, a useful format to follow is that of a proposal to an external funding agency. The document should begin with a one-page abstract. The main body should lead off with an introduction that places the work in context: describing what is known in related areas, and explaining the importance of the proposed work. This background section should be sufficient to summarize the state of knowledge for a technically-competent reviewer not familiar with this precise subject area. (Consider the three faculty members you suggested as potential reviewers for your Second Proposition, and write the background section with them in mind.) The background section is important only insofar as it is needed to properly frame the proposed research; excessively long background sections (resembling a paper one might submit as a course assignment) generally diminish the quality of a proposition. The heart of a Second Proposition is the research idea. The approach to the work (whether it be experimental, theoretical, or computational) must be described in sufficient detail for the reviewer to gauge its feasibility. Preliminary results demonstrating feasibility are not required, but if they are available, they may be included here to strengthen the proposal. The description should include not only the method needed to generate results, but should also present a framework for interpreting the results so that the reviewer may reasonably project that the goals of the research will be met. (Collecting data is not a goal; arriving at new understanding, or designing new products or processes, is.) As with any proposal or paper, the document should provide an ample reference list in support of statements made in the text. To ensure speedy review by the faculty, a 40-page limit (double-spaced, 12-point font, 1" margins, excluding abstract and references but *including* figures and tables, which should be incorporated into the proposition's body) will be imposed on Second Propositions. (Do not feel obliged to use all 40 pages; note that length limitations for proposals to federal agencies are typically more stringent than this.) Propositions exceeding this length will be returned for revision without review.

While the Second Proposition is most commonly a research *proposal*—that is, it will typically contain few, if any, actual research *results* generated by the student—in exceptional cases, a student may not only conceive an idea but actually push it to completion. Such situations would of course be rare, since original research outside of one's thesis area would normally require an investment of time (and perhaps of capital) out of proportion to that which a student can afford to dedicate to the Second Proposition. However, in such unusual situations, the completed research may constitute an acceptable, even excellent, Second Proposition. As an example, one might use a recently-developed concept to reinterpret a body of existing experimental data (much as, in the earlier days of chemical engineering, correlations for heat transfer coefficients or distillation column performance were developed). In such a case the format for the Second Proposition should follow that of a standard-length journal article in the relevant field. Its originality and correctness will be assessed by a faculty reviewer in much the same way that any manuscript submitted to any high-quality journal would be peer-reviewed. Note that simple completion of a project does not guarantee its acceptability as a Second Proposition; the reviewer must still be persuaded of the merit of the research and the correctness of the conclusions.

Students must submit their Second Propositions to the Graduate Coordinator by the first day of classes in their fourth year of residence; two copies (one velo-bound, one unbound) should be submitted, and the proposition's cover page should include the date of submission. The DGS will assign the Second Proposition to one faculty member for review (normally the faculty member most expert in the area, but assignments are made in the context of other faculty

responsibilities). The faculty member will scrutinize the document and provide a written evaluation of the Second Proposition, much as one would review a proposal to a funding agency (government or industrial). This written evaluation is returned to the student, and a copy is deposited in the student's personnel file. This evaluation will be completed within six weeks (holiday periods excluded) from the time of submission. The reviewer of the Second Proposition then becomes a part (the fourth member) of a student's thesis (Final Public Oral) committee.

Some Second Propositions are approved as originally submitted. Occasionally, if the reviewer finds that the proposition does not contain any new ideas, the proposition may be rejected and the student advised to begin again on a different topic. Many Second Propositions are judged to lie between these two extremes: the basic idea is sound, but some aspects of the proposition need to be reworked or fleshed out, and consequently the proposition is returned to the student for required revisions. The reviewer's evaluation should clearly spell out the deficiencies in the proposition. If revisions are required, the student should submit two copies of a revised Second Proposition with a supplemental page indicating a summary of the changes made, to the Graduate Coordinator by the first day of classes in the spring semester of the fourth year of residence; the cover page should include the dates of original submission and resubmission. The proposition will be re-reviewed by the original reviewer (unless the subject of the proposition has changed), and a written evaluation will be provided to the student within six weeks of resubmission (again with a copy to the student's personnel file).

In most cases, the Second Proposition is approved on the first or second submission. In some cases, however, the proposition may still be deemed unacceptable after revision. There is no limit to the number of times which a Second Proposition may be revised; however, each submission-and-review cycle must be allotted six weeks, and it is the intent of the faculty that each student should have his or her Second Proposition approved by June 1 of his/her fourth year of residence. (This goal is reflected in the schedule outlined above.) In any case, the Second Proposition must be approved before the Final Public Oral Examination may be scheduled.

Students in good standing in our program are normally accorded a rate of pay (stipend) during the two summer months which exceeds the monthly rate of pay during the academic year. Students who have not secured approval of their Second Proposition by June 1 of their fourth year of residence will be deemed delinquent in this program requirement, and receive a monthly summer stipend equivalent to the post-generals Assistant in Research pay rate during the following academic year. If approval of the Second Proposition is still not secured by June 1 of the fifth year of residence, this formula for the summer stipend will persist into the summer of the fifth year. If a significant portion of the student's stipend derives from a funding source outside the University, then the department will withhold any summer supplements it would grant to students in good standing so as to bring the total annual stipend as close as possible to the level described above.

A Second Proposition Archive has been set up for consultation by students planning their own Second Propositions. The Archive consists of several excellent Second Propositions submitted and approved in recent years, which can serve as examples of the Second Proposition format. Copies of the Archive may be checked out from the Graduate Coordinator for two-week periods, but as these are not public documents, they should not be copied or distributed.

ASSISTANTSHIPS IN INSTRUCTION

Every PhD student is required to serve once (one semester) as an Assistant in Instruction (teaching assistant), to broaden the student's experience and expose him/her to the other side of the instructional process. Under special circumstances, to be discussed with the Director of Graduate Studies, this requirement can be lifted. The precise requirement, in University

parlance, is that the student serves for "six hours", which we in Chemical and Biological Engineering consider to be a "full" AI position. Such a position is expected to require 20 hours/week for the semester (not six; the difference is "contact hours" with undergraduates *vs.* "total hours", but since many of our AI positions are laboratory-based, the number we focus on is the total workload of 20 hours/week). Students generally serve in their second year of residence, never in their first. Some students may serve more than once, if the student so desires, if AI service is needed to ensure a student's continued financial support, or if the department cannot fill the AI position otherwise. In addition, some "half" ("three-hour") AI positions may be available, which should require 10 hours/week; these would normally be filled by students who have already completed their term of "full" AI service.

DISSERTATION

The *Graduate School Announcement* contains some information on the content and format of the dissertation. Instructions for preparing the dissertation in proper form for its archiving in Mudd Library may be obtained from their website at: http://www.princeton.edu/~mudd/thesis/index.shtml. However, the best information on the dissertation would come from conversations with your advisor, coupled with a perusal of other theses from your laboratory or other laboratories in the department.

When you embark on the writing of your dissertation, have a thorough talk with your advisor first. Some advisors prefer to receive the entire dissertation at once; others prefer to read individual chapters as they are completed. Normally, the student and advisor will iterate on the dissertation until both are satisfied. Then the advisor will prepare a written document, known as a Reader's Report, evaluating the dissertation, and the student provides a copy of the dissertation to the Second Reader. The Second Reader then reads the dissertation and provides comments to the student, most likely generating some revisions to the thesis. Once the Second Reader is satisfied with the dissertation, he/she writes an independent, second Reader's Report.

Since many of our students are jointly advised, in many cases the Second Reader is really a second advisor, and the advisor and Second Reader's evaluations may proceed roughly in parallel. A Second Reader who has not been directly involved in the research may (or may not) be willing to read the dissertation in parts, after these have been approved by the advisor, but would almost certainly be unwilling to read anything which has not been approved by the advisor. The two signed, written Reader's Reports must be received by the Graduate Coordinator before the student can proceed to schedule a Final Public Oral Examination.

The student is responsible for costs incurred in the preparation of the dissertation (copying, binding, *etc.*). However, students are advised not to prepare final copies of the dissertation (on high-quality paper) or to bind these copies prior to the FPO, as the FPO committee may require revisions.

FINAL PUBLIC ORAL EXAMINATION (FPO)

The student defends his or her thesis before a faculty committee, normally consisting of the advisor, Second Reader, Third Reader, and reader of the Second Proposition. All four members of the committee are expected to have read the thesis, and are also provided with copies of the Second Proposition.

FPOs are open to the public. During the FPO, the student makes a formal oral presentation of the work. A suggested format is an approximate 45 minute presentation.

Several forms need to be filed before conducting the FPO; these may be obtained from the Graduate Coordinator, who will also be able to provide an interpretation for some of the more obscure ones. The most important form, which must be filed with the Graduate School, is

the "Request to Hold the Final Public Oral". All FPOs must be authorized by the Graduate School; the department cannot do this on its own authority. Before a student can request a date for his/her FPO, the Graduate Coordinator must have received: 1) a copy of the dissertation's title page and abstract (from the student) for forwarding to the Graduate School, 2) each of the two signed, written Reader's Reports, 3) a "PhD Dissertation Report" describing the status of publications from the thesis (completed by the advisor), 4) the Degree Application form (completed on-line at the Graduate School website, 5) four copies of the dissertation, in three-ring binders, and 6) four copies of the Second Proposition (which can be included in the three-ring binder behind the dissertation). The student is responsible for orchestrating a date and time for the FPO which is agreeable to all four committee members, and for reserving a suitable room in which to conduct the examination (typically the Lapidus Lounge or Eisenhart Room). The Graduate School asks that this request be submitted two weeks (ten working days) prior to the actual FPO. Under *extenuating* circumstances, we have been able to shave this period to one week (five working days), but as this provides rather little time for the committee to read the thesis, we ask that the two-week period be honored unless the circumstances are *truly extenuating*. (Committee members may *insist* on having the full two weeks to read the thesis, if they so desire.)

FPOs are not normally conducted in the summer (between Commencement and the start of fall term classes). Faculty is not paid by the University over the summer, so we cannot require them to perform University business (such as sitting on FPO committees). Also, as a practical matter, faculty travel more extensively during the summer, meaning that finding a mutually agreeable date can be difficult. However, there is no rule *prohibiting* the holding of FPOs over the summer, provided all four committee members are agreeable. (Many will agree, given that the alternative is to hold the FPO during the academic year, when they are generally busier. Also, this is a situation where building a relationship with your committee members can pay off.)

Though a student's FPO committee normally consists of the First Proposition committee (advisor, Second Reader, Third Reader) and the reader of the Second Proposition, there are inevitably situations where one or more of these committee members becomes unavailable and must be replaced, as described under the section entitled "First Proposition". However, the DGS will generally take a dim view of requests to reshuffle a student's committee solely to make it possible for a student to hold an FPO a couple weeks earlier, or to make it possible for a student to defend during the summer months, as this defeats the idea of having a committee which can follow the student's progress during his/her time at Princeton. Again, you are heartily encouraged to build relationships with the faculty members comprising your committee.

A guide to the various steps leading directly to the FPO is provided on the following page.

A Student Guide to the Final Public Oral Examination (FPO) and Beyond

Arranging a mutually-convenient time for the FPO and reserving an appropriate room should be done by the student. The degree candidate must inform the Graduate Coordinator of the FPO date, time, and place at least two weeks (ten working days) in advance of the FPO. At that time, the degree candidate should provide all items enumerated in the seven points below to the Graduate Coordinator (if she has not already received these). All necessary forms are available on-line at the Graduate School website: http://gradschool.princeton.edu/academics/processes/.

1) **Ph.D. Dissertation Report and Request to Hold Final Public Oral Examination** form (will be completed by the Graduate Coordinator). DGS will sign when all other materials are received.
2) completed **Degree Application** form (on-line submission at Graduate School website)
3) **two** signed, written **Reader's Report** forms (should have been sent separately to the Graduate Coordinator)
4) completed **PhD Dissertation Report** form (should have been sent separately to the Graduate Coordinator by the advisor)
5) one copy of the dissertation **abstract** (including your name and title) for forwarding to the Graduate School
6) one copy of the dissertation **title page** (including the degree date: September, November, January, April, or June, with the year) for forwarding to the Graduate School
7) **four** copies of the **dissertation** (in three-ring binders) and **four** copies of the **Second Proposition** (in three-ring binder behind dissertation) to be distributed by the Graduate Coordinator to your FPO committee members

Many of these items must be sent on to the Graduate School for the FPO to be scheduled. To ensure that these arrive there on time (the Graduate School requests ten working days notice, though this can be shaved by a few days in extenuating circumstances), we suggest that the degree candidate personally deliver these items to the staff of Dean David Redman's office, 111 Clio Hall. Otherwise they will be sent via campus mail.

Foreign students must report to Mladenka Tomasevic, Office of Visa Services, 8-1445, to review their visa status upon completion of the FPO and termination as graduate students. After the FPO is sustained, all degree candidates must do the following to actually get on the degree list:

1) complete the departmental **Forwarding Address** form and return this to the Graduate Coordinator
2) complete the departmental **Closing Laboratory Checkout** form, have this approved by a member of the departmental Safety Committee, and turn this in to the Graduate Coordinator
3) turn in all keys to the Graduate Coordinator
4) take the following items to Mudd Library within two weeks of completion of FPO:
    a) a check for the **degree fee**, made out to the Princeton University Library; degree fee is $80, and there is a $55 surcharge if the student wishes to copyright the dissertation
    b) a completed **ProQuest Publishing Option and Copyright Registration** packet
    c) **two** bound copies of the **dissertation** to Mudd Library
    d) **one** electronic copy of the **dissertation** in Adobe PDF format on a CD, **with both the jewel case and CD properly labeled**, with author's name, title of dissertation, and Princeton University
    e) **two** copies of the **Final Public Oral Examination Report** form (signed by the DGS and provided by the Graduate Coordinator after completion of the FPO); one copy of this form must be signed by the librarian (in Mudd) and returned to the student
    f) **one** copy of the dissertation **abstract** (including your name and title)
    g) **one** copy of the dissertation **title page** (including the degree date: September, November, January, April, or June, with the year)
5) once step 4 is completed, turn in the following items to the Graduate Coordinator, who will make copies for our files and forward the originals on to Dean David Redman's office:
    a) the **Final Public Oral Examination Report** form, with all signatures
    b) a completed **End of Enrollment Form**
    c) a completed **Exit Questionnaire** (on-line at Graduate School website)
    d) a completed **Survey of Earned Doctorates** (on-line at Graduate School website)

PhD DURATION AND REENROLLMENT

In consonance with the policies of the Graduate School, the department encourages diligent pursuit of the objectives of graduate study. Students are expected to complete all requirements for the PhD within five years from the date of entry. Students in good standing may expect to receive financial support for that period of time, though this support may entail AI service. However, the Graduate School will not approve reenrollment of a student for a sixth year except in *truly* extenuating circumstances clearly beyond the student's control (*e.g.*, documented and severe medical problems suffered by the student; death of the student's advisor, resulting in a change of thesis project; *etc.*). Students and advisors should thus jointly plan a scope and course of research which can be completed within five years, while the student attends diligently to the completion of program requirements other than the dissertation (*e.g.*, the Second Proposition).

That said, reenrollment for five years is not automatic. In March of each year, PhD students must be recommended in writing by their advisors and the DGS for reenrollment, so that the Graduate School knows that each student is progressing well through the program. This reenrollment process results in the generation of a new support contract for the student for the following academic year. Reenrollment provides an opportunity for students and their advisors to engage in performance evaluation (looking back over the past year) and goal setting (defining objectives for the coming year). This exercise is particularly important for those who are more senior students (any student being recommended for reenrollment to a fifth, or even fourth, year). To this end, each statement for a student requiring reenrollment to a fifth year should consist of a detailed description of the student's status and a plan for completion of the remaining research milestones such that the dissertation can be completed by the end of the fifth year. The initial draft of the statement can be drawn up by either the advisor or the student, but in either case, the statement must be agreed to by both parties. For any student requiring reenrollment to a fourth year, a similar (but probably shorter) evaluation and statement of goals to be accomplished in the coming year should be submitted. If, a year later, reenrollment to a fifth year appears necessary, then these would serve as points of comparison to assess the student's progress (*i.e.*, were these goals met? if not, why not? were other goals substituted because of exciting unexpected developments?). A thesis committee meeting is required every year and is held typically in the spring semester prior to drafting of the readmission document.

Sometimes students will leave campus without having written their dissertations, often because they have reached the end of their five years of enrollment and because their future employers are asking them to start work. The writing of the dissertation is a substantial undertaking, and one often does not know whether one has *really* done all the necessary research until it is written up. In a few unfortunate (but recent) cases, students who left Princeton sincerely intending to write their dissertations part-time were unable to do so, and their PhD degree candidacies were terminated—wasting five years of work at Princeton. Consequently, the faculty greatly prefers that a student not leave campus until, at a minimum, a complete draft of the dissertation is written.

PhD IN CHEMICAL AND MATERIALS ENGINEERING: DEGREE REQUIREMENTS

The PhD in Chemical and Materials Engineering is a degree option offered to those students with strong interests in materials, and is conducted jointly with the Princeton Institute for the Science and Technology of Materials through its graduate program. The difference in degree name recognizes the fact that students on this degree track have demonstrated mastery of core areas in both chemical engineering and materials science, and have produced original research at the nexus between these two fields. Most of the requirements and procedures for this degree are identical to those for the PhD in Chemical Engineering (consult the relevant entries there for "First Proposition", "Second Proposition", "Assistantships in Instruction", "Departmental Seminar", "Final Public Oral Examination", and "PhD Duration and Readmission"). There, are, however, three key differences. The first is in the choice of thesis topic: students in the Chemical and Materials Engineering program must naturally be pursuing a materials-related thesis. Otherwise, the procedures for "Research Topic Selection" and "Dissertation" described for students pursuing the PhD in Chemical Engineering apply. The other two differences lie in the required coursework and in the General Examination, and are described in more detail below. A requirements checklist for students pursuing the PhD in Chemical and Materials Engineering appears on the following page.

Students may elect to join the Chemical and Materials Engineering PhD track at any point prior to their Final Public Oral examination. Just as with students pursuing a PhD in Chemical and Biological Engineering, students advance to post-generals status (and are eligible to the receive the degree of Master of Arts in Chemical and Biological Engineering) as soon as: 1) they satisfactorily complete the required core courses in Chemical and Biologocial Engineering (CBE 501-505) with a grade of B- or above and, 2) they present a satisfactory defense of the First Proposition. To become a post-generals candidate for the PhD in Chemical and Materials Engineering, students must in addition pass the Materials examination and complete the course requirements in Materials Science and Engineering (MSE, described under "Course Requirements" below). If students do not satisfactorily complete either the Materials exam or the MSE course requirements, they remain eligible to receive the PhD in Chemical and Biological Engineering, provided all the other requirements for that degree are met.

CHEMICAL AND MATERIALS ENGINEERING PH.D. PROGRAM CHECKLIST

Coursework
___ CBE 501, semester_____, grade for General Examination _____
___ CBE 502, semester_____, grade for General Examination _____
___ CBE 503, semester_____, grade for General Examination _____
___ CBE 504, semester_____, grade for General Examination _____
___ CBE 505, semester_____, grade for General Examination _____
___ MSE 502, semester _____
___ MSE 50x, course number and semester _____
___ MSE 5xx, course number and semester _____
___ Technical 5xx elective, course number and semester_____
___ Free elective, course number and semester_____
___ Free elective, course number and semester_____
___ Free elective, course number and semester_____

Written/Oral Examination
___ passed Materials, date (also indicate date of any failure)_____

First Proposition
___ submitted, date:_____
Advisor: _____
Second Reader (or Co-Advisor): _____
Third Reader: _____
___ approved, date:_____

AI Service
___ course number, semester, instructor _____

Second Proposition
___ topic approved, date:_____
___ submitted, date:_____
Reader: _____
if returned to student for revision, date(s) of return and resubmission:

___ approved, date:_____

Departmental Seminar
___ forum and date:_____

Final Public Oral Examination
Advisor:_____
Second Reader:_____
Member:_____
Member:_____ (indicate chair of committee)
___ sustained, date:_____

COURSE REQUIREMENTS

Students pursuing the PhD in Chemical and Materials Engineering must pass a total of twelve courses, divided as follows:

5 ChemE "core" courses:

CBE 501	Incompressible Fluid Mechanics OR
MAE 552	Viscous Flows and Boundary Layers
CBE 502	Mathematical Methods of Engineering Analysis II
CBE 503	Advanced Thermodynamics
CBE 504	Chemical Reactor Engineering
CBE 505	Advanced Heat and Mass Transfer

3 MSE courses, including 2 "core"

MSE 502	Thermodynamics and Kinetics of Materials
MSE 50x	[501, 503, 504, or 505; see below for explanation]
MSE 5xx	[see below for explanation]

2 additional graduate-level (500-level) technical courses

2 unrestricted electives (any level, any subject)

Courses which satisfy the "MSE 50x" requirement are any of the other MSE "core" courses, which currently comprise:

MSE 501/Chem 525	Introduction to Materials
MSE 503/Chem 520	Structure of Materials
MSE 504/Chem 510	Modeling and Simulation in Materials Science
MSE 505	Characterization of Materials

Courses which satisfy the "MSE 5xx" requirement are any courses which have their primary listing in MSE (as opposed to a course which is simply crosslisted with MSE). Currently, this includes MSE 501, 503, 504, and 505 (though a course cannot be double-counted for the "MSE 50x" and "MSE 5xx" requirement) and three additional courses with MSE primary listings:

MSE 515/APC 515/Chem 513	Random Heterogeneous Materials
MSE 519/Chem 519	Electronic Excitations of Organic Crystals and Conjugated Polymers
MSE 531	Introduction to Nano/Microfabrication

The two additional technical courses may be offered in any natural science or engineering department or interdisciplinary program, *including* Chemical and Biological Engineering and Materials Science and Engineering, though a course may not simultaneously satisfy this requirement and any other (*i.e.*, courses cannot be double-counted).

GENERAL EXAMINATION

Students pursuing the PhD in Chemical and Materials Engineering must satisfactorily complete the same General Examination as students pursuing the PhD in Chemical and Biological Engineering, to wit: 1) mastery of graduate-level chemical and biological

engineering material in each of the five departmental core courses, and 2) a written First Proposition (thesis research proposal) and its oral defense. At this level, there is no distinction

between students on either degree track; the regulations pertaining to the courses and the First Proposition are described in detail in the corresponding sections for students pursuing the PhD in Chemical and Biological Engineering. Upon passing all five core courses and successfully defending the First Proposition, the student advances to "post-generals" candidacy, and receives a modest enhancement in stipend. A post-generals student may also receive the degree of Master of Arts (MA) in Chemical and Biological Engineering.

Students who wish to pursue the PhD in Chemical and Materials Engineering must pass one additional examination, that in Materials. The Materials examination is intended to assess a student's mastery of the fundamentals of materials science and engineering, broadly construed. The Materials component of the General Examination consists of both and written and oral parts, taken back-to-back on a single day. The written part consists of three broad questions covering the cornerstone areas of materials science and engineering: structure, thermodynamics, kinetics, and processing. These questions will assume a basic knowledge of materials science equivalent to the coverage in MSE 501, as well as some advanced material corresponding to required materials courses (*e.g.*, MSE 502) and to specialty undergraduate courses commonly taken by chemical engineers with materials interests (*e.g.*, ChE 415). Students will have two hours to work on the written part of the examination. The written part of the examination is open-book; students may consult whatever references they wish.

Immediately following the two-hour period allotted for the written examination, the student will meet with a committee comprised of three faculty knowledgeable about materials. The student will present his/her results on the three questions orally to the committee (with the aid of whatever notes or written solutions the student prepared during the preceding two hours). These results form the basis for the oral part of the examination, in which the committee members ask additional follow-on questions. The oral examination is closed-book and has no fixed time period, though it normally would be concluded within two hours.

The Materials examination will be offered only once per year, either in January or May. Normally, the month in which the exam will be offered is determined by majority vote of the students who wish to take the exam, although in some years availability of the faculty setting the exam will predetermine the offering period. If the examination is not sustained on the first attempt, the student may request to be reexamined during a subsequent examination period. If a student does not sustain the Materials examination on his/her second attempt, he/she will remain on the degree track for the PhD in Chemical Engineering.

MSE DEGREE REQUIREMENTS

The Master of Science in Engineering (MSE) is a research-based master's degree. Students can generally complete all requirements for the MSE degree by June of their second year of residence (within 21 months, but frequently less, sometimes as few as 15). Some students are admitted to the MSE track directly. Students admitted in candidacy for other degrees (PhD and MEng) cannot switch to the MSE degree track automatically; such a change of degree candidacy must be requested from the Director of Graduate Studies (DGS), who may consult with the full faculty before rendering a decision.

MSE RESEARCH TOPIC SELECTION

Since the department grants relatively few MSE degrees, there is no formal procedure for MSE topic selection; each case is handled individually. Students who are admitted directly for the MSE degree, and who require financial support from the University, will generally be matched with a funded research project within a few weeks of arrival (project selection is likely to be quite limited). Students admitted directly for the MSE with their own support (typically funding from their employers) are encouraged, as soon as they arrive, to begin discussing possible projects with faculty in whose research they are interested (project selection is likely to be ample, if no funding is required). Defining a project quickly and promptly starting work towards its completion will shorten the time to degree. Students who are admitted to the PhD track but who request a switch to the MSE track will be handled individually; the procedure is likely to vary depending on the time at which a student requests the change of degree track. Discuss the procedure and possible outcomes with the DGS when considering such a request for a change of degree track.

The requirements for the MSE degree are as follows:

COURSE REQUIREMENTS

Students must pass six (6) graduate (500-level) courses in chemical and biological engineering. These may be our "core" courses for PhD students (CBE 501, 502, 503, 504, and 505) or any elective course. The student may request that up to two of these requirements be fulfilled through the completion of 500-level technical courses outside chemical engineering, where such courses would better support the student's planned research. Such requests should be made in writing to the DGS. Courses taken at other institutions cannot be counted towards this requirement. As with PhD candidates, graduate courses in chemical and biological engineering, whether "core" or elective, are graded pass/fail (P/F) for chemical and biological engineering MSE degree candidates, though we do retain an internal record of letter grades (which some students have requested later, such as for admission to business school). Courses taken outside the department, or undergraduate courses in chemical engineering taken in addition to the six required graduate-level courses, may be taken either P/F or for a letter grade, according to the preferences of the student and the policies of the instructor and offering department. Courses which are audited, or which are not completed, do not satisfy any of the above requirements.

ASSISTANTSHIPS IN INSTRUCTION

There is no requirement for MSE students to serve as AIs. However, MSE students may need to serve if AI service is needed to ensure a student's continued financial support, or if the department cannot fill the AI position otherwise.

THESIS

The MSE thesis must be read by the advisor, who drafts a report evaluating the thesis and assigns a grade for the work. This report is provided to the Graduate School. The *Graduate School Announcement* contains some information on the content and format of the thesis. Instructions for preparing the dissertation in proper form for its archiving in Mudd Library may be obtained from their website at: http://www.princeton.edu/~mudd/thesis/index.shtml. However, the best information on what information should be included in the thesis would come from conversations with your advisor, coupled with a perusal of other theses from your laboratory or other laboratories in the department. The student is responsible for costs incurred in the preparation of the thesis (copying, binding, *etc.*).

DEPARTMENTAL SEMINAR

The student must present his/her work in an open seminar in the department, not necessarily as part of a standing seminar series. There is no formal thesis defense.

MENG DEGREE REQUIREMENTS

The Master of Engineering (MEng) is a coursework-based master's degree. Students for this degree must successfully complete at least eight graduate-level courses, and if enrolled full-time, will normally satisfy that requirement in one ten-month academic year. (Part-time study is also possible; the typical course load is two courses per semester, allowing the degree to be completed in two academic years.) No research or thesis is required, and financial support is normally not offered. A minimum of six of these eight courses must be technical, having their primary listing in a department or program within the natural sciences or engineering. A minimum of four of these six courses must be chosen from graduate offerings in the Department of Chemical and Biological Engineering; options include any of the five core courses for the PhD degree (CBE 501, 502, 503, 504, 505), as well as numerous graduate-level chemical engineering electives chosen according to the student's area of interest. To complete the set of eight courses, students with an interest in entrepreneurship, finance, economics, or public policy may choose up to two graduate-level courses from the Department of Economics or the Woodrow Wilson School of Public and International Affairs. Courses taken at institutions other than Princeton cannot be counted towards any of these requirements. These eight courses must be taken for a letter grade (not P/D/F), and a "B" (3.0) cumulative grade-point average in the eight required courses is necessary to receive the MEng degree.

Many students may wish to focus their course choices so as to develop significant expertise in a particular area. Possible specializations, and some courses which fall within each area, include: (1) materials, CHE 522, 523, 531, 532, 541, 543, 544; MSE 501, 502, 503, 504, 505, 515, 519, 531; MAE 562, 563, 564; ELE 541, 549, 551; CHM 507, 511, 522; PHY 525, 526; GEO 501; (2) environmental engineering, CHE 522, 546; CEE 571, 576, 581, 582, 586, 587; MAE 571; GEO 537; WWS 582b, 583, 584, 585, 586b, 586c; (3) systems engineering, CHE 521, 527, 528, 530, 554; MAE 541, 545, 546; ELE 521, 523; ORF 522, 526, 562; COS 525; and (4) bioengineering, CBE 532, 533, 534, 535; CHM 515, 516, 538, 542, 543; MOL 504, 505; WWS 586a. Any of the core chemical and biological engineering courses (CBE 501, 502, 503, 504, and 505) can be used to complement selections from any of these areas.

There is no research component to the MEng degree, hence no thesis and no departmental seminar. There is no AI requirement, and only in unusual circumstances would AI positions be available to MEng students. Students admitted to the PhD or MSE degree track, and who have received any form of financial support from any University source *may not* switch to the MEng degree track. However, students who start as MEng candidates may later apply for full-time study as PhD students; these applications will be evaluated in the same fashion by which the department evaluates all applicants for PhD study.

SOME POLICIES COMMON TO
PhD, MSE, AND MENG CANDIDATES

ACADEMIC INFRACTIONS IN WRITTEN WORK

Princeton upholds the highest standards for academic work, and appropriately so. These standards are set through very strict definitions for what constitutes an academic infraction, and through meting out penalties to anyone committing such an infraction—particularly the most serious acts, those which are deemed to constitute academic fraud. Even during this decade, Princeton students (fortunately, not in engineering—to our knowledge) have had their PhD degrees revoked when it was subsequently found that sections of their dissertations were taken verbatim from other sources.

Princeton's standards, which we expect that our students will continue to uphold even after leaving the University, may differ from those used by your previous institutions, so it is essential that you familiarize yourself with what constitutes an academic violation here. The best guide is the University's publication *Rights, Rules, Responsibilities* (*RRR*), and particularly the "orange pages" in the center of the booklet. You should have received a printed copy of *RRR* in the packet of material which you received when arriving at the University. While *RRR* is revised and reprinted each year (and you may not have the latest printed version handy), the standards for plagiarism and other academic violations do not change. A copy of the current edition of *RRR* is also available on the Web:

http://www.princeton.edu/pr/pub/rrr/08/home/index.htm (Table of Contents)
http://www.princeton.edu/pr/pub/rrr/08/two/#twod (section on "Academic Regulations")

Each student should read the "Academic Regulations" section in *RRR* thoroughly, though a general description of the types of violations is provided briefly below. Quoted sections and page numbers cited below come from the 2008 printed edition of *RRR*.

Note that the seriousness of an academic infraction is not mitigated by the nature of the work submitted: beyond manuscripts submitted for publication in journals (which will be seen by the entire research community), infractions could occur in the writing of the dissertation (which also becomes available to the broad research community), or in the writing of internal documents such as the First Proposition, Second Proposition, or any number of course assignments. In fact, it is violations committed during fulfillment of University requirements, not in submitting one's work for publication outside, with which University regulations are principally concerned. Moreover, it is incumbent on the student to be aware of the University's standards: "The only adequate defense for a student accused of an academic violation is that the work in question does not, in fact, constitute a violation…the defense that the student was ignorant of the regulations concerning academic violations…[is not] considered an adequate defense." [*RRR*, p. 63]

Plagiarism

The University defines plagiarism as "the use of any outside source, without proper acknowledgment. 'Outside source' means any work, published or unpublished, by any person other than the student." [*RRR*, p. 62]. Several examples are provided in *RRR*. Note that "plagiarism" is not limited to the egregious case where text is lifted verbatim and not cited. Any text which is taken verbatim must be placed in quotation marks, *and* the source properly cited; citing the source, but omitting the quotation marks, constitutes a violation. One situation where

this may arise is when reproducing a figure from another source. Even if the source is indicated, if the caption is also taken from that source, it must be enclosed in quotation marks (or better yet, a new caption written in its place). Also, simply rephrasing the text sentence by sentence, but retaining the structure of the initial source text, mandates that the source be cited. Please read the examples in *RRR*; such things are best illustrated by example.

Please note that plagiarism is defined operationally above; plagiarism does not imply, or require, intent. (Generally speaking, intentionally presenting someone else's ideas as one's own would constitute academic fraud, a very serious infraction and the sort that could get one's PhD candidacy terminated or degree revoked.) *RRR* is very clear on this point: "occasionally, students maintain that they have read a source long before they wrote their papers and have unwittingly duplicated some of its ideas. This is not a valid excuse." [*RRR*, p. 60] Consequently, some instances of plagiarism might be committed unintentionally by the student—lack of intent, however, does not make the act acceptable. Such infractions might typically arise when writing a background section for a manuscript, a dissertation, a First or Second Proposition, or a writing assignment for a course. Such documents would normally require background sections to set the stage for the original work to be described. In writing such sections, students would naturally consult relevant background literature. If the student is writing the background section while reading the source, he/she may fall into the trap of paraphrasing the source material sentence by sentence and then failing to cite the document. Or more commonly, in cases where the source being consulted while writing is itself a review (such as a book, review article, or the background section in another student's dissertation or First Proposition), a student paraphrasing sentence by sentence may cite only the references cited by the review source, rather than acknowledging that the structure of the material was borrowed from the review source itself. Finally, the severity of the infraction is not mitigated by the nature of the source material: "published or unpublished, by any person", as noted at the beginning of this section. Unpublished documents would certainly include sources such as the First or Second Propositions of other current or former students.

Clearly, the best way to avoid such infractions is to write the first draft of the text naturally and independently, not working closely from any source. Independent of issues of plagiarism and proper citation, this is a valuable exercise: being able to explain something in one's own words is good evidence that the writer really does understand the material.

False or Incomplete Citation

False citation is "the attribution to, or citation of, a source from which the material was not, in fact, obtained." [*RRR*, p.62] False citation is likely to occur when a student recalls work done on a particular subject, perhaps even by a particular group, but does not bother to hunt down the actual article and inadvertently cites another in its place. It may also occur when reading a review source (*e.g.*, book, reference article, *etc.*) and referring to work cited (perhaps erroneously) in the review without hunting down and reading the actual original work. False citation *does* constitute an academic infraction.

Incomplete citation would generally describe the case where a writer provides a citation insufficiently detailed for the reader to easily find the material which is referenced. Suitable style guides are listed in *RRR* (p. 61); alternatively, you may choose to use a format mandated by various professional societies for their journals (*e.g.*, the American Chemical Society, which publishes "Notes to Authors" in the first issue of each of its journals each year). Incomplete citations are becoming more common these days as electronic sources (*e.g.*, documents on the Web) are being cited. *RRR* (p. 61) discusses some of the information which a citation to such a

Web document should contain; note in particular that the date which the site was visited must be provided, as documents on the Web may change frequently and without notice.

Unauthorized Multiple Submission

Please read this section in *RRR* (p. 62). The key word here is "unauthorized": it *is* possible, under certain circumstances, to use the same material in partial fulfillment of multiple academic requirements here and elsewhere. However, all parties involved (*e.g.*, course instructors) should be apprised in advance that the same material is being used twice, and must agree (they are free to decline). A common case where this situation arises in our department is when a student wishes to incorporate background material (or preliminary results) written for the First Proposition as part of the dissertation. This would be permissible; consider this "authorized" by the DGS, unless your advisor explicitly instructs you to the contrary. In addition, it is common practice to submit manuscripts describing one's research findings to scientific journals prior to the writing of the dissertation. These results and sections of the associated text may be incorporated into the dissertation.

False Data

This very serious infraction probably requires no explanation, though one is provided in *RRR* (p. 62). It is difficult to conceive of circumstances under which fabrication of data would not constitute academic fraud.

If aspects of any of these infractions remain unclear, please feel free to discuss this matter with your advisor or with the Director of Graduate Studies.

PRINCETON ORAL PROFICIENCY TEST (POPT)

Students whose bachelor's degree was not awarded in the United States (or in select other countries where the colloquial language is English) are subject to an evaluation of their English proficiency by the Graduate School (using the SPEAK test) shortly after their initial matriculation, in late September. Strong performance on the SPEAK test will exempt a student from further required study towards English proficiency. Students whose performance on the SPEAK test is less satisfactory will be required to enroll in the term-time English as a Second Language (ESL) program, offered by the McGraw Center for Teaching and Learning, for each semester of enrollment until they pass the Princeton Oral Proficiency Test (POPT) administered by the University.

All students who are candidates for the PhD in Chemical and Biological Engineering or the PhD in Chemical and Materials Engineering are required to pass the POPT (if not previously exempted through receiving a bachelor's degree in the U.S. or select other county where the colloquial language is English, or through passing the SPEAK test). Students cannot be appointed as Assistants in Instruction (AIs) until they have passed the POPT. PhD candidates who do not pass the POPT by May of their first year of enrollment will be required to enroll in an intensive English language program at Princeton the following summer. This intensive program begins in mid-June and runs for six weeks, with 25 hours per week of instruction. PhD candidates who do not pass the POPT by January of their second year of enrollment will have their reenrollment decisions (for year three) deferred until the results of the May examination are available. Students who do not pass the POPT by May of their second year of enrollment will not be reenrolled to a third year of PhD study, though they may be permitted to switch to the MSE track.

MSE and MEng students are not required to be screened for oral English proficiency or pass POPT. They may, however, enroll in the English Language Program (ELP) on a voluntary

basis. MSE students whose native language in not English and who have not earned their bachelor's degree in the U.S. must be screened by taking the SPEAK test in September and, depending on the result, may be required to enroll in the term-time ELP and pass the Princeton Oral Proficiency Test (POPT).

ADDING AND DROPPING COURSES

Graduate students may add or drop courses, or switch status (*e.g.*, from P/D/F to audit) until nearly the end of the semester—though we do not advise students to wait until the last minute! A course worksheet, which is available on-line at: https://ps9web.princeton.edu/pu_pages/WebCourseEnrollmentWorksheet.pdf must be completed and signed by the DGS. For MEng students studying part-time, tuition for a dropped course is partially refundable, but the fraction refunded decays more rapidly than the fraction of the semester remaining, and goes to zero after approximately three months. Please see the Graduate Coordinator if you have any questions.

SEMINARS AND SYMPOSIA

One outstanding aspect of being at a world-class university is the number of distinguished external speakers who visit Princeton each year. These seminars range from the successful Public Lectures held each term for the benefit of the broad University community (see postings on the boards outside the departmental office, or on the kiosks around campus), to standing seminar series in the academic departments, including Chemical and Biological Engineering. Chemical and Biological Engineering's most prestigious lectureship is the endowed Wilhelm Lecture, named for a distinguished past head of the department who was a pioneer in reaction engineering. The Wilhelm Lectures take place every year; the visitor delivers two lectures, typically in early Fall. As for weekly seminars, our "official" department seminar series runs each Wednesday during the academic year, with the speaker typically starting at 4 pm (usually preceded by refreshments). Check the "white board" outside the Graduate Office for details. Speakers in this series include our own graduate students and occasionally our own faculty, but are typically distinguished researchers, teachers, or entrepreneurs from other universities or industry. This seminar series is the best standing forum for promoting a broad and lively exchange of ideas among students and faculty, and for acquainting all members of the department with research activities here and elsewhere. Regular attendance at the departmental seminars is encouraged for all graduate students, and is expected particularly of first-year students. Seminars often provide ideas which you could apply in your own research, or perhaps an "unsolved problem" identified by a seminar speaker would provide the germ of an idea for a Second Proposition topic.

Many other seminars are given in the department, outside the "official" department seminar series. Frequently these are given by visitors who happen to be in Princeton for the day (which may often be during the summer). Such seminars will be advertised on the "white board". In addition, another standing seminar series has its home in the department: the Graduate Student seminar series, which runs on Mondays at 4 pm (and is advertised on the "white board"). Speakers in this series are graduate students who need to fulfill their departmental seminar requirement and are unable to schedule in the official department seminar held on Wednesdays.

Every year, the fourth-year students coordinate a major event for chemical engineering graduate students: the Graduate Student Symposium (GSS), held on a Friday in mid-October. In this student-run event, upper-year students present their work to an industrial audience either as talks or as poster presentations. Many of these companies are the eventual employers of our

graduates, and indeed, some of the attendees are also recruiters for these companies. Besides providing an opportunity for these students to present their own work, the GSS also provides an excellent forum for students to learn about each others' work, and especially for first-year students to learn about the research now going on in the department. Graduate chemical and biological engineering classes are cancelled on the day of the symposium.

GRADUATE STUDENT COMMITTEE

The Graduate Student Committee (GSC) is elected each October by the department's graduate student body. It is composed of two representatives from each of the five graduate student "classes" (corresponding to the five years of enrollment). The GSC is the best channel for expressing your ideas, concerns, and opinions about all aspects (academic, social, pre-professional) of graduate student life in the department. The GSC meets monthly with the Director of Graduate Studies, interviews junior faculty candidates, and meets with our department's external Advisory Council. Each class' GSC representatives are the conduits for communicating the concerns of each class to these bodies and to the faculty, so if you have concerns or suggestions, be sure to raise them with your class reps.

DEPARTMENTAL, SEAS, AND UNIVERSITY COMMITTEES

Graduate students are represented on several key committees. Service as a graduate student representative on one of these committees is an opportunity for interested people to have a hand in departmental and University governance. The term of office for each position is September 1 through August 31, except for the Graduate Student Government position whose term is November 1 through October 31. The positions are described very briefly below; the current holders of these positions are listed on the "CBE Graduate Program Information" board across from A217.

Facilities Representative (Chemical Engineering)

Serves as the focal point for graduate student concerns and ideas about facilities at all levels (department, school, and University), and hence will interact as necessary with relevant staff outside the department.

Seminar Committee (Chemical Engineering)

Member of the departmental Seminar Committee (which otherwise consists of one faculty member, the seminar coordinator; the faculty member rotates each term). One external seminar speaker per semester is selected by the graduate students. The seminar rep is responsible for soliciting student ideas for speakers, selecting these speakers (subject to the usual constraints of cost), and for coordinating the visits with the faculty member overseeing the seminar series.

Graduate Engineering Council (SEAS)

The GEC works for the general welfare of all SEAS graduate students, and represents graduate students on issues which cut across the various SEAS departments. The GEC meets regularly with the Associate Dean of the SEAS for Graduate Student Affairs (currently Stephen Friedfeld). Each department has two representatives (with EE having three).

Graduate Student Government (University)

The GSG is intended to broadly represent the interests of graduate students to the rest of the University, particularly the upper administration. Each department has a representative; the GSG Assembly meets monthly.

PROFESSIONAL SOCIETY LOCAL CHAPTERS

There is a Student Chapter of the AIChE at Princeton. While this group is directed by undergraduates with the aid of a Counselor (currently Professor Rodney Priestley), graduate students are always welcome at the meetings and are encouraged to affiliate with the Chapter. Low-cost affiliation with the national American Institute of Chemical Engineers is also available to graduate students. Among other privileges, it entitles the student to subscriptions to *Chemical Engineering Progress* and the *AIChE Journal* at reduced rates. For further information, consult the faculty Counselor. There is also a Central Jersey Section of the AIChE which meets regularly in the Quadrangle. Notices of these meetings are posted on the bulletin board outside the departmental office.

Graduate students are invited to join the meetings of the Princeton Section of the American Chemical Society, normally held in the Frick Auditorium each month from October through May. The Princeton ACS maintains a web page describing their activities: http://www.princeton.edu/~pacs/.

TRAVEL FUNDS AND REIMBURSEMENTS

To obtain reimbursement for research-related travel, complete a Student Invoice form (available in Room A220, by the copy machine). You will need to submit receipts with this form. All invoices should be placed in the boxes directly above the paper shredder for processing. See Karen or Mary Beth if you have any questions.

In addition to your advisor's research grants, several (competitive) sources of funds from various University sources exist for graduate students to travel to professional meetings to present their work, as described below:

Schowalter Award

The William R. Schowalter Travel Fund was generously endowed by an alumnus of the Department and named for a distinguished former faculty member and department head. The income from this endowed fund supports graduate student travel to professional meetings at which the student will present one or more papers. Depending on the amount requested, successful applicants will receive either full or (more commonly) partial support in defraying expenses. The Schowalter fund currently provides enough income to grant partial support for about half of our students to attend one meeting during the course of their time as graduate students. (When you become an alumnus/a, you'll have the opportunity to donate to the fund and increase these numbers!) Twice per year, you'll receive a memo from the DGS soliciting applications for the Schowalter Fund (one in July for meetings scheduled in September through February; one in December for meetings scheduled in March through August). Interested students should submit (to the Graduate Coordinator) a one-page statement specifying the conference to be attended, the title of the paper(s) to be presented and whether they will be oral or poster, and an itemized list of the estimated total expenses associated with participating in the conference. Students should also indicate the status of their proposal to present (*i.e.*, "accepted", "submitted", *etc.*); if the meeting program listing is already available, please provide a copy of the part(s) showing your presentation(s).

As noted above, these Schowalter awards are competitive, and receiving a Schowalter award is indeed a distinction. A compelling case for support should be made in the one-page statement. Guidelines which the Graduate Committee will apply in selecting successful Schowalter applicants are:

1) The award will be for significant, but in nearly all cases partial, support of the student's costs. Over the past few years, awards have ranged from $400-$750. Applicants need not request a particular dollar figure from the Schowalter fund; simply provide a budget showing the total estimated expenses associated with travel to the conference.

2) Among those applications deemed meritorious, preference will be given to applicants who have *not* received a previous Schowalter award. Since in recent years there have invariably been more meritorious requests than funds, it has been several years since any student received more than one Schowalter award during his/her time at Princeton.

3) A lack of travel money on the advisor's part will *not* be considered in the student's favor. To apply for a Schowalter award, the paper must already have been submitted (and usually accepted), so there should already exist some mechanism to ensure that the paper will be given.

4) More visible presentations will be accorded greater weight. For example, students presenting two or more papers at a meeting will be favored over students presenting a single paper at the same meeting, and oral presentations at a meeting will be favored over poster presentations at the same meeting.

5) Among those applications deemed meritorious, preference will be given to those students who have already given an internal presentation (which is a good "warm-up" for an external presentation). The most common internal forum is the Graduate Student Symposium, where students can give either talks (more senior students) or posters (more junior students) which members of the Graduate Committee can listen to.

Other Sources of Travel Funds

Two funds administered by the Graduate School provide support on a competitive basis for students to present their work at professional meetings. For meetings during the academic year, there is the Dean's Fund for Scholarly Travel, and for meetings during the summer, there are the Association of Princeton Graduate Alumni/ae (APGA) Summer Travel Awards. To quote the policies of the Dean's Fund: "There is no special application form. An application consists of a letter from the applicant describing the event to which he/she has been invited, a brief budget statement of the costs of the proposed trip, a copy of the letter of invitation to present a paper [posters do not qualify] or a copy of the program showing the student's paper scheduled, a letter of support from the Director of Graduate Studies, and, in the case of post-Generals students, a letter of support from the advisor. (These latter two documents should specify whether the student can expect to receive any support from the department, the advisor, or a source other than the Graduate School, and if so, how much.) The maximum amount of a grant will be $500. The Graduate School will, in cases where there is a departmental or other non-Graduate School contribution, consider matching that contribution, up to the $500 limit. Only one grant from the Dean's Fund will be made to a student in any given academic year. Students may apply for assistance in subsequent academic years. First-year students are normally not eligible for assistance."

The application should be turned in to the office of the Associate Dean for Academic Affairs (currently David Redman). Currently, Dean's Fund deadlines are September 15 (for meetings September – November), December 15 (for meetings December – February), and March 15 (for meetings March – May). The APGA deadline is approximately May 1 (for meetings June 1 – August 31). Unlike Schowalter awards, where the funds are directly disbursed

from a departmental account, the Dean's and APGA awards are sent to you in the form of a check. They are, therefore, taxable. It is suggested that you keep this fact in mind and discuss the matter with your advisor when completing your travel reimbursement form.

There are other, less broad-based sources of travel funding available, such as to members of the Graduate Women in Science and Engineering (GWISE). Generally speaking, if you're eligible for one of these awards, you'll find out about it. In addition, most professional organizations (MRS, APS, ACS/PMSE, Society of Rheology, many Gordon Conferences…sadly, the AIChE is an exception) *do* have awards for graduate student travel to their professional meetings, often on a competitive basis. Winning a competitive award such as these is a significant honor, and worth your effort to apply.

Students may apply for both a Schowalter award and one or more of these "other sources" for travel to the same meeting. Since these other sources typically also provide partial support, it is normally possible to apply both a Schowalter and an external award for the same meeting. If by chance the sum total of these awards should exceed your actual expenses for travel to the meeting, and you are granted a Schowalter award, we will be happy to "save" all or part of the Schowalter funds for you to apply towards travel to a future meeting.

AIR PRODUCTS AND LAYN AWARDS

Through the generosity of the Air Products Corporation, three annual excellence awards for graduate students have been instituted. Two awards recognize the best Assistant in Instruction (AI) in each of the fall and spring semesters, as judged by vote of the undergraduates. The third is for the most outstanding Second Proposition approved that year, as assessed by the faculty. Each award consists of a certificate and a cash prize of $500.

In addition, in 1999 the department inaugurated the Kristine M. Layn Award, which recognizes outstanding research achievement by a graduate student before the end of his/her third year. This award was established in memory of Kris Layn, a former PhD student in the department, and in recognition of her accomplishments while a student here. The winner's name is recorded on a plaque in the Elgin Room (A224).

VACATIONS, SUMMER RESIDENCE AND EMPLOYMENT

[Relevant to PhD and MSE students only.] Each year, graduate students are entitled to a vacation period not to exceed four weeks, including all University breaks such as the winter recess, fall and spring breaks. Vacation time may not be accumulated for use in subsequent years.

Summers are generally the most productive times for research, for both students and faculty. Therefore, it is expected that a student who receives financial support from the University (PhD or MSE students receiving a Fellowship, Assistantship in Research, or Assistantship in Instruction) during the academic year will remain on campus for the following summer, unless all degree requirements are completed (or unless pursuit of the research requires the student to leave campus, such as for field work). Students should neither seek nor accept employment elsewhere for the summer.

Certain external fellowships require that the student spend one or more summers off campus (at a corporate research lab, Air Force base, *etc.*). If a student wins and accepts such a fellowship, we will of course comply with its terms. However, the student should be aware that not being here for the summer(s) will likely increase the time to degree, and perhaps interfere with timely completion of departmental requirements (notably the First Proposition), unless the summer project is carefully crafted to be an integral part of the student's PhD research.

LEAVE OF ABSENCE AND *IN ABSENTIA* STATUS

Students *in absentia* are enrolled graduate students who are pursuing their program of study someplace other than Princeton, where research and human resources necessary for their work exist. Students may apply for one term or for a whole year. You must have your plans approved by your advisor and the Director of Graduate Studies and you must be working full-time on degree requirements. In most cases the term or year *in absentia* counts as a year of the Department's usual (four- to five-year) program length.

A student can continue to receive fellowship assistance while *in absentia*. Although no tuition is charged, the premium for the student health insurance plan is still paid by the University, so graduate student health insurance continues. University ID cards can be revalidated for the study period away from Princeton; however, students *in absentia* cannot remain in University housing.

No limit is prescribed for *in absentia* status. A second year, however, must be reapplied for, re-justified, and again approved by your advisor and the DGS. In every case the twin criteria of need to pursue research elsewhere and satisfactory academic progress apply. Two years of study *in absentia* should be the maximum amount of time needed if the research plan is well conceived. This status does not apply to students who have come to the end of their regular program and are unenrolled.

A Leave of Absence is a temporary withdrawal from the Graduate School for personal reasons. These reasons may include serious illness, second thoughts about graduate school, need to generate income, or family emergencies. One must have spent one full term in residence before requesting a Leave of Absence. Students on leave are not enrolled, with all the consequences that implies: termination of health insurance, University housing, University ID, financial aid and loan deferrals (your loan's grace period, if any, begins to be used), and being out of status with your student visa if you are a foreign student.

Students who have been on leave for a year may reapply for up to one more year of this status, but no more. Readmission from leave status requires that you request reinstatement in writing by December 15 for a return to the Spring term or by March 15 for a return in the Fall.

END OF ENROLLMENT AND UNENROLLED STUDENTS

When a student's degree candidacy terminates, or he/she takes a leave of absence, he/she must clean up all related laboratory or office space to the satisfaction of the advisor and the Safety Committee. All students who are terminating their enrollment must file an End of Enrollment form with the Graduate School (form available on-line at their website) not less than two weeks before the actual termination date. Foreign students must coordinate a change in visa status as described below.

The normal period of enrollment for the PhD degree is five years maximum; only in truly exceptional circumstances will the Graduate School allow readmission for a sixth year (only one such readmission was permitted in the 1990s). With the loss of enrolled student status at the end of five years comes the loss of other benefits as well, so it is strongly recommended that students plan to finish all degree requirements prior to the end of five years in residence. Nonetheless, some students do come to the end of five years without having completed all their requirements. Students who leave Princeton at this point frequently have difficulty completing their remaining requirements part-time and from a distance, and indeed some students have eventually been subjected to termination of their degree candidacies. It is therefore recommended that each student remain in Princeton at least until he/she can provide a complete draft of his/her dissertation to the advisor.

In 2006, the Graduate School established the status "Degree Candidacy Enrollment" (DCE). Enrolled Ph.D. students who have not completed their degree within their department's normal program period have the opportunity to be enrolled for up to two additional years in this status. Students in DCE status are fully and formally enrolled graduate students. Marginal-cost tuition and the mandatory Student Health Fee Plan fee will be charged, which currently is $3,740. These charges are paid either directly by the student or can be funded by the advisor. The advisor also has the option to appoint the student as an A/R in order for the student to receive a stipend.

If a student does not chose DCE status, they will enter Enrollment Terminated/Degree Candidacy Continues (ET/DCC) status, in which students are not enrolled and do not receive any benefits. More information on DCE and ET/DCC status can be found in the *Dissertation Completion Enrollment Handbook*, available on the Graduate School's website:

http://gradschool.princeton.edu/about/docs/academics/dce_handbook.pdf

Foreign Students: Visa Status

Students on an F-1 or J-1 visa must meet certain conditions in order to maintain their status, and must continue to work full time toward completion of degree requirements. When a student terminates enrollment, he/she should consult with Mladenka Tomasevic, Office of Visa Services, 120 Alexander Street.

Continuation of ET/DCC Status

Students who remain in Princeton, actively progressing on their dissertations, will have their ET/DCC status continued as needed after DCE status has ended. However, PhD degree candidacy is not an open-ended process, and unenrolled students who fail to make substantial progress towards their degrees risk having their candidacies terminated. The Graduate School's policy on continued degree candidacy beyond the period of enrollment is described in the *Graduate School Announcement*: "In the case of Ph.D. students in particular, degree candidacy terminates automatically…after five years from the date of the student's having passed the general examination if the student has not maintained regular contact with the department and dissertation adviser." For PhD students in the Department of Chemical and Biological Engineering, this five-year mark typically arrives in either January or May of the seventh year of enrollment, which is the second year of DCE status.

Clearly students in Princeton actively pursuing their degrees meet the requirement for "regular contact" and are not at risk for termination. Problems often arise, however, when students depart Princeton to begin full-time employment elsewhere, or in some cases, where they remain in Princeton but are no longer pursuing their dissertation research. Therefore, the Department of Chemical and Biological Engineering has set the following criteria for "regular contact", pertinent to those who are no longer physically in the department on a daily basis: 1) students should engage in communication with the advisor(s) at least monthly—perhaps through face-to-face technical discussions, or through the back-and-forth exchange of draft sections of the dissertation by mail or email, as appropriate, and 2) students should inform the Director of Graduate Studies at least bimonthly with regards to their progress; a short email containing the specific items accomplished in the past two months is sufficient. The burden of contact rests upon the student, who should not expect the advisor or DGS to prompt these updates. Students who fail to meet these criteria for "regular contact" can have their candidacies terminated at any time after the "five-years-past-generals" mark passes, with no further warning.

Post-Enrolled Master's Students

Since the MEng is a coursework-only degree, it cannot be completed while unenrolled; hence, enrollment and degree candidacy end simultaneously. For MSE candidates, however, it is possible for a student to be unenrolled but remain a degree candidate (ET/DCC) while completing the MSE thesis. Such situations are quite unusual, however, and as for PhD students, continuous progress towards the degree requirements is expected for degree candidacy to continue. MSE students who come to the end of their enrollment period and request ET/DCC status will receive this status for the duration required provided they meet the same standards for "regular contact" described above for PhD students; that is, a minimum of monthly communication with the advisor(s) and bimonthly reports to the DGS. For MSE students, these criteria become effective on the date which ET/DCC status is granted. Since any period of ET/DCC status is unusual for MSE students, only in truly exceptional cases will this period be continued beyond one year.

SUPPLIES, SHOPS, AND TECHNICAL SERVICES

Following assignment of research topics, each student will receive one or more account numbers from his/her thesis advisor. Such a number must appear on all orders and requisitions.

PURCHASING

Special equipment, chemicals and other supplies that are not available in the University must be purchased. A purchase requisition is required in all cases; blank forms are obtainable in A220. It is necessary to supply full specifications and a close estimate of the cost, gathered by you. Your advisor may wish to review your requisitions before you submit them; consult him/her on this point. To submit a requisition, place it in boxes located directly above the paper shredder in A220. If any essential fields were not completed on the requisition, it will be returned to you without the order being placed. The essential fields are:

- your name
- your office or laboratory telephone number
- complete vendor name (no acronyms are acceptable)
- complete vendor address
- vendor telephone and fax numbers
- contact person at the company (unless price was obtained from a current catalog)

The PeopleSoft system requires accurate and detailed information. Item description and cost must be exact. Part numbers or formulas are not acceptable in lieu of a description. Once placed, orders cannot be cancelled.

All orders over $1000 require that you complete a sole-source form (describing why this vendor is the preferred, or only possible, choice). Append the sole-source form and any quotes received to the requisition. Such orders are forwarded to the Purchasing Department, and after all approvals are granted, Purchasing will place the order.

The orders are entered into the PeopleSoft system only once per day, in the morning. Requisitions in box before 9 am will be entered that day; requisitions deposited later will be entered the next day. If you prefer to place your own orders by telephone and require a purchase order (PO) number, *all* the information on the requisition form must be filled in (a new "feature" of PeopleSoft). The requisition form will be placed back in your mailbox; *please* retain this form until your order arrives, as we may need it to track down any mislaid orders.

Packages are delivered to the department and placed in A214 once per day unless they are very large; in this case you will be notified and asked to remove them from the loading dock. However, any package bearing a DOT warning label will not be delivered but will be held at the loading dock. You will be notified of its arrival and must pick it up or send a representative to sign for it and pick it up. **All packing slips should be placed in the boxes directly above the paper shredder in A220; this is the only way we have of knowing that the material has been received and the invoice can be approved for payment.**

To return unsatisfactory material, please call the vendor and obtain a returned material authorization (RMA) number. Copy the packing slip, attach the RMA number, and leave a copy in the same group of boxes in A220. Packages should be returned via UPS to ensure that their location can be tracked. To ship via UPS, box the materials, affix an address label, and bring the package to the EQuad stockroom, which is located in AD-3B (extension 8-4739). The clerk in the stockroom will need an account number to bill the UPS charges.

To obtain reimbursement for research-related incidental expenses (*e.g.*, items bought for the lab at the Home Depot or the U-Store), complete a Student Invoice form (available in Room A220).

UNIVERSITY STOCKROOMS

EQuad Stockroom (AD-3B; 8-4739). General purpose supply center where selections of brass Swagelok fittings, pipe fittings, fasteners, electrical supplies and circuit elements, tools, and office supplies are available for purchase on a university account. The stockroom clerk also oversees the gas cylinder storerooms on the loading dock. High pressure cylinders of many common gases are kept in inventory in one room; another room houses specialty gases which students individually order from vendors. For a cylinder of a common gas taken from inventory, when taking the cylinder out, be sure to sign your name and account number on the slip at the dock. When the cylinder is returned, sign it back in. Ask the stockroom clerk to describe the procedures for specialty gases to you. Liquid nitrogen is also available from the smaller storage vessel next to the loading dock; the key locking the dispensing valve is available from the stockroom clerk.

Chemistry Stockroom (A-101 Frick). Broad selection of glassware and chemicals. Also a limited selection of gas cylinder regulators and stands, safety equipment, and thermocouple wire.

Grounds and Building Stockroom (MacMillan). Carpentry, plumbing, and electrical supplies, including large selections of pipe fittings, threaded rod and pipe, paint, and conduits.

Physics Stockroom (A01 Jadwin). Similar to the E Quad stockroom with a broader selection of brass Swagelok fittings and wiring components. Also a much better selection of stock materials, including stainless steel, brass, copper, iron, and composite building materials.

University Surplus. Used desks, chairs, filing cabinets, and even computers can be obtained free of charge, and even delivered to your office or laboratory. Located in a rented building on Alexander Road in West Windsor; open Wednesdays 10 am – noon. Contact Karen Haskin for more information.

SHOPS AND CRAFT SERVICES

Building Maintenance: Maintenance requests for building infrastructure (plumbing, electrical, HVAC, fume hoods, doors, cabinetry, *etc.*) should be submitted to Eric Litostansky (B6 H Wing, 8-4565, eqmaint@princeton.edu). Even for work which is ultimately handled by other campus shops (Glaziers; Painters; A/C and Refrigeration), talking with Eric is usually a good place to start.

Machining: The E Quad Machine Shop, C115 E Quad, is available for welding and machining. Stop by the shop and discuss your needs with one of the machinists (currently Larry McIntyre or Barry Runner), who will assist you in placing a work order. Be sure to have an account number ready.

Glassblowing: Glass Shop, B3 Hoyt. Mike Souza, expert glassblower, runs the shop (8-3915). Custom design and fabrication of parts in Pyrex and quartz, as well as repair of broken glassware. Mike is a willing and helpful consultant if you are designing a piece of glass apparatus from scratch.

Environmental Health and Safety (EHS): 262 Alexander Street, 8-5294. The staff here is prepared to test hoods and ductwork, supply smoke generators for rough flow visualization in hoods, and notify you of the regulations you must comply with in your particular experimental work. Further information is available at http://web.princeton.edu/sites/ehs/.

Electronics: There is no open electronics shop on campus. However, we do have an informal arrangement with a technical staff member for electronics jobs. Contact Sharon Malley to arrange.

CENTRAL RESEARCH FACILITIES

Analytical Services, Department of Chemistry, Frick. Various ^{1}H and ^{13}C NMR solution instruments, solid-state NMR, FTIR (including GC/FTIR and an FTIR microscope), ESR, and mass spectrometry instruments are available. Use is generally by the student after receiving appropriate training from a staff member; responsible individual varies by instrument. Best bet is to ask a knowledgeable upper-year grad student about what is available, but otherwise, contact the analytical services staff in the basement of Frick (around B25 Frick) for more information.

Electron Microscopy. PRISM, Bowen Hall. State-of-the-art TEM, SEM, and analytical electron microprobe instruments are available, as are a range of sample preparation facilities. Responsible individual is Nan Yao, 8-6394. Training courses on the various instruments are offered year-round, as well as PRISM's formal microscopy graduate course, MSE 505.

COMPUTER RESOURCES

All students should register at OIT (Office of Information Technology) located at 87 Prospect. Rather than try to describe all the computer resources available at the University (which are constantly changing and growing), best to let the folks at OIT do it. The Information Center operates on a daytime and evening schedule and provides considerable and usually able assistance. A computer clinic is located at OIT. These people are paid to help you; do not be shy. This group sponsors a regular series of OIT lectures with schedules available at the center and many other locations.

The department also employs a part-time system administrator (currently Eric Paul, A220C EQuad, ericpaul@princeton.edu) who is an invaluable resource for problems with desktop, workstation, and network computing. As usual, the most ready (and often most useful) assistance comes from other students. Each research group should have a (student) computer system manager, who should also know the system managers from other groups (and hence who to ask when a *really* tough problem comes up). If you have any issues which you believe affect a broad spectrum of users in the chemical engineering department, bring these to the attention of the graduate student member of the Computing Committee.

SAFETY POLICIES AND PROCEDURES

SAFETY COMMITTEE

The Department of Chemical and Biological Engineering Safety Committee Members meet once a month to discuss safety issues. The Safety Committee currently has the following makeup:

Professor Jay B. Benziger Chair and Chemical Hygiene Officer	Room A-423	8-4691
Sharon Malley, Department Manager	Room A-217	8-4650
Dale Grieb, SEAS Safety Coordinator	Room C-227	8-8688

One Graduate Student Representative from each research group

Recent regulations of the federal Occupational Health and Safety Act make it imperative that safety rules are followed. Substantial fines can be imposed on the University and department for noncompliance. The departmental response to this is the Chemical Hygiene Plan which is available in every laboratory and in Room A214. This should be read and referred to by all graduate students. Environmental Health & Safety information is available on the web at http://web.princeton.edu/sites/ehs/.

EMERGENCY NOTICES

There are three emergency notices:

Emergency Escape Procedure: bright orange, located on the inside door of each room. Follow the instructions for leaving the building in the event of a fire or emergency.

Emergency Information Poster: yellow, located on the outside of laboratory doors. Contains information pertaining to hazardous materials and whom to contact in case of an emergency.

Emergency Shutdown (as needed): All experimental equipment will be posted with emergency shutdown instructions that include the telephone number of the responsible person. Critical switches or other controls referred to in the shutdown instructions will be clearly labeled. Emergency instructions will be kept up to date and summarized on a poster on the inside of a laboratory door next to the Emergency Escape Procedure poster.

CHEMICALS ARE DANGEROUS

The statement is so true that it warrants re-emphasis. Nothing you work with is innocuous. Every experiment you plan should be approached from a defensive point of view. This means that if an explosion is possible -- even remotely -- appropriate precautions must be taken. Most people understand this and act accordingly. Much more insidious are the various toxic properties of most chemicals. Because their effects do not appear immediately, we tend to ignore them. Every time you do an experiment you should give due consideration to the short- and long-term toxic properties of the materials you are using. This means not only that you

should take care not to expose yourself to known "bad actors" but should take the trouble to look up in reference books the properties of every chemical with which you come in contact. In a sense it is not the obviously dangerous materials that are most dangerous. These we all know about and can handle with care. Much more difficult to protect yourself against is the chemical you know nothing about or have assumed is harmless. If in doubt, take the trouble to check it out. There are numerous manuals and books on safety and chemical properties in the library and also in A214 (*Dangerous Properties of Industrial Materials* by N. I. Sax, for example), and you should -- indeed must -- take the trouble to make sure you know how to handle the materials with which you are working.

Material Data Safety Sheets (MSDS) for all chemicals shipped to the Department are filed in Room A214, where they are accessible at all times. MSDS sheets are also accessible on the EHS website.

It is the responsibility of each student to look after both his/her own safety and that of fellow workers by:

-- becoming familiar with and complying with all safety rules and procedures including the Chemical Hygiene Plan.

-- calling to the attention of the proper people hazards in working areas and making recommendations for their correction or control.

SAFETY RULES

The general safety rules are stated briefly below. Further discussion of these rules and general precautions are on the following pages.

1. New and revised experimental equipment must be inspected by the Safety Committee prior to operation.

2. Working areas must be clean and uncluttered.

3. Experimental or shop work conducted by lone workers is especially discouraged during off hours. If you must work alone you should alert a coworker.

4. Know the location of fire extinguishers and use protective equipment.

5. All accidents must be reported to the department within 24 hours.

6. Gases and gas cylinders must be handled strictly according to established procedures.

7. Handle chemicals and other toxic material with caution.

8. Smoking is permitted only in designated areas (none of which is inside a building).

9. Follow general safety precautions and use your common sense.

GENERAL PRECAUTIONS

1. Refrigerators and freezers may be designated for chemicals or for food, never for both. Each refrigerator and freezer must have a label -- **FOOD ONLY : NO CHEMICALS** or **CHEMICALS ONLY : NO FOOD** -- prominently displayed on the door.

2. All connections between rubber or plastic hoses and solid pipes or tubes (*e.g.*, water coolant lines) must be held fast by hose clamps. Should a hose come loose (even a water line), the hazard -- let alone the mess -- can be serious.

3. Any exposed hot surfaces should have appropriate caution signs on them.

4. All sharp edges shall be covered with friction or adhesive tape in such a manner as to prevent their acting as cutting edges.

5. All moving parts that present a potential hazard must be surrounded by a shield.

6. All glass tubing shall be fire polished.

7. When any piece of equipment is dismantled, all ends of glass tubing which protrude from the dismantled member, whether the ends are cut or broken, shall be removed.

8. The exhaust from all mercury vapor diffusion pumps must be vented to an operating hood.

9. Failure to keep laboratories clean leads to an unsightly condition and can readily produce a dangerous condition. Uncleanness can lead to suspension of operations in the laboratory.

ENGINEERING SCHOOL SAFETY POLICY

The object of the SEAS Safety Policy is to ensure the physical safety of all faculty, staff, students and visitors. The Safety Policy is determined and monitored by the Safety Committee with the advice of the Environmental Health and Safety Office, endorsed by the Dean's Cabinet and enforced by the Dean. The University Safety Manual, to be issued by the Environmental Health and Safety Office, will amplify and amend this policy. A Departmental Chemical Hygiene Plan detailing procedures for safe handling of chemicals in laboratories has been issued. The Plan is available for your review and reference in A214; each laboratory has a copy as well.

The SEAS Safety Committee is composed of the Health and Safety Coordinators of the six departments, their alternates, the Facilities Manager, the Associate Dean for Operations and Research Affairs, his Administrative Assistant and one graduate student from each department. The Facilities Manager is the Chairman of the committee.

INSPECTIONS

All laboratories, classrooms, offices and public areas are to be formally inspected twice each year. The Coordinators are responsible for scheduling and leading the inspections. Once per year, the inspection team will consist of the Coordinator (or Alternate), the University Safety Engineer and a departmental Coordinator from another SEAS department. The faculty member responsible for each laboratory (or his/her designate) will be available for the inspection team. The second annual inspection will be an internal inspection conducted by the Departmental Safety Committee.

Infractions will be reported in writing to the faculty member (or Department Manager in the case of office infractions), the Department Chair and the Safety Committee. All records are kept in A215. The faculty member will request reinspection when corrections have been made, which should, under most circumstances, be no longer than one month. If a correction requires physical modifications to a laboratory or to an experiment which cannot reasonably be accomplished within a month, that information shall be transmitted to the Chairman of the Safety Committee with copies to the Department Chair and the University Safety Engineer.

However, any faculty member may suspend the operation of any project at any time, the suspension to continue until conditions are considered satisfactory. Before leaving the University for any reason, all students must clean up their laboratory and/or office to the satisfaction of the Thesis Advisor and the Safety Committee. An appropriate form is available from the Department Manager (A215).

NEW EQUIPMENT, RADIATION SAFETY, OTHER SPECIAL HAZARDS

New construction, pressure piping, pressure vessels, electrical and structural work will be reviewed and approved by the University Planning and Engineering Office. Safety and health review of new or significantly revised experimental equipment is the joint responsibility of the faculty member and the Department Chair through the Departmental Safety Committee.

The Health Physics Section of the Office of Environmental Health and Safety coordinates the University's Radiation Safety program. Questions regarding the use of these materials or equipment should be addressed to Sue Dupré, extension 8-6252.

SAFETY EQUIPMENT

Fire extinguishers must be present in each laboratory. Access to them must not be blocked. Such equipment, as well as safety showers and first aid cabinets, are located throughout the building. Know the location and use of equipment in your immediate area and know how to get to the nearest exit in case of fire or other emergency.

FIRE AND OTHER EMERGENCIES

If you observe a fire, sound an alarm. **Call 9-1-1** on the nearest telephone. Public Safety will respond to all alarms and take appropriate action. No person who has not been trained in the use of fire extinguishers should attempt to fight a fire. On the sounding of a fire alarm, it is the responsibility of each individual to secure any experimental equipment (if doing so does not endanger his/her personal safety), close the door of the work area and leave the building by prescribed exit routes. Emergency exit routes are posted throughout the EQuad buildings and on the inside door of each room.

Hall monitors are designated for each corridor of each floor of the EQuad. It will be the responsibility of the hall monitor to assist everyone in leaving the building. On leaving, everyone is to gather behind the Bowen Building next to Parking Lot 1A.

All injuries more serious than very minor cuts and burns should be treated at McCosh Infirmary and reported to the department chairman. This procedure is for your own protection. All injuries treated at the Infirmary are registered, and insurance problems are avoided if complications set in later. Any accident requiring surgery or other major medical treatment should be treated at the Princeton Medical Center. Call 8-3134 or the hospital, 921-7700.

In the event of a serious accident, some member of the faculty should be immediately notified. For accidents involving radioactive or carcinogenic materials, also call Environmental Health and Safety, 8-5294, or the general emergency number, **9-1-1.**

SAFETY EDUCATION

A regular series of seminars on safety topics will be offered by the School of Engineering and Applied Science Safety Committee and conducted by Environmental Health and Safety. **A core set of lectures has been developed; attendance is mandatory for undergraduate and graduate students who are about to begin experimental research who have not had previous basic training in laboratory safety at Princeton University.** The Department Chairs are responsible for ensuring attendance by students in their departments. The Departmental Safety Committee offers additional safety training, some of which is mandatory.

SAFETY GLASSES AND PROTECTIVE CLOTHING

A significant number of eye injuries occur in University laboratories each year. For example, in recent years there have been twelve laboratory eye injuries and even more "near misses", *i.e.*, incidents where caustic or corrosive materials were splashed or sprayed on people's faces. All of these could easily have resulted in permanent eye damage and loss of vision -- at least one did.

In all laboratories and shop areas where eye hazards exist (*e.g.*, toxic or corrosive chemicals, high pressure liquids, air or other gases, high temperature solids or fluids, or when using shop equipment), federal law requires that all persons wear eye protectors (not just own them).

It is University policy that the department procures eye protection devices at departmental expense. This applies to face shields, goggles, welding helmets, plain (non-corrective) safety glasses, and indeed all other types of protective equipment that may be required. An exception to this policy is required in the case of prescription (corrective) industrial safety glasses. They are traditionally and universally regarded as "employee owned" protective equipment due to their personal and unique characteristics. Those who normally require prescription glasses and whose work requires eye protection are required to wear prescription industrial safety glasses that meet federal standards. Such glasses are available from LensCrafters in the Princeton Market Fair on US Route 1. To relieve the employee or student of the additional cost of such glasses, the university maintains a subsidy program which provides partial reimbursement toward the purchase of such glasses. The reimbursement is applicable toward the cost of the glasses only; the cost of eye examination or fitting charges is not covered by this program. Before going to LensCrafters, call 8-5294 and ask for a voucher which you should take to the store with you for redemption.

In all laboratories where hazardous chemicals are used, workers should wear long-sleeve shirts and long pants or skirts, or long lab coats. The extra layer will protect the skin from chemicals which might splash or spill.

Bare feet or sandals are <u>not acceptable</u> in laboratories where experiments are in progress or where equipment is being installed or modified.

TRANSPORT AND STORAGE OF GASES AND CHEMICALS

SEE Web site: "http://web.princeton.edu/sites/ehs/.