Princeton University

Department of Chemical and Biological Engineering
Graduate Handbook

August 2020

FIRST-SEMESTER ORIENTATION

WELCOME!

We are happy that you have chosen Princeton for your graduate work, and we are delighted to welcome you here. We think you will enjoy your stay here for the next few years. Princeton has much 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 Poconos…). 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.

As a graduate student here—especially as a new graduate student—two people with whom will interact extensively are the Director of Graduate Studies (DGS) and Graduate Program Administrator (GPA):

CBE Director of Graduate Studies (DGS): Professor Rick Register, A423 EQuad, 8-4691, register@princeton.edu

CBE Graduate Program Administrator (GPA): Karen Oliver, A209 EQuad, 8-4619, koliver@princeton.edu

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, and 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 the GPA. But some other CBE staff with whom you are likely to interact include:

CBE Department Manager: Kate Braunstein, A215 EQuad, 8-4650, kraunst@princeton.edu

CBE Financial Assistant (for purchasing): Pam Raney, A220C EQuad, 8-4690, praney@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 up for discussion and brainstorming. If you have any concerns that apply specifically to you (personal or professional), feel free to contact the DGS.

INTRODUCTION

Many rules and procedures at Princeton are common to graduate students in all departments, and can be found on the various tabs of the Graduate School's website (https://gradschool.princeton.edu). Among other things, this website contains descriptions of all graduate courses currently "on the books" (Academics > Fields of Study > Fields of Study Menu), including those in CBE. The principal purpose of the present *Handbook* is to provide you information regarding rules and procedures specific to the Department of Chemical and Biological Engineering (CBE) and the School of Engineering and Applied Science (SEAS). It contains detailed descriptions of the requirements for the PhD degree, MSE, and MEng degrees, and also "orientation" material for students new to Princeton, such as descriptions of normal office, shop, and laboratory safety procedures. 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 GPA; she may, in turn, refer you to the 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.

We have a spacious lounge for graduate students, in A214 E-Quad ("Graduate Lapidus Lounge"). Unfortunately, as long as the University is at "Level 2" for research, due to COVID-19 concerns, occupancy in this room will be strictly limited to a maximum of 3 persons at any one time. Each enrolled graduate student has a mailbox (cubbyhole) in the Graduate Lounge; mail that arrives in the department is sorted and deposited in the appropriate mailbox. There is also a desk with a PC and printer in the lounge for your use. The Graduate Lounge also contains a microwave, shared refrigerator, and a coffee/tea/cocoa machine (bring your own mug)—unfortunately, these are currently closed at "Level 2". Once the "Level 2" restrictions are lifted, you will be most welcome to eat in the Lapidus Lounge and to use those facilities, but please keep the area neat.

Any packages that arrive for you (anything too large to fit in your box in the Graduate Lounge, including equipment or supplies which you will order from outside vendors in the course of your research) will be deposited in the mailroom in A220 EQuad. Please check both your mailbox and 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 bins (wire baskets) in A220. Interdepartmental (manila) envelopes for campus mail are available in A220. For personal US Mail, you are responsible for adding postage to the letter; for posting mail related to your research, see your advisor's faculty assistant.

The bulletin board in the hallway across from the Graduate Office (A209) contains announcements and syllabi for new graduate courses and other official notices, including those of upcoming Final Public Oral Examinations (FPOs). Notices of permanent and postdoctoral positions, both academic and industrial, are posted on the board outside the Lapidus Lounge (A210/214). The monitor outside A215/217 will show any upcoming departmental-wide events (such as seminars).

BUILDING ACCESS, OFFICE SPACE, AND KEYS

For Fall 2020, doors to academic buildings will be locked at all times. For CBE grad students, during normal business hours (Mon-Fri 7 am – 5 pm), your University ID will unlock any EQuad or Hoyt door equipped with an RFID card reader (black rectangular items, typically mounted on the right side of the door frame at about hip level, with an LED in the upper left corner, against which you should hold your ID card). 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. Handicapped access to Hoyt is via the courtyard-side door, across from Corwin Hall.

As described below, the matches of new students with research projects is finalized in January, at which time students move into an office or lab overseen by their advisor. 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 is electronically accessible at https://library.princeton.edu. From this site, you can access the University's on-line catalog, many databases (such as *Web of Science*), and the electronic forms of nearly all of the University's journal holdings journals. The University also has an electronic document delivery service, where you can request articles from journals not held by the Library, or in older 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 – now located in Fine Hall, connected to the Lewis Science Library.

Firestone Library – the University's main library, though engineering students generally have little need to access its collections. Recently renovated, and worth a visit at least once during your time at Princeton (it's impressive).

Lewis Science Library – located at the corner of Washington Road and Ivy Lane, it houses collections for Astrophysics, Biology, Chemistry, Geosciences, Mathematics, Neuroscience, Physics, and Psychology.

Plasma Physics Library - located at the Princeton Plasma Physics Laboratory on the Forrestal Campus, it contains materials on thermonuclear fusion, plasma physics, fusion reactor technology, optics, and ionized gases.

PHOTOCOPYING

Once you join a research group in January, you should request from your advisor an account number to use for photocopying of research-related material using the departmental copiers in A220 EQuad and in Hoyt.

CLERICAL MATTERS

Departmental staff should not be asked to type, scan, reformat, edit, etc. a student's work. Staff members' desks, 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 E-Quad you will find bins for cans and bottles. In each office and laboratory there are two kinds of trashcans: one labeled for recyclable paper items, the other for trash that 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

The tax code is frequently revised, but fortunately the Graduate School maintains a page with a good deal of current, useful information: https://gradschool.princeton.edu/costs-funding/tax-information.

PhD IN CHEMICAL ENGINEERING:

DEGREE REQUIREMENTS

The PhD program aims to prepare students for positions as independent researchers, whether in industry or in academia. Many students eventually assume managerial or administrative positions; we believe that the close mentorship that 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. A checklist of PhD program requirements is given on page 17.

PhD RESEARCH TOPIC / ADVISOR SELECTION

In the first year, at the end of September, students receive a packet of short descriptions of the PhD thesis topics being offered this year. Students who arrive at Princeton with their own funding (*e.g.*, full support for three or more years from a source *outside* the University) should feel free to discuss with faculty whether there are potential projects not listed in the packet. Each faculty member offering a project will also present his/her work in CBE 507. After identifying a few topics of particular interest, students make appointments with the faculty members offering these topics to discuss them in greater depth. To ensure investigation of a broad range of topics, we ask that students meet with a minimum of five faculty members during this process. In all likelihood, you will wish to meet multiple times with faculty in whose research you are particularly interested (*e.g.*, scheduling followup meetings second meeting after reading articles or proposals relevant to the topic being offered). Besides the faculty members, upper-year graduate students are often very good sources of information about the nature of research in various groups. 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!

Project choices are due before winter break. Conflicts in project selection (*e.g.*, two or more students choosing a project which can accommodate only one) are usually 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.

COURSE REQUIREMENTS

PhD students must pass a total of ten (10) courses, divided as follows:

5 "core" courses:

MAE 501	Mathematical Methods of Engineering Analysis I [–or– CBE 502, Mathematical Methods of Engineering Analysis II, not currently offered]
CBE 503	Advanced Thermodynamics
CBE 504	Chemical Reactor Engineering
CBE 510	Transport Phenomea [–or– MAE 552, Viscous Flows and Boundary Layers]
CBE 507	Research Topics in Chemical & Biological Engineering

1 engineering ethics course (EGR 501, runs only a half-semester)

3 technical electives (400-level or higher, in engineering or the natural sciences)

1 unrestricted elective (any level, any subject)

The unrestricted elective 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. Technical electives need to have their primary (first) listing in an engineering or natural science department (*e.g.*, Chemistry, Physics, Molecular Biology); with permission from the DGS, some 300-level courses may be considered as technical electives.

Students, particularly those entering with Master's degrees, who have previously taken a graduate-level course similar in coverage to one of our "core" courses, may request exemption from this course from the Director of Graduate Studies. 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 10 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 five requirements (EGR 501, 3 technical electives, 1 unrestricted elective) on the basis of prior work elsewhere will not be granted.

Core graduate courses in chemical engineering, with the exception of CBE 507, are graded with a letter grade; CBE 507 is graded pass/fail (P/D/F). CBE graduate electives, courses taken outside the department, or CBE undergraduate chemical engineering courses taken to fulfill the "unrestricted elective" requirement, may be taken either P/D/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.

In the first (fall) semester students are expected to complete four core courses (CBE 502, 503, 504, and 507), and are encouraged to consider adding an additional elective course (depending on course offerings and student interest). The normal course load for the second (spring) semester of the first year is to take CBE 510, EGR 501, and two electives.

GENERAL EXAMINATION

The General Examination consists of two components: 1) mastery of graduate-level chemical engineering material in the departmental core courses, and 2) a written First Proposition (thesis research proposal) and its oral defense, as described in the following section. Upon passing the General Examination, the student advances to "post-generals" candidacy. In addition, passing the General Examination entitles the student to receive a Master of Arts (MA) degree.

FIRST PROPOSITION

Written Document

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 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 First Proposition is due by 4:30 pm on the first Friday in December of the second year of residence; an electronic (.pdf) version should be submitted to the DGS, with a copy to the GPA, along with suggestions for two additional thesis committee members (described below). This deadline is strictly enforced; failure to submit the document on time is taken into account by the examination committee. 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 feasible? 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. There should be an Abstract and a Table of Contents on separate (unnumbered) pages; the date of submission should appear on the cover page. First Propositions should not exceed 15 pages, single-spaced, font size 12. This includes all figures, tables, and any appendices provided, but excludes the title page, table of contents, and references. Propositions not conforming to these guidelines will be returned for revisions.

First Proposition Committee

The First Proposition is read and evaluated by the student's advisor and two other faculty members. Most students have only one advisor; in these cases, the two other faculty members are denoted the "Second Reader" and "Third Reader". Students' suggestions for these two readers will be honored if possible, within the constraint of an equitable readership and advising load across the faculty; final assignments of readers are made by the DGS. Second and Third Readers may be drawn from Chemical and Biological Engineering associated faculty as well as other departments within or outside of Princeton. 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. A thesis committee may contain one (at maximum) member from outside the University, but any travel and other costs associated with such committee members are the responsibility of the project advisor or the external committee member, and such committee members need to be appointed through the Graduate School, so this is also a matter to discuss with the DGS *prior* to submitting your First Proposition. In addition to the Advisor, Second Reader, and Third Reader, an additional faculty member (the "Fourth Member") will be appointed to the committee by the DGS; this person is normally, but not always, the faculty member who evaluated the student's CBE 507 original research proposal, if that person is not the

Advisor, Second Reader, or Third Reader. The Fourth Member is not expected to read the First Proposition, but should nevertheless be provided a copy of the document at the same time as the Second and Third Readers; the Fourth Member participates in the oral defense and evaluation, as described below.

For jointly advised thesis projects, the First Proposition committee membership is modified from the above. One of the advisors is formally designated as the advisor and the other as the Second Reader. Two additional faculty members, the "Third Reader" and "Fourth Reader", are assigned by the DGS based on student suggestions; both of these faculty read and evaluate the written First Proposition. Also, the DGS will assign an additional faculty member, the "Extra Member", to the committee; this person is not expected to read the written document, but should nevertheless be provided a copy of the document at the same time as the Third and Fourth Readers; the Extra Member participates in the oral defense and evaluation, as described below. This modification ensures that each student's written First Proposition is evaluated by two examiners who have no advising role for the student, and that each student's oral defense is evaluated by three examiners with no advising role.

Students will be informed of the composition of their First Proposition committee (Second Reader, Third Reader, Fourth Member/Reader, and when necessary, Extra Member) within two weeks of submitting their First Propositions.

First Proposition Oral Defense

The oral defense of the First Proposition takes place in January, during the General Examination period specified by the University, and is scheduled by the student in consultation with their committee members. The advisor(s) provide a written assessment of the student, his/her performance to- date in the laboratory, and his/her First Proposition document, in advance of the oral defense. The advisor(s) also participate in the oral defense, but it is the non-advisor members of the committee who assess the student's performance. The oral exam consists of a 15-20 minute presentation of the proposed work, followed by questions by the faculty examiners. 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. The outcome of the General Examination will be reported to the student after being discussed at a full-faculty meeting in January.

In addition to passing, other outcomes of the oral defense are possible. Students may be asked to revise the written document, to re-defend the proposition orally, or both. Students might also be asked to take additional courses to augment their understanding of a particular area. The faculty must approve the First Proposition before a student can advance to post-generals candidacy. There is no strict 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 (May) of the student's second year in residence, or the student's PhD degree candidacy is automatically terminated by the Graduate School. The deadline of May of the second year for successful completion of the first proposition is not extended by any changes in project or research groups, occurring either before or after the initial defense of the First Proposition.

Summary of Key Dates for First Proposition (all in 2nd Year of Residence)

September/October:	Contact prospective faculty for thesis committee
First Friday in December:	First Proposition document and names of two faculty due
December:	Schedule oral exam with committee members (date, time, room)
January:	Oral defense of First Proposition

Change of Primary Advisor

On exceedingly rare occasions, a change of primary advisor may take place, after a formal request by the student; such a change requires approval by the DGS and the planned new advisor, who must be able to support the student financially. If such a change takes place after the First Proposition has been successfully defended on the topic corresponding to the original advisor, the student will need to prepare a new document equivalent to the First Proposition (thus containing initial results and a plan for completing the doctoral dissertation on the new topic), and defend it before the new thesis committee at the next annual reenrollment meeting following the change of advisors, or at a special meeting of the full doctoral committee, whichever comes earlier. The new advisor will need to submit a detailed report to the DGS on the outcome of this meeting. The report should specifically address (a) whether continuing enrollment in the doctoral program is recommended, with or without concerns and (b) if any weaknesses have been identified that will need to be addressed, possibly by asking the student to revise the document. The DGS will note these recommendations in the reenrollment report to the Graduate School.

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. 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.

THESIS COMMITTEE AND ANNUAL MEETINGS

The advisor, Second Reader/co-advisor, Third Reader, and Fourth Member/Reader from the First Proposition form the student's four-person thesis committee, which normally follows the student all the way through to the Final Public Oral Examination (FPO). (In cases where an "Extra Member" was assigned for the First Proposition, that person does not normally continue as a member of the thesis committee.) 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.

It thus behooves the student (you) to build relationships with the members of the thesis committee, and to keep them informed of your progress throughout your time at Princeton. Committee members may be able to provide feedback on your research, guidance on career opportunities, letters of recommendation, *etc*. Each committee also convenes annually with the student to review progress and plans for the coming year, as described in the following section.

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. 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 that can be completed within five years, while the student attends diligently to the completion of program requirements other than the dissertation (*e.g.*, courses).

Reenrollment for five years is not automatic. In April of each year, PhD students must be recommended by their advisors and the DGS for reenrollment. This process results in the generation of a new support contract for the student for the following academic year, and gives an opportunity for students, their advisors, and members of their committees to engage in past performance evaluation and future goal setting.

For third- through fifth-year PhD students, reenrollment requires a meeting of the thesis committee, with the exception of fifth-year students planning an FPO over the summer or in September who will not be reenrolling. Prior to the meeting, students email a description of progress over the past year and plans for the coming year, including a summary (<250 words) suitable for submitting as part of the reenrollment process. Following the summary, the description should run to a maximum of five double-spaced pages (12-point font, 1" margins). If there are written preprints or published manuscripts from work during the past year, they can also be attached, but in any case the description should be a self-contained document. Students may discuss this description (and, especially, future plans) with their advisor(s) in advance of submitting it to the committee. Please email your description directly to the committee members, not to the DGS or GPA. You will also need to schedule a meeting of your committee. The meeting should start off with a short (15 min. maximum) presentation by you, highlighting key milestones from the past year and briefly summarizing plans for the coming year, reinforcing and expanding upon the written document submitted earlier. The presentation will be followed by a discussion with the committee, whose task it is to assess the progress made over the past year and the suitability of the plans for the coming year.

In the event that one of your committee members (other than the advisor) is on leave during the Spring semester, the meeting should proceed one person short. In the event that the advisor or two committee members are on leave, special arrangements will be made in consultation with the DGS. Given that faculty tend to have quite busy calendars, it is a good idea to start trying to find a date and

time for the meeting early on. A good strategy would be to talk to your advisor(s) and identify several one-hour candidate time slots in late March and early April. You can then email the other committee members asking them if the specific time slots that have been prescreened by the advisor(s) are also ok with them.

DISSERTATION

When you embark on the writing of your dissertation, have a thorough discussion 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 will provide 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 Program Administrator before the student can proceed to schedule a Final Public Oral Examination.

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 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 department greatly prefers that a student not leave campus until, at a minimum, a complete draft of the dissertation is written.

Instructions for preparing the dissertation in proper form for its archiving in Mudd Library may be obtained from the GPA. However, the best information on the contents of 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. 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 FPO is the culminating event of PhD candidacy, at which the student defends his/her thesis before the four-person thesis committee, whose composition was outlined above. Prior to the FPO, the dissertation must have been approved in writing by two faculty, the advisor (First Reader) and Second Reader (or co-advisor, if any), as outlined above. The other two members of the committee

(Third Reader and Fourth Member/Reader) are not expected to have read the thesis, but should nevertheless be provided a copy of the document at the time of FPO scheduling; these latter two faculty will participate in the oral examination.

As the name implies, FPOs are open to the public. During the FPO, the student makes a formal oral presentation of the work. A suggested format is for the student to present an overview of the thesis for approximately 45 minutes, followed by questions by committee members and the public. The committee may also ask additional questions after the audience is excused.

Several forms need to be filed before conducting the FPO; these may be obtained from the Graduate Program Administrator, 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 GPA must have received: 1) a copy of the dissertation's title page and abstract (from the student), 2) each of the two signed written Reader's Reports, 3) a "Prior Presentation and Publication Report" describing the status of publications from the thesis (from the advisor), 4) the Degree Application form (completed on-line at the Graduate School website, and 5) an electronic (.pdf) copy of the dissertation (plus, if requested by some of the four FPO committee members, hard copies in three-ring binders – please check with your committee for their preferences). The student is responsible for determining 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, Eisenhart Room, or the Hoyt Conference Room). This request must be submitted to the Graduate School two weeks (ten working days) prior to the actual FPO.

FPOs are not normally conducted in the summer (between Commencement and the start of Fall term classes). Faculty members are 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 thesis committee outlined above, there are inevitably situations where one or more of these committee members becomes unavailable, including cases where a committee member is on leave. 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

A checklist for this process is provided by the Graduate School (https://gradschool.princeton.edu/sites/gradschool/files/508_checklist_phd_defense.pdf), but in addition, please read the guide below, which contains some additional information and CBE-specific procedures.

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 Program Administrator (GPA) 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 six points below to the GPA (if s/he has not already received these). All necessary forms are available on-line at the Graduate School website: https://gradschool.princeton.edu/forms/academic .

1) **Ph.D. Dissertation Report and Request to Hold Final Public Oral Examination** form (will be completed by the GPA). DGS will sign when all other materials are received.
2) completed **Advanced Degree Application** form (on-line submission in TigerHub)
3) **two** signed, written **Reader's Report** forms (should have been sent separately to the GPA)
4) completed **PhD Prior Presentation and Publication Report** form (should have been sent separately to the GPA by the advisor)
5) one copy of the dissertation **abstract** (including your name and the dissertation title)
6) one copy of the dissertation **title page** (including the month—September, November, January, April, or May—and year of expected degree conferral (*not* the month of the FPO))

All of these items required by the Graduate School are to be attached (either by the student or by the GPA) to the online Advanced Degree Application.

International students should review and follow the guidance of the Davis International Center regarding degree completion: https://davisic.princeton.edu/immigration/current-students/termination-or-completion.

After the FPO is sustained, all degree candidates must do the following to actually get on the degree list:

1) turn in all keys to the GPA
2) 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 $15, and there is a $55 surcharge if the student wishes to copyright the dissertation
    b) a completed ProQuest Publishing Option and Copyright Registration confirmation page (completed online at www.etdadmin.com/princeton.) You will also upload an electronic PDF of your dissertation at this time.
    c) **one** bound copy of the **dissertation** to Mudd Library
    d) **two** copies of the **Final Public Oral Examination Report** form (signed by the DGS and provided by the GPA after completion of the FPO); one copy of this form must be signed by the librarian (in Mudd) and returned to the student
3) once step 2 is completed, turn in the following items to the Graduate School, in Clio Hall:
    a) the Final Public Oral Examination Report form, with all signatures
    b) a completed End of Enrollment Form
    c) a completed confirmation page of the **Exit Questionnaire** (on-line in TigerHub)
    d) a completed confirmation page of the **Survey of Earned Doctorates** (on-line in TigerHub)

CHEMICAL ENGINEERING PhD PROGRAM CHECKLIST

Coursework

_____MAE 501, semester_____ grade for General Examination _____
_____CBE 503, semester_____ grade for General Examination _____
_____CBE 504, semester_____ grade for General Examination _____
_____CBE 507, semester _____
_____CBE 510, semester _____ grade for General Examination _____
_____EGR 501, semester_____

_____Technical 4xx/5xx elective, course number and semester_____
_____Technical 4xx/5xx elective, course number and semester_____
_____Technical 4xx/5xx elective, course number and semester_____
_____Unrestricted elective, course number and semester_____

First Proposition

_____submitted, date: _____
Advisor: _____
Second Reader (or Co-Advisor): _____
Third Reader: _____
Fourth Reader/Member:_____
Extra Member (if assigned):_____
_____approved, date:_____

AI Service

_____course number, semester, instructor _____

Final Public Oral Examination

Advisor:_____
Second Reader:_____
Member:_____
Member:_____
(indicate chair of committee)_____
sustained, date:_____

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 (PRISM) 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 "General Examination," "First Proposition," "Assistantships in Instruction," "PhD Duration and Readmission," "Dissertation," and "Final Public Oral Examination"). There, are, however, two key differences. The first is in the choice of thesis topic: students in the Chemical and Materials Engineering program must be pursuing a materials-related thesis, approved as such by the PRISM academic director; at least one of the thesis committee members must be associated with PRISM (see https://materials.princeton.edu/people/faculty for a list). The other difference is in the required coursework, and is described in more detail below. A requirements checklist for students pursuing the PhD in Chemical and Materials Engineering appears on page 20.

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 Engineering, students advance to post-generals status (and are eligible to the receive the degree of Master of Arts) as soon as they: 1) complete the required core courses for the PhD in Chemical Engineering (MAE 501, CBE 503, CBE 504, CBE 507, CBE 510) and 2) 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 complete the course requirements in Materials Science and Engineering (MSE, described under "Course Requirements" below), with a grade of B- or above. If students do not satisfactorily complete the MSE course requirements, they remain eligible to receive the PhD in Chemical Engineering, provided all the other requirements for that degree are met.

COURSE REQUIREMENTS

Students pursuing the PhD in Chemical and Materials Engineering must pass a total of ten (10) courses, divided as follows:

5 "core" courses:

MAE 501	Mathematical Methods of Engineering Analysis I [–or– CBE 502, Mathematical Methods of Engineering Analysis II, not currently offered]
CBE 503	Advanced Thermodynamics
CBE 504	Chemical Reactor Engineering
CBE 510	Transport Phenomena [–or– MAE 552, Viscous Flows and Boundary Layers]
CBE 507	Research Topics in Chemical & Biological Engineering

1 engineering ethics course (EGR 501, runs only a half-semester)

3 MSE 5xx courses (see below for explanation)

1 unrestricted elective (any level, any subject)

Courses that satisfy the "MSE 5xx" requirement are any of the graduate courses in the field of Materials Science and Engineering listed in https://materials.princeton.edu/graduate%20courses and not otherwise already listed above (*e.g.*, CBE 503 cannot be double-counted). The full list is quite extensive, but some popular choices for CBE students include:

MSE 501/MAE 561	Introduction to Materials
MSE 502	Phase Transformations n Materials
MSE 504/CBE520	Monte Carlo and Molecular Dynamics Simulation
MSE 505	Characterization of Materials
MSE 515/APC 515	Random Heterogeneous Materials
CBE 526/MSE 526	Surface Science: Processes and Probes
CBE 543/MSE 525	Structure and Properties of Complex Fluids
CHM 503/MSE 514	Introduction to Statistical Mechanics

It is also possible to request that an MSE 4xx-level course be counted in lieu of a 5xx-level course, particularly when no analogous course exists at the graduate level. Such a request requires approval by PRISM; email the PRISM Academic Coordinator (currently Sandra Lam, sclam@princeton.edu) with the following information: your name, your advisor's name, your year of enrollment, a list of Princeton courses taken to date, the number of the course in question and a ≤1 paragraph justification. Copy the CBE Graduate Program Administrator on your request and the response.

CHEMICAL AND MATERIALS ENGINEERING PhD PROGRAM CHECKLIST

Coursework

_____MAE 501, semester_____ grade for General Examination _____
_____CBE 503, semester_____ grade for General Examination _____
_____CBE 504, semester_____ grade for General Examination _____
_____CBE 507, semester _____
_____CBE 510, semester _____ grade for General Examination_____
_____EGR 501, semester_____

_____MSE 5xx, course number and semester_____
_____MSE 5xx, course number and semester_____
_____MSE 5xx, course number and semester_____
_____Unrestricted elective, course number and semester_____

First Proposition

_____submitted, date: _____
Advisor: _____
Second Reader (or Co-Advisor): _____
Third Reader: _____
Fourth Reader/Member:_____
Extra Member (if assigned):_____
_____approved, date:_____

AI Service

_____course number, semester, instructor _____

Final Public Oral Examination

Advisor:_____
Second Reader:_____
Member:_____
Member:_____
(indicate chair of committee)_____
sustained, date:_____

SOME POLICIES COMMON TO PhD CANDIDATES

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 (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 (https://gradschool.princeton.edu/sites/gradschool/files/enrollment.pdf) with the Graduate School at least a week before the actual termination date. Foreign students must coordinate a change in visa status as described below.

The period of regular enrollment for the PhD degree is five years maximum, and 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.

Enrolled Ph.D. students who have not completed their degree within five years have the opportunity to be enrolled for up to two additional years in "Dissertation Completion Enrollment" (DCE) status. However, unlike the guaranteed tuition and stipend support during the five-year period of regular enrollment (subject to satisfactory academic progress), there is no guarantee of support during DCE status. Marginal-cost (reduced) tuition is charged to DCE students; the default is that this tuition will be paid by the student, although it is possible for this to be paid by the advisor. Additionally, it is possible for the advisor to provide a stipend, of any amount ranging up to the usual Assistant in Research rate, if funds are available—but no stipend support is guaranteed.

If a student does not choose DCE status, or once the DCE status ends, if the student has *still* not completed all requirements, then the student enters Enrollment Terminated/Degree Candidacy Continues (ET/DCC) status. As the name implies, ET/DCC students remain degree candidates but are not enrolled, and do not receive any stipend support or other benefits.

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 the Office of Visa Services, Davis International Center, Louis A. Simpson International Bldg., room A45.

Continuation of ET/DCC Status

Students who remain in Princeton, actively progressing on their dissertations, will have their ET/DCC status continued as needed. However, PhD degree candidacy is not an open-ended process; unenrolled students who fail to make substantial progress towards their degrees risk having their candidacies terminated. The Graduate School may terminate an ET/DCC student's degree candidacy if the student "has not been in regular contact with the adviser, committee, or academic department; has not made progress towards completing degree; and more than five years have passed from the date the student passed the general examination." (https://gradschool.princeton.edu/academics/statuses/former-degree-seeking-statuses/termination).

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, 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.

CERTIFICATE IN BIOENGINEERING

Concurrent with the PhD degree, students may earn one or more graduate certificates. The graduate certificate in bioengineering (http://bioeng.princeton.edu/certificate) is designed to formalize the training of students specializing in the engineering analysis of living systems. It recognizes the efforts and accomplishments of Ph.D. students who have gone beyond the requirements of the degree program to acquire training in bioengineering. The certificate is based on core graduate courses, a research seminar, and graduate research. The bioengineering core classes can be taken as graduate electives.

To earn the certificate, students must complete three requirements: (a) take for credit and pass (earning a grade of B+ or better) three core courses, one each from a thematic area within bioengineering, defined below; (b) complete a thesis in the area of engineering analysis of biological systems; and (c) attend the Bioengineering Colloquium (https://cbe.princeton.edu/events/bioeng) and present a seminar on their research.

Students are required to take one course in each of the thematic areas ("molecules", "cells", "tissues and organs") for a total of three courses.

Molecules:	CBE 438 / MOL 438, Biomolecular Engineering CBE 467, Metabolic Engineering MOL 515 / EEB 517 / CHM 517, Method and Logic in Quantitative Biology
Cells:	CBE 433, Introduction to the Mechanics and Dynamics of Soft Living Matter PHY 412, Biological Physics MAE 566, Biomechanics and Biomaterials: From Cells to Organisms
Tissues/Organs:	CBE 440, Physical Basis of Human Disease QCB 511 / CBE 511, Modeling Tools for Cell and Developmental Biology CBE 439 / MOL 439, Quantitative Physiology and Tissue Design ELE / NEU / PSY 480, fMRI Decoding: Reading Minds Using Brain Scans NEU / MOL / PSY 404, Cellular and Systems Neuroscience

Graduate research should be conducted under the supervision of one of the participating faculty (see http://bioeng.princeton.edu/certificate for the current list). In order to earn the certificate, students are also required to attend the biweekly Bioengineering Colloquium, which serves as a venue for reporting current results and discussing the integration of different research approaches to the analysis and design of living systems. They are required to give a research presentation in this colloquium before completing their FPO.

Satisfactory completion of the requirements for the Bioengineering Certificate will be recognized with a notation on the student's transcript.

TRAVEL FUNDS

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 Karen 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 apply through SAFE (https://studentfunding.princeton.edu/) including 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. 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 up to $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.

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

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 "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, LAYN, AND SABIC 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 PhD thesis submitted 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).

Each year at the Graduate Student Symposium, the department presents two SABIC Awards, one for best General Examination (including First Proposition) and another for the best First Publication as first author. Each award comes with a certificate and a cash prize.

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 (MAE 501/CBE 509, CBE 503, CBE 504, or CBE 510; CBE 507 is reserved for PhD students only) or any 500-level elective course with a primary CBE listing or CBE cross-listing. The student may request that up to two of these requirements be fulfilled through the completion of 500-level technical courses outside CBE, 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. Courses may be graded with either letter grades or pass/D/fail (P/D/F) for MSE degree candidates, 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. Instructions for preparing the dissertation in proper form for its archiving in Mudd Library may be obtained from the GPA. 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.*).

UNENROLLED STUDENTS

It is possible for MSE candidates to be unenrolled but remain a degree candidate (ET/DCC, see corresponding section above for PhD students) 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.

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 four core courses for the PhD degree (MAE 501/CBE 509, CBE 503, CBE 504, or CBE 510; CBE 507 is reserved for PhD students only), as well as 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 Princeton School of Public and International Affairs. Students may wish to focus their course choices so as to develop expertise in a particular area. 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.

There is no research component to the MEng degree, hence no thesis. 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. Since the MEng is a coursework-only degree, it cannot be completed while unenrolled; hence, enrollment and degree candidacy end simultaneously.

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. 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*); while *RRR* is revised and each year, the standards for plagiarism and other academic violations do not change. The current edition of *RRR* is available at https://rrr.princeton.edu/. Each student should read section "2.4 Academic Regulations" in *RRR* thoroughly, though a general description of the types of violations is provided briefly below. Quoted text and section numbers cited below come from the 2020 edition of *RRR* (accessed August 5, 2020).

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, 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 or a mitigating factor." [*RRR*, section 2.4.8]. If aspects of any of these infractions remain unclear, please feel free to discuss this matter with your advisor or with the DGS.

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*, section 2.4.7]. Several examples are provided in *RRR*, section 2.4.9. 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 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*, section 2.4.6] 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 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 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*, section 2.4.7] 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*, section 2.4.6; alternatively, you may choose to use a format mandated by various professional societies for their journals (*e.g.*, the American Chemical Society, which publishes "Author Guidelines" for each of its journals). Incomplete citations are becoming more common these days as electronic sources (*e.g.*, documents on the Web) are being cited. *RRR*, section 2.4.6 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

In *RRR*, section 2.4.7. 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*, section 2.4.7. It is difficult to conceive of circumstances under which fabrication of data would not constitute academic fraud.

ENGLISH LANGUAGE PROFICIENCY

Princeton English Language Proficiency (ELP) policy applies to all incoming international graduate students who are non-native English speakers who have not earned their undergraduate degree in the United States and who scored below a 27 on the speaking section of the TOEFL iBT or below an 8.0 on the speaking subsection of the IELTS. At a minimum, any such students need to have their English language proficiency evaluated upon arrival, and based on that evaluation, may be required to participate in ELP classes. This policy is developed and implemented by the Graduate School, and may be found at https://gradschool.princeton.edu/policies/english-language-proficiency.

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! 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 GPA 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 typically in early Fall. The Saville Lectureship for exceptional early-career chemical engineers and scientists is usually offered in the Spring. The regular department seminar series runs each Wednesday during the academic year at 4:00 pm, preceded by refreshments. Speakers in this series 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 strongly 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.

The Bioengineering Colloquium, another ongoing series housed within CBE, typically runs on Fridays at 3:00 pm during the academic year. 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).

Every year, the fourth-year students coordinate a major event for chemical and biological 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 other's work, and especially for first-year students to learn about the research now going on in the department. Graduate CBE 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 periodically 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.

SEAS AND UNIVERSITY COMMITTEES

In addition, CBE graduate students are represented on committees and councils beyond the department. Service as a graduate student representative 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 "Graduate" board across from A209.

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 Diversity and Inclusion (currently Julie Yun). Each department

has up to two representatives on the GSC.

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

Low-cost affiliation with the American Institute of Chemical Engineers is available to graduate students, but there is not a local section which meets close to Princeton. 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://chemists.princeton.edu/pacs/.

VACATIONS, SUMMER RESIDENCE AND EMPLOYMENT

[Relevant to PhD and MSE students only.] As set by the Graduate School (https://gradschool.princeton.edu/policies/student-vacation-time), graduate students are entitled to an annual 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.

SUPPLIES, SHOPS, AND BUSINESS EXPENSES (for PhD and MSE CANDIDATES)

Following assignment of students to research groups, 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 already available must be purchased. A purchase requisition is required in all cases. 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, submit a shopping cart through Prime Marketplace and/or a purchase order form (Purchase order form.pdf) and place it in boxes located directly above the paper shredder in A220 All orders must include a chart string. Quotes that exceed $5,000 will need a PI's signature.

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. All orders over $10,000 require a competition summary (describing why this vendor is the preferred, or only possible, choice). This is done when the order is placed. Append the competition summary form (https://finance.princeton.edu/document/191) 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.

Packages are delivered to the department and placed in A220 twice 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 receive an e-mail that your package is in the mailroom. **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. Pam Raney can create a shipping label for UPS/FedEx. All packages will need to be weighed and have dimensions if custom packaging.

Amazon orders need to go through Pam Raney since she holds the tax-exempt Prime account. To obtain reimbursement for research-related incidental expenses (*e.g.*, items bought for the lab at the Home Depot or the U-Store), submit reimbursement through Concur with attached receipts.

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 on the loading dock, near the J-Wing entrance; the key locking the dispensing valve is available from the stockroom clerk.

Chemistry Stockroom (Frick B01). 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 Resource Recovery Program (https://facilities.princeton.edu/services/resource-recovery-program, 755 Alexander Road). Used desks, chairs, filing cabinets, and even computers can be obtained free of charge, and even delivered to your office or laboratory.

SHOPS AND CRAFT SERVICES

Building Maintenance: Maintenance requests for building infrastructure (plumbing, electrical, HVAC, fume hoods, doors, cabinetry, *etc.*) are handled via the submission of a work order (https://facilities.princeton.edu/services/request-service).

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: Glassblowing Shop, 123 Jadwin Hall (https://chemistry.princeton.edu/research-facilities/glassblowing-shop). 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 https://ehs.princeton.edu/.

CENTRAL RESEARCH FACILITIES

Spectroscopy, 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.

Electron Microscopy. PRISM, Andlinger Laboratory. 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

Most research groups will have a designated (student) computer system manager, to handle routine issues. For more complicated questions, the department's system administrator (Eric Paul, A208 EQuad, ericpaul@princeton.edu) is an invaluable resource for problems with desktop, workstation, and network computing.

BUSINESS EXPENSES AND RESEARCH-RELATED TRAVEL

The University has regulations that must be properly followed in order to be reimbursed for business expenses related to your research, as well as for travel to conferences. Detailed information regarding all policies pertaining to reimbursement of business expenses and rules related to business travel are available at http://finance.princeton.edu/. The website contains the most up-to-date policies and procedures regarding Business Expenses, Reimbursement Policies, and Travel Policy, including the Business Travel Expense Report. The policies change from time to time, so make to sure to consult the website for the most up-to-date information. When traveling outside of the US, extra consideration must be taken in order to follow University and grant-agency mandated policies. The website above has been compiled clearly and should be referenced accordingly if there are any questions.

To obtain reimbursement for research-related travel, complete all information in Concur. You will need to upload receipts and have the form signed by your advisor. See your advisor's assistant if you have any questions. All University-sponsored graduate student international travel, including to scholarly conferences, must be registered in Concur. For the most current information, see **https://travel.princeton.edu/graduate-students**.

SAFETY POLICIES AND PROCEDURES

SAFETY COMMITTEE

The Department of Chemical and Biological Engineering Safety Committee Members meet two to three times per year to discuss safety issues. The Safety Committee currently has the following makeup:

Professor Bruce Koel, Chemical Hygiene Officer	A311 EQuad	8-4524	bkoel@princeton.edu
Professor Bob Prud'homme	A301 EQuad	8-4577	prudhomm@
Kate Braunstein, Department Manager	A217 EQuad	8-4650	kbraunst@
Kevin Lamb, Safety Manager	Bowen 119	8-0018	kplamb@

…plus one representative (graduate student, postdoc, or research staff) 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. 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

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.

Safety Data Sheets (SDS) for all chemicals shipped to the Department are accessible on the EHS website https://ehs.princeton.edu/laboratory-research/chemical-safety/chemical-hygiene-plans/chemical-engineering-chp.

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. 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.

Questions regarding the use of radioactive materials or radiation-produced equipment can be answered by EHS staff, listed at https://ehs.princeton.edu/laboratory-research/radiation-safety.

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 at one of the two assembly points: across Olden Street in front of Computer Science, or in the area between the G-Wing and the North Garage.

All injuries more serious than very minor cuts and burns should be treated at McCosh Infirmary and reported to the department manager. 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, the department manager, department chair, and/or chemical hygiene officer 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 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 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, see https://ehs.princeton.edu/workplace-construction/workplace-safety/physical-safety/personal-protective-equipment-ppe/eye-and-face-protection.

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 not acceptable in laboratories where experiments are in progress or where equipment is being installed or modified.