

Chemical Engineering Graduate Studies Guide

2009-10

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ChE Option Representative

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The ChE Ph.D. Program

1. Coursework

a. Coursework Consultation

Upon arrival at Caltech, the PhD students will meet in consultation with a member of the faculty to evaluate their background in the areas of Kinetics, Thermodynamics and Transport Phenomena. The chief intention of these consultations is to set up a course program for the first year of study. A written copy of the recommendations will be entered into each student's permanent file.

b. Requirements

Students are required to take ChE 151ab, ChE 152, ChE 164, ChE 165, and one additional ChE course from the following list: Ch/ChE 140, 147, 148, 155, ChE/ESE 157, 158, 159, ChE 163, 174, 115 and BE/ChE 200b (or ChE 210). Students are expected to take a normal load of four courses per term. Only graded courses must be taken during the first term; a grade of C or better is required to remain qualified for the PhD program.

c. Subject Minor or External Course Requirements:

Each student is required to complete either a subject minor or a general program of courses outside chemical engineering. The requirements for the subject minor are established by the option offering the minor. The general program of courses consists of at least 54 units. A maximum of 27 units from the following list of doubly-listed courses can be used by graduate students as part of the 54 unit requirement: ChE/Env 157, 158, 159; ChE-Ch 140, 147, 155. A course in the ACM 100abc sequence will be credited **9** units instead of the nominal 12 units as listed in the catalog, provided it is not taken on a P/F grade basis.

The general program of courses must be approved *in advance* by the Option Representative. It is intended that the courses chosen should constitute an integrated program of study rather than a randomly chosen collection of courses outside chemical engineering. Within these guidelines, the only courses specifically excluded are AM 113,114 and research in another option. A grade of C or better is required in any of these courses to remain qualified for the PhD program. The requirements for a subject minor in any option may be found in the current Caltech Catalog.

2. Research Advisor

During the first term, the each ChE faculty will present PhD research topics to the first-year ChE grad students. Following these presentations, the students are expected to meet individually with the various faculty members to discuss proposed research and generally obtain information for choosing a research advisor. At the end of the first term, each student is required to submit three faculty names, listed in order of preference. Every possible effort will be made to accommodate the student's first choice, subject to an opening in the desired research group, availability of necessary funding etc. The final decision will be made by the Chemical Engineering faculty in consultation with the students.

3. Oral Qualifying Exams

Each student is required to take a subject oral qualifying examination at the beginning of the second term of the first year in residence, the purpose of which is to examine expertise in kinetics, thermodynamics and transport phenomena. The intended level of these exams is approximately that of the corresponding undergraduate courses at Caltech.

Three types of decisions will be possible: *pass*, *provisional pass*, *fail*. A student with a *pass* or *provisional pass* is permitted to begin his/her PhD research. However, a student with a *provisional pass* will usually be required to satisfy some additional requirements, such as successful completion of specified coursework. Students who *fail* an oral subject exam may be permitted to repeat the exam once at the end of the spring term upon recommendation of the faculty.

The format and topics to be covered for the oral subject exam are listed on page 5 of this guide.

4. Candidacy Exam and Approval of Research Progress Report

A student will be eligible for admission to candidacy upon satisfactory completion of the requirements described in this section.

Prior to admission to candidacy for the PhD degree, a student is required to pass the candidacy examination. This exam consists of two parts: a *research progress report* and an *oral examination* based primarily upon the content of the report. A student who fails to pass the candidacy exam according to the timetable and procedures described below will *not* be permitted to register in any subsequent terms, except for the purpose of completing work toward the MS degree, with the permission of the graduate studies committee and the research advisor.

The written research progress report required for admission to candidacy must be submitted to the faculty *before the end of the second term* of the second year in residence. The report is to be based upon the PhD research project and is expected to exhibit a professional quality of exposition and should outline the research problem, the progress of the student at the time of writing, and a proposal for the planned thesis research. It is also important that the report provide clear evidence of the student's understanding of the motivation for the research problem and its relevance to the general research area, as well as an appreciation of relevant techniques and methodology. The student should strive for a precise and concise format.

The research progress report needs to be approved by an oral examination committee consisting of *no less than three faculty members*, including the research advisor, and *at least two members of the Chemical Engineering faculty*. The choice of the oral exam committee will be made by the student and his/her research advisor, and must be approved by the ChE Option Representative. It is the responsibility of the student to obtain approval from each proposed committee member for the date and time of the oral exam. The list of the recommended committee members must be submitted at the same time as the research progress report, and the exam should be scheduled so that the committee is given ample time to review the

report. The exam should be scheduled no later than **four** weeks after the submission of the report.

The examining committee may require *revision* of the report, and possibly a reexamination. In this case, the committee chair will put in writing any such requests, with a copy to the ChE Executive Officer, the ChE Option Representative, and the ChE graduate studies assistant. The *approved* report, including any revisions, modifications etc., must be submitted to the chemical engineering graduate studies secretary *before* **May 15th** of the second year in residence, and the reexamination, if required, must be scheduled no later than **June 15th**. Exceptions to the rule may be granted by the faculty in unusual circumstances such as extended illness or a change of research advisors, but only upon written petition by the student to the graduate studies committee *prior* to the end of the first term of the second year in residence.

See "Procedures for Approval of Research Progress Report and Application for Candidacy" on page 8 for details.

5. Appointment of Thesis Review Committee

After a student passes the second-year candidacy exam, a faculty committee known as the *thesis review committee* will be appointed to review periodically the student's progress. Usually, the thesis review committee will include members of the candidacy committee, and will be appointed by the Option Representative based upon the student's recommendations. This committee will meet with the student before fall registration each year, either as a group or individually, to review progress, suggest improvements in research, etc. In order to expedite the review, the student should submit a two or three page *concise outline* of progress and of proposed future research to each member of his/her committee before the annual review meeting.

6. Final Thesis and Oral Exam

As a final step in the PhD program, the student is required to submit a satisfactory thesis, present a ChE seminar (open to the general public), and pass a final oral examination. "PhD Examination Procedures" on page 9 describes the procedures in detail.

7. Graduate Teaching Assistantship Duties

All PhD students are required to perform a minimum of **18** term-hours of GTA duties during their studies. The GTA duties will normally be assigned after the first year in residence. Most students find the teaching assistantships a valuable experience for their future careers. TA'ing classes outside ChE may be allowed at the discretion of the Option Representative.

Choosing a Research Advisor

The choice of a research advisor is perhaps the most important decision a graduate student makes during the first year of graduate study. This decision must be made before the end of the Fall term of the first year, and so it is reasonable to devote significant thought to this task before then. The following is intended to give you an idea of the information available in making this choice, and to offer some suggestions concerning questions you may want to have answered before you make your final decision.

There are two formal mechanisms in Chemical Engineering at Caltech for distribution of research information: the sessions of *research presentations* by the ChE faculty and the Web homepage of Chemical Engineering, which contains a summary of ongoing research, a brief bio of each faculty member, and a very abbreviated list of publications of each research group. The web page can be accessed at <http://www.che.caltech.edu>.

The series of short, informal research talks is designed so that each ChE faculty member can inform new graduate students about his/her respective research. These talks will be presented in October and November. You will gain by attending all of these sessions because this is perhaps the only time you will be able to obtain a comprehensive idea of the overall breadth and activity of the work in Chemical Engineering.

Following these talks, you are expected to meet individually with various faculty members to discuss specific projects and to gain a better understanding of each faculty's philosophy of graduate research and individual style of operation. Because of the importance of your decision, it is strongly recommended that you see *each* faculty member before making a final decision. In addition, you are strongly encouraged to talk with the current students in each research group to gain their insight. These individual interviews are an important phase of your information-gathering process.

After the individual meetings, you will be asked to submit a list of three research groups, in order of priority, that you'd like to join. You should also provide a list of the faculty with whom you have spoken to about their research. We endeavor to allow each student to join the group of his/her first choice, but you should recognize the possibility that you may be asked to work for any of the three individuals on your list. Thus, the third choice on your list should receive just as much thought as the first!

Ph.D. Qualifying Exams

Format

There will be three exam subjects: *transport*, *thermodynamics*, and *kinetics*, i.e. three separate exams, each administered by a committee. Two hours is allotted for each subject. During the first 90 minutes you will be given a written copy of the exam questions, and will have the opportunity to prepare your answers; during the following 30 minutes you will present your answers to the questions orally at the direction of a committee. While preparing your answers, you are not allowed to consult references of *any* kind. All information that we do not expect you to know (or be able to derive) will be supplied as part of the question. Two to four questions will be typical in each of the exam areas. Thus, you should strive to present your answers in a concise and incisive manner. Due to scheduling, we will not be able to extend the answer period beyond 30 minutes. You will receive a schedule for each exam.

To determine potential subject matter for these exams, please consult the lists below. Feel free to discuss relevant references etc. with members of the faculty; however, do not expect the questions to be derived from any specific reference. Decisions on *Pass/Fail* will be announced either the same day as the exam or within a few days after the completion of the exams. Upon recommendation of the faculty, **one** additional opportunity may be given to retake failed exams at the end of the spring term.

Subject Matter

Transport Phenomena

1. *Fundamentals*
Derivation of governing equations.
Constitutive equations (Newtonian/non-Newtonian fluid behavior).
Boundary conditions (including those related to fluid interface).
Dimensional analysis and dimensionless groups.
2. *Approximate Solutions - Fluid Mechanics, Heat and Mass Transfer*
Low Reynolds number flows (Stokes Law, heat or mass transfer correlations, etc.).
Boundary-layer theory (separated vs. nonseparated flows, correlations).
3. *Macroscopic Balances*
Fluid mechanics, heat and mass transfer (including friction factors, heat transfer coefficients, etc.).
4. *Natural Convection*
Governing equations, dimensionless groups, etc.
Physics of natural convection flows (including concepts such as criteria for onset of convection, etc.).
5. *Turbulence*
Qualitative nature of..
Effect on transport processes or drag, etc.

6. *Special Topics in Heat Transfer*
Radiation. Steady and unsteady conduction.
Evaporative heat transfer (simultaneous heat and mass transfer).
7. *Special Topics in Mass Transfer*
Governing equations for multi-comp. systems (including homogeneous reaction).
Coupled mass transfer/heterogeneous chemical reaction.

Thermodynamics

1. *General Thermodynamics*
First law for closed systems.
First law for open systems (control volume).
Equations of state for pure substances.
Thermal effects and thermochemical calculations.
The second law and definition of entropy.
Applications of the second law, ideal work.
Thermodynamic property calculations for real fluids.
Thermodynamic cycles, steam cycle, refrigeration, gas turbine cycle, gas liquefaction.
2. *Thermodynamics of Mixtures*
Partial molar properties, properties of mixing, excess properties.
Ideal mixtures (ideal solutions).
Fugacities of pure components and in mixtures, standard states and activity coefficients.
Estimation of fugacities, excess Gibbs free energy, and activity coefficients.
Models for nonideal solutions.
Chemical reaction equilibrium including gas-solid reactions.
3. *Phase Equilibria*
Vapor-liquid. Liquid-liquid.
Solubility of a gas or a solid in a liquid. Solid-solid-liquid phase diagrams.

Textbooks reflecting the level of the examination:

- Smith and Van Ness, "Introduction to Chemical Engineering Thermodynamics", McGraw-Hill, 1996.
Sandler, "Chemical and Engineering Thermodynamics", John Wiley, 1989.
K. Denbigh, "The Principles of Chemical Equilibrium", Cambridge Univ. Press, 1971.

Chemical Kinetics and Reaction Engineering

1. *The Reaction Rate:* stoichiometry of reactions, extent of a reaction, elementary reactions and mechanism, the steady-state approximation, chemical kinetics and thermodynamics.
2. *Ideal Reactors:* plug flow and batch reactors, the continuous stirred tank reactor, design and comparison between CSTR and PFR for conversion (one reaction) and selectivity (multiple reactions).
3. *Temperature Effects in Homogeneous Reactors:* PFR, CSTR, comparison and optimization of reactors, reactor stability.

4. *Noncatalytic Fluid-Solid Reactions*: shrinking and nonshrinking particles, limiting regimes of reaction, film diffusion and ash film diffusion control.
5. *Two Fluid-Phase Reaction Systems*: adsorption into quiescent and agitated liquids, the film model, surface renewal models, adsorption and chemical reaction, limiting regimes of slow reaction, fast reaction and instantaneous reaction.
6. Residence-time distribution and nonideal reactors.
7. *Heterogeneous Catalysis*: catalysts and catalytic processes, physical structure and characterization of catalysts, chemisorption rate and isotherms, reaction mechanisms and rates, diffusion in porous catalysts, reaction and diffusion, effectiveness factors, film diffusion, the global rate, catalytic reactor design, thermal effects.

Procedures for Approval of the Research Progress Report and Application for Candidacy

The procedure for scheduling the candidacy examination discussed earlier in section 4 is as follows:

1. Obtain a *Committee and Date Form* from the Graduate Records Secretary.
 - a. Select and set a date and time for the exam with your advisor and each committee member. The examining committee must have at least three members. Check with the ChE Graduate Records Secretary to avoid time/place conflicts. (The usual place of the exam is the Spalding Lab conference room #113.) Complete the Committee and Date Form and return it to the ChE Graduate Records Secretary.
 - b. When a definite date and committee have been decided and the Committee and Date Form returned, the ChE Graduate Records Secretary will prepare confirming memoranda to your committee members. This will be done no later than *three weeks prior to the examination*.
2. Obtain a *Candidacy Form for the Degree of Doctor of Philosophy* from the Graduate Records Secretary. Enter your name, major, and minor (if any) at the top of the first page of the Candidacy Form, and complete page 2. Submit the proposed committee to the Graduate Option Representative, Professor Giapis, who will have final responsibility for approving the committee.

Minor or External Coursework Requirements. You are responsible for fulfilling the requirements for advanced work outside your major field of interest. This may be a subject minor (Chemistry, Applied Mathematics, etc.) or a general program of courses approved in advance by the Option Representative, for which 54 units are required. If you choose to pursue a subject minor, fill in the top of page 3, and get the proper approval signature of the relevant department representative. Give the form to the ChE Graduate Records Secretary.

3. Deliver a copy of your Research Progress Report to each of your committee members no later than *two weeks* prior to your examination.

This report should describe concisely the present state-of-the-art of your research topic, your progress to date, your proposed research, and the nature of the contribution that you expect to make in the general problem area. All of this should not exceed *20 pages typed* (single-spaced ok).

4. When the research progress report is satisfactory, the members of the examining committee will sign the *Candidacy Form*. Return this form immediately after the examination to the ChE Graduate Records Secretary, who will obtain the final signatures and give the form to the registrar and graduate offices. You will be notified later by the Dean of Graduate Studies that you have been admitted to Candidacy for the Degree of Doctor of Philosophy.

Ph.D. Examination Procedures

The final PhD exam will consist of a defense of the candidate's thesis research. Prior to the formal exam, each candidate is required to present a seminar (open to the public) on his/her work; this seminar will be scheduled in the Caltech Calendar as a regular Chemical Engineering Seminar. The exam and seminar must be held at least two weeks before the degree is conferred.

1. Procedures for Processing Necessary Forms

At least *three weeks* prior to the exam date, obtain the following *forms* from the ChE Graduate Records Secretary:

- a. Committee and Date
- b. Seminar Notice

Obtain from the graduate office the *Petition for Examination for the Degree of Doctor of Philosophy*, and other forms/instructions, also available online at www.gradoffice.caltech.edu. Note that the coversheet of the *Petition* has form instructions.

The *Committee and Date* and *Seminar Notice* forms are used to schedule your exam and seminar. Both should be scheduled on the same day: the exam (room #113 Spalding Lab) immediately following the seminar (room #106 Spalding Lab). The committee members will be determined by you and your research advisor, and must be approved by the ChE Option Representative. The examining committee must include at least **four** members, of which at least **three** CIT faculty and at least **two** ChE faculty; one member of the committee may be from off-campus with prior approval of the ChE Option Representative.

Check with the members of your committee for agreement on the date and time of the exam. Once a definite date and committee are set, the ChE Graduate Records Secretary will send a confirming memo to the committee members.

Complete the first and last pages of the *Petition* then give it to the ChE Graduate Records Secretary, who will process page 2. The *Petition* will remain with the graduate office until just before your exam when you should pick it up and take it into your exam; at your exam, all of your committee members should sign at the appropriate places on page 3; then return the *Petition* to the ChE Graduate Records Secretary immediately following your exam.

2. Procedures for Submitting the Ph.D. Thesis

At least two weeks prior to your exam, supply each member of your committee with a copy of your thesis. Also, submit one copy of your thesis to the Graduate Office for proofreading (you will be notified as soon as the proofreading is complete). The *Petition* will be signed at the time of your exam unless the thesis requires revision or correction. If corrections or revisions are required, it is your responsibility to:

- a. Make the necessary corrections/revisions.

- d. Submit the revised thesis to members of your examining committee.
- c. Secure committee signatures on the *Petition* after the acceptance of the corrections/revisions.

After the exam is passed in all respects and the committee has signed the *Petition*, obtain the signature of the Option Representative of your subject minor, if appropriate, and return the form to the ChE Graduate Records Secretary.

Submit the final and approved thesis to the Grad Office per the Grad Office instructions. Also submit three copies on Perma-Life bond paper, reproduced from the original, to the ChE Graduate Records Secretary. (These will be bound--one for the ChE department, one for the advisor, and one for the student.)

Ph.D. Residency

The Chemical Engineering faculty believes that, to maintain the vigor and vitality of the Department as well as the quality of the graduate program, the normal period of residence for completion of the PhD degree can be reduced to the minimum level which is consistent, on an individual basis, with the high standards of intellectual accomplishment that we expect of all our students. To facilitate the timely completion of PhD requirements, the faculty has adopted the following policies.

1. A faculty committee, known as the *Thesis Review Committee*, is appointed for each student to monitor his/her progress and serve as a resource in the student's area of research. This committee will be selected as described earlier in section 5 on page 3. The thesis review committee will meet with the student at least once a year, either as a group or individually, to review progress, suggest improvements in research etc. Failure to comply will result in the student not being allowed to register for that or subsequent terms until the requirement is satisfied.

It is the responsibility of the student to insure that arrangements are made for the yearly review process, and it is obviously important this is not delayed to the last moment. Each student should submit a two/three page, *concise outline* of progress and of research proposed for future work to each member of his/her committee at least once each year. Beyond this, there are no specific requirements for reports, seminars etc. The *modus operandi* of each committee shall be left to the discretion of its members in consultation with the student. The "ideal" is a continuing communication between the student and his/her committee, leading to "automatic" approval of each year, rather than a forced, exam-style meeting.

2. Financial aid for graduate students is awarded on a year-by-year basis in accord with policies of the Institute. We expect a PhD thesis to take no more than four calendar years. However, the Department will endeavor to provide stipend support for all PhD students through a maximum period of five calendar years in residence, subject in all cases to the approval of the research advisor. Under normal circumstances, no support will be awarded after the fifth year of residence unless by *petition*.

To provide support levels beyond the fifth year of residence ("excessive registration"), exceptions may be granted by *petition* from the student to the graduate studies committee. This petition must be submitted before the end of the summer term of the fifth year of residence, and consideration will be based on the following criteria:

- a. Approval of the research advisor and the ChE Option Representative.
- b. A written statement from the student explaining the circumstances that have led to the need for a longer period of residency—this could include any legitimate reasons such as long-term illness, technical reasons associated with a particular research project, etc.
- c. A written timetable from the student for completion of degree requirements established in consultation with his/her advisor.

3. The petition is then submitted to the Dean of Graduate Studies for approval to register for the sixth year. The petition form is available online at http://www.gradoffice.caltech.edu/documents_default.htm.

The ChE M.S. Program

1. Coursework

a. Requirements

The MS program, unlike the PhD, is based primarily upon the successful completion of coursework. This coursework must include at least **135** units in order to satisfy Institute requirements, and must include the following courses and research units:

ChE 151ab, ChE 152, ChE 165	42 units
Additional Advanced Courses in Chemical Engineering	18 units
Science or Engineering Electives	27 units
General Electives	18 units
ChE 280 Research	27 units

The 18 units of general electives should include science and engineering subjects or research, but may be, with special permission, humanities and social sciences. The 27 required units of research will in most cases be taken during the summer following the first academic year in residence. A student must maintain a GPA above 1.4 in any given term and above 1.9 in any given year, as required by the Institute's policy.

b. Coursework Consultation

Upon arrival at Caltech, MS students will meet with a member of the faculty to evaluate their level of preparation in Kinetics, Thermodynamics and Transport Phenomena with respect to that expected at the MS level. The chief intention of these consultations is to provide a guide for the student's course program for the first year of study. A written copy of the recommendations will be entered into each student's permanent file.

2. MS Research Advisor

Shortly after the beginning of the first term, the faculty will meet with the first-year grad students to outline present and proposed topics of research. Following these meetings, students are expected to meet individually with various faculty members to discuss proposed research and generally inform themselves in order to choose a research advisor. At the end of the first term, each student is required to submit three faculty names, listed in order of preference. Every possible effort will be made to accommodate the student's first choice, subject to an opening in the desired research group, availability of necessary funding, etc. The final decision will be made by the Chemical Engineering faculty in consultation with the students.

3. MS Candidacy Forms

All MS students are required to submit candidacy forms to the Institute for approval of the proposed course of study for the MS degree. The MS candidacy form must be submitted by midterm (approximately mid-November) of the first term of the year when the degree is expected. These forms can be obtained at the Institute Graduate Office.

4. MS Research Requirement

An MS student is required to complete at least 27 units of ChE 280, which can consist either of a research project under the supervision of a Chemical Engineering faculty member or an industrial research or development project performed with a member of the faculty in cooperation with professional staff at a local industrial laboratory. Successful completion of the MS research requirement needs the approval of a research report, which the student must submit to his/her advisor at least three weeks prior to the end of the final term of residence. Although this report is *not* a thesis and is therefore not subject to the final exam and other requirements for a thesis, it must be written in the form of a technical paper, and must be approved by at least two members of the chemical engineering faculty.

5. MS Degree in Combination with the PhD

A student enrolled in the PhD program may be awarded an MS degree at an intermediate stage of his/her PhD residence provided that he/she applies for the degree in the normal manner (point #3, above) and satisfies all the MS degree requirements. A request for an MS degree must first be discussed with and approved by the research advisor. The PhD candidacy report may be considered in lieu of the MS research project report provided that it is written as a technical paper and approved in the normal manner (point #4, above).

Graduate Studies Advisor, Graduate Option Representative, and ChE Graduate Studies Committee

During graduate studies, students will interact with several members of the Chemical Engineering faculty. The most intensive interaction will be with the research advisor who will advise on all aspects of PhD research, coursework, and will approve various formal requirements. Students will also interact with the members of the thesis review committee, as discussed earlier, the Graduate Studies Advisor, and the ChE Option Representative. During the first year, the Graduate Studies Advisor will advise the students about choice of research advisor, choice of courses, and the PhD qualifying exams. The ChE Option Representative is responsible for GRA or GTA assignments beyond the first year, and for approval of Candidacy and Thesis Review Committees and other formal requirements for the MS and PhD degrees. Students may contact either of these two faculty members for any question or problem. In a case where the relationship between a student and his/her research advisor becomes strained and the student desires advice or help from other faculty, he/she should consult with the Chemical Engineering Grad Studies Committee (GSC) consisting of the ChE Option Representative, the Graduate Studies Advisor and the ChE Option Executive Officer, chaired by the ChE Option Executive Officer.

Policy for Students Joining or Changing a Research Group

1. When a faculty member accepts a graduate student into his/her group, he/she accepts responsibility for arranging financial support for the student beginning no later than the end of the first term of the student's first year in residence.
2. If an advisor-advisee relationship degrades to the point where termination is the most viable course of action, the advisor must notify (in writing) both the student and the Graduate Study Committee of the student's termination from his/her group and detail the reasons. The date of this letter is the beginning of a relocation period during which the student may want to search for a new advisor at Caltech. This relocation period will extend for six weeks. During the relocation period, the student will continue to be supported in whatever manner has been arranged before termination (e.g., with GRA funds from the previous advisor's grants), and the G.S.C. chairman will accept responsibility for monitoring the student's progress and assigning research grades. During this time, the student may work in the lab of a new group, but the new advisor is not responsible for financial support until the student is officially accepted into the new group.
3. If a student decides voluntarily to switch research groups, the student is required to file a petition with the G.S.C. requesting to leave the old group. The previous advisor is required to provide support only so long as the student continues to carry out research in the previous advisor's group. The advisor is under no responsibility to employ the student subsequent to the filing of the petition, but the G.S.C. *may* decide to allow the student to be a full-time GTA for one term (if funding is available and the student's teaching is adequate). The G.S.C. chair must interview the previous advisor, the student, and the new advisor (if any), and the G.S.C. must resolve any conflicts concerning support or switching groups.

Chemical Engineering Seminars

Graduate Students are expected to attend *all* regular Chemical Engineering Seminars. The opportunity to learn about the research at other institutions is an important part of a graduate education, even if that research is not in your own specific dissertation area. From time to time, we schedule *Special* Chemical Engineering Seminars, announced on relatively short notice. Although wide attendance at these special seminars is, of course, desired, we recognize that these may be of interest to only a limited number of students and do not necessitate the full attendance that we require at our regular seminars. Notices of seminars are distributed via email, posted on bulletin boards in the Spalding Lab building and announced in the Caltech master calendar.

ChE Grad Student-Faculty Liaison Committee

Please note that there is a ChE Graduate Student-Faculty Liaison Committee, whose members are one graduate student (chosen by their respective group) from each research group, one representative of the first-year students (chosen by the first-year students), and (currently) Professors. Flagan and Kornfield. This committee was formed to foster a better communication between the graduate students and the faculty. It also offers an opportunity for the graduate students to take an active role in the shaping of the ChE graduate program and, more generally, the operation of the department. The Committee seeks input on all issues affecting you, the department, and Caltech—especially items like the recruitment of new graduate students (what works, what doesn't), graduate courses, advisor selection, seminars, social events, etc. As you become more familiar with life at Caltech, feel free to offer your input to the Committee via your representative; these items will then be placed on the agenda for the next Liaison Committee meeting.

Vacation Policy

Graduate students are entitled vacation on all Institute staff holidays as listed in the Institute Catalog. In addition, the Institute allows two weeks vacation per year. The Chemical Engineering faculty believes that the allowance of two weeks of vacation, in addition to Institute holidays, is adequate. We regard a request for more than two weeks of vacation per year as a special request, which your advisor may grant without compensation or, *at his/her discretion*, with compensation. It is a matter of the personal integrity of all the students and the faculty to ensure that the flexibility in the ChE policy is not abused. In all cases, vacation should be scheduled in consultation with your research advisor.