REQUIREMENTS FOR A GRADUATE DEGREE

COURSE REQUIREMENTS

Prerequisites

Before enrollment in graduate courses in chemical engineering occurs, the candidate must fulfill minimal course prerequisites either by previous experience or by taking selected undergraduate courses. An undergraduate degree in Chemical Engineering from an accredited program is considered the necessary previous experience. These minimal prerequisites are:

(1) Mathematics through Ordinary and Partial Differential Equations:
(2) Chemistry (including Organic Chemistry and Physical Chemistry);
(3) One year of college physics;
(4) Chemical engineering undergraduate courses:
   a. Mass and Energy Balances (ChE 2114)
   b. Fluid Transport (ChE 3114)
   c. Chemical Engineering Thermodynamics (ChE 2164)
   d. Chemical Reactor Analysis and Design (ChE 3184)
   e. Separation Processes (ChE 3134)
   f. Mass Transfer (ChE 3144)
   g. Heat Transfer (ChE 3044)

Certain of these prerequisites may be fulfilled by concurrent registration if necessary.

Departmental Core Graduate Courses

The following five courses or equivalent are required by all those studying for an advanced degree in chemical engineering:

ChE 5044  Engineering Mathematics  Fall
ChE 5094  Advanced Chemical Engineering Kinetics  Fall
A grade of B- or higher in each core course is required for each Ph.D. candidate to attempt their Preliminary exam.

**Department of Chemical Engineering Elective Courses**

- ChE 5064 Solids and Solid Surfaces
- ChE 5084 Heterogeneous Catalysis
- ChE 5164 Process Dynamics and Simulation
- ChE 5214 Polymeric Biomaterials
- ChE 5224 Advanced Polymer Processing
- ChE 5304 Biological Transport Phenomena
- ChE 5334G Colloid & Interface Science
- ChE 5544G Advanced Protein Separation Engineering
- ChE 5564 Non-Newtonian Fluid Mechanics

*Not all electives are offered each year.*

**Preregistration**

Registration typically occurs in two phases. First, a course request period of approximately seven days occurs at the midpoint of the current term. The course request period allows students opportunities to meet with advisors and to plan their schedules for the upcoming term(s). Students will input their request using HOKIE SPA which is accessed using their PID (personal identifier). Hours of access are typically 7:30 am to 4:00 am daily. It is strongly urged that students access the course request system early in the registration period to avoid the high volume of activity that may cause difficulty in accessing the system. The entire registration process usually occurs over a three week period. Students will receive an e-mail from the University Registrar indicating that their schedule results are available for viewing via HOKIE SPA.

Second, a schedule adjustment period, or “DROPADD” period, follows the processing of course requests. Typically, currently enrolled students have two weeks prior to the end of a term to access DROPADD. If a student failed to submit a course request, they may access the registration DROPADD and add courses. Students may not add or drop past the published add and drop deadlines.

Note that since research credits are variable, the amount of hours taken will need to be entered for those courses. Research hours should not be taken until a research advisor has been assigned. Also, the departmental seminar course, ChE 5944, is a required class for all graduate students each semester.
**Academic Eligibility**

All candidates for graduate degrees must maintain a 3.0 "B" grade point average (GPA) overall and on the plan of study. In addition, the Department of Chemical Engineering requires that each student maintain a "B" average for all courses numbered 5000 and above. Failure to maintain this average in graduate study requires that you be placed on departmental probation. Enrollment for one semester of probation is usually permitted to remedy an unsatisfactory GPA. If a student fails to make satisfactory progress toward the degree, permission may be denied to continue the program. This decision may be reached by the advisory committee or the department head and recommended to the Graduate School.

**Temporary Advisors**

New graduate students will be assigned a temporary advisor for the first semester or until a research advisor is chosen. Students should talk with their temporary advisor when making decisions concerning registration. Students on assistantships will register for the core courses plus the seminar course and any additional elective courses to equal at least 12 credit hours each semester. Once they start doing research, they can register for Research and Thesis (MS) or Research and Dissertation (PhD) hours. Students should be registered for at least 12 semester hours for full-time status each semester.

**PLAN OF STUDY**

The Plan of Study is your schedule of research and coursework to complete your degree. The plan should be submitted to the department to be entered and sent electronically to the Graduate School for approval according to the following schedule:

- **MS & MEng:** Due by end of the second academic semester.
- **PhD:** Due by end of the third academic semester.

A blank form to use for submitting the plan of study is available from the ChE Department website at www.che.vt.edu. (See Appendix for sample form). You must complete the form and have it signed by the members of your research advisory committee. The completed form is submitted to the Departmental Graduate Program Coordinator for further processing electronically. The Department Head and then the Graduate School approve the plan and the student will receive a hard copy for his/her records. Another copy is placed in the student's file. Students may also access their approved plan of study via HOKIE SPA. For the MS and MEng degree, the plan must contain the 14 credits of core courses in transport phenomena, thermodynamics, kinetics and mathematics, as well as all the credits to meet Virginia Tech's requirements for the MS and MEng Degree.

Changes that may occur relative to this plan should be immediately filed with the Departmental Graduate Program Coordinator so that at the time of graduation, there will
be no question by the Graduate School as to what the student's program has been and if it meets the requirements for graduation. Once a course included on the Plan of Study is taken for a grade, it cannot be eliminated from the Plan of Study. The form necessary to make these changes may be obtained from the Graduate School website.

Your Plan of Study is usually completed with the help of your advisor and committee members. You must obtain at the minimum a 3.00 GPA on all courses listed on the Plan of Study, including prerequisite and supporting courses.

A maximum of three credit-hours of seminar for MS and MEng degrees and four credit-hours for PhD may be included on the plan of study. Courses numbered below 4000 are not counted toward the minimum credits required for the MS, MEng or PhD degree. For clarification on any point, you are encouraged to consult the Graduate Catalog on the Graduate School’s website (www.graduateschool.vt.edu).

Requirements for a Master of Engineering (MEng) Degree

Minimum total credits = 30

- minimum of 24 graded credit hours which may include:
  - maximum of 9 credits total of 5974, 5984 and 6984 courses
  - maximum of 6 credits of 4000 level undergraduate coursework
  - maximum of 3 credits of 5944 (seminar)
  - all other coursework must be 5000 level or higher

- minimum of 3 credits of 5904 (Project and Report) and a maximum of 6 credits (Note: Project and Report cannot be used on PhD plan of study)

The requirements for a MEng degree are basically the same as for a MS degree except for the minimum and maximum number of credit hours. A MEng student must take a minimum of 24 graded credit hours. He/she must register for a minimum of three and a maximum of six credit hours of ChE 5904, Project and Report. The student must have a final oral examination and turn in a final project report to his/her advisory committee. This document does not have to be turned in to the Graduate School. The student must be registered for ChE 5904, Project and Report before and/or during the semester he/she takes the final examination and completes his/her degree requirements. The composition of the report will be at the discretion of the student’s advisory committee. The guidelines for the plan of study should be the same as for a MS degree other than the minimum and maximum credit hours. A minimum of 30 total credit hours is required. Note: ChE 5904, Project and Report, cannot be used on plan of study for PhD.


Requirements for a Master of Science (MS) Degree

Minimum total credits = 30

- minimum of 20 graded credit hours which may include:
  - maximum of 6 credits total of 5974, 5984 and 6984 courses
  - maximum of 6 credits of 4000 level undergraduate coursework
  - maximum of 3 credits of 5944 (seminar)
  - all other coursework must be 5000 level or higher

- minimum of 6 credits of 5994 (Research and Thesis)

Fourteen hours of 5000 level and higher courses will be the major core courses in chemical engineering (ChE 5094--Kinetics; 5125--Transport I; 5126--Transport II, 5144--Thermodynamics and 5044--Engineering Mathematics). The remainder of the plan of study may concentrate in fundamental areas of study such as transport phenomena, reaction kinetics, or polymers. The student may pursue fundamental study in topics related to the application of fundamentals such as polymer engineering, biochemical engineering or natural resource utilization. You will be encouraged to recognize the interdisciplinary nature of chemical engineering study and may choose background courses from chemistry, physics, mathematics, the life sciences, or other engineering fields.

Requirements for a Doctor of Philosophy (PhD) Degree

Minimum total credits = 90*

- minimum of 27 graded credit hours at the 5000 level or higher which may include:
  - maximum of 18 credits total of 5974, 5984 and 6984 courses
  - maximum of 4 credits of 5944 (seminar)

- maximum of 6 credits of graded 4000 level undergraduate coursework

- minimum of 30 credits of 7994 (Research and Dissertation)

*A maximum of 50 percent of the graded credit hours may be in the form of approved transfer credits.

Other important requirements for the PhD degree are the successful passing of the PhD qualifying examination, as well as the successful completion of a preliminary examination and passing of a final defense (oral exam) related to the student’s research project. The details of these requirements are described in subsequent sections.

In addition to a PhD degree, students will also be awarded a Master of Engineering degree upon completion of their preliminary exam. This requires no extra coursework from the students, mainly more paperwork described in the checklist for
PhD students. The students will be required to register for 3 - 6 hours of Project and Report before and/or during the semester they plan to do their preliminary exam. The only exception to this is that students with MS degrees in chemical engineering from Virginia Tech or another U.S. university will not need to complete the requirements for a MEng degree.

SEMINAR REQUIREMENTS

Attendance at all departmental seminars is required of all Chemical Engineering graduate students. The faculty member in charge of the seminar program for the year will circulate a list of the seminars at the beginning of the semester. Additionally, all graduate students must register for ChE 5944, Graduate Seminar, each semester. Any absences from the departmental seminars must be approved by the faculty in charge in advance. All PhD students must present a seminar before completion of their requirements for graduation. The student should see the faculty member in charge of the seminars to schedule their presentation.

THESIS TOPIC SELECTION

Students will be issued a document during the Fall Semester that will contain short descriptions of research topics from each faculty member within the Department. Soon thereafter faculty presentations will be scheduled by the Graduate Committee. Each graduate student who is selecting a topic must attend these scheduled presentations, which are usually held before the end of the Fall Semester. Following these presentations, two to three weeks are given for the student to further discuss any specific topics with the individual faculty member. Next, a list of the student's choices of advisors is submitted to the departmental Graduate Program Coordinator. This list of choices should include at least three different professors such that when the Graduate Committee (in conjunction with the faculty) looks over the student's choices, a degree of flexibility will exist regarding the assignment of research advisors. Based on several factors such as research support of the given advisor and the size of their particular research group, assignments are made. Whenever possible, the faculty will try to match the student with their first choice of research project. It should be emphasized that this match is not always possible.

GRADUATE RESEARCH ADVISORY COMMITTEE

The graduate research advisory committee for Masters candidates should consist of at least three faculty members. These include the research advisor (who will act as chairman of the advisory committee), a second member of the chemical engineering faculty, and a third member of the committee who may be chosen from the chemical engineering faculty or one of the other faculty at this University. Additional members of the research advisory committee may be chosen at the discretion of the research advisor and the student.

If a student is planning to use a non-Virginia Tech faculty member on their advisory committee, that person will need to be approved by the Graduate Dean. There is a form (see Appendix) that will need to be completed and sent to the Graduate
School along with a current copy of the person’s vita. Once the person has been approved by the Graduate School, they will be issued an ID # so they may be added to the plan of study.

The research advisory committee for PhD candidates should consist of at least four faculty members. These include the research advisor and three additional members including at least two from the Department of Chemical Engineering.

The research advisory committee is responsible for approving the plan of study, evaluation and approval of the research proposal and should be available for consultation and advice during the entire duration of the research project.

ANNUAL GRADUATE STUDENT EVALUATION REPORT

The student’s advisor and/or committee are required to conduct a yearly review of a student’s academic progress. The Annual Graduate Student Evaluation Form is located on the Chemical Engineering website. The self-evaluation portion of the form should be completed by the student, then given to their advisor for his/her comments. The student and advisor should set up a meeting to discuss the complete evaluation, sign and then return the form to the Graduate Program Coordinator by the specified deadline. These forms should be done during Spring semester of each year.

QUALIFYING EXAMINATION FOR PHD CANDIDATES

In order to qualify as a PhD candidate within the Department of Chemical Engineering, the student must pass the qualifying examination, which will be a research-based oral exam given in the week immediately preceding the first week of classes in the Fall semester. An exam committee of at least three members of the Chemical Engineering Faculty will conduct the exam. The exam committee will recommend a result to the Graduate Committee based on (a) the student’s grades in graduate school; (b) the advisor’s comments and (c) the student’s abilities demonstrated in an oral exam. The exam will be preceded by a discussion of (a) and (b) by the exam committee, and preparation of a 20-30 minute research talk by the candidate. The following subsections may be useful when preparing the talk: (1) the hypothesis; (2) the application or scientific interest that makes the topic worthy of study; (3) background literature and theory (4) outline of methods to be used; (4) objectives and timeline. During the exam, the committee will ask questions on the research topic and may ask questions on any area of chemical engineering, particularly those in which course grades suggest deficiencies. Possible grades for the exam are: Pass, Conditional Pass, Fail, Discontinuing Fail.

The research topic for the oral exam will be provided to each student three weeks before the exam date, and will be in the general area of research of the advisor.
PRELIMINARY EXAMINATION: PHD CANDIDATES

The preliminary examination is required of all doctoral students. The proposal and its preparation, discussion and utility, are determined by the student’s PhD advisory committee. An oral examination of the PhD candidate’s research proposal will be conducted by the student’s advisory committee shortly after the submission of the written proposal. The preliminary exam must occur within the first three years after enrollment in the PhD program for students commencing in Fall 2011 and subsequent semesters. To avoid tuition charges in the summer, preliminary exams should be conducted during Fall and Spring semesters.

The preliminary exam has to be scheduled through the Graduate School. The student must have a plan of study on the system and be registered during the semester that the exam is taken. The preliminary exam is scheduled just as you would schedule the final exam, at least two weeks in advance of the date of the exam. A form to schedule the exam can be obtained from the Graduate School website. The signature card for the exam will be sent to the student’s advisor electronically. After the exam, the card is returned to the Graduate School with the signatures of the student’s advisory committee. The Graduate Program Coordinator needs to sign the card and make a copy for her records before it is returned to the Graduate School.

One negative vote is permitted on the preliminary examination. If performance on the preliminary examination is unsatisfactory, one full semester must lapse before the administration of a second examination. The preliminary exam may only be attempted twice.

PROCEDURES FOR THE DEFENSE OF A GRADUATE THESIS/DISSERTATION

A final oral examination is required of each candidate for the MS and PhD degrees. The student must be registered during the semester he/she takes the final examination and completes his/her degree requirements. If registration is for defense only, the minimum registration is for 3 credit-hours, unless the student is on an assistantship. Students on assistantship or fellowship must be registered for minimum credit of 12 credit hours as specified in the Graduate Catalog. If a student is not on an assistantship and will be defending within the first 3 weeks (15 business days) of the semester, they may be eligible for defending student status and may only register for one hour (see Defense Only Registration below).

At least two weeks before the date of the final examination, a formal written request for scheduling the final examination must be submitted by the student to the Graduate School. Please refer to the Appendix for a sample of this form which can be obtained from the Graduate School website. It is the responsibility of the student to ensure that this petition is prepared and delivered to the Graduate School within the time constraints of the academic semester. The examination must be scheduled between the first day of class and the last day of final examinations in an academic semester. Students graduating in the Spring will be required to submit the completed and corrected thesis/dissertation to the Graduate School at least ten full days (excluding Saturdays and Sundays) before the day on which commencement exercises are held.
Deadlines are posted on the Graduate School website. The final exam signature card will be sent electronically to the student’s advisor. This card must be returned to the Graduate School by noon of the following day. The Graduate Program Coordinator needs to sign the card and make a copy for her records before it is returned to the Graduate School.

**DEFENSE ONLY REGISTRATION**

Defending student registration is available to those graduate students who have fulfilled all course and residence requirements and have completed all the requirements for their thesis or dissertation except for the final defense. These students may register for 1 credit hour. In order for a student to do this, he or she must obtain approval for defense only registration from the Graduate School. The defense has to be scheduled prior to the beginning of the academic term and within the first 15 class days of the term. Eligible students may not hold an assistantship and must not require the use of university resources, including faculty time, except for those required for the defense. The student will need to register for either Grad 6864 (Defending Masters Student) or Grad 7864 (Defending Doctoral Student) for 1 credit hour. Students do not register for this credit hour themselves. Registration takes place at the Graduate School when the form for defending student status is turned in. Also, the student needs to schedule and pay for the defense BEFORE the academic term begins and this fee is non-refundable.

**APPLICATION FOR DEGREE**

Students should complete an Application for Degree during the semester they plan to complete their degree requirements. Applications can be submitted online through HOKIE SPA. The deadlines for submission of the Application for Degree are as follows:

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<th>Completing Degree Requirements in:</th>
<th>Apply on or before:</th>
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<td>June</td>
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**SUBMISSION OF THESIS/DISSERTATION**

All graduate students are required to submit their thesis/dissertation electronically. The Graduate School has software that will allow documents to be converted to PDF files that can be received by different computer platforms and operating systems. Electronic theses and dissertations will be forwarded to the library and made available on the World Wide Web. Documents will be fully word searchable and will therefore become much more accessible to scholars. To obtain more information about electronic thesis/dissertation, you may access the website at [http://etd.vt.edu](http://etd.vt.edu). The Graduate School conducts periodic workshops for instructions on using the electronic thesis/dissertation software. Keep an eye out for the announcements.
If a student cannot meet the two-week requirement after the defense to turn in their electronic thesis/dissertation, their advisor must send an e-mail request to the Graduate School asking for an extension. If an extension is not asked for and the student does not turn the ETD in within two weeks, the application for degree for that semester will be terminated and the student will have to enroll for the next semester.

The Department does not require a hard copy of the thesis/dissertation because of limited storage space, however, the graduate advisor may request a hard copy for his or her use.

**FINANCIAL SUPPORT**

The Department will make every effort to supply financial aid to qualified MS and PhD students. This aid may take the form of internally-funded or externally-funded fellowships and scholarships, support as a graduate research assistant on sponsored research projects, or as a teaching assistant supported by state and/or departmental resources.

Graduate students of "regular" status may be offered graduate assistantships. Stipends are determined by student's qualifications (i.e., academic achievement and experience) and the work required of the student. Exact stipends are determined annually based on the departmental review of the student's prior qualifications and academic/research performance according to different stipend levels set by the Graduate School.

An assistantship constitutes half-time (20 hours/week) commitment. Students on an assistantship must be enrolled for 12 credit hours per semester. There are two types of assistantships available: the Graduate Teaching Assistant/Graduate Assistant (GTA/GA) position and Graduate Research Assistant (GRA) position. These are explained in further detail below.

**Graduate Teaching Assistantships**

Typical duties of a teaching assistant are (1) to grade homework assignments, quizzes and tests; (2) to hold regular office hours for the purpose of helping students with problems; and (3) to conduct problem sessions in class. At the discretion of the individual professor, actual duties may include all or some of those listed above. Students appointed to GTA positions must demonstrate a high degree of communication skills. It is the responsibility of the student to understand the specific duties required by the professor in charge of the course. GTAs are funded by departmental monies which are allocated to teaching. It is taxable income for the student.

**Graduate Research Assistantships**

GRA support money comes from sponsored research programs by professors in the Chemical Engineering Department. The funding level of GRA positions is totally at
the discretion of the professor directing the research project, therefore, any questions concerning GRA support should be addressed to your major professor. GRA support is taxable income for the student.

**Additional Department Funding**

**The Mike and Lisa Kender Graduate Fellowship**

Eligibility: First-year PhD student  
Stipend: Add-on stipend, amount may vary. Recipients to be determined by Department Head.

**Steven Reese Graduate Assistantship**

Eligibility: Graduate student providing teaching or research support to faculty within the department  
Stipend: Add-on stipend, amount may vary. Recipients to be determined by Department Head.

**Robert Hord Fellowships**

Eligibility: Top first-year students.  
Stipend: Add-on stipend, amount may vary. Recipients to be determined by Department Head.

**Pratt Graduate Fellowships**

Eligibility: Academically outstanding students. No restriction on national origin or immigration status.  
Stipend: Add-on stipends considered research scholarships can be offered to either GTAs or GRAs

**Graduate School Funding**

**Cunningham Doctoral Fellowships**

Eligibility: Outstanding academic record and potential for successful completion of a doctoral degree. US citizen  
Stipend: Competitive assistantship stipend for GRA or GTA (9 or 12 month appointment) and tuition  
Duration: Up to 2 years support from Graduate School with equivalent department matching support  
• Outstanding graduate applications to Chemical Engineering are considered for fellowship.
**Graduate Dean’s Assistantships**

**Eligibility:** U.S. Minority Students.

**Stipend:** Assistantship stipend plus in-state tuition scholarship.

**Duration:** 9-month assistantship at typical department level.
  * Selections made by Graduate School Dean based on requests from the departments

**Dean’s Diversity Assistantships**

**Eligibility:** U.S. citizens or permanent residents entering first year of graduate study

**Stipend:** Assistantship stipend plus in-state tuition scholarship

**Duration:** One year followed by a minimum of one additional year of funding from department.
  * Apply to Graduate School

**David W. Francis and Lillian Francis Scholarship Fund**

**Eligibility:** PhD student doing research emphasizing longer, safer and healthier lives in agriculture, engineering, bioinformatics, plant pathology, wood science and forest products, veterinary medicine and biotechnology. Students must be in their final year of research.

**Stipend:** $18,000 plus tuition

**Duration:** One academic year.
  * Students are nominated by respective department and selections are made by the Graduate School Dean.

**Clare Boothe Luce Fellowships**

**Eligibility:** Incoming females pursuing a PhD degree in physical sciences, mathematics or engineering fields. U.S. citizens.

**Stipend:** $30,000 per year for four years of study and research at the doctoral level, plus tuition, academic fees and health insurance. Also, a $3,000 research allowance will be provided.

**Duration:** 4 years
  * Students are nominated by the academic department and selection will be made by the Graduate School Dean.

**Powell Fellowship**

**Eligibility:** Long-term Virginia resident. Master’s or Doctoral students. U.S. citizen or permanent resident entering first-year of graduate study.

**Stipend:** $20,000 plus in-state tuition

**Duration:** One year
• Nominations are made by the department and the Graduate School Dean makes selections.

**GEM Fellowships (Masters)**

Eligibility: Minorities in engineering.
Stipend: Pays tuition and fees plus a stipend.
Duration: One year followed by a research or teaching assistantship.
• Apply to GEM

**GEM Fellowships (PhD)**

Eligibility: Minorities in engineering and natural sciences.
Stipend: Pays tuition and fees plus a minimum $14,000 stipend.
Duration: One year from GEM with continuation of up to four years from academic department.
• Apply to GEM

**Other Scholarships and Fellowships Available from Outside Resources:**

These require the student to make application to the agency supporting the fellowship. Applications may be obtained from the Sponsored Programs Office. Specific deadlines may apply to these programs. These cannot be reported here as they change each year. More extensive description of these awards is available on the Research and Graduate Studies website.

**NSF Graduate Fellowships**

Eligibility: Students with special aptitude for advanced training in science and engineering; U.S. citizens or permanent residents
Stipend: $30,000 for 12-month awards (prorated monthly at $2,500 for lesser periods). Tuition & fees paid for Fall and Spring semesters. Supplement of $1000 per year used for research materials, travel, health insurance, books and other related expenses.
Duration: Awards are for 3 years of financial support, tenable over a 5-year period
• Apply to National Science Foundation

**STUDENT ACCOUNT INFORMATION**

**Electronic Bills**

Student’s account statements are available online for viewing and payment through an electronic system called QuickPAY. E-mail notifications are sent to Virginia Tech e-mail addresses when a statement has been posted and available for viewing.
Students can access their accounts through HOKIE SPA. You may visit the Bursar's website at [www.bursar.vt.edu](http://www.bursar.vt.edu) to find out more information.

**Late Payment Fee**

If your payment is not received by the designated deadline date, you will be dropped from class rolls, will have to late register, and will be assessed a late payment fee of 10% of the past due balance, not to exceed $100 per term. A reinstatement fee is charged if your registration is cancelled due to non-payment of fees. These are two separate fees. Please be sure to pay your fees by the deadline which is located on the timetable of classes website.

**Billing Address**

The Bursar's Office uses the student’s Virginia Tech e-mail address to notify students when their statements have been posted and are available for viewing. It is the student’s responsibility to view their bills and be sure the necessary payments are made by the due dates. The student should also make sure their contact information is kept up-to-date on HOKIE SPA.

**Budget Tuition Plan**

The Budget Tuition Plan allows a student to divide the cost of tuition and fees into monthly installments by using direct debits to his/her bank account. The cost of this service is a non-refundable $65 application fee. Inquiries about the Budget Tuition Plan should be directed to the Office of the University Bursar. BTP applications may be accessed on their website at [www.bursar.vt.edu](http://www.bursar.vt.edu).

**Payroll Deduction for Comprehensive Fees**

Students may enroll in payroll deduction for payment of their comprehensive fees and capital fees by going to HOKIE SPA and registering under the University Account Information link. Students must be on a graduate assistantship in order to participate in this payroll deduction.

**Direct Deposit of Pay**

All employees of Virginia Tech are required to have their pay directly deposited to the bank. You may download the direct deposit form from the website at [www.bursar.vt.edu](http://www.bursar.vt.edu) or pick one up at their office in 150 Student Services Building. Once the direct deposit request has been processed, you will receive a copy of your request confirming the payday that your direct deposit will begin.

**STUDENT MEDICAL INSURANCE**

Virginia Tech offers graduate assistants an enhanced insurance benefit. Assistantship packages will include a medical insurance benefit, covering 90% of the
university-sponsored health care premium (for a single student at the $50,000 coverage level). Students must meet the following criteria: 1) must maintain at least a half-time graduate assistantship; 2) enroll in the university-sponsored health insurance plan; and 3) sign up for the payroll deduction option for payment of premiums. To find out the proper procedures for receiving this benefit and the appropriate forms needed, visit the Student Medical Insurance website by following the link on the Graduate School website (www.graduateschool.vt.edu).

INTERNATIONAL STUDENT INFORMATION

General assistance: International Graduate Student Services
Graduate Life Center
Office Hours: Mon., Tues., Thurs., Fri.: 8:00 a.m. - 5:00 p.m.
Wed. - 10:00 a.m. - 5:00 p.m.

Legal Status

All international students must hold valid non-immigrant status to enroll at Virginia Tech. No international student will be permitted to register for classes prior to the issuance of a Certificate of Eligibility (I-20AB or IAP-66) and the approval of the Immigration Service to attend the university.

International Teaching Assistants

International students who are offered Teaching Assistantships are required to pass an institutional version of the Test of Spoken English (SPEAK) before actually discharging teaching responsibilities. Students who do not pass this examination are required to enroll in English 0014, Oral Communication for ITAs. This exam is administered by the Graduate School, International Student Office.

All international students are required to take the English Placement Test, which is administered by the Graduate School during the orientation period, unless they have both a TOEFL score of 620 (paper)/260 (computer)/80 (internet) or higher and an Essay Writing score (Test of Written English) of 4.5 or higher. Students who do not demonstrate sufficient competency will be required to satisfactorily complete a semester-long Advanced Academic Writing course taught by the Virginia Tech Language Institute. For international GTAs to be exempted from oral testing, a minimum speaking score of 26 (internet) is required.

Health Insurance for International Students

All international students who began their academic program at Virginia Tech since Fall 1991 must have adequate health and accident insurance. In addition, any spouse and dependent who arrived since September 1992 must also have this insurance. The minimum coverage for each international student and their dependents can be found on the Graduate School website.
In order to prevent difficulties in subsequent registration for classes or possible termination of enrollment, it is the responsibility of the student to either purchase the university sponsored insurance plan, or show proof of other insurance meeting the minimum requirements. Students choosing coverage other than the university sponsored plan must present a completed and signed/certified Alternative Insurance Compliance Form to the Student Medical Insurance Office in 110 Student Services Building. For further information, they can be reached at 231-6226 or e-mail at smi@vt.edu.

**Social Security Card Information**

All international students must have a Social Security number for employment either on-campus or off-campus. Students may apply for an original Social Security Number (SSN) at a Social Security Administration (SSA) field office by submitting a Form SS-5, Application for a Social Security Card, and providing documentary evidence of age, identity and work-authorized lawful alien status. Documents include: valid passport, Form I-94 (arrival/departure card), I-20 or DS-2019 and proof of employment authorization. The Social Security number is used to record your earnings in this country.

**Tax Information**

All international students are required to submit Federal and State Income Tax Forms at the end of every year regardless of employment. Forms can be obtained from the Cranwell International Center or Newman Library. There will be a Tax Seminar to help international students in completing tax forms. Please save all receipts from your bank, tuition payments, W-2 statements from your employer, etc. These documents will be needed to complete the forms. Forms must be submitted by April 15 of each year.

**Cranwell International Center**

The Cranwell International Center is located on the extension of West Clay Street. The center serves international students, scholars, faculty and spouses from 120 countries and provides a focal point for an extensive array of educational, cultural and social activities. One of the center’s main purposes is to encourage interchange between the international guests and their U.S. colleagues, including members of the local community. National and international student organizations schedule meetings at the center and student leaders are provided with office spaces.

Other services offered by the center include: crisis support and personal assistance, English conversation groups, social events like International Week and the International Street Fair, orientation sessions and cultural adjustment workshops. The main focus of the center is to provide resources and referrals for international spouses and families. More information may be obtained by calling the center at 231-6527 or visiting their website at [www.international.vt.edu](http://www.international.vt.edu).
The English Language Institute provides English as a second language class to international visitors, students and families. Classes include: conversation, pronunciation, composition, listening, vocabulary and grammar on all levels for full- and part-time study. You may stop by the office at 840 University City Blvd., Suite #2, or visit their website at www.lci.vt.edu/elp. Their phone number is 231-9814. E-mail address: lci-info@vt.edu.
DEPARTMENT, GRADUATE SCHOOL AND UNIVERSITY INFORMATION

DEPARTMENT OFFICE IN GENERAL

Copy Machines

A copy machine is available in the back room behind the main office in Randolph 133 for graduate students to use for research related copying. Students should enter this room by using the door beside the elevator and not through the main office.

Scanner

A HP digital sender/scanner is located in the main office for business related use.

Audio-Visual Aids

A computer-driven LCD projector is available for check-out in the main office. Be sure to reserve the projector and/or laptop, in advance, on the calendar in the Head Secretary’s office and return promptly after using. The conference room also has a projector mounted overhead which requires a remote to operate which can be picked up in the main office.

Mailboxes

Mailboxes for graduate students are located in the hall outside Room 155. These should be checked periodically for important notices and messages.

Graduate Bulletin Boards

There are two bulletin boards located on the wall outside Randolph 154 for graduate student related information. Notices such as seminars, job openings, deadlines etc. will be posted here.

Keys

Keys will be issued to new graduate students for the rooms where they will have a desk assignment. There is a $20.00 deposit for each key that will be refunded when the keys are turned back in. Cash is accepted. Checks should be made payable to: Treasurer, Virginia Tech. Keys may be obtained from the bookkeeper in Room 147A1. A form will need to be completed and she will issue a receipt. When a student needs access to a research lab, the faculty advisor will need to send an e-mail to her requesting the keys for the student and indicating which rooms they will need access to. All keys should be returned to her as soon as possible after they are no longer needed. Keys should not be passed along to other students. Please allow sufficient time for a refund to be issued. International students should allow more time so they can cash the
refund check while still in the United States.

**Graduate Student Study Room**

The Graduate Student Study Room is located in the basement, Room 4-B. This room is used for desk space for entering graduate students and teaching assistants. Keys can be obtained from our bookkeeper for a $20 deposit.

**ChEGSA (Chemical Engineering Graduate Student Association)**

In the Fall of 2008, the department formally established a graduate student organization (ChEGSA). The purpose of this organization is to promote interactions between graduate students that are separate from their work in the department, specifically social interactions and to provide a forum for communication between the Chemical Engineering graduate student body and the Chemical Engineering departmental faculty and staff. Another purpose is to organize a graduate student symposium, the first of which was a great success. This symposium was held in April of this year and will continue to be an annual event. The organization holds regular meetings and membership is open to all graduate students enrolled in the department or advised/co-advised by a faculty member in Chemical Engineering. You can check out more information regarding ChEGSA on the department’s website. We hope every student will take an active part in the gatherings and social events and help to make their graduate experience more enjoyable.

**Safety Training**

All faculty, graduate students, postdocs and undergraduate researchers are required to undergo chemical lab safety training once a year. This requirement can be fulfilled either by attending a safety seminar or by taking the online course offered by EHSS ([www.ehss.vt.edu](http://www.ehss.vt.edu)). The mandatory safety seminar is usually done in Spring semester, however, if you will be starting work in a lab before then, you should take the online course. More information about laboratory safety requirements can be found on the department website. Our Lab Safety Coordinator is Dr. Stephen Martin.

**MACHINE SHOPS**

**Departmental**

This machine shop is located on the basement floor of Randolph Hall, Room 4-F. Two machinists are available for assistance on research projects. Short and simple job requests are recommended. A work order signed by the advisor is required for all submitted job requests. These forms may be obtained from the shop personnel. Drawings and detailed descriptions are desirable and may be required for the machinists. In addition, tools and other parts may be checked out on request. DO NOT remove anything without permission and return items promptly when finished.
**Electronics Technician**

The department employs one electronics technician located in 4-G Randolph Hall for assistance on research projects. He is available for consultation regarding electrical or computer related projects.

**Other Departmental Facilities**

An ice machine is located in the hallway outside Room 153 Randolph for department use.

The Conference Room (143 Randolph) may be reserved for presentations, meetings, defenses, etc. A calendar is located in the main office in which students may reserve the room. If you are planning to use the projector, there is a separate sign-up book in the Head Secretary’s office.
DEPARTMENT PERSONNEL

FACULTY

Luke E. K. Achenie
Professor
B.S. - Massachusetts Institute of Technology; M.S. - Northwestern University; Ph.D. - Carnegie Mellon University

Donald G. Baird
Alexander F. Giacco Professor
B.S., M.S. - Michigan State Univ.; Ph.D. - Univ. of Wisconsin

David F. Cox
Professor and Interim Dept. Head
B.S. - Univ. of Tennessee; M.S., Ph.D. - Univ. of Florida

Richey M. Davis
Professor
B.S. - Clemson Univ.; Ph.D. - Princeton Univ.

William Ducker
Professor and Chair of Graduate Program
B.S., Ph.D. - Australian National University

Aaron S. Goldstein
Associate Professor
B.S. - Univ. of California, Berkeley; Ph.D. - Carnegie Mellon Univ.

Erdogan Kiran
Professor
B.S. - Massachusetts Institute of Technology; M.S. - Cornell Univ.; Ph.D. - Princeton Univ.

Y. A. Liu
Frank C. Vilbrandt Professor and Alumni Distinguished Professor
B.S. - National Taiwan Univ.; M.S. - Tufts Univ.; Ph.D. - Princeton Univ.

Eva Marand
Professor
B.S. - Univ. of Illinois; M.S., Ph.D. (Polymer Sci./Engr.) - Univ. of Massachusetts

Stephen M. Martin
Assistant Professor
B.S. – Princeton University; Ph.D. – University of Minnesota
Abby Whittington  
*Assistant Professor of Chemical Engineering and  
Assistant Professor of Materials Science & Engineering*  
B.S. - Auburn University; Ph.D. - Univ. of Illinois at Urbana-Champaign

Padma Rajagopalan  
*Associate Professor*  
B.S. & M.S. - Indian Institute of Technology, Kharagpur  
Ph.D. - Brown University

**ADJUNCT, RESEARCH AND VISITING FACULTY**

Preston Durrill  
(Professor Emeritus, Chemistry Dept., Radford University)  
(Undergraduate Advisor)  
B.S., M.S. - Massachusetts Institute of Technology  
Ph.D. - Virginia Tech

Eugene Joseph  
(Research Faculty)  
B.S., M.S., Ph.D. - Virginia Tech

S. Ted Oyama  
(Research Faculty)  
B.S. - Yale Univ.; M.S., Ph.D. - Stanford Univ.

Peter Rim  
*Joseph H. Collie Distinguished Visiting Professor*  
B.S., M.S. & Ph.D. – Penn State University  
MBA – University of Richmond

John Y. Walz  
(Adjunct Faculty)  
B.S. & M.S. - Tulane University  
Ph.D. - Carnegie Mellon University

**UNIVERSITY DISTINGUISHED PROFESSOR EMERITUS**

Garth L. Wilkes  
(Professor Emeritus)  
B.S. & M.S. – New York State College of Forestry  
M.S. & Ph.D. – University of Massachusetts
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Riley Chan  
Electrical Engineer  
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rchan@vt.edu
GRADUATE SCHOOL

Graduate Student Assembly

The Graduate Student Assembly is the University-recognized student governance organization for graduate students at Virginia Tech. The GSA represents the interests, concerns and needs of the graduate student body and is their liaison with the University administration. All graduate students are automatically members of the GSA. The organization is served and governed by a delegate assembly composed of two delegates from each department on campus. The graduate students shall elect two representatives for one-year terms to serve on the Graduate Student Assembly each fall. The GSA has several programs that they are involved with. These include: The Travel Fund Program, Graduate Research Development Project (GRDP), Graduate and Professional School Fair and the Graduate Research Symposium. The GSA also organizes two picnics, one in the fall and another in the spring, as well as other social events during the year. You may find out more information about the programs at the GSA website: http://gsa.graduateschool.vt.edu.

Graduate Honor System

The Graduate Honor Code demands a firm adherence to a set of values and is founded on the concept of honesty with respect to the intellectual efforts of oneself and others. Compliance with the honor code requires that all graduate students exercise honesty and ethical behavior in all their academic pursuits here at Virginia Tech, whether these undertakings pertain to study, coursework, research, extension or teaching. All graduate students must make it their responsibility to know what is and is not allowed in their academic work. Ignorance is not an excuse. The Constitution of the Graduate Honor System may be found in the Graduate Policies and Procedures and Course Catalog or online at www.graduateschool.vt.edu.

CAMPUS FACILITIES

Newman Library

The Newman Library has over 2 million books, over 30,000 serials/journals, over 15,000 videos, over 6 million microforms, and a computerized inventory that enables users to find most anything in the library. Items may be located using the ADDISON on-line catalog accessible from the libraries' website at www.lib.vt.edu. There are three branch libraries: Art and Architecture, Veterinary Medicine, and the Northern Virginia Resource Service Center. Computer terminals are located throughout the library and detailed instructions are available adjacent to most terminals or at the Information Desk in the Lobby. Other services are also available on the University Libraries’ website.
Computing Center

The Computing Center is the one-stop computing resource site for Virginia Tech. They provide customer support for all computer issues. They provide information concerning activating PIDs, passwords, sign-up for modem pool accounts, wireless access, IP addresses, software and hardware purchasing, and much more. Their website address is www.computing.vt.edu.

Innovationspace

The Virginia Tech InnovationSpace (formerly the New Media Center) is located in 1140 Torgersen Hall and offers access to multimedia hardware and software. They have video editing bays, Macintosh and Windows-based computers, scanners, tutorials, classes and knowledgeable staff to help with any project. The InnovationSpace loans out digital audio recorders, digital still cameras, video cameras and video camera accessories. High-definition digital video cameras and video camera accessories are available by reservation for academic purposes only. Equipment should be reserved at least two weeks in advance. They may be contacted at www.is.vt.edu or 231-4826.

Math Emporium

The Math Emporium is a learning center developed by the Department of Mathematics. This facility, located near campus, includes 537 workstations and additional specialized spaces and equipment. The environment provides for a variety of learning methods and offers opportunities for faculty and students to explore better ways to blend technology and personal interaction in their courses. To find out more about the Math Emporium and its services, visit their web site at www.emporium.vt.edu.

Media Productions Services

Printing Services

Digital Print Center I is located in 132 Burruss Hall. Digital Print Center II is in 142 Smyth Hall. These print centers provide convenient and timely reproduction of both black & white and full color original materials with a wide selection of binding and packaging options. Material may be left at either of these places for copying. Payment can be made either on a cash basis or through a research grant. In the case of the latter, the appropriate form must be obtained from the appropriate secretary in the main office.

There are several other private copy centers located in downtown Blacksburg and at University Mall. These should not be used for university related copying unless the Copy Center on campus cannot handle the specific job.

Digital Imaging

Digital Imaging, located at 1220D Torgersen Hall, maintains a full-featured traditional photo lab as well as a state-of-the-art digital imaging facility with high
resolution full-color laser printing, low-cost scanning, and on-site Photo CD services. Visit their website to learn more at www.emd.vt.edu.

**University Bookstore**

The University Bookstore has two main locations as well as several smaller stores to serve the university. These facilities operate under the name Virginia Tech Services, Inc., a nonprofit corporation which provides support services for the university. The University Bookstore is located on campus next to the library and Graduate Life Center. University Volume Two Bookstore is located off-campus at University Mall near Kroger. Both locations provide a full range of new and used textbooks, course packs and supplemental class materials, as well as a fax service, computer department, office and school supplies, art and engineering supplies and other specialty items. The Clothing and Gifts Department carries a large selection of clothing and souvenir items.

Textbooks are arranged by departments by course numbers. During the first week of classes, any textbook may be returned provided a receipt is presented and the book is in its original condition. After the first week, and through the day after the last day to drop a class, a receipt and a drop slip are required.

Purchases at the bookstore that are related to research may be charged to the department or to a research grant. The bookstore form is obtained from the appropriate secretary in the office. You may also leave material at the Bookstore for binding, including theses and other manuscripts.

**Chemistry/Biochemistry Stockroom**

The chemistry stockroom is on the bottom floor, 24 Hahn Hall. Glassware and chemicals are available here. An inter-departmental form with the appropriate research account number is required. These forms can be completed using the HokieMart ordering system. The biochemistry stockroom can also be used which is located in 110 Engel Hall.

**Glass Blowing Shop**

Located in 1006 Hahn Hall, the glass blowing lab is an important source of custom-made glassware. An inter-departmental request bearing the appropriate grant number is required.

**Fleet Services**

The university maintains a fleet of vehicles that may be used for official business such as traveling to a conference. Please see the appropriate secretary to make reservations. Students will need to be registered on the Fleet Services website in order to drive a vehicle.
Schiffert Student Health Center

Schiffert Student Health Center is located in McComas Hall. The health center provides quality health care and health education in support of the university’s mission to educate the whole person. SHC has wellness and health services offered by board-certified physicians, nurse practitioners, a physician assistant, health educators and certified college health nurses. The staff also includes pharmacists, medical technologists and radiology technologists. Services are available to all enrolled Virginia Tech students who have paid their health fee. Every student must have a complete health history form on file documenting required immunizations. If not, the student will be blocked from registering for classes. Health care expenses outside of SHC are not covered by the health fee. SHC strongly recommends that you purchase a health insurance policy from a reputable insurance company to cover these expenses.

Center hours are Monday - Friday -- 8 a.m.-5 p.m. and Saturday -- 9 a.m.-noon (appointment only system). Other times are for emergency cases only. Telephone number is 231-6444.

RECREATION AND RELAXATION

Virginia Tech provides an abundant and varied supply of recreational activities, as do all major universities. However, the University’s geographic location also produces a myriad of outdoor activities not available at many schools.

McComas Student Health and Fitness Center

The Center includes 3 basketball/volleyball courts, elevated walking/jogging track, 2 fitness studios, weight training and cardiovascular area, 8-lane/25-yard swimming pool, locker and shower facilities and the Recreational Sports Office. You may visit their website at www.recsports.vt.edu. The Schiffert Health Center is also located in McComas Hall.

War Memorial Hall

For use by students, faculty and staff, includes many different sport and recreational activities such as racquetball, basketball, aerobics, swimming, volleyball, gymnastics, handball and more. The gym also houses weight rooms, lockers, showers and saunas.

Virginia Tech Golf Course

9-hole golf course located on the west side of campus. Green fees are $13.00/$15.00 for students and golf clubs and carts are available for rent.
**Peter Dye River Course of Virginia Tech**

The River Course is located at 8400 River Course Drive in Radford, Virginia. The course wraps along 2½ miles of the majestic New River. The course has two distinct but complimentary nine-hole loops which start and finish adjacent to the club area. Fourteen of the eighteen holes have views to the river. Eight of these play directly to the river's edge. The course also offers a complete practice facility with a driving range, large putting green, chipping green, sand bunkers, a fully stocked Professional Golf Shop and a complete teaching center. Private lessons or group clinics for all ages and playing abilities are available. Student rates are $32, Monday through Thursday; $39 on Fridays and $42 on Saturdays, Sundays and holidays. Contact telephone number is 633-6732. Website: www.rivercoursegolf.com

**Tennis Courts**

Tennis courts are located at different locations on campus. There are 12 outdoor lighted courts on Washington Street and six on the South Recreational fields that are available to students, faculty and staff.

**Intramural Sports Program**

Virginia Tech has an extensive intramural sports program in which graduate students may participate. More information may be obtained through the Intramural Sports Hotline at 231-6060 or at www.recsports.vt.edu.

**Squires Student Center**

Squires Student Center offers many recreational facilities and opportunities to students. Leisure Services located on the first floor behind the Food Court provides 24 billiard tables, 8 bowling lanes, three table tennis tables and a large assortment of video games. Wide screen TV and cd jukebox are available for relaxation in the lounge area. The Venture Out Outdoor Equipment Rental Center is located on the first floor for all your camping, skiing, skating and canoeing needs.

Squires also offers several movie series, coffeehouse and theater events through the Virginia Tech Union. The art gallery on the Second Floor of Squires shows several exhibits during the year. For more information on current happenings, refer to the information desk on the ground floor of Squires.

**G. Burke Johnston Student Center**

The G. Burke Johnston Student Center is located between Burruss and Cowgill Halls and in fact, is connected to Burruss by a third-floor bridge. An underground tunnel runs from the first floor to Pamplin Hall. The student center contains three classrooms on the first floor. Student organizations and departments may request to use these classrooms during evenings and weekends through Event Planning, 221 Squires Student Center (231-5005).
Johnston Student Center also contains the following: study lounges on the third floor, Food Court, vending machines, public telephones, automatic teller machines, commuter lockers, Lost & Found and a table checkout service for student groups. Johnston Student Center also has the only revolving door on campus.

**War Memorial Chapel**

The War Memorial Chapel is located on Drillfield Drive across from the Library. It is a tribute from alumni and friends to those sons of Virginia Tech who made the supreme sacrifice in our nations wars. The space easily accommodates events such as weddings, memorial services, initiations, military commissionings, departmental commencement ceremonies, concerts, religious services and meetings. The doors remain unlocked every day from 6:00 am until 12:00 am.
COURSE LISTINGS BY RESEARCH AREA

The following listings give courses which may be helpful to you as you prepare your plan of study.

SUGGESTED COURSES FOR CELL AND TISSUE ENGINEERING AREA

Biochemistry

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
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</thead>
<tbody>
<tr>
<td>BCHM 4115</td>
<td>General Biochemistry</td>
</tr>
<tr>
<td>BCHM 5124</td>
<td>Biochemistry for the Life Sciences</td>
</tr>
<tr>
<td>BCHM 5204</td>
<td>Molecular Biology of Eucaryotic Gene Expression</td>
</tr>
<tr>
<td>BCHM 5304</td>
<td>Enzyme Kinetics and Reaction Mechanisms</td>
</tr>
<tr>
<td>BCHM 5214</td>
<td>Molecular Biology of the Cell</td>
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Biology

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<tr>
<th>Course</th>
<th>Title</th>
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<tbody>
<tr>
<td>BIOL 3604</td>
<td>General Microbiology</td>
</tr>
<tr>
<td>BIOL 4614</td>
<td>Industrial Microbiology</td>
</tr>
<tr>
<td>BIOL 5604</td>
<td>Physiology of Microorganisms</td>
</tr>
</tbody>
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Biomedical Engineering

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<thead>
<tr>
<th>Course</th>
<th>Title</th>
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<tbody>
<tr>
<td>BMES 5004</td>
<td>Mammalian Physiology</td>
</tr>
<tr>
<td>BMES 5034</td>
<td>Introduction to Biomedical Engineering</td>
</tr>
<tr>
<td>BMES 5984</td>
<td>Biomaterials</td>
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Chemical Engineering

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<tr>
<th>Course</th>
<th>Title</th>
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<tbody>
<tr>
<td>CHE 5304</td>
<td>Biological Transport Phenomena</td>
</tr>
<tr>
<td>CHE 5544G</td>
<td>Advanced Protein Separation Engineering</td>
</tr>
<tr>
<td>CHE 5984</td>
<td>Cell Adhesion</td>
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</table>

Vet Medicine

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<thead>
<tr>
<th>Course</th>
<th>Title</th>
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</thead>
<tbody>
<tr>
<td>VMS 4074</td>
<td>Pharmacology</td>
</tr>
</tbody>
</table>
SUGGESTED COURSES FOR CATALYSIS

Chemical Engineering

ChE 5084        Heterogeneous Catalysis

Chemistry

CHEM 4424        Descriptive Inorganic Chemistry
CHEM 5404        Advanced Inorganic Chemistry
CHEM 5614        Advanced Physical Chemistry
CHEM 5644        Colloid and Surface Chemistry
CHEM 5664        Chemical Kinetics
CHEM 6164        Current Topics in Analytical Chemistry (NMR)
CHEM 6434        Organometallic Chemistry
CHEM 6614        Advanced Chemical Kinetics

Geology

GEOL 5504        Crystallography and Crystal Chemistry
GEOL 5524        X-ray Crystallography

Materials Engineering

MATE 5094        Analytical Electron Microscopy
MATE 5144-5154   Atomic Arrangements in Solids

Physics

PHYS 4554        Introduction to Solid State Physics
PHYS 5555-5556   Solid State Physics
PHYS 6555-6556   Advanced Solid State Physics
# Suggested Courses for Computational Science and Engineering

## Biochemistry
- **BCHM 5024**: Computational Biochemistry for Bioinformatics
- **BCHM 5444**: Molecular Modeling of Proteins and Nucleic Acids

## Chemical Engineering
- **CHE 5164**: Process Dynamics & Simulation

## Chemistry
- **CHEM 6654**: Statistical Mechanics

## Computer Science
- **CS 4214**: Simulation & Modeling
- **CS 5045**: Computation For The Life Sciences

## Mathematics
- **MATH 5474**: Finite Difference Methods for Partial Differential Equations
- **MATH 5484**: Finite Element Methods for Partial Differential Equations
- **MATH 5515-5526**: Mathematical Methods for Modeling and Simulation of Biological Systems

## Physics
- **PHYS 5794**: Computational Physics
SUGGESTED COURSES IN COLLOIDS AND INTERFACES

Chemical Engineering

CHE 5334G  Colloid & Interface Science
CHE 5984  Soft Materials and Self-Assembly

Chemistry

CHEM 5644  Colloid and Surface Chemistry
CHEM 5653  Adhesion Science

Engineering Science and Mechanics

ESM 5264  Mechanisms of Adhesive Bonding and Interfaces

SUGGESTED COURSES IN POLYMER MATERIALS

Chemical Engineering

ChE 4214  Introduction to Polymer Materials
ChE 4224  Introduction to Polymer Processing
ChE 5564  Non-Newtonian Fluid Mechanics (crosslisted as ESM 5564)
ChE 5984  Theory of Polymer Dynamics
CHE 5984  Soft Materials and Self-Assembly
ChE 6014  Advanced Applied Rheology

Chemistry

CHEM 4534  Organic Polymer Chemistry
CHEM 5522  "Modern Aspects" Advances in Polymer Synthesis
CHEM 5644  Colloid and Surface Chemistry
CHEM 5654  Adhesion Science
CHEM 6674  Physical Chemistry of High Polymers

Engineering Science and Mechanics

ESM 5024  Viscoelasticity
ESM 5734  Introduction to the Finite Element Method
ESM 6734  Finite Element Analysis

Materials Engineering

MatE 5094  Analytical Electron Microscopy
### Suggested Courses for Polymer Processing

#### Chemical Engineering
- ChE 4224: Introduction to Polymer Processing
- ChE 5564: Non-Newtonian Fluid Mechanics

#### Chemistry
- CHEM 4074: Laboratory in Polymer Science
- CHEM 4534: Polymer Chemistry
- CHEM 4634: Polymer and Surface Chemistry
- CHEM 5014: Laboratory Automation
- CHEM 5654: Adhesion Science
- CHEM 6674: Physical Chemistry of Polymers

#### Engineering Science and Mechanics
- ESM 4734: Introduction to Finite Elements
- ESM 5014: Introduction to Continuum Mechanics
- ESM 5024: Viscoelasticity
- ESM 5734: Introduction to Finite Element Method

#### Macromolecular Science
- MACR 5015-5016: Fundamentals of Macromolecular Science I
SUGGESTED COURSES FOR SURFACE SCIENCE

Chemical Engineering

ChE 5084  Heterogeneous Catalysis
ChE 5064  Solids and Solid Interfaces

Chemistry

CHEM 4424  Descriptive Inorganic Chemistry
CHEM 5124  Analytical Spectroscopy
CHEM 5404  Advanced Inorganic Chemistry
CHEM 5644  Colloid and Surface Chemistry
CHEM 6434  Organometallic Chemistry
CHEM 6634  Quantum Chemistry
CHEM 6644  Spectroscopy and Molecular Structure

Physics

PHYS 4554  Introduction to Solid State Physics
PHYS 5455-5456  Quantum Mechanics
PHYS 5555-5556  Solid State Physics