

# UNDERGRADUATE STUDENT HANDBOOK



COLLEGE OF SCIENCE  
**CHEMISTRY**  
VIRGINIA TECH<sup>®</sup>

2024-2025

**Student Handbook**  
**Virginia Tech Department of Chemistry**  
**2024–2025 Edition**

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## Introduction

Welcome to the Chemistry Department at Virginia Tech! Chemistry has earned the nickname *Central Science* for its ubiquitous and critical connections to everything in our physical world – from physics to the life sciences and from deep-sea ecosystems to the farthest reaches of space. Chemistry is about *material transformations and energetics at the molecular level*. Molecules are transforming everywhere – a few at a time in the ozone layer or in vast numbers within plastics or human cells. Chemists use their training and creativity to improve quality of life by creating new drugs, inventing new materials, improving the efficiency of processes, developing new energy systems, and providing critical data for policy decisions.

## Key Links to Official Documents and Information at Virginia Tech

While this Handbook is designed to outline your degree requirements in Chemistry and to answer many of the most common student questions, always remember that there are official sources for all of the information provided herein. In particular:

1. Main Chemistry Department website for undergraduate students:

- <http://www.chem.vt.edu/undergrad>

2. The Virginia Tech Undergraduate Catalog is the official reference source on academic policies.

- <https://catalog.vt.edu/undergraduate/>

3. Degree requirements are spelled out in official documents known as Checksheets. Requirements can change year-to-year, so you should always refer to the appropriate checksheet. When you first join Virginia Tech, you are bound to the checksheet and the full set of Catalog policies for your year of entry. So, if you entered in the Fall of 2024 or the Spring of 2025, the Registrar's link for your checksheet will say "**2024/2025**" and those links will be activated during the preceding summer (Summer of 2024).

- <https://chem.vt.edu/undergraduate/degree-programs.html>
- <https://www.registrar.vt.edu/graduation-multi-brief/checksheets.html>

4. The College of Science maintains a web page with many of the academic forms that you may need from time to time, along with instructions for submitting them. Always read the instructions carefully!

- <https://www.science.vt.edu/academics/advising/forms.html>

## Chemistry Degree Programs at Virginia Tech

Virginia Tech offers two undergraduate degree programs. One is the Bachelor of Science (B.S.) in Chemistry and the other is the Bachelor of Arts (B.A.) in Chemistry. Our **B.S. degree** prepares students for industrial jobs, graduate school, and professional school leading to STEM-oriented careers. Your education can be expanded by adding a minor or even a second major – but the Chemistry B.S. degree is intended to function *by itself* as an educational platform for career development. Our **B.S. degree** offers three distinct majors that are listed here and then described in more detail below and compared side-by-side on the next page.

- B.S. in Chemistry – Major in Chemistry (our traditional ACS-Certified, all-inclusive program)
- B.S. in Chemistry – Major in Medicinal Chemistry (tailored for life sciences)
- B.S. in Chemistry – Major in Polymer Chemistry (tailored for materials science)

### **B.S. in Chemistry – Major in Chemistry – CHEM**

The CHEM curriculum includes all areas of chemistry with laboratory courses, five semesters of math, and a full year of engineering physics with lab. Only our CHEM program is fully certified by the American Chemical Society (ACS). This degree and major prepares students for careers as professional chemists in industry or government or to continue their academic training in graduate study in chemistry or related fields. It is also suitable to prepare for professional school or teaching at all levels.

### **B.S. in Chemistry – Major in Medicinal Chemistry – MDCH**

The MDCH curriculum also prepares students for careers as professional chemists in industry or government or to continue their academic training in graduate study in chemistry or related fields. Specifically, students in this curriculum are interested in the pharmaceutical field or plan to attend pharmacy, medical, dental, or other health-related professional programs after graduation. The MDCH curriculum does not include inorganic chemistry or polymer chemistry. This curriculum includes three semesters of math and the life-sciences versions of physics and physical chemistry. The MDCH curriculum is often chosen as a second major by students pursuing degrees in the College of Agriculture and Life Sciences (CALS).

### **B.S. in Chemistry – Major in Polymer Chemistry – POLY**

The POLY curriculum also prepares students for careers as professional chemists in industry or government or to continue their academic training in graduate study in chemistry or related fields. This curriculum gives the student additional expertise in the critically important field of polymer chemistry with additional courses in this area. The POLY curriculum does not include inorganic chemistry, bioorganic chemistry, or quantum mechanics. This curriculum includes four semesters of math and a full year of engineering physics with labs. The POLY curriculum is often chosen as a second major by students pursuing a B.S. in Chemical Engineering.

### **B.A. in Chemistry – Major in Chemistry**

Our B.A. degree is intended to support and supplement another major, or to allow students to build their own diversified educational programs toward individual goals, such as high-school teaching, law, health professions, or business. The B.A. also provides a fallback for students who have struggled in college but still wish to graduate with a chemistry degree in a timely fashion. Against that background, we rarely recommend that a student start college in our B.A. program. Due to the math requirements of the B.S. degree, it is easier to start on a B.S. and switch to the B.A. rather than vice versa. Our B.A. has only one major – Chemistry.

## Comparison of Chemistry Programs – Required CHEM and Other STEM Courses

|  | BS CHEM   | BS MDCH  | BS POLY                                     | BA CHEM   |
|--|---|--|---|---|
| <b>First-Year Experience</b>               | 1004  | 1004   | 1004  | 1004  |
| <b>General Chem<br/>General Lab</b>        | 1055–1056<br>1065–1066                          | 1055–1056<br>1065–1066                         | 1055–1056<br>1065–1066                      | 1055–1056<br>1065–1066                                |
| <b>Organic Chem<br/>Organic Lab</b>        | 2565–2566 & 2564<br>2555–2556                   | 2565–2566 & 2564<br>2555–2556                  | 2565–2566 & 2564<br>2555–2556               | 2565–2566 & 2564<br><b>2545–2546</b>                  |
| <b>Inorganic Chem</b>                      | 2424 & 4404                                     |  |   | 2424  |
| <b>Physical Chem<br/>Physical Lab</b>      | 3615–3616<br>3625–3626                          | <b>4615,4616</b><br><b>No lab</b>              | <b>3615 or CHE 2164</b><br><b>3625 only</b> | <b>4615,4616</b><br><b>3625 only</b>                  |
| <b>Analytical Chem<br/>Analytical Lab</b>  | 2154<br>2164                                    | 2154<br>2164                                   | 2154<br>2164                                | 2154<br>2164  |
| <b>Instrumental<br/>Analysis &amp; Lab</b> | 4114<br>4124                                    |  |   |   |
| <b>Polymer Chem</b>                        | 4534 or 4634 or 4424                            |  | 4534  |   |
| <b>Med/Bio Chem</b>                        | 4584  | 4584   |   |   |
| <b>Capstone Lab</b>                        | <b>Inorganic 4414</b>                           | <b>Med–Chem 4544</b>                           | <b>Polymer 4074</b>                         | <b>BA Capstone Lab 4034</b>                           |
| <b>Technical Writing</b>                   | 4014  | 4014   | 4014  | 4014  |
| <b>Career Planning</b>                     | 3004  | 3004   | 3004  | 3004  |
| <b>CHEM Electives<br/>for Enrichment</b>   | One 4XXX course from<br>CHEM, CHE, or BCHM      | Two 4XXX courses<br>from an approved list      | Three 4XXX courses<br>from an approved list | Two 3XXX or 4XXX from<br>CHEM, CHE, or BCHM           |
| <b>Biology &amp; Lab</b>                   |   | BIOL 1105,1106<br>BIOL 1115,1116               |   |   |
| <b>Mathematics</b>                         | MATH 1225–1226<br>MATH 2114<br>MATH 2204 & 2214 | MATH 1225–1226                                 | MATH 1225–1226<br>MATH 2204                 | <b>MATH 1025–1026</b><br><b>(Elementary Calculus)</b> |
| <b>Physics &amp; Lab</b>                   | PHYS 2305–2306<br>Includes lab                  | <b>PHYS 2205–2206</b><br><b>PHYS 2215–2216</b> | PHYS 2305–2306<br>Includes lab              | <b>PHYS 2205–2206</b><br><b>PHYS 2215–2216</b>        |
| <b>Statistics</b>                          | STAT 3005 or 3615                               | STAT 3005 or 3615                              | STAT 3005 or 3615                           | STAT 3005 or 3615                                     |

## Flexibility

Students often ask whether there is any flexibility or “wiggle room” in the course requirements of our degree programs. There can be – when circumstances require it, and when it’s reasonable for the student while maintaining the integrity of the overall program. These circumstances might range from requirements for a second major to personal issues affecting your schedule and your progress. Always consult with your advisor with questions about prerequisites, co-requisites, and possible course substitutions. Especially, you are strongly urged to meet with your advisor during the period leading up to Course Request. Above all – do not assume! Don’t assume that something is possible, or impossible. Instead, ask your advisor.

## Minimum Grade Requirements and Progress Towards Degree

### **For students who started as Chemistry, Medicinal Chemistry, or Polymer Chemistry Majors at Virginia Tech**

Upon having attempted 72 credits, a student must have completed the following: CHEM 1004, CHEM 1055-1056, CHEM 1065-1066, CHEM 2565-2566, and CHEM 2555-2556. PHYS 2305-2306 (for BS CHEM or BS POLY majors) or PHYS 2205-2206 and PHYS 2215-2216 (for BS MDCH or BA majors), and MATH 1225-1226 (BS students) or MATH 1025-1026 (BA students), all with the required grades as described below.

Chemistry majors must maintain both overall AND in-major GPAs of 2.0. If a chemistry major fails to meet this requirement for one academic term the student will be placed on academic probation. Failure to meet the standard for two consecutive terms will result in academic suspension.

#### *Minimum Grades in Chemistry Courses:*

- Chemistry majors must earn a grade of “C” or better in CHEM 1055, CHEM 1056, and CHEM 2565.
- A Chemistry major who earned a grade lower than “C” in CHEM 1055 may repeat this course and earn the required grade (“C” or better), or they may take CHEM 1035 and earn a “B” or better.
- A Chemistry major who earned a grade lower than “C” in CHEM 1056 may repeat this course and earn the required grade (“C” or better), or they may take CHEM 1036 and earn a “B” or better.
- A Chemistry major who earned a grade lower than “C” in CHEM 2565 may repeat this course and earn the required grade (“C” or better), or they may take CHEM 2535 and earn a “B” or better. A student repeating CHEM 2565 does not need to repeat CHEM 2564.

**For students who transfer in or start at Virginia Tech as a major other than Chemistry**, we offer a series of substitutions for general chemistry and organic chemistry.

*General Chemistry Lecture Substitutions.* A student who earned prior credit for CHEM 1035 with a grade of “B” or better prior to joining the major in Chemistry may substitute CHEM 1035 for CHEM 1055. A student who earned credit for CHEM 1036 with a grade of “B” or better prior to joining the major in Chemistry may substitute CHEM 1036 for CHEM 1056.

*General Chemistry Lab Substitutions.* A student who earned credit for CHEM 1045 prior to joining the major in Chemistry may substitute CHEM 1045 for CHEM 1065. A student who earned credit for CHEM 1046 prior to joining the major in Chemistry may substitute CHEM 1046 for CHEM 1066.

*Organic Chemistry Lecture Substitutions.* A student who earned credit for CHEM 2535 with a grade of “B” or better prior to joining the major in Chemistry may substitute CHEM 2535 for CHEM 2565. A student who is substituting CHEM 2535 for CHEM 2565 may also substitute one additional credit of free elective for the one credit CHEM 2564, since CHEM 2564 is meant as a companion course to CHEM 2565. A student who earned credit for CHEM 2536 with a grade of “B” or better prior to joining the major in Chemistry may substitute CHEM 2536 for CHEM 2566.

*Organic Chemistry Lab Substitutions.* A student who earned credit for CHEM 2545 prior to joining the major in Chemistry may substitute CHEM 2545 for CHEM 2555. To compensate for differences in content (mostly with respect to training on specific instrumentation), the substitution requires the student to enroll in one credit of CHEM 4994 with a project that uses the same types of instrumentation (such as IR and NMR). A student who earned credit for CHEM 2546 prior to joining the major in Chemistry may substitute CHEM 2546 for CHEM 2556. To compensate for differences in content (mostly with respect to training on specific instrumentation), the substitution requires the student to enroll in one credit of CHEM 4994 with a project that uses the same types of instrumentation (such as IR and NMR).

## How to Use the Recommended Course Schedules

Select the course schedule for your degree and major. If you have any doubts about your course requirements, check the [Registrar's Office Checksheets](#) or consult with your academic advisor.

The **CR** column shows you the number of credits corresponding to each course.

**Prerequisites and Co-requisites.** Prerequisites are indicated by “Pre” and co-requisites are indicated by “Co.”

**Pathways** is the name given to the General Education (liberal arts core) of Virginia Tech's undergraduate system. Pathways consists of seven **Core Concepts**, which are listed below along with the number of credits corresponding to each. In our course schedules, General Education courses are marked with codes starting with the letter **P** as follows:

**P1F** – Discourse, foundational (6 credits, two semesters of First-Year Writing are recommended)

**P1A** – Discourse, advanced or applied (3 credits)

**P2** – Critical thinking in the humanities (6 credits)

**P3** – Reasoning in the social sciences (6 credits)

**P4** – Reasoning in the natural sciences (8 credits, covered by physics)

**P5F** – Quantitative and computational thinking, foundational (6 credits, covered by calculus)

**P5A** – Quantitative and computational thinking, advanced (3 credits, covered by statistics)

**P6A** – Critique and practice in design (3 credits)

**P6D** – Critique and practice in the arts (3 credits)

**P7** – Critical analysis of identity and equity in the U.S. (3 credits).

→ Key Time-Saver: Concept No. 7 is the **only** Pathways Concept that may be double-counted with another by taking a single course. Concept No. 7 is often combined with Concept No. 2. For example, HIST 1115 (History of the United States) counts three credits toward P2 and three credits toward P7. Consult the cross-table (below) for more options. There are MANY options.

Options for Pathways courses can be researched using the Timetable or Hokie Scheduler.

## Readiness for General Chemistry and Calculus of a Single Variable

Virginia Tech requires students to demonstrate a sufficient background in quantitative reasoning in order to enroll in MATH 1225 Calculus of a Single Variable, CHEM 1035 General Chemistry, or CHEM 1055 General Chemistry for Majors. This readiness can be verified in several ways, but the simplest is to take the ALEKS assessment that is offered prior to the start of each Fall semester. To enroll in CHEM 1035 or CHEM 1055, you need an ALEKS score of 61 or higher, otherwise you will be asked to complete CHEM 1014 before enrolling in General Chemistry (more on p. 11 about rescheduling your program to accommodate that minor setback). To enroll in MATH 1225, you need an ALEKS score of 80 or higher, otherwise you will be asked to complete MATH 1214 before enrolling in Calculus of a Single Variable.

- <https://chem.vt.edu/undergraduate/chem-readiness.html>

| Course           | Prerequisites and Corequisites. Note that prerequisites and co-requisites are enforceable by purge. In other words, <b>you can be unenrolled</b> from BIOL 1115 if you are not <b>also</b> registered for BIOL 1105. When in doubt, always check the catalog: <a href="https://catalog.vt.edu/undergraduate/course-descriptions/">https://catalog.vt.edu/undergraduate/course-descriptions/</a> |
|------------------|---|
| BIOL 1115        | Co: BIOL 1105   |
| BIOL 1116        | Co: BIOL 1106. BIOL 1105/1115 and BIOL 1106/1116 may be taken in either order, but BIOL 1105 and BIOL 1115 are not offered in the Spring, while BIOL 1106 and BIOL 1116 are not offered in the Fall.  |
| CHE 4104         | Pre: CHE 2164 and (CHEM 2535 or CHEM 2565).   |
| CHEM 1055        | Co: CHEM 1065 with CHEM 1055; CHEM 1066 with CHEM 1056.<br>Pre: CHEM 1055 requires the same ALEKS placement exam that is required for CHEM 1035. Refer to this page for help: <a href="https://chem.vt.edu/undergraduate/chem-readiness.html">https://chem.vt.edu/undergraduate/chem-readiness.html</a>   |
| CHEM 1056        | Pre: CHEM 1055. (If you took CHEM 1035 instead of CHEM 1055, consult your advisor)  |
| CHEM 1065 – 1066 | For 1065: Co: CHEM 1055. For 1066: Pre: CHEM 1065, Co: CHEM 1056.   |
| CHEM 2154        | Pre: CHEM 1036 or CHEM 1056. Co: CHEM 2164  |
| CHEM 2164        | Pre: CHEM 1046 or CHEM 1066. Co: CHEM 2154  |
| CHEM 2424        | Pre: CHEM 1036 or CHEM 1056   |
| CHEM 2555        | Pre: CHEM 1045 or CHEM 1065. Co: CHEM 2565 for CHEM 2555.   |
| CHEM 2556        | Pre: CHEM 2555. Co: CHEM 2566.  |
| CHEM 2564        | Co: CHEM 2565   |
| CHEM 2565 – 2566 | Pre: CHEM 1035 or CHEM 1055 for CHEM 2565; CHEM 2565 for CHEM 2566  |
| CHEM 3615        | Pre: (CHEM 1035 or 1055) and (CHEM 1036 or 1056) and PHYS 2305 and MATH 2204. Co: PHYS 2306.  |
| CHEM 3616        | Pre: CHEM 3615, PHYS 2306, and MATH 2214.   |
| CHEM 3625 – 3626 | Pre: CHEM 3615 or 4615 for 3625; (3616 or 4616) and 3625 and 4014 for 3626.   |
| CHEM 4044        | Pre: CHEM 3616 and CHEM 2424  |
| CHEM 4074        | Pre: CHEM 3615 and CHEM 4534  |
| CHEM 4414        | Pre: CHEM 2424, CHEM 3616, and CHEM 4404. Co: CHEM 4424 and CHEM 3616   |
| CHEM 4424        | Pre: CHEM 2536 or CHEM 2566; course is cross-listed with SBIO 4424  |
| CHEM 4524        | Pre: CHEM 2536 or CHEM 2566) and (CHEM 3616 or CHEM 4616).  |
| CHEM 4534        | Pre: CHEM 2536 or CHEM 2566   |
| CHEM 4444        | Pre: CHEM 2536 or CHEM 2566) and (CHEM 3616 or CHEM 4616).  |
| CHEM 4544        | Pre: CHEM 4584, BIOL 1105 and BIOL 1106.  |
| CHEM 4554        | Pre: CHEM 2536 or CHEM 2566   |
| CHEM 4584        | Pre: CHEM 2536 or CHEM 2566   |
| CHEM 4615, 4616  | Pre: (CHEM 1036 or CHEM 1056) and (MATH 1026 or MATH 2015 or MATH 1226) and (PHYS 2205 or PHYS 2305) for both 4615 and 4616. → Note that CHEM 4615 and CHEM 4616 may be taken in either order.  |
| CHEM 4634        | Pre: CHEM 3615 or CHEM 4615; course is cross-listed with MSE 4534   |
| MATH 1225 – 1226 | Pre: MATH 1225 (C–) for MATH 1226   |
| MATH 2114        | Pre: MATH 1225 or MATH 1226   |
| MATH 2204        | Pre: MATH 1226  |
| MATH 2214        | Pre: ( MATH 1114 or MATH 2114), (MATH 1206 or MATH 1226)  |
| PHYS 2205 – 2206 | Pre: MATH 1016 or MATH 1025 or MATH 2015 or MATH 1026 or MATH 1205 or MATH 1525 or MATH 1535 or MATH 1225 for 2205; Pre: PHYS 2305 or PHYS 2205 for PHYS 2206.  |
| PHYS 2305        | Pre: MATH 1225; Co: MATH 1226   |
| PHYS 2306        | Pre: PHYS 2305 and MATH 1226  |
| PHYS 4564        | Pre: PHYS 2306  |
| STAT 3005        | Pre: MATH 1205 or MATH 1225; Co: MATH 1206 or MATH 1226   |
| STAT 3615        | Pre: MATH 1205 or MATH 1225 or MATH 1025 or MATH 1525   |

**Course scheduling note:** The *only* chemistry *majors* course that is offered both fall and spring is CHEM 4014. There are no chemistry *majors* courses offered either in Summer Session or Winter Session.



## B.S. in Chemistry – Major in Chemistry – Recommended Schedule – Entry in 2024/2025

**PLEASE!** Read the guide on p. 6 so that you will know what is provided here. This tentative schedule can be rearranged, so long as you meet the prerequisites for all planned courses.

- Pre- and co-requisites not listed may be found here: <https://catalog.vt.edu/undergraduate/course-descriptions/>
- Math readiness is explained here: <https://chem.vt.edu/undergraduate/chem-readiness.html>

| Fall Semester Freshman 2024   | 16 CR | Spring Semester Freshman Year 2025  | 16 CR |
|---|-------|---|-------|
| <b>CHEM 1004</b> First Year Experience in Chemistry   | 1     | <b>CHEM 2565</b> Principles of Organic Chemistry<br><i>Pre:</i> CHEM 1035 or CHEM 1055  | 3     |
| <b>CHEM 1055</b> General Chemistry for Majors<br><i>Pre:</i> Math Readiness <sup>a</sup>  | 4     | <b>CHEM 2555</b> Organic Synthesis & Techniques Lab<br><i>Co:</i> CHEM 2565   | 2     |
| <b>CHEM 1065</b> General Chemistry for Majors Lab<br><i>Co:</i> CHEM 1055   | 1     | <b>CHEM 2564</b> Problem Solving in Organic Chemistry<br><i>Co:</i> CHEM 2565   | 1     |
| <b>MATH 1225</b> Calculus of a Single Variable ( <b>P5F</b> )<br><i>Pre:</i> Math Readiness <sup>a</sup>  | 4     | <b>MATH 1226</b> Calculus of a Single Variable ( <b>P5F</b> )<br><i>Pre:</i> MATH 1225 (C- or better)   | 4     |
| Pathways Concept 1F ( <b>P1F</b> ) <i>Recommended:</i> ENGL 1105  | 3     | Pathways Concept 1F ( <b>P1F</b> ) <i>Recommended:</i> ENGL 1106  | 3     |
| Pathways Concept 3 ( <b>P3</b> )<br><i>Recommended:</i> Students planning on health-professional school should use PSYC 1004 and SOC 1004 for P3. | 3     | <b>MATH 2114</b> Elementary Linear Algebra<br><i>Pre:</i> MATH 1225 or MATH 1226<br><i>Option:</i> Exchange this course with <b>P2</b> course in Fall 2026. | 3     |
| Fall Semester Sophomore 2025  | 17 CR | Spring Semester Sophomore 2026  | 16 CR |
| <b>CHEM 1056</b> General Chemistry for Majors<br><i>Pre:</i> CHEM 1055  | 4     | <b>CHEM 2154</b> Majors Analytical Chemistry<br><i>Pre:</i> CHEM 1036 or 1056 or ISC 1106. <i>Co:</i> CHEM 2164   | 4     |
| <b>CHEM 1066</b> General Chemistry for Majors Lab<br><i>Pre:</i> CHEM 1065. <i>Co:</i> CHEM 1056  | 1     | <b>CHEM 2164</b> Majors Analytical Chemistry Lab<br><i>Pre:</i> CHEM 1046 or CHEM 1066. <i>Co:</i> CHEM 2154  | 1     |
| <b>CHEM 2566</b> Principles of Organic Chemistry<br><i>Pre:</i> CHEM 2565   | 3     | <b>CHEM 4014</b> Survey of the Chemical Literature<br><i>Recommended:</i> Complete ENGL 1105-1106 first   | 1     |
| <b>CHEM 2556</b> Organic Synthesis & Techniques Lab<br><i>Pre:</i> CHEM 2555  | 2     | <b>CHEM 2424</b> Descriptive Inorganic Chemistry<br><i>Pre:</i> CHEM 1036 or CHEM 1056  | 3     |
| <b>MATH 2204</b> Introduction to Multivariable Calculus<br><i>Pre:</i> MATH 1226  | 3     | <b>MATH 2214</b> Introduction to Differential Equations<br><i>Pre:</i> (MATH 2114 or ISC 2105) and MATH 1226  | 3     |
| Pathways Concept 2 ( <b>P2</b> )  | 3     | <b>PHYS 2305</b> Foundations of Physics ( <b>P4</b> )<br><i>Pre:</i> MATH 1225. <i>Co:</i> MATH 1226  | 4     |
| Fall Semester Junior 2026   | 13 CR | Spring Semester Junior 2027   | 13 CR |
| <b>CHEM 3615</b> Physical Chemistry<br><i>Pre:</i> CHEM 1056, PHYS 2305, and MATH 2204. <i>Co:</i> PHYS 2306                                      | 3     | <b>CHEM 3616</b> Physical Chemistry<br><i>Pre:</i> CHEM 3615 and MATH 2214 and PHYS 2306  | 3     |
| <b>CHEM 4584</b> Bioorganic Chemistry<br><i>Pre:</i> CHEM 2536 or CHEM 2566   | 3     | <b>CHEM 3625</b> Physical Chemistry Lab<br><i>Pre:</i> CHEM 3615 or CHEM 4615 or MATH 2214  | 1     |
| <b>PHYS 2306</b> Foundations of Physics ( <b>P4</b> )<br><i>Pre:</i> PHYS 2305 and MATH 1225  | 4     | <b>CHEM 4114</b> Instrumental Analysis<br><i>Pre:</i> CHEM 2154   | 3     |
| <b>CHEM 3004</b> Bridge to the Future   | 1     | <b>Statistics Elective</b> (STAT 3005 or STAT 3615) ( <b>P5A</b> )  | 3     |
| Pathways Concept 2 ( <b>P2</b> )  | 3     | Pathways Concept 3 ( <b>P3</b> )  | 3     |
| Fall Semester Senior 2027   | 14 CR | Spring Semester Senior 2028   | 15 CR |
| <b>CHEM 3626</b> Physical Chemistry Lab<br><i>Pre:</i> (CHEM 3616 or 4616) and CHEM 3625 and CHEM 4014  | 1     | <b>CHEM 4414</b> Inorganic Chemistry Laboratory<br><i>Pre:</i> CHEM 2424 and CHEM 3616 and CHEM 4404  | 2     |
| <b>Polymer Elective</b> (CHEM 4424, 4534, or 4634)<br><i>Note:</i> CHEM 4424 and CHEM 4634 are spring courses only.                               | 3     | <b>Restricted Elective</b> (CHEM or BCHM or CHE 4XXX)   | 3     |
| <b>CHEM 4404</b> Physical Inorganic Chemistry<br><i>Pre:</i> CHEM 2424 and CHEM 3616  | 3     | Pathways Concept 7 ( <b>P7</b> )  | 3     |
| <b>CHEM 4124</b> Instrumental Analysis Lab<br><i>Pre:</i> CHEM 4114   | 1     | Pathways Concept 6 ( <b>P6A</b> or <b>P6D</b> )   | 3     |
| Pathways Concept 1 Advanced or Applied ( <b>P1A</b> )   | 3     | Free Electives  | 4     |
| Pathways Concept 6 ( <b>P6D</b> or <b>P6A</b> )   | 3     |   |       |

## B.S. in Chemistry – Major in Medicinal Chemistry – Recommended Schedule – Entry in 2024/2025

**PLEASE!** Read the guide on p. 6 so that you will know what is provided here. This tentative schedule can be rearranged, so long as you meet the prerequisites for all planned courses.

- Pre- and co-requisites not listed may be found here: <https://catalog.vt.edu/undergraduate/course-descriptions/>
- Math readiness is explained here: <https://chem.vt.edu/undergraduate/chem-readiness.html>

| Fall Semester Freshman 2024   | 17 CR | Spring Semester Freshman Year 2025   | 17 CR |
|---|-------|--|-------|
| <b>CHEM 1004</b> First Year Experience in Chemistry   | 1     | <b>CHEM 2565</b> Principles of Organic Chemistry<br><i>Pre:</i> CHEM 1035 or CHEM 1055                               | 3     |
| <b>CHEM 1055</b> General Chemistry for Majors<br><i>Pre:</i> Math Readiness <sup>a</sup>  | 4     | <b>CHEM 2555</b> Organic Synthesis & Techniques Lab<br><i>Co:</i> CHEM 2565  | 2     |
| <b>CHEM 1065</b> General Chemistry for Majors Lab<br><i>Co:</i> CHEM 1055   | 1     | <b>CHEM 2564</b> Problem Solving in Organic Chemistry<br><i>Co:</i> CHEM 2565  | 1     |
| <b>MATH 1225</b> Calculus of a Single Variable ( <b>P5F</b> )<br><i>Pre:</i> Math Readiness <sup>a</sup>  | 4     | <b>MATH 1226</b> Calculus of a Single Variable ( <b>P5F</b> )<br><i>Pre:</i> MATH 1225 (C- or better)                | 4     |
| <b>BIOL 1105</b> Principles of Biology  | 3     | <b>BIOL 1106</b> Principles of Biology   | 3     |
| <b>BIOL 1115</b> Principles of Biology Laboratory<br><i>Co:</i> BIOL 1105   | 1     | <b>BIOL 1116</b> Principles of Biology Laboratory<br><i>Co:</i> BIOL 1106  | 1     |
| Pathways Concept 1F ( <b>P1F</b> )<br><i>Recommended:</i> ENGL 1105 First-Year Writing  | 3     | Pathways Concept 1F ( <b>P1F</b> )<br><i>Recommended:</i> ENGL 1106 First-Year Writing                               | 3     |
| Fall Semester Sophomore 2025  | 17 CR | Spring Semester Sophomore 2026   | 13 CR |
| <b>CHEM 1056</b> General Chemistry for Majors<br><i>Pre:</i> CHEM 1055  | 4     | <b>CHEM 2154</b> Majors Analytical Chemistry<br><i>Pre:</i> CHEM 1036 or 1056 or ISC 1106. <i>Co:</i> CHEM 2164      | 4     |
| <b>CHEM 1066</b> General Chemistry for Majors Lab<br><i>Pre:</i> CHEM 1065. <i>Co:</i> CHEM 1056  | 1     | <b>CHEM 2164</b> Majors Analytical Chemistry Lab<br><i>Pre:</i> CHEM 1046 or CHEM 1066. <i>Co:</i> CHEM 2154         | 1     |
| <b>CHEM 2566</b> Principles of Organic Chemistry<br><i>Pre:</i> CHEM 2565   | 3     | <b>CHEM 4014</b> Survey of the Chemical Literature<br><i>Recommended:</i> Complete ENGL 1105-1106 first              | 1     |
| <b>CHEM 2556</b> Organic Synthesis & Techniques Lab<br><i>Pre:</i> CHEM 2555  | 2     |  |       |
| <b>PHYS 2205</b> General Physics ( <b>P4</b> )<br><i>Pre:</i> MATH 1205 or MATH 1225  | 3     | <b>PHYS 2206</b> General Physics ( <b>P4</b> )<br><i>Pre:</i> PHYS 2205 or PHYS 2305                                 | 3     |
| <b>PHYS 2215</b> General Physics Lab ( <b>P4</b> )<br><i>Co:</i> PHYS 2205  | 1     | <b>PHYS 2216</b> General Physics Lab ( <b>P4</b> )<br><i>Pre:</i> PHYS 2215 or PHYS 2305. <i>Co:</i> PHYS 2206       | 1     |
| Pathways Concept 3 ( <b>P3</b> )<br><i>Recommended:</i> Students planning on health-professional school should use PSYC 1004 and SOC 1004 for P3. | 3     | Pathways Concept 6 ( <b>P6D</b> or <b>P6A</b> )  | 3     |
| Fall Semester Junior 2026   | 13 CR | Spring Semester Junior 2027  | 15 CR |
| <b>CHEM 4615</b> Physical Chemistry for Life Sciences<br><i>Pre:</i> (CHEM 1036 or 1056) and MATH 1226 and PHYS 2206                              | 3     | <b>CHEM 4616</b> Physical Chemistry for Life Sciences<br><i>Pre:</i> (CHEM 1036 or 1056) and MATH 1226 and PHYS 2206 | 3     |
| <b>CHEM 4584</b> Bioorganic Chemistry<br><i>Pre:</i> CHEM 2536 or CHEM 2566   | 3     | <b>Statistics Elective</b> (STAT 3005 or STAT 3615) ( <b>P5A</b> )   | 3     |
| <b>CHEM 3004</b> Bridge to the Future   | 1     | Pathways Concept 2 ( <b>P2</b> )   | 3     |
| Pathways Concept 2 ( <b>P2</b> )  | 3     | Pathways Concept 3 ( <b>P3</b> )   | 3     |
| Pathways Concept 7 ( <b>P7</b> )  | 3     | Pathways Concept 1 Applied or Advanced ( <b>P1A</b> )  | 3     |
| Fall Semester Senior 2027   | 14 CR | Spring Semester Senior 2028  | 14 CR |
| Advanced Electives*   | 3     | <b>CHEM 4544</b> Medicinal Chemistry Capstone Laboratory   | 2     |
| Pathways Concept 6 ( <b>P6A</b> or <b>P6D</b> )   | 3     | Advanced Electives*  | 3     |
| Free Electives  | 8     | Free Electives   | 9     |

\*Advanced electives: Student must choose a total of two courses (6 cr) from CHEM 4524, 4444, 4514, 4554, and 4424 (SBIO 4424). Note that CHEM 4524 and CHEM 4444 are Fall courses, whereas CHEM 4514, CHEM 4554, and CHEM 4424 are Spring courses.

## B.S. in Chemistry – Major in Polymer Chemistry – Recommended Schedule – Entry in 2024/2025

**PLEASE!** Read the guide on p. 6 so that you will know what is provided here. This tentative schedule can be rearranged, so long as you meet the prerequisites for all planned courses.

- Pre- and co-requisites not listed may be found here: <https://catalog.vt.edu/undergraduate/course-descriptions/>
- Math readiness is explained here: <https://chem.vt.edu/undergraduate/chem-readiness.html>

| Fall Semester Freshman 2024   | 16 CR | Spring Semester Freshman Year 2025   | 16 CR |
|---|-------|--|-------|
| <b>CHEM 1004</b> First Year Experience in Chemistry   | 1     | <b>CHEM 2565</b> Principles of Organic Chemistry<br><i>Pre:</i> CHEM 1035 or CHEM 1055                               | 3     |
| <b>CHEM 1055</b> General Chemistry for Majors<br><i>Pre:</i> Math Readiness <sup>a</sup>  | 4     | <b>CHEM 2555</b> Organic Synthesis & Techniques Lab<br><i>Co:</i> CHEM 2565  | 2     |
| <b>CHEM 1065</b> General Chemistry for Majors Lab<br><i>Co:</i> CHEM 1055   | 1     | <b>CHEM 2564</b> Problem Solving in Organic Chemistry<br><i>Co:</i> CHEM 2565  | 1     |
| <b>MATH 1225</b> Calculus of a Single Variable ( <b>P5F</b> )<br><i>Pre:</i> Math Readiness <sup>a</sup>  | 4     | <b>MATH 1226</b> Calculus of a Single Variable ( <b>P5F</b> )<br><i>Pre:</i> MATH 1225 (C– or better)                | 4     |
| Pathways Concept 1F ( <b>P1F</b> ) <i>Recommended:</i> ENGL 1105  | 3     | Pathways Concept 1F ( <b>P1F</b> ) <i>Recommended:</i> ENGL 1106   | 3     |
| Pathways Concept 3 ( <b>P3</b> )<br><i>Recommended:</i> Students planning on health-professional school should use PSYC 1004 and SOC 1004 for P3. | 3     | Pathways Concept 2 ( <b>P2</b> )   | 3     |
|   |       |  |       |
| Fall Semester Sophomore 2025  | 17 CR | Spring Semester Sophomore 2026   | 13 CR |
| <b>CHEM 1056</b> General Chemistry for Majors<br><i>Pre:</i> CHEM 1055  | 4     | <b>CHEM 2154</b> Majors Analytical Chemistry<br><i>Pre:</i> CHEM 1036 or 1056 or ISC 1106. <i>Co:</i> CHEM 2164      | 4     |
| <b>CHEM 1066</b> General Chemistry for Majors Lab<br><i>Pre:</i> CHEM 1065. <i>Co:</i> CHEM 1056  | 1     | <b>CHEM 2164</b> Majors Analytical Chemistry Lab<br><i>Pre:</i> CHEM 1046 or CHEM 1066. <i>Co:</i> CHEM 2154         | 1     |
| <b>CHEM 2566</b> Principles of Organic Chemistry<br><i>Pre:</i> CHEM 2565   | 3     | <b>CHEM 4014</b> Survey of the Chemical Literature<br><i>Recommended:</i> Complete ENGL 1105-1106 first              | 1     |
| <b>CHEM 2556</b> Organic Synthesis & Techniques Lab<br><i>Pre:</i> CHEM 2555  | 2     | <b>PHYS 2305</b> Foundations of Physics ( <b>P4</b> )<br><i>Pre:</i> MATH 1225. <i>Co:</i> MATH 1226                 | 4     |
| <b>MATH 2204</b> Introduction to Multivariable Calculus<br><i>Pre:</i> MATH 1226  | 3     |  |       |
| Pathways Concept 2 ( <b>P2</b> )  | 3     | Pathways Concept 6 ( <b>P6A</b> or <b>P6D</b> )  | 3     |
|   |       |  |       |
| Fall Semester Junior 2026   | 16 CR | Spring Semester Junior 2027  | 15 CR |
| <b>CHEM 3615</b> Physical Chemistry<br><i>Pre:</i> CHEM 1056, PHYS 2305, and MATH 2204. <i>Co:</i> PHYS 2306                                      | 3     | <b>CHEM 3625</b> Physical Chemistry Lab<br><i>Pre:</i> CHEM 3615 or CHEM 4615 or MATH 2214                           | 1     |
| <b>CHEM 4534</b> Organic Chemistry of Polymers<br><i>Pre:</i> CHEM 2536 or CHEM 2566  | 3     | <b>Statistics Elective</b> (STAT 3005 or STAT 3615) ( <b>P5A</b> )   | 3     |
| <b>CHEM 3004</b> Bridge to the Future   | 1     | Pathways Concept 3 ( <b>P3</b> )   | 3     |
| <b>PHYS 2306</b> Foundations of Physics ( <b>P4</b> )<br><i>Pre:</i> PHYS 2305 and MATH 1225  | 4     | Free Electives   | 6     |
| Pathways Concept 7 ( <b>P7</b> )  | 3     |  |       |
| Free electives  | 3     |  |       |
|   |       |  |       |
| Fall Semester Senior 2027   | 15 CR | Spring Semester Senior 2028  | 14 CR |
| <b>Restricted Elective</b> (CHEM 4524 or CHE 4104 or PHYS 4564)<br><i>Note:</i> CHEM 4524 is a fall course only.                                  | 3     | <b>Restricted Elective</b> (CHEM 4424 or CHEM 4634)<br><i>Note:</i> CHEM 4424 and CHEM 4634 are spring courses only. | 3     |
| <b>Restricted Elective</b> (CHEM 4524 or CHE 4104 or PHYS 4564)   | 3     | <b>CHEM 4074</b> Laboratory in Polymer Science<br><i>Pre:</i> CHEM 4534, 3625, and (CHEM 3615 or CHE 2164)           | 2     |
| Pathways Concept 1A ( <b>P1A</b> )  | 3     | Pathways Concept 6 ( <b>P6D</b> or <b>P6A</b> )  | 3     |
| Free Electives  | 3     | Free Electives   | 6     |

## B.A. in Chemistry – Major in Chemistry – Recommended Schedule – Entry in 2024/2025

**PLEASE!** Read the guide on p. 6 so that you will know what is provided here. This tentative schedule can be rearranged, so long as you meet the prerequisites for all planned courses.

- Pre- and co-requisites not listed may be found here: <https://catalog.vt.edu/undergraduate/course-descriptions/>
- Math readiness is explained here: <https://chem.vt.edu/undergraduate/chem-readiness.html>

| Fall Semester Freshman 2024  | 15 CR | Spring Semester Freshman Year 2025   | 16 CR |
|--|-------|--|-------|
| <b>CHEM 1004</b> First Year Experience in Chemistry  | 1     | <b>CHEM 2565</b> Principles of Organic Chemistry<br><i>Pre:</i> CHEM 1035 or CHEM 1055                               | 3     |
| <b>CHEM 1055</b> General Chemistry for Majors<br><i>Pre:</i> Math Readiness <sup>a</sup>   | 4     | <b>CHEM 2564</b> Problem Solving in Organic Chemistry<br><i>Co:</i> CHEM 2565  | 1     |
| <b>CHEM 1065</b> General Chemistry for Majors Lab<br><i>Co:</i> CHEM 1055  | 1     | <b>MATH 1206</b> Elementary Calculus (P5F)<br><i>Pre:</i> MATH 1205 or MATH 1225                                     | 3     |
| Pathways Concept 1F (P1F) <i>Recommended:</i> ENGL 1105  | 3     | Pathways Concept 1F (P1F) <i>Recommended:</i> ENGL 1106  | 3     |
| <b>MATH 1025</b> Elementary Calculus (P5F)   | 3     | Pathways Concept 7 (P7)  | 3     |
| Pathways Concept 3 (P3)<br><i>Recommended:</i> Students planning on health-professional school should use PSYC 1004 and SOC 1004 for P3. | 3     | Pathways Concept 2 (P2)  | 3     |
|  |       |  |       |
| Fall Semester Sophomore 2025   | 13 CR | Spring Semester Sophomore 2026   | 14 CR |
| <b>CHEM 1056</b> General Chemistry for Majors<br><i>Pre:</i> CHEM 1055   | 4     | <b>CHEM 2154</b> Majors Analytical Chemistry<br><i>Pre:</i> CHEM 1036 or 1056 or ISC 1106. <i>Co:</i> CHEM 2164      | 4     |
| <b>CHEM 1066</b> General Chemistry for Majors Lab<br><i>Pre:</i> CHEM 1065. <i>Co:</i> CHEM 1056   | 1     | <b>CHEM 2164</b> Majors Analytical Chemistry Lab<br><i>Pre:</i> CHEM 1046 or CHEM 1066. <i>Co:</i> CHEM 2154         | 1     |
| <b>CHEM 2566</b> Principles of Organic Chemistry<br><i>Pre:</i> CHEM 2565  | 3     | <b>CHEM 4014</b> Survey of the Chemical Literature<br><i>Recommended:</i> Complete ENGL 1105-1106 first              | 1     |
| <b>CHEM 2545</b> Organic Chemistry Lab<br><i>Pre:</i> CHEM 1046 or 1065 or ISC 1116. <i>Co:</i> CHEM 2535 or 2565                        | 1     | <b>CHEM 2546</b> Organic Chemistry Lab<br><i>Pre:</i> CHEM 2545. <i>Co:</i> CHEM 2536                                | 1     |
|  |       | <b>CHEM 2424</b> Descriptive Inorganic Chemistry<br><i>Pre:</i> CHEM 1036 or CHEM 1056                               | 3     |
| <b>PHYS 2205</b> General Physics (P4)<br><i>Pre:</i> MATH 1205 or MATH 1225  | 3     | <b>PHYS 2206</b> General Physics (P4)<br><i>Pre:</i> PHYS 2205 or PHYS 2305  | 3     |
| <b>PHYS 2215</b> General Physics Lab (P4)<br><i>Co:</i> PHYS 2205  | 1     | <b>PHYS 2216</b> General Physics Lab (P4)<br><i>Pre:</i> PHYS 2215 or PHYS 2305. <i>Co:</i> PHYS 2206                | 1     |
|  |       |  |       |
| Fall Semester Junior 2026  | 16 CR | Spring Semester Junior 2027  | 16 CR |
| <b>CHEM 4615</b> Physical Chemistry for Life Sciences<br><i>Pre:</i> (CHEM 1036 or 1056) and MATH 1226 and PHYS 2206                     | 3     | <b>CHEM 4616</b> Physical Chemistry for Life Sciences<br><i>Pre:</i> (CHEM 1036 or 1056) and MATH 1226 and PHYS 2206 | 3     |
| <b>CHEM 3004</b> Bridge to the Future  | 1     | <b>CHEM 3625</b> Physical Chemistry Lab<br><i>Pre:</i> CHEM 3615 or CHEM 4615 or MATH 2214                           | 1     |
| <b>Statistics Elective</b> (STAT 3005 or STAT 3615) (P5A)  | 3     | Pathways Concept 3 (P3)  | 3     |
| Pathways Concept 2 (P2)  | 3     | Free Electives   | 9     |
| Pathways Concept 1A (P1A)  | 3     |  |       |
| Free Elective  | 3     |  |       |
|  |       |  |       |
|  |       |  |       |
| Fall Semester Senior 2027  | 15 CR | Spring Semester Senior 2028  | 15 CR |
| <b>Restricted Elective</b> (CHEM, BCHM or CHE 3XXX / 4XXX)   | 3     | <b>Restricted Elective</b> (CHEM, BCHM or CHE 3XXX / 4XXX)   | 3     |
| Pathways Concept 6 (P6D or P6A)  | 3     | Pathways Concept 6 (P6A or P6D)  | 3     |
| Free Electives   | 9     | Free Electives   | 9     |

## Course Plans – Setbacks and Alternatives

Student Has an Insufficient ALEKS Score for CHEM 1055. A student who scores below 61 on the ALEKS readiness exam cannot enroll in CHEM 1055 or CHEM 1065. (These students also cannot enroll in MATH 1225 – see below.) All terms should be filled out to 15-17 credits with Pathways courses to create a “drop cushion.” Students are also encouraged to enroll in summer school (e.g., MATH 1225-1226 or HIST 1115-1116) after the freshman year when internships and research opportunities are less forthcoming, to help them get caught up and create less credit pressure during the regular academic year.

Semester 1. CHEM 1014 Calculations in Chemistry.

Semester 2. CHEM 1035 – need to earn a “B” or better. Need to enroll in CHEM 1045 and pass. Cannot enroll in CHEM 2565, CHEM 2555, or CHEM 2564. (“Delayed Organic.”)

Semester 3. CHEM 1056 and CHEM 1066. Because the student is not taking organic, they should be able to start Physics (PHYS 2305 or PHYS 2205/2215) if they have the math prerequisites (MATH 1225). Note that PHYS 2305 also requires MATH 1226 as a co-requisite.

Semester 4. CHEM 2154, CHEM 2164, CHEM 2565, CHEM 2555, CHEM 2564. Note that CHEM 2424 can be moved to a future term, such as Semester 6. CHEM 2424 is only in the BS CHEM and the BA. BS CHEM students need to take it before CHEM 4404. BA students can take it at any time. Moving CHEM 2424 creates credit space to complete Physics.

Semester 5. CHEM 2566, CHEM 2556, CHEM 3004, CHEM 4414, CHEM 4584, and CHEM 3615 or 4615.

Student Does Not Earn “C” Grade in CHEM 1055. This plan is essentially the same as the plan for students with a low ALEKS score except that the student may pass CHEM 1065 (there is no requirement for “C” grades in the lab courses.) A student who has passed CHEM 1065 does not need to enroll in CHEM 1045.

Student Does Not Earn “C” Grade in CHEM 1056 or CHEM 2565. Please consult your advisor for help.

Student Has an Insufficient ALEKS Score for MATH 1225. A student who scores below 80 on the ALEKS exam cannot enroll in MATH 1225, *even if they have AP or DE credit for MATH 1225*. In the first semester, the student will take MATH 1214 Preparation for Calculus. From that point forward, all MATH courses are delayed by one semester. Note that MATH 2114 Linear Algebra has MATH 1225 as a prerequisite, so MATH 2114 needs to be pushed to a future semester as well. Any credit gap should ideally be filled by a Pathways course. Any BS student (CHEM, MDCH, or POLY) who has not completed MATH 1226 by the end of the second semester will be advised to consider completing their MATH 1225-1226 sequence over the summer (for instance, using VCCS equivalent courses) if their personal and financial circumstances will allow it.

Scheduling Physics. To alleviate pressure in the Fall of the Second Year, we have advised that BS Chemistry and BS Polymer Chemistry majors delay the start of PHYS 2305 by one semester, until the Spring of the Second Year. The reason we do NOT recommend delaying the start of PHYS 2205/2215 for BS Medicinal Chemistry or BA Chemistry majors is because PHYS 2205/2215 is offered on quite a limited schedule in the Spring term, and the same for PHYS 2206/2216 in the fall (only one lecture section – in the evening – and only three lab time slots to choose from). Any student who has a second major or a minor that requires physics will need to consult their advisor(s) regarding the scheduling of their courses.

Scheduling Linear Algebra. Students in the BS CHEM major (and only this major) need to take MATH 2114 Linear Algebra. One option is to trade this course for a Pathways course from a future semester. However MATH 2114 must be completed before CHEM 3616 (prerequisite). The obvious semester to trade this course is the fall of Year 3, however a student who is using some of the other schedule modifications such as “Delayed Organic” or the “Physics Shuffle” may find that the fall of Year 3 has become more busy.

## Advising

Please use **Navigate** to schedule advising appointments. If your primary advisor does not have enough availability, please reach out to them by email. You are expected to make a **good-faith effort** to schedule with your **primary academic advisor** for all of your questions **before** reaching out to others.

Advising is one of the core strengths of the Chemistry Department. Advising provides you with guidance to help you make important decisions. Your advisor will provide advice on what he or she thinks will serve you best. Life – including college – is a journey full of expected and unexpected curves with many different paths. We are here to help you make decisions that seem right for you.

It stands to reason that if you never meet with your advisor, then you are missing potentially valuable guidance that you have already paid for with your tuition and fees. You should meet each semester with your advisor at minimum, and not necessarily only to choose your courses for the next term. Your advisor is a resource to help you prepare yourself for a rewarding career.

Your professors and advisors want and expect to know every chemistry major personally. As you move through the program, please try to meet and know your professors; they are available for help and guidance. A complete and current faculty listing is found on the department website ([www.chem.vt.edu](http://www.chem.vt.edu)). Students may schedule appointments directly with their advisors whenever questions or issues arise.

When you are invited to meet your advisor for Course Request, you must do so. In the last few years, approximately 1-2 students *per year* who failed to discuss their future courses with their advisor have made mistakes that have delayed their graduation by one semester or more. Don't be that student.

### Core Advising Team

- Prof. Paul A. Deck, Director of Undergraduate Programs, Freshman & Sophomore Advising  
2101 Hahn Hall South, [pdeck@vt.edu](mailto:pdeck@vt.edu)
- Amy Kokkinakos, Undergraduate Program Coordinator, Academic Advisor  
117B Davidson Hall, [amyk@vt.edu](mailto:amyk@vt.edu)
- Dr. Tim Saarinen, Professor of Practice, Academic and Career Advisor  
117A Davidson Hall, [tsaarinen29@vt.edu](mailto:tsaarinen29@vt.edu)
- Dr. Jeannine Eddleton, Senior Instructor, Freshman & Sophomore Advising, Teacher Certification  
109 Davidson Hall, [jeddleto@vt.edu](mailto:jeddleto@vt.edu)

### Health Professions Advising

- For many years, the Chemistry Department maintained its own office for health-professions advising. The breadth of the health professions has made this task impossible. Students are encouraged to consult with our Career Advisor (Dr. Tim Saarinen, [tsaarinen29@vt.edu](mailto:tsaarinen29@vt.edu)) with general questions and to use the university's [Health Professions Advising Center](#) for detailed assistance with preparation for medical, dental, pharmacy, veterinary, and other health-professional graduate programs.

### Expectations

Student advising is a two-way street. The link below shares the “top ten” expectations for student advising within the College of Science. The Chemistry Department Advising Team follows these principles, each of which assigns responsibilities to both the advisor and the student. Remember: It's your degree program!

- <https://www.science.vt.edu/academics/advising/expectations.html>

## Highlights from the Undergraduate Catalog (Academic Policies)

The following is a general summary. Refer to the complete text in the Undergraduate Course Catalog (<https://catalog.vt.edu/undergraduate/> -- click on "Academic Policies" in the menu at left) for full details.

### Academic Eligibility Policy

A GPA of 2.0 (a C average) overall and in-major is required for graduation. Any time your overall GPA falls below 2.0 you are placed on academic probation. Probation is lifted when your GPA is again at least 2.00. The policy on academic probation, suspensions, and appeals is extensive. See the [Catalog](#) for details.

### Registration for Classes

Course Request (pre-registration) is a period in the middle of each semester during which students enrolled currently may select classes for the following semester. Prior to, or during, course request, you should plan your schedule, consult with your advisor, and utilize course request/Hokie scheduler in Hokie SPA.

### Course Loads

A student is classified as "full-time" if enrolled for 12 credits in fall and spring semesters and/or 6 credits during a summer session. A normal course load is 15-17 credits per semester. Overloads (more than 19 credits per semester, or seven each summer session, or six for winter session) require prior, written permission from your Academic Dean's office.

### Late Adds

Adding a course to your schedule after the deadline requires permission of your Academic Dean.

### Grade Options

Students may take certain courses on a pass-fail basis, according to the following regulations:

- No Pathways requirements or Chemistry Department degree requirements may be taken pass-fail. Essentially, none of the courses listed in the 4-year course plans in this Handbook can be taken P/F.
- Minimum credit hours already passed on graded courses must equal 30 with a minimum GPA = 2.50. (Does not apply for courses offered only on a pass-fail basis.)
- Maximum number of pass-fail credits allowed = 10% of the requirements for graduation taken at Virginia Tech. For example, if a student takes 120 credits at Virginia Tech, 12 hours may be taken Pass-Fail. If a student takes only 90 credit hours at Virginia Tech (with 30 transfer credits), then only 9 (10% of 90) credits may be taken Pass-Fail.
- For courses taken pass-fail, P or F is recorded on the student's transcript and credit is given if the grade is P. If the course is failed, the "F" is considered as an "F" received under the "A-F" grading system and is included in calculation of the GPA.
- Pass-fail courses are normally non-transferable to other institutions.
- No more than 2 courses may be taken pass-fail in any semester unless they are offered only pass-fail.



## Enrollment in Graduate Courses

- With permission of the instructor, senior chemistry majors with a 3.0 GPA may enroll in 5000-level and even 6000-level chemistry courses. Chemistry majors wishing to take graduate courses in other departments must have the approval of the instructor and the Dean of the Graduate School.

## Course Drop and Withdrawal

**Dropping a course:** Students may drop courses prior to a specific deadline that is announced for each term; the course is removed from your transcript. If you will have fewer than 12 credits after dropping a course, then you may jeopardize your scholarships, athletics, housing, etc. Consult with your advisor in this situation.

### Course Drop Involving Co-Requisite Courses (Lecture and Lab, or Lecture and Recitation)

A common issue in science courses is the co-requisite relationship between lecture and lab/recitation courses. **In Chemistry**, if you drop a lab or recitation course you may generally continue in the lecture course. However, if you drop a lecture course *before the drop deadline* then you are expected to drop the lab or recitation course also. After the drop date, then you may keep the lab or recitation course. Other departments such as Physics and Biological Sciences may have more strict rules about this!!

**Course Withdrawal:** A maximum of three (3) courses may be dropped beyond the normal drop deadline date during a student's academic career at Virginia Tech, subject to the following stipulations:

1. Students must formally request to withdraw from a course **by the last day of classes** in that term. The form is provided here: <https://www.science.vt.edu/academics/advising/forms.html>. The form must be approved by the student, the student's advisor, and the academic dean.
2. Courses from which a student withdraws under the terms of this policy will appear on their transcript with a W. The W signifies that this policy was invoked; the reasons for its use are the (private) responsibility of the student.
3. A student's decision to invoke this policy is irrevocable and unappealable.
4. Withdrawals may not be employed to reduce or obviate any penalty otherwise accruing to students under the University Honor System.
5. Students may request withdrawal from any course, irrespective of the grade earned to that point.

## Repeated and Duplicated Courses

A course that partially or wholly duplicates another (already taken) course does not count toward graduation. Duplication of two courses does not necessarily mean that they are equivalent; rather, it means that there is sufficient material overlap that credit is not allowed for both. No credit will be given toward graduation for duplicated courses nor may duplicate courses be used for GPA enhancement unless the grade in the course already taken is a C- or less. Students may repeat courses in which they received grades of C- or below, however a student may only attempt a course three times. An "attempt" is when a student is enrolled in a course on the last day to add courses during each semester. Courses designated as repeatable credit (to the limit allowed) are excluded from this policy (e.g. undergraduate research, etc.). Both grades stay on the record and figure into the overall and in-major GPA, but the course hours count only once toward graduation. Transcripts will display all hours attempted whether or not they count toward graduation. Repeating a course may affect financial aid and eligibility for certain programs for veterans, athletes, and international students.



## Attendance in Class

It is the policy of the Chemistry Department that students must attend all timetable-scheduled lectures, labs, and recitations *for all of their courses*, not just chemistry courses. However, students who are sick should stay home and avoid infecting others. *It is considered polite to send your instructors a note indicating that you must miss lecture due to illness.* Normally, in lab courses, such notifications are absolutely required.

## Incomplete Grades

When a student has missed an assignment or two in the latter portion of a semester, or missed the final exam, an instructor may assign an Incomplete ("I") grade, giving the student more time to complete the work. Assignment of Incomplete grade is the sole discretion of the course instructor. After completion and grading, the instructor can then enter a final grade (A to F or P/F) for the student. The instructor and student must have a written agreement as to the absolute deadline for completion of the missed work. The deadline must be *before the end of the next regular term*. Resources for completion of the work cannot include attending lectures or gaining access to Canvas in a subsequent term. In addition, there can be no lab activities after the end of the enrolled term. If the completion deadline is missed, then zeroes are assigned for work that has not been completed. If the instructor fails to enter a new grade, the Registrar's Office will replace the "I" grade with an "F". An "incomplete" is not intended for a situation where a student has missed a significant portion of the graded work for the term, or when assignments or exams were missed during the early part of the term, because those issues should have been rectified sooner. Students who have missed a lot of work for a course during a given term should use "W" or consider Academic Relief. The intention is to use any of these means of relief rarely, but they do have a purpose.

## Transfer Credit

Students transferring to Virginia Tech from a community college may transfer as many as 60 credits. Those who transfer from a four-year college have no such limitation. However, all students must take at least 27 of their last 45 hours at Virginia Tech. Also, chemistry majors and minors must take at least 25% of the required chemistry courses at Virginia Tech.

More information is available online at the University Registrar's website: <http://www.registrar.vt.edu>. Transfer students should also review the Transfer Guide: <https://transferguide.registrar.vt.edu/>

Students frequently wish to take summer school courses at other institutions for transfer back to Virginia Tech. The student should contact the college or university they wish to attend to determine what courses will be offered. An "Authorization to Take Courses Elsewhere" form should be obtained from the student's advisor or primary major's academic dean's office. For students whose (primary) major is chemistry, the form may be found in the College of Science's administrative office or from the COS forms webpage:

- <https://www.science.vt.edu/academics/advising/forms.html>

The Authorization form must be returned to the Dean's office at least 3 weeks before matriculation at the other institution. An evaluator will determine whether the desired courses will transfer as expected, and you will receive an email when the request form has been reviewed. After the courses are completed, the student must request that an official transcript be sent to the University Registrar at Virginia Tech.

## Double Majors and Second Degrees

Students who complete the requirements for two majors within the same academic term are considered Double Majors. Students receive a diploma for the primary major (degree) and a double major certificate for the secondary major (double major).

Students may complete the requirements for a Second Degree in a different academic term. Students pursuing a Second Degree must complete an additional 30 credits over the minimum required for their first degree. Students will receive a separate diploma for each degree. You should indicate on your Application for Degree on Hokie SPA if your secondary major should be a double major or a second degree.

## Change of Major

Even though we would love to retain as many students in our program as possible, if you decide that your current major in chemistry is not the right program, the Advising Team will do everything possible to facilitate your transfer to another program or even to another institution.

Virginia Tech provides a means for incoming first-year students to inquire about changing their major before they arrive in Blacksburg. The student can email [appchange@vt.edu](mailto:appchange@vt.edu) to see if they are able to change their major. If your major cannot be changed before you matriculate, then **you will have the opportunity, during your regular July orientation meeting with CHEM advisors in July, to discuss your preferences and to plan a schedule of courses that will facilitate your entry into your preferred major.** Please note that CHEM advisors cannot influence admissions decisions made by other departments. Moreover, you are responsible to research the department you wish to enter and to make sure you are aware of their requirements.

Changing majors within the Chemistry Department (such as a change from BS-CHEM to BS-MDCH) is the easiest change and can be processed at any time. You need to complete the College of Science Change of Major form – in a special way that your advisor can describe to you (with printed instructions).

Changing to a major outside the Chemistry Department is processed only during certain time intervals. In addition, some majors have restrictions for your GPA, prerequisite courses, and so on. Before reading further here, please consult this link: [https://www.registrar.vt.edu/dates-deadlines/Change\\_of\\_Major\\_Dates.html](https://www.registrar.vt.edu/dates-deadlines/Change_of_Major_Dates.html)).

We are often asked about changing to a restricted major within the College of Engineering (COE) such as Chemical Engineering. Entry into a restricted COE major, from a major outside COE, can be a long process that requires you to pass specific courses before you can be admitted to COE. Details are provided at the link below. The required courses include (but are not necessarily limited to) ENGE 1215-1216 Foundations of Engineering, MATH 1225–1226 Calculus of a Single Variable, and ENGL 1105 First-Year Writing. Completion of ENGE 1215-1216 is problematic because of major restrictions on ENGE 1215 in the fall semester; students often address this issue by completing ENGE 1215-1216, either partially or entirely, over the summer using equivalent Virginia Community College System (VCCS) courses. Please reach out to your advisor for help in planning your change of major and to answer any questions that were not answered here or at the links provided on this page.

<https://eng.vt.edu/academics/undergraduate-students/resources-support/change-of-major/restricted.html>

## Combining Chemistry Majors with the Integrated Science Curriculum (ISC)

ISC is a two-year program offered by the College of Science, in which chemistry, biology, math, and physics are woven into a unique four-semester lecture-and-lab sequence. ISC is popular and growing. Completion of the four-semester ISC sequence gives equivalent credit for: BIOL 1105, 1115, and 1116 (but not BIOL 1106); CHEM 1035–1036 and CHEM 1045–1046 (which can substitute for CHEM 1055–1056 and CHEM 1065–1066 in our majors); PHYS 2305–2306 (which can substitute for PHYS 2205–2206 and PHYS 2215–2216 in the BS-MDCH program), and MATH 1025–1026, which can NOT substitute MATH 1225–1226 (CHEM/ISC students should take MATH 1225-1226 along with first-year ISC). Because of the way chemistry content is organized in ISC, organic chem (CHEM 2565–2566, CHEM 2555–2556, and CHEM 2564) must be delayed one full year. BS-MDCH and BS-POLY students can overcome this delay by pushing some courses into the third and fourth year, where there is more credit space. For BS-CHEM students the transition from ISC to CHEM is more challenging but can still be accomplished with initiative and creativity. This transition is one that the student should discuss in detail with their CHEM advisor.

## Minors

Any department that offers a major may offer a minor. If you desire a minor in a particular subject, contact the appropriate department for their requirements or ask your advisor. Note that Majors and Minors are supposed to be added before senior year. A full listing of minors can be found on the Registrar's website:

- <https://www.registrar.vt.edu/graduation-multi-brief/checksheets.html>

## Graduation

You should apply for your Degree on Hokie Spa during the first semester of your junior year. You may then generate a Degree Audit Report System (DARS) report in Hokie Spa to review your record to see what requirements remain to be completed for graduation. Applying for your degree early ensures that you will have time to take courses that you may have overlooked, and it allows you and your advisor to correct the Registrar's analysis if errors are present. Finally, you should be advised that the Registrar's graduation analysis is not a binding contract. Do not assume that you are excused from a required course on the basis of error in DARS; the Registrar will eventually find the mistake and you will not graduate.

## Other General Requirements

1. No more than 60 hours in the major may be counted towards the total required for graduation.
2. Students must demonstrate proficiency in a foreign language equivalent to one year of university instruction. This requirement can be met in several ways:
  - a. Completing the third year (Level III) of a language in high school.
  - b. Completing two years each of two different foreign languages in high school (for COS majors).
  - c. Completing the 1106 course in Chinese, French, German, Greek, Italian, Japanese, Latin, Portuguese, Russian, or Spanish, including any prerequisites.
  - d. NOTE: Students who have not completed foreign language requirements in high school may not count these hours toward the 120 required for graduation.
  - e. Passing an oral examination in a language not taught at Virginia Tech.
  - f. Documenting that English is not your primary language (see Department of Foreign Languages & Literatures for obtaining documentation).

## Honors College

The Chemistry Department has faculty members who are active participants in the Honors College at VT. We encourage those who are eligible to apply to the Honors College and pursue an Honors Laureate Diploma.

Additional information on the Honors College can be found at (<http://www.honorscollege.vt.edu/>), or by calling their office to speak with someone or to schedule an appointment – (540) 231-4591. The Chemistry Department's liaison to the Honors College is Prof. Gordon Yee (HHS 2103, [gyee@vt.edu](mailto:gyee@vt.edu)).

## Undergraduate Research

Background. You can explore CHEM 4994 research as soon as the spring of your freshman year! The chemistry advising team recommends considering a credit of CHEM 4994 undergraduate research to all students who are performing well academically\* and who want to learn beyond the classroom and gain vital career-relevant experience. Research provides knowledge, skills, and critical thinking opportunities that support and complement your classroom and lab-course education. \*CHEM 4994 requires a minimum GPA of 2.5; for second semester freshmen, the recommended minimum is 3.0.

Typically, one credit of CHEM 4994 corresponds to about 3-4 hours per week of research work, which may include lab experiments, computer work, reading, preparing presentations, attending a group meeting, etc. This is only a guideline and not a rule. Each professor will manage CHEM 4994 students differently. Some professors require students to do their first semester of work on a not-for-credit ("volunteer") basis.

You can – and should – look on the VT Chemistry website for information about different research programs in our department. Then, you can – and should – email faculty members whose research interests you to inquire about opportunities in their area. Professors *expect and want* you to reach out to them! Don't be shy! You may receive some rejections based on their availability or your academic background. Those are minor disappointments that should not deter you from your objective. Opportunities to learn about research programs during CHEM 1004 or through the Chemistry Club are also highly valuable. Ideally these explorations would take place around weeks 10-13 of the *previous semester*.

You do NOT have to do research in a certain area to have a rewarding experience. It's more important that you find a professor and research group that you feel will be a good learning environment for you. Especially, there is a large demand for projects in medicinal chemistry, partly because the major in Medicinal Chemistry has become very popular. Likely there is not enough availability in the drug-discovery and natural-products research groups to accommodate everyone for CHEM 4994. Meanwhile, other areas of active research such as theoretical, computational, and inorganic chemistry are often undersubscribed. Therefore, students need to be open-minded about the kinds of research that they would find enjoyable and stimulating. This issue also underscores the importance of reaching out to professors sooner rather than later.

### Registration Workflow.

**Students cannot course-request CHEM 4994 or add CHEM 4994 to their own schedules.**

1. Before you can sign up for CHEM 4994, you need to have a serious discussion with your research supervisor and agree on the kind of experience you will have under their guidance, and to agree on all of the details that will be needed to complete the registration form (see below).
2. The "normal" combination is a Chemistry student working with a Chemistry professor. If that's not your situation, then read this carefully: If your primary major is not in College of Science, then you need to use the form in your own college, even if you are signing up for CHEM 4994. Note that College of Engineering has a shorter deadline of Wednesday of the first week of classes. On the other hand, if you're a chemistry

major who will be doing research in a department *other* than Chemistry, then you can use the COS form, but you'll need the CRN number from the other department.

3. You **must** start this process **early** (ideally before classes have even started) **because the form – which is submitted by the student – is due on the Friday of the first week of classes, 5:00 PM.** As long as the student has submitted a fully executed form by this deadline, then it's okay if some of the *other* approvals happen over the next few days. We HAVE had late forms rejected by the Associate Dean!! Don't be the one!!

4. Chemistry students need to use a COS Form to sign up for research credit (CHEM 4994).

<https://www.science.vt.edu/academics/advising/forms.html>

Scroll down on the page and look for "Experiential Learning"

The form is submitted by the student, and then it goes (electronically, automatically) to the research mentor (4994 instructor), then to the student's regular academic advisor, and then to Dr. Timothy Saarinen for department approval, before going to the COS Associate Dean. Once the Dean's Office approves your form (which might take up to a week), then the Dean's Office will add CHEM 4994 to your schedule. You cannot add CHEM 4994 by yourself, but you can drop it, before the "last day to drop."

5. There are several parameters that you need to negotiate with your research advisor BEFORE trying to complete and submit the COS form:

- How many credits of research do you wish to enroll? A typical expectation for CHEM 4994 is 3-4 hours of research-related activities per week per credit hour. Most students start out with one credit, but you may take more if your schedule is quite open.
- Will you enroll pass-fail or for a grade (A-F)? Almost all CHEM 4994 credits are A-F.
- What is the CRN? On the timetable, there is a CRN for CHEM 4994 for each faculty member. If you need an Honors section (4994H), please contact Amy K, and she will assign a section of CHEM 4994H to your research advisor.
- What is the title of your research project?
- Which of the following will you do as part of your experience? Usually students will do at least a few of these, and there are check-boxes for all of these activities on the form.
  - ☐ Will you assist in data collection?
  - ☐ Will you assist in data analysis?
  - ☐ Will you engage in extensive amounts of reading?
  - ☐ Will you give a formal presentation to your advisor's research group?
  - ☐ Will you give a talk or a poster at a research meeting or conference (the Chemistry Department Research Poster Session that is held every semester qualifies)?
  - ☐ Will you contribute to a manuscript for publication?

6. Make sure your research advisor knows the Department Approver is Tim Saarinen (tsaarinen29@vt.edu).

7. The form will also ask you for information about yourself such as your GPA overall and in-major. You can get your in-major GPA from your DARS.

Questions? Ask your advisor.

## Clubs and Organizations

One of the big advantages of a large public institution like Virginia Tech is the breadth of opportunity beyond the classroom. Are you a poet? A musician? A dancer? A stand-up comedian? Do you enjoy video games or hiking or bowling or ping-pong or working out? Do you want to socialize with others who share your characteristics or your interests or your world view? Virginia Tech offers innumerable clubs, organizations, and cultural centers to explore and nurture your unique mix of interests.

Your advisor may ask you, from time to time, whether you have joined any clubs or organizations. That's because we recognize their value in maintaining a wholesome and healthy lifestyle, even as a busy student. Members of the Virginia Tech faculty and staff are people, too, with hobbies and lives beyond the university.

There are two student groups affiliated with the Chemistry Department at Virginia Tech: Alpha Chi Sigma, the co-ed professional chemistry fraternity; and the Chemistry Club, a student affiliate chapter of the American Chemical Society. All chemistry majors are encouraged to join one and/or both of these groups. Activities include meetings, socials, tutoring, and hosting "illusion shows" and other fun activities. These organizations are great opportunities for you to network with your peers, organize study groups, and broaden your social opportunities at Virginia Tech.

### Alpha Chi Sigma

AXE is a co-ed professional chemistry fraternity.

- <https://alphachisigma.wixsite.com/axsvt>

### Chemistry Club

The Chemistry Club is affiliated with the American Chemical Society (SAACS).

- <https://chem.vt.edu/undergraduate/student-organizations.html>

## Scholarships and Awards

Scholarship Central (<https://vt.academicworks.com/>) is the best site to explore scholarship opportunities for Virginia Tech students.

The Chemistry Department also maintains direct control over its own collection of scholarships, including those that are need-based and several that are merit-based. The Department also nominates students for various awards, including some that are offered by other agencies such as the College of Science, the American Chemical Society, and so on. Award recipients are selected annually by the Undergraduate Education Committee within the Chemistry Department. Most recipients are seniors – but not all!! If you think you would be a good candidate for a particular award, discuss that with your advisor.

Regarding awards and scholarships administered by the Chemistry Department, students need to be aware of two key criteria for eligibility:

- You must have submitted your **Application for Degree** to be eligible.
- You may not have any convictions within the Honor System to be eligible.



## Your Well-Being and Work-Life Balance

The Chemistry Department believes strongly in educating, advising, and supporting the whole student in view of Hokie Wellness, which strives to educate and empower every Hokie to take an active and engaging day-to-day approach to their wellness in order to enjoy a long, healthful, and purpose-filled life. Your advisor can direct you to resources on campus that can help you with individual needs. Many of the resources described here are also embedded within Virginia Tech's new Residential Well-Being program.

- University or "Cook" Counseling Center (UCC): short-term individual, couples, and group counseling for a variety of concerns. Students come in for counseling to help them with issues such as stress, depression, anxiety, loneliness, sexual concerns, academic motivation, and relationship problems.
  - Website: <https://www.ucc.vt.edu>
  - Daytime phone: 540-231-6557
  - Emergency phone: 540-231-6444 or dial 911
- Public Health Information: Virginia Tech maintains an information-rich website on many aspects of Public Health, with sections for COVID-19, cold & flu, monkeypox, norovirus, sexual health, and substance misuse. Of course, many of these areas are advised and maintained by the staff at UCC.
  - Website: <https://www.vt.edu/public-health.html>
- Student Success Center: free academic support – such as tutoring and a wide variety of seminars and information sessions (including seminars on time management, honing test-taking and note-taking skills, and how to stay focused through the semester) – to undergraduate students.
  - Website: <https://www.studentsuccess.vt.edu>
- Virginia Tech Police Department: The Virginia Tech Police Department is nationally accredited by the Commission on Accreditation for Law Enforcement Agencies. VTPD strives to enhance the safety and quality of life for students, faculty, staff and visitors through effective law enforcement and proactive crime prevention in partnership with the university community. Several programs are offered by the department, free of charge, to VT students, including Student's Police Academy, Self-Defense/Rape Aggression Defense System course, and VT C- CERT (Campus Community Emergency Response Team) training. Please visit the department's website ([www.police.vt.edu](http://www.police.vt.edu)) for more information. The police department also sponsors a nighttime campus safety escort service known as Safe Ride. Safe Ride operates from dusk until dawn and provides transportation or a walking escort upon request.
  - Website: <https://www.police.vt.edu>
  - Phone for Safe Ride: 540-231-SAFE
- Dean of Students Office: If you have an extended or serious illness, a death in your family, or other significant personal difficulty that will cause you to miss a significant number of classes (or any labs), or from meeting course deadlines, notify the Dean of Students (website = <http://dos.vt.edu>, email = [dos@vt.edu](mailto:dos@vt.edu)) of your issue. They will manage your personal verification and private documentation such as notes from doctors, funeral directors, etc., which instructors normally do not wish to handle. The Dean of Students will also notify, via your Academic Dean, all of your course instructors of your situation with a date range for your 'verified absence.' This endorsement from the Dean of Students does *not* guarantee extensions on deadlines, but it *allows* an instructor to help you with less concern about unfairness toward others. There are practical limits on academic accommodations and that some situations are severe enough to warrant other forms of assistance such as course withdrawal or academic relief, which are described elsewhere in this Handbook.

## Inclusion and Diversity

- The Chemistry Department is committed to providing an inclusive educational and working space for all of its students and employees.
- If there are aspects of your program that prevent you from learning or exclude you, please let your advisor know as soon as possible. We can set up a private meeting (in person or Zoom) and work together to develop strategies to meet both your needs and the requirements of program, and we can advocate for you with other individuals including your course instructors or campus administrators.
- All members of the Advising Team will honor your request to address you by your chosen name or personal pronoun. Please advise us so that we may make appropriate changes to our records.
- If you are a veteran or active-duty military personnel with special circumstances (e.g., upcoming deployments, drill requirements, disabilities) please know that we want to accommodate your special circumstances. You will find that course instructors are quite accommodating toward the needs of veterans and active-duty military personnel.
- In the event an instructor or advisor suspects you need additional support, they will often express their concerns and remind you of resources that might be helpful to you. It is not their intention to pry into the details of what might be bothering you, but simply to let you know we are concerned and that help, if needed, is available.
- Any student who has difficulty affording groceries, accessing sufficient food to eat every day, or who lacks a safe and stable place to live, or who lacks child care, and who believes this may affect your performance in this course, is urged to contact the Dean of Students office for support at 540-231-3787 ([dos@vt.edu](mailto:dos@vt.edu)) or complete an interest form to participate in The Market at Virginia Tech. The Dean of Students, through [The Market at Virginia Tech](#), offers food options and other resources. There is also a [Student Emergency Fund](#) program. If you are comfortable in doing so, please notify your professor or departmental advisor of your situation. This will enable them to provide any resources to which they may have access.
- We respect and support your decision to honor your cultural and religious holidays. If you have religious or cultural observances that coincide with your classes, please notify your instructor through email at least one week before the date that is in conflict. Otherwise, they will reasonably assume that you plan to attend all class meetings.
- Your advising team wants you to feel able to share your life experiences in our advising conversations. We want you to trust that we will keep any information you share private. Please be aware that we do have a mandatory reporting responsibility related to our roles as members of the faculty or staff. This means we are required to share information regarding sexual misconduct or information about a crime that may have occurred on campus with the university Title IX Coordinator.

## Disability and Other Special Needs

Virginia Tech welcomes students with disabilities into the University's educational programs and promotes efforts to provide equal access and a culture of inclusion without altering the essential elements of coursework. If you anticipate or experience academic barriers that may be due to disability, including but not limited to ADHD, chronic or temporary medical conditions, deaf or hard of hearing, learning disability, mental health, or vision impairment, please contact the Services for Students with Disabilities (SSD) office (540-231-3788, [ssd@vt.edu](mailto:ssd@vt.edu), or visit [ssd.vt.edu](http://ssd.vt.edu)).



## Conflict and Discrimination

The Chemistry Department promotes and supports an educational and working space that is free of conflict and discrimination. This page describes resources for navigating conflict and for reporting discrimination.

If you are unsure who to talk to, the University Ombudsperson provides a safe place for you to be heard and engage in a confidential and informal conversation to bring clarity to your situation and plan a path forward. Note that The Ombudsperson is **not** a mandatory reporter (see boxed definition at the bottom of the page\*). Email [Ombuds@vt.edu](mailto:Ombuds@vt.edu) or call 540-231-3125 to set up an appointment. You should also feel free to talk with other undergraduate students about how similar problems have been handled previously.

### Do you want to file a formal report?

**NO or NOT YET** – You can remain anonymous, *depending on the circumstances*

**Departmental issue or conflict** → Talk to a fellow student or visit Dean of Students ([dos.vt.edu](https://dos.vt.edu)).

**Bias incident** → Report bias at [Express-A-Concern](#) (a service of the Dean of Students)

**Personal problem or conflict** → Several resources are available:

Dean of Students ([dos.vt.edu](https://dos.vt.edu)) or the University Ombudsperson ([ombuds@vt.edu](mailto:ombuds@vt.edu))

Women's Center ([womenscenter.vt.edu](https://womenscenter.vt.edu)) or University Counseling Center ([ucc.vt.edu](https://ucc.vt.edu))

Conflict Resolution ([oea.vt.edu](https://oea.vt.edu))

Cultural and Community Centers ([ccc.vt.edu](https://ccc.vt.edu))

**Harassment or Discrimination** (for this category, mandatory reporting requirements will apply\*)

Dean of Students ([dos.vt.edu](https://dos.vt.edu)) or the University Ombudsperson ([ombuds@vt.edu](mailto:ombuds@vt.edu))

Women's Center ([womenscenter.vt.edu](https://womenscenter.vt.edu)) or University Counseling Center ([ucc.vt.edu](https://ucc.vt.edu))

Office for Equity and Accessibility ([equityandaccess@vt.edu](mailto:equityandaccess@vt.edu))

### Do you want to file a formal report?

**YES** – **Mandatory reporting\* will apply (see box at the bottom of the page)**

**Departmental issue or conflict** → You may speak with a trusted faculty member; or the Department Head (Amanda Morris); or the Undergraduate Program Director (Paul Deck).\* If action is required by the departmental administration, then final action will be taken by the Department Head.

**Personal problem or conflict** → You may speak with the Undergraduate Program Director (Paul Deck) or any other trusted faculty member.\*

**Harassment or Discrimination** → Contact the Office for Equity and Accessibility at 540-231-2010 or by email at [equityandaccess@vt.edu](mailto:equityandaccess@vt.edu). The OEA will respond to the report and manage all aspects of any appropriate investigative and disciplinary processes.

**\*Mandatory Reporting.** University [Policy 1025](#) and [Policy 1026](#) require VT faculty, staff, and oftentimes graduate students with employment responsibilities, to report incidents of discrimination or harassment to the Office for Equity and Accessibility. This responsibility to report applies fully, *even if the person raising the concern asks that no action be taken or requests confidentiality*. For more information, see the policies or contact OEA at [equityandaccess@vt.edu](mailto:equityandaccess@vt.edu).

## Course Descriptions

**Pathways Concept numbers are defined on p. 6.**

### **CHEM 1004 - First Year Experience in Chemistry (1 credit)**

Orientation to the Chemistry Department and to the discipline of chemistry for chemistry majors and for individuals considering CHEM as a major, including transfer students. Resources for success, both generally as a college student and specifically as a chemistry major. Opportunities for mentoring, individual research and community involvement across the university and within the Chemistry Department. Exploration of career pathways for chemistry majors. Interconnections among professional practice, disciplinary progress, accepted standards for ethical use of information, principles of diversity and inclusion, and individual or personal value systems. Scientific communication, professional networking, and chemistry in the public eye.

### **CHEM 1014 - Calculations in Chemistry (3 credits)**

Mathematical problem solving skills required for success in general chemistry. Manipulation of symbolic algebraic formulas. Dimensional analysis and narrative mathematical exercises. Application of problem solving techniques to chemical processes and reactions. Generation and interpretation of graphs using computer software. Elementary features of atoms, molecules, and the periodic table of the elements. Molar quantities, chemical nomenclature, reaction stoichiometry, and introductory solution chemistry.

### **CHEM 1015 - Chemistry in Context (3 credits) (P4)**

Survey of chemistry across areas of specialization for students enrolled in curricula other than science and engineering. History and fundamental concepts and theories of chemistry, including the consequences of changes in parameters on chemical systems. Impact of chemistry in the context of areas of public concern and policy, including best practices for sustainability, rational decision-making, ethical use of scientific information, product and process stewardship. Chemistry as a basis for decision-making in the context of individual values and beliefs, and the roles of values and beliefs in the progress of chemistry as a human endeavor. The foregoing to be based on the concepts of chemistry as follows: 1015: Periodicity and atomic structure; nuclear chemistry; chemical bonding and reactivity; organic chemistry, polymer chemistry, and medicinal chemistry. 1016: Chemical stoichiometry including conservation of matter and energy; acid-base and oxidation-reduction chemistry of solutions; stoichiometry and thermodynamics, agricultural and environmental chemistry, chemistry of household and personal care products

### **CHEM 1016 - Chemistry in Context (3 credits) (P4)**

Survey of chemistry across areas of specialization for students enrolled in curricula other than science and engineering. History and fundamental concepts and theories of chemistry, including the consequences of changes in parameters on chemical systems. Impact of chemistry in the context of areas of public concern and policy, including best practices for sustainability, rational decision-making, ethical use of scientific information, product and process stewardship. Chemistry as a basis for decision-making in the context of individual values and beliefs, and the roles of values and beliefs in the progress of chemistry as a human endeavor. The foregoing to be based on the concepts of chemistry as follows: 1015: Periodicity and atomic structure; nuclear chemistry; chemical bonding and reactivity; organic chemistry, polymer chemistry, and medicinal chemistry. 1016: Chemical stoichiometry including conservation of matter and energy; acid-base and oxidation-reduction chemistry of solutions; stoichiometry and thermodynamics, agricultural and environmental chemistry, chemistry of household and personal care products

### **CHEM 1025 - Introduction to Chemistry Laboratory (1 credit) (P4)**

Virtual laboratory exercises and reading and writing assignments designed to accompany 1015 and 1016, as applicable. Illustrates and elaborates on principles addressed in lecture, including history and fundamental concepts, theories, contexts, with an emphasis on sustainability issues and ethical consequences of decision-making in chemistry. Students will identify foundational concepts in chemistry, enumerate parameters likely to influence the outcome of an experiment, analyze the ways that values and beliefs influence progress in the discipline and communicate chemical concepts to a lay audience.

### **CHEM 1026 - Introduction to Chemistry Laboratory (1 credit) (P4)**

Virtual laboratory exercises and reading and writing assignments designed to accompany 1015 and 1016, as applicable. Illustrates and elaborates on principles addressed in lecture, including history and fundamental concepts, theories, contexts, with an emphasis on sustainability issues and ethical consequences of decision-making in chemistry. Students will identify foundational concepts in chemistry, enumerate parameters likely to influence the outcome of an experiment, analyze the ways that values and beliefs influence progress in the discipline and communicate chemical concepts to a lay audience.

### **CHEM 1034 - General Chemistry Recitation (1 credit)**

A companion course for students needing supplemental help with mathematical and problem-solving skills required for CHEM 1035 General Chemistry. Manipulation of algebraic formulas. Application of problem-solving techniques to chemical processes and reactions. Quantitative methods applied to unit conversions, reaction yields, energy of reactions, and gas properties. Examination of atomic structure, periodicity, and molecular bonding. May not count towards degree requirements; consult advisor. Pass/Fail only.

- Co: CHEM 1035.

### **CHEM 1035 - General Chemistry (3 credits) (P4)**

First chemistry course for students in science curricula. Applications of reasoning in the natural sciences using chemical laws in an applied context and in the student's own discipline. Overview of the universal aspects of chemistry and of application of chemistry to address global challenges. 1035: Problem-solving, elements and periodic table, stoichiometry of chemical reactions, gas phase of matter, energy flow and chemical change, atomic structure, and theories of chemical bonding. 1036: Kinetics, equilibrium, thermodynamics, electrochemistry, transition elements, nuclear chemistry. (Duplicates 1015-1016.)

- Pre: CHEM 1014 or or MATH 1025 or MATH 1536 or MATH 1225 or MATH 1214 or ALEKS 61.
- Co: MATH 1025 or MATH 1225.

### **CHEM 1036 - General Chemistry (3 credits) (P4)**

First chemistry course for students in science curricula. Applications of reasoning in the natural sciences using chemical laws in an applied context and in the student's own discipline. Overview of the universal aspects of chemistry and of application of chemistry to address global challenges. 1035: Problem-solving, elements and periodic table, stoichiometry of chemical reactions, gas phase of matter, energy flow and chemical change, atomic structure, and theories of chemical bonding. 1036: Kinetics, equilibrium, thermodynamics, electrochemistry, transition elements, nuclear chemistry. (Duplicates 1015-1016.)

- Pre: CHEM 1035 or 1055 or 1055H.
- Co: MATH 1025 or MATH 1225.

**CHEM 1045 - General Chemistry Laboratory (1 credit) (P4)**

Hands-on, real-world activities that illustrate and elaborate on concepts taught in general chemistry lecture (1035), including acids and bases, heat capacity, ideal gases, states of matter, concentration, mixtures, energy flow and spontaneity in processes, equilibrium, kinetics, colligative properties, and electrochemistry. Use of instrumentation to analyze water and soil contaminants, biofuel mixtures, nanoparticles, and polymer properties. Laboratory safety, chemical hygiene, hazard mitigation, waste management, and the influence of procedure on experimental outcomes. Global challenges, including recycling and sustainable energy sources, water resource management, global warming, and environmentally friendly reagents in chemical contexts. Use of computers in data analysis, collaboration, and report-writing.

- Pre: CHEM 1014 or MATH 1014 or MATH 1025 or MATH 1536 or MATH 1225 or MATH 1214.
- Co: CHEM 1035.

**CHEM 1046 - General Chemistry Laboratory (1 credit) (P4)**

Hands-on, real-world activities that illustrate and elaborate on concepts taught in general chemistry lecture (1036), including acids and bases, heat capacity, ideal gases, states of matter, concentration, mixtures, energy flow and spontaneity in processes, equilibrium, kinetics, colligative properties, and electrochemistry. Use of instrumentation to analyze water and soil contaminants, biofuel mixtures, nanoparticles, and polymer properties. Laboratory safety, chemical hygiene, hazard mitigation, waste management, and the influence of procedure on experimental outcomes. Global challenges, including recycling and sustainable energy sources, water resource management, global warming, and environmentally friendly reagents in chemical contexts. Use of computers in data analysis, collaboration, and report-writing.

- Co: CHEM 1036.

**CHEM 1055 - General Chemistry for Chemistry Majors (4 credits)**

In depth treatment of chemical bonding, thermodynamics, chemical equilibrium, reaction kinetics, descriptive chemistry of the elements, acid-base chemistry, chemistry of gases, liquids and solids, and other topics. This class is restricted to chemistry and biochemistry majors. Other students may request consent of instructor.

- Pre: CHEM 1014 or MATH 1014 or MATH 1025 or MATH 1225 or MATH 1214 or ALEKS 61.
- Co: CHEM 1065 and (MATH 1025 or MATH 1225).

**CHEM 1056 - General Chemistry for Chemistry Majors (4 credits)**

In depth treatment of chemical bonding, thermodynamics, chemical equilibrium, reaction kinetics, descriptive chemistry of the elements, acid-base chemistry, chemistry of gases, liquids and solids, and other topics. This class is restricted to chemistry and biochemistry majors. Other students may request consent of instructor.

- Pre: CHEM 1055
- Co: CHEM 1066

**CHEM 1065 - General Chemistry for Chemistry Majors Lab (1 credit)**

Accompanies 1055-1056. Selected experiments illustrate principles taught in lecture. This class is restricted to chemistry and biochemistry majors. Other students may request consent of instructor.

- Pre: CHEM 1014 or MATH 1014 or MATH 1025 or MATH 1536 or MATH 1225 or MATH 1214
- Co: CHEM 1055

**CHEM 1066 - General Chemistry for Chemistry Majors Lab (1 credit)**

Accompanies CHEM 1056. Selected experiments illustrate principles taught in lecture. This class is restricted to chemistry and biochemistry majors. Other students may request consent of instructor.

- Co: CHEM 1056

**CHEM 2114 - Analytical Chemistry (3 credits)**

A first course in analytical chemistry. Topics covered include volumetric and gravimetric analysis, and elementary spectroscopy. This analytical chemistry course is required for degree programs in environmental science (ENSC) and geosciences (geochemistry option).

- Pre: CHEM 1036 or CHEM 1056 or CHEM 1056H
- Co: CHEM 2124

**CHEM 2124 - Analytical Chemistry Laboratory Techniques and Practice (1 credit)**

Practical introduction to wet methods of quantitative chemical analysis based on fundamental chemical principles.

- Pre: CHEM 1045 or CHEM 1066
- Co: CHEM 2114

**CHEM 2154 - Analytical Chemistry for Chemistry Majors (4 credits)**

A one-semester course in analytical chemistry emphasizing the principles of equilibrium with examples from acid-base, complexation, solubility, and redox chemistry. The course also introduces the principles of spectroscopic, electrochemical, and chromatographic instrumentation.

- Pre: CHEM 1036 or CHEM 1056 or CHEM 1056H
- Co: CHEM 2164

**CHEM 2164 - Analytical Chemistry for Chemistry Majors Lab (1 credit)**

A one-semester laboratory course in analytical chemistry that provides practical training in wet chemical methods, atomic and molecular spectroscopy, electrochemistry, and separations.

- Pre: CHEM 1046 or CHEM 1066
- Co: CHEM 2154

**CHEM 2424 - Descriptive Inorganic Chemistry (3 credits)**

Application of fundamental principles in a systematic study of bonding and reactivity of the elements and their compounds.

- Pre: CHEM 1036 or CHEM 1056

**CHEM 2514 - Survey of Organic Chemistry (3 credits)**

Short course in fundamentals of organic chemistry with emphasis on nomenclature, isomerism, and properties of organic compounds. Compounds of importance to biology and biochemistry stressed. (Prior credit for 2535 precludes credit for this course.) One year of Chemistry required.

- Pre: (CHEM 1035 or CHEM 1055 or CHEM 1055H) and (CHEM 1036 or CHEM 1056 or CHEM 1056H)

**CHEM 2535 - Organic Chemistry (3 credits)**

Structure, stereochemistry, reactions, and synthesis of organic compounds.

- Pre: (CHEM 1036 or CHEM 1056 or CHEM 1056H or ISC 1106 or ISC 1106H)

**CHEM 2536 - Organic Chemistry (3 credits)**

Structure, stereochemistry, reactions, and synthesis of organic compounds. Pre: One year of chemistry, including lab.

- Pre: CHEM 2535 or CHEM 2565 or CHEM 2565H

**CHEM 2545 - Organic Chemistry Laboratory (1 credit)**

The laboratory accompanies lectures in organic chemistry 2535.

- Pre: CHEM 1046 or CHEM 1066 or ISC 1116
- Co: CHEM 2535 or CHEM 2565

**CHEM 2546 - Organic Chemistry Laboratory (1 credit)**

The laboratory accompanies lectures in organic chemistry 2536.

- Pre: CHEM 2545
- Co: CHEM 2536

**CHEM 2555 - Organic Synthesis and Techniques Lab (2 credits)**

Synthesis and characterization of organic compounds using modern laboratory techniques.

- Pre: CHEM 1045 or CHEM 1065
- Co: CHEM 2565

**CHEM 2556 - Organic Synthesis and Techniques Lab (2 credits)**

Synthesis and characterization of organic compounds using modern laboratory techniques.

- Pre: CHEM 2555
- Co: CHEM 2556

**CHEM 2564 - Problem-Solving in Organic Chemistry (1 credit)**

Writing organic reaction mechanisms; rationalizing and predicting organic reaction outcomes; selecting reagents for organic reactions; designing syntheses of several elementary steps; visualizing molecular stereochemistry.

- Co: CHEM 2565

**CHEM 2565 - Principles of Organic Chemistry (3 credits)**

Organic chemistry for chemistry majors. Structure and reactions of organic compounds, with emphasis on fundamental principles, theories, synthesis, and reaction mechanisms. The subject matter partially duplicates that of 2535-2536; no credit will be given for the duplicated courses.

- Pre: CHEM 1035 or CHEM 1055 or CHEM 1055H

**CHEM 2566 - Principles of Organic Chemistry (3 credits)**

Organic chemistry for chemistry majors. Structure and reactions of organic compounds, with emphasis on fundamental principles, theories, synthesis, and reaction mechanisms. The subject matter partially duplicates that of 2535-2536; no credit will be given for the duplicated courses.

- Co: CHEM 2565

**CHEM 3615 - Physical Chemistry (3 credits)**

Principles of thermodynamics, kinetics, and quantum mechanics applied to chemical equilibria, reactivity, and structure. Partly duplicates 4615, cannot receive credit for both 3615 and 4615.

- Pre: (CHEM 1035 or CHEM 1055 or CHEM 1055H) and (CHEM 1036 or CHEM 1056 or CHEM 1056H) and PHYS 2306 and (MATH 2204 or MATH 2204H or MATH 2224).

**CHEM 3616 - Physical Chemistry (3 credits)**

Principles of thermodynamics, kinetics, and quantum mechanics applied to chemical equilibria, reactivity, and structure. Partly duplicates 4616, cannot receive credit for both 3616 and 4616.

- Pre: (CHEM 3165 or CHEM 3615H) and MATH 2214

**CHEM 3625 - Physical Chemistry Laboratory (1 credit)**

Laboratory study of selected physico-chemical principles and methods. Data acquisition, data analysis, and report writing are stressed.

- Pre: CHEM 3615 or CHEM 3615H or CHEM 4615 or CHE 2164

**CHEM 3626 - Physical Chemistry Laboratory (1 credit)**

Laboratory study of selected physico-chemical principles and methods. Data acquisition, data analysis, and report writing are stressed. I

- Pre: (CHEM 3616 or CHEM 3616H or CHEM 4616) and CHEM 3625 and CHEM 4014

**CHEM 3684 (PHYS 3684) - Quantum Software I (2 credits)**

Organization of quantum information (assemblies of bits) for quantum-computing applications in chemistry, physics, biology, and computer science. Numerical methods for quantum software, emphasizing spin lattices and simulations such as quantum games. Best practices for programming, including techniques for quantum-coding (in Python or Julia), structuring a software product for quantum-computational science use, version control, and cloud-based documentation and code-sharing (via Github). Classical/quantum translation.

- Pre: MATH 2114 or MATH 2114H or MATH 3144
- Co: PHYS 3684

**CHEM 3900 - Bridge Experience (0 credits)**

Application of academic knowledge and skills to in a work-based experience aligned with post-graduation goals using research-based learning processes. Satisfactory completion of work-based experience often in the form of internship, undergraduate research, co-op, or study abroad; self-evaluation; reflection; and showcase of learning.

- Pre: Departmental approval of 3900 plan.

**CHEM 4014 - Survey of Chemical Literature (1 credit)**

Use of the chemical literature as an aid to professional activities

- Pre: Junior standing in the major.

**CHEM 4074 (MSE 4544) - Laboratory in Polymer Science (2 credits)**

Experimental techniques used in the synthesis of various linear polymers, copolymers, and crosslinked networks. Determination of polymer molecular weights and molecular weight distribution. Methods used in the thermal, mechanical, and morphological characterization of polymeric systems.

- Pre: CHEM 4534 and CHEM 3625 and (CHEM 3615 or CHE 2164).

**CHEM 4114 - Instrumental Analysis (3 credits)**

Principles of instrumental methods including data analysis, phase equilibrium, spectroscopy, and electrochemistry. Applications of modern instrumentation to chemical analyses using chromatography, electrophoresis, atomic and molecular spectroscopy, potentiometry, and voltammetry. Note: Graduate students will not be expected to take the corequisite lab 4124.

- Pre: CHEM 2154

**CHEM 4124 - Instrumental Analysis Laboratory (1 credit)**

Hands-on experience with modern instrumental methods of analysis. Experiments use spectroscopy, electrochemistry, and separations.

- Co: CHEM 4114

**CHEM 4404 - Physical Inorganic Chemistry (3 credits)**

A study of spectroscopic, bonding, and structural properties of inorganic compounds.

- Pre: (CHEM 3616 or CHEM 3616H) and CHEM 2424

**CHEM 4414 - Inorganic Chemistry Lab (2 credits)**

Synthesis and characterization of inorganic compounds using modern laboratory techniques.

- Pre: CHEM 2424, (CHEM 3616 or CHEM 3616H), and CHEM 4404
- Co: CHEM 3616 and CHEM 4424



### **CHEM 4424 (SBIO 4424) - Polysaccharide Chemistry (3 credits)**

Structure, properties, and applications of natural polysaccharides. Natural sources and methods of isolation. Synthetic chemistry and important polysaccharide derivatives. Relation of structure and properties to performance in critical applications including pharmaceuticals, coatings, plastics, rheology control, and films. Conversion by chemical and biochemical methods of polysaccharide biomass to fuels and materials.

- Pre: CHEM 2536 or CHEM 2566

### **CHEM 4434 - Organometallic Chemistry (3 credits)**

Synthesis, structure, properties, and reactivity patterns of main-group and transitionmetal organometallic compounds. Applications of organometallic compounds in chemical synthesis and catalysis.

- Pre: CHEM 2424 and CHEM 2566 and CHEM 4404

### **CHEM 4444 - Bioinorganic Chemistry (3 credits)**

Principles underpinning the study of metal ions in biological systems. Review of basic coordination chemistry. Evolution of the distribution of metal ions in biology. Uptake of metal ions from the environment into living organisms. Regulation of metal ion concentrations in cells. Central functions of metal ions in biological systems including modulation of structure, electron transfer reactions, substrate binding and activation, and selective transfer of atoms and groups. Roles of biopolymers in the binding, regulation, and function of metal ions. Physical methods of analysis relevant to bioinorganic chemical research questions. Senior standing.

- Pre: (CHEM 2566 or BCHM 4115) and BIOL 1105 and BIOL 1106

### **CHEM 4514 - Green Chemistry (3 credits)**

Sustainability, waste prevention, conservation of energy resources, avoidance of toxins, pollutants, and hazards in chemical processes and products. Life-cycle analysis applied to case studies involving process development and product stewardship. Applications in chemical industry, process and product design, and public policy.

- Pre: CHEM 2536 or CHEM 2566

### **CHEM 4524 - Identification of Organic Compounds (3 credits)**

Structure determination of organic compounds by spectroscopic methods, with an emphasis on mass spectrometry and nuclear magnetic resonance. Course will emphasize problem-solving skills.

- Pre: (CHEM 2536 or CHEM 2566) and (CHEM 3616 or CHEM 3616H or CHEM 4616)

### **CHEM 4534 - Organic Chemistry of Polymers (3 credits)**

Structure, synthesis, and basic characteristics of the major classes of polymerization reactions including step-growth (condensation) and chain growth (addition), free radical, and ionic mechanisms.

- Pre: CHEM 2536 or CHEM 2566

### **CHEM 4544 - Medicinal Chemistry Capstone Laboratory (2 credits)**

Laboratory experience tracing a standard pathway that potential drug targets follow in many medicinal chemistry laboratories. Synthesis of potential drug compounds and verification of their purity and structural identity primarily using mass spectrometry and nuclear magnetic resonance (NMR) spectroscopy. Optimization of conditions for a biochemical assay and verification of its reproducibility. Use of an optimized assay to measure the potency of potential drug compounds to achieve a desired biochemical effect. Application of structure-activity relationships to propose new chemical structures that might show further improvements in potency. Best practices in laboratory safety, chemical hygiene, note-keeping, and professional report-writing. Senior standing.

- Pre: CHEM 4584 and BIOL 1105 and BIOL 1106

### **CHEM 4554 - Drug Chemistry (3 credits)**

Structure, synthesis, and physiological effects of major classes of pharmaceutical agents including CNS depressants and stimulants, analgesics, anesthetics, cardiovascular agents, chemotherapeutic drugs, and oral contraceptives.

- Pre: CHEM 2536 or CHEM 2566

### **CHEM 4584 - Bioorganic Chemistry (3 credits)**

The organic chemistry underlying the structure and properties of amino acids, peptides, and nucleic acids. Mechanisms of enzyme catalysis and coenzyme-mediated reactions. Mechanisms and thermodynamics of catabolism and anabolism of fats, carbohydrates, and proteins, and of other key biological reactions. Principles of solid-phase synthesis applied to peptides and nucleic acids. Biosynthesis of lipids, sugars, and terpenoids.

- Pre: CHEM 2536 or CHEM 2566

### **CHEM 4615 - Physical Chemistry for the Life Sciences (3 credits)**

Principles of thermodynamics, chemical kinetics, and chemical bonding for students in the life sciences. Laws and applications of thermodynamics. Partly duplicates 3615, cannot receive credit for 3615 and 4615.

- Pre: (CHEM 1036 or CHEM 1056 or CHEM 1056H) and (MATH 1026 or MATH 1226) and (PHYS 2206 and PHYS 2306)

### **CHEM 4616 - Physical Chemistry for the Life Sciences (3 credits)**

Principles of thermodynamics, chemical kinetics, and chemical bonding for students in the life sciences. Chemical kinetics and chemical bonding including spectroscopy. Partly duplicates 3616, cannot receive credit for both 3616 and 4616.

- Pre: (CHEM 1036 or CHEM 1056 or CHEM 1056H) and (MATH 1026 or MATH 1226) and (PHYS 2206 and PHYS 2306)

### **CHEM 4624 - Materials Chemistry in Energy Sciences (3 credits)**

Fundamental principles of solid-state materials chemistry in energy sciences. Thermodynamics and kinetics of electron and ion transport in solid materials. Application of electrochemical and photochemical principles to batteries, fuel cells, solar cells, and other energy devices. Analytical tools and characterization methods for elucidating mechanisms within electrochemical and photoelectrochemical cells, with an emphasis on using electrochemical principles to evaluate battery chemistry. Solid-liquid interfacial mechanisms in energy devices. Critical analysis of relevant primary literature. Formulation of hypotheses and experimental design for improving device performance. Pre: Senior standing.

- Pre: CHEM 3615 or CHEM 4615

### **CHEM 4634 - Polymer and Surface Chemistry (3 credits)**

Physical chemical fundamentals of polymers and surfaces including adhesives and sealants.

- Pre: CHEM 3615 or CHEM 4615

### **CHEM 4684 (PHYS 4684) - Quantum Software II (1 credit)**

Modern software collaboration techniques and tools including collaborative code repositories and cloud-based documentation. Application of structure and version control to software and documentation. Developing code with industry-standard quantum-software modules. Hands-on scientific coding for quantum problems. Project management skills including proposal development and technical presentation delivery.

- Pre: CHEM 3684 or PHYS 3684

### **CHEM 4734 (CSES 4734, ENSE 4734) - Environmental Soil Chemistry (3 credits)**

Chemistry of inorganic and organic soil components with emphasis on environmental significance of soil solution-solid phase equilibria, sorption phenomena, ion exchange processes, reaction kinetics, redox reactions, and acidity and salinity processes.

- Pre: (CSES 3114 or ENSC 3114 or GEOS 3614) and (CSES 3124 or ENSC 3124 or GEOS 3624) and (CHEM 2514 or CHEM 2535) and CHEM 2114 and (MATH 1026 or MATH 1226).

**CHEM 2964 and CHEM 4964 - Field Study (1-19 credits)** This course number is never used.

**CHEM 2974 and CHEM 4974 Independent Study (1-19 credits)** This variable-credit elective is used for faculty-directed studies of special topics in chemistry on an individual basis. Whether a faculty member will instruct you through an “independent study” course, and the “level” of the course (2000 or 4000) is entirely at the faculty member’s discretion. Topics for independent study have included advanced techniques in chemical instrumentation such as GCMS, LCMS, or NMR. Independent Study may be awarded honors credit (2974H or 4974H).

**CHEM 2984 and CHEM 3984 and CHEM 4984 Special Study (1-19 credits)** Special study courses are usually new courses that are being piloted before starting the formal process of proposing a new course for the catalog. A special study might also be an unusual topic in chemistry that is being taught by a visiting faculty member, or it might be a course that a regular faculty member is teaching on a one-time basis. Each special study will be named “TS” followed by the topic of the course. Special study courses can be at either the 2000 level or the 4000 level.

**CHEM 4994 - Undergraduate Research (1-19 credits)** Please see p. 16 of this Handbook.