Preventing for Graduate Study
Dr. Vesna Gasperov (vg2231@columbia.edu)

Coursework Taken Outside of Columbia
Advanced Placement
The department grants advanced placement (AP) credit for a score of 4 or 5 or the equivalent. The amount of credit granted is based on the results of the department assessment exam and completion of the requisite course. Students who register for CHEM UN1604 (2ND TERM GEN CHEM, INTENSIVE) are granted 3 points of credit; students who register for CHEM UN2045 (INTENSIVE ORGANIC CHEMISTRY I-CHEM UN2046 INTENSIVE ORGANIC CHEM II) are granted 6 points of credit. In either case, credit is granted only upon completion of the course with a grade of C or better. Students must complete a department assessment exam prior to registering for either of these courses.

Transfer Courses
Students who are transferring to Columbia should contact Dr. Vesna Gasperov (vg2231@columbia.edu) to have any chemistry courses assessed for equivalency. Please email a detailed syllabus and transcript.

Study Abroad Courses
Chemistry department majors who are planning to study abroad should contact Dr. Vesna Gasperov (vg2231@columbia.edu) if they wish to study any chemistry abroad.

Undergraduate Research
Undergraduate Research in Courses
Students can get academic credit for undergraduate research by registering for CHEM UN3098 Supervised Independent Research. Generally, students register for 4 credits as this will fulfill one of the requirements of the Chemistry major. You will be expected to commit the same number of hours to research as you would for any other 4 credit class, around 12-16 hours per week throughout the entire semester. You need to obtain permission from your faculty sponsor and Dr. Gasperov to register for UN3098. At the end of the semester, you will be required to present a poster of your research results at a poster session for all UN3098 students.

Undergraduate Research Outside of Courses
Students often ask, why should I do research? Research is exciting! You will design experiments, discover phenomena and make new molecules that no one has ever seen before. Furthermore, there are several practical reasons why you should consider research as an undergraduate student.

Research is a great way to learn more about chemistry. The concepts you learn in the classroom will come to light when you do research. You will also learn more about instrumentation, data analysis, and gain experience in writing reports, preparing posters, and discussing science with your research group members.

Research is a great career builder! Whether you are considering graduate school, professional school, or joining the workforce after graduation, research as an undergraduate will be an invaluable experience that will sharpen your critical thinking and provide you with the unique opportunity to work alongside world-leading faculty, graduate students and post-doctoral fellows.

Student Advising
Consulting Advisers
Dr. Vesna Gasperov (vg2231@columbia.edu)

Enrolling in Classes
Dr. Vesna Gasperov (vg2231@columbia.edu)
The faculty in the Department of Chemistry carry out fundamental and applied research at both the core and frontiers of this scientific discipline. There are many opportunities for research during the academic year and in the summer with faculty in the department.

If you are interested in working in a research laboratory, you should take the following steps:

- Investigate faculty research projects by using the department’s website, http://chem.columbia.edu/research/, or by speaking directly with faculty members.
- Decide which faculty research project interests you.
- Contact that faculty member directly to inquire about research opportunities within his/her laboratory.

The Program Manager for Undergraduate Studies, Dr. Vesna Gasperov, can assist you with this process.

Qualified students can take the First Year Seminar in Chemical Research course (CHEM UN2408) during the Spring semester in which you will have the opportunity to learn about research conducted within the chemistry department and other science departments in the university. This can help to identify areas of interest that you may not have considered.

**Department Honors and Prizes**

**Department Honors**

Departmental honors are awarded to 10 percent of the graduating majors each year.

To be considered for department honors, students must have a grade point average of at least 3.6 in major courses and have participated in research on a project of high quality.

Biochemistry majors may be considered for Honors in either Chemistry or Biological Sciences.

**Academic Prizes**

THE THOMAS J. KATZ PRIZE

Established in 2009 by friends and colleagues of Professor Katz, this prize may be awarded to the Columbia College, General Studies, or SEAS student majoring in the chemical sciences who is deemed by the faculty to have demonstrated outstanding achievement as a scholar and as a researcher.

THE RICHARD BERSOHN PRIZE

Established in 2009 by Professor Louis Brus, who was a student of Professor Bersohn, this prize may be awarded to the Columbia College, General Studies, or SEAS student majoring in the chemical sciences who is deemed by the faculty to have demonstrated outstanding achievement as a scholar and as a researcher.

**Sample Programs**

Some typical programs are shown below. Programs are crafted by the student and the Director of Undergraduate Studies and Program Manager to meet individual needs and interests.

**Track 1**

**First Year**

- CHEM UN1403 GENERAL CHEMISTRY I-LECTURES
- CHEM UN1404 GENERAL CHEMISTRY II-LECTURES
- CHEM UN1500 GENERAL CHEMISTRY LABORATORY
- CHEM UN2408 1ST YEAR SEM IN CHEMICAL RES

Calculus and physics as required.

**Second Year**

- CHEM UN2443 ORGANIC CHEMISTRY I-LECTURES
- CHEM UN2444 ORGANIC CHEMISTRY II-LECTURES
- CHEM UN2493 ORGANIC CHEM. LAB I TECHNIQUES
- CHEM UN2494 ORGANIC CHEM. LAB II SYNTHESIS

Calculus and physics as required.

**Third Year**

- CHEM UN3079 PHYSICAL CHEMISTRY I-LECTURES
- CHEM UN3080 PHYSICAL CHEMISTRY II-LECTURES
- BIOC GU4501 BIOCHEM I-STRUCTURE/METABOLISM
- CHEM UN3546 ADVANCED ORGANIC CHEMISTRY LAB
- CHEM UN3098 SUPERVISED INDEPENDENT RES
Fourth Year
CHEM UN3085 PHYSICAL-ANALYTICAL LABORATORY I
CHEM UN3086 PHYSICAL-ANALYTICAL LABORATORY II
CHEM UN3920 SENIOR SEMINAR
CHEM GU4071 INORGANIC CHEMISTRY
Advanced courses (4000-level or higher)

Track 2
First Year
CHEM UN1507 INTENSIVE GENERAL CHEMISTRY-LAB
CHEM UN1604 2ND TERM GEN CHEM (INTENSIVE)
CHEM UN2408 1ST YEAR SEM IN CHEMICAL RES
Calculus and physics as required.

Second Year
CHEM UN2443 ORGANIC CHEMISTRY I-LECTURES
CHEM UN2444 ORGANIC CHEMISTRY II-LECTURES
CHEM UN2493 ORGANIC CHEM. LAB I TECHNIQUES
CHEM UN2494 ORGANIC CHEM. LAB II SYNTHESIS
Calculus and physics as required.

Third Year
CHEM UN3079 PHYSICAL CHEMISTRY I-LECTURES
CHEM UN3080 PHYSICAL CHEMISTRY II-LECTURES
BIOC GU4501 BIOCHEMISTRY I-STRUCTURE/METABOLISM
CHEM UN3546 ADVANCED ORGANIC CHEMISTRY LAB
CHEM UN3098 SUPERVISED INDEPENDENT RES

Fourth Year
CHEM UN3085 PHYSICAL-ANALYTICAL LABORATORY I
CHEM UN3086 PHYSICAL-ANALYTICAL LABORATORY II
CHEM UN3920 SENIOR SEMINAR
CHEM GU4071 INORGANIC CHEMISTRY
Advanced courses (4000-level or higher)

Professors
Luis Campos
Virginia W. Cornish
Richard A. Friesner
Ruben Gonzalez
Laura Kaufman
James L. Leighton
Ann E. McDermott
Wei Min
Jack R. Norton
Colin Nuckolls
Gerard Parkin
David R. Reichman
Tomislav Rovis
Dalibor Sames
Brent Stockwell
James J. Valentini
Latha Venkataraman
Xiaoyang Zhu

Associate Professors
Timothy Berkelbach
Angelo Cacciuto
Jonathan Owen
Xavier Roy

Assistant Professors
Milan Delor
Neel Shah
Makeda Tekle-Smith

Senior Lecturers
Luis Avila
Anna Ghurbanyan
Sarah Hansen
Fay Ng
Joseph Ulichny

Lecturers
Robert Beer
John Decatur
Charles E. Doubleday
Christopher Eckdahl
Ruben Savizky
Talha Siddiqui
Environmental Chemistry

Guidance for Undergraduate Students in the Department

Program Planning for all Students

The Department of Chemistry offers four distinct academic major programs for undergraduates interested in professional-level training and education in the chemical sciences: chemistry, chemical physics, biochemistry and environmental chemistry. For students interested in a program of less extensive study and coursework, the department offers a concentration in chemistry.

In the first year, Track 1 students with one year of high school chemistry take a one-year course in general chemistry, and the one-term laboratory course that accompanies it. In the second year, students study organic chemistry, and take organic chemistry laboratory.

Students who qualify by prior assessment during orientation week can place into the advanced tracks. There are two options. Track 2 students take, in the fall term, a special one-term intensive course in general chemistry in place of the one-year course. In the second year, students study organic chemistry and take organic chemistry laboratory. Track 3 students take a one-year course in organic chemistry for first-year students and the one-term intensive general chemistry laboratory course. In the second year, students may enroll in physical chemistry and the organic chemistry laboratory course.

The results of the department assessment exam are used to advise students which track to pursue. The Department of Chemistry offers three different tracks. Students who wish to take Track 2 or 3 classes must take the department assessment exam. Students who wish to pursue Track 1 classes do not need to take the assessment exam.

Additional information on the tracks can be found in the Requirements section.

Guidance for Transfer Students

Students who are transferring to Columbia should contact Dr. Vesna Gasperov (vg2231@columbia.edu) to have any chemistry courses assessed for equivalency. Please email a detailed syllabus and transcript.

Undergraduate Programs of Study

Required Coursework for all Programs

Students majoring in chemistry or in one of the interdepartmental majors in chemistry should go to the director of undergraduate studies or the undergraduate program manager in the Department of Chemistry to discuss their program of study. Chemistry majors and interdepartmental majors usually postpone part of the Core Curriculum beyond the sophomore year.

Chemistry Tracks

All students who wish to start with Track 2 or 3 courses must take an assessment during orientation week ahead of fall semester. The results of the assessment are used to advise students which track to pursue. Unless otherwise specified below, all students must complete one of the following tracks:

Track 1

- CHEM UN1403 GENERAL CHEMISTRY I-LECTURES
- CHEM UN1404 GENERAL CHEMISTRY II-LECTURES
- CHEM UN1500 GENERAL CHEMISTRY LABORATORY
- CHEM UN2443 ORGANIC CHEMISTRY I-LECTURES
- CHEM UN2444 ORGANIC CHEMISTRY II-LECTURES
- CHEM UN2493 ORGANIC CHEM. LAB I TECHNIQUES
- CHEM UN2494 ORGANIC CHEM. LAB II SYNTHESIS

Track 2

- CHEM UN1500 GENERAL CHEMISTRY LABORATORY
  or CHEM UN1507 INTENSIVE GENERAL CHEMISTRY-LAB
- CHEM UN1604 2ND TERM GEN CHEM (INTENSIVE)
- CHEM UN2443 ORGANIC CHEMISTRY I-LECTURES
- CHEM UN2444 ORGANIC CHEMISTRY II-LECTURES
- CHEM UN2493 ORGANIC CHEM. LAB I TECHNIQUES
- CHEM UN2494 ORGANIC CHEM. LAB II SYNTHESIS

Track 3

- CHEM UN1507 INTENSIVE GENERAL CHEMISTRY-LAB
- CHEM UN2045 INTENSIVE ORGANIC CHEMISTRY
- CHEM UN2046 INTENSIVE ORG CHEM-FOR 1ST YEAR
- CHEM UN2545 INTENSIVE ORGANIC CHEM LAB

Physics Sequences

Unless otherwise specified below, all students must complete one of the following sequences:

Sequence A

For students with limited background in high school physics:

- PHYS UN1401 INTRO TO MECHANICS # THERMO
- PHYS UN1402 INTRO ELEC/MAGNETSM # OPTCS
- PHYS UN1403 INTRO-CLASSCL # QUANTUM WAVES

For chemistry majors, the following laboratory courses are recommended, NOT required. For chemical physics majors, ONE of the following laboratory courses are required:

- PHYS UN1494 INTRO TO EXPERIMENTAL PHYS-LAB
- PHYS UN3081 INTERMEDIATE LABORATORY WORK

Sequence B

- PHYS UN1601 PHYSICS I:MECHANICS/RELATIVITY
- PHYS UN1602 PHYSICS II: THERMO, ELEC # MAG
- PHYS UN2601 PHYSICS III:CLASS/QUANTUM WAVE

For chemistry majors, the following laboratory course is recommended, NOT required. For chemical physics majors, the following laboratory course is required:

- PHYS UN3081 INTERMEDIATE LABORATORY WORK

Sequence C

For students with advanced preparation in physics and mathematics:

- PHYS UN2801 PHYSICS I:MECHANICS/RELATIVITY
  and ACCELERATED PHYSICS I
- PHYS UN2802 PHYSICS II: THERMO, ELEC # MAG

For chemistry majors, the following laboratory course is recommended, NOT required. For chemical physics majors, the following laboratory course is required:

- PHYS UN3081 INTERMEDIATE LABORATORY WORK
**Major in Chemistry**
Select one of the tracks outlined above in Guidelines for all Chemistry Majors, Concentrators, and Interdepartmental Majors and complete the following lectures and labs.

**Chemistry**
Select one of the chemistry tracks outlined above.
- CHEM UN2408 1ST YEAR SEM IN CHEMICAL RES (Recommended NOT required)
- CHEM UN3079 PHYSICAL CHEMISTRY I-LECTURES
- CHEM UN3080 PHYSICAL CHEMISTRY II-LECTURES
- CHEM UN3085 PHYSICL-ANALYTCL LABORATORY I
- CHEM UN3086 PHYSICL-ANALYTCL LABORATORY II
- CHEM UN3546 ADVANCED ORGANIC CHEMISTRY LAB
- CHEM GU4071 INORGANIC CHEMISTRY

Select one course from the following:
- CHEM UN3098 SUPERVISED INDEPENDENT RES
  OR Chemistry courses numbered CHEM GU4000 or above for 2 credit points or more

**Physics**
Select one of the physics sequences outlined above in the Guidelines section.

**Mathematics**
Select one of the following sequences:
- Four semesters of calculus:
  - MATH UN1101 CALCULUS I
  - MATH UN1102 and CALCULUS II
  - MATH UN1201 and CALCULUS III
  - MATH UN1202 and CALCULUS IV
- Two semesters of honors mathematics:
  - MATH UN1207 HONORS MATHEMATICS A
  - MATH UN1208 and HONORS MATHEMATICS B

**Major in Biochemistry**
Select one of the tracks outlined above in Guidelines for all Chemistry Majors, Concentrators, and Interdepartmental Majors and complete the following lectures and labs.

**Chemistry**
Select one of the chemistry tracks outlined above.
- CHEM UN2408 1ST YEAR SEM IN CHEMICAL RES (Recommended NOT required)
- CHEM UN3079 PHYSICAL CHEMISTRY I-LECTURES
- CHEM UN3080 PHYSICAL CHEMISTRY II-LECTURES
- CHEM UN3546 ADVANCED ORGANIC CHEMISTRY LAB
- CHEM GU4071 INORGANIC CHEMISTRY

**Biology**
- BIOL UN1908 First Year Seminar in Biology (Recommended NOT required)
- BIOL UN2005 INTRO BID I: BIOCHEM,GEN,MOLEC
- BIOL UN2006 INTRO BID II:CELL BIO,DEV/PHTS
- BIOL GU4501 BIOCHEM I-STRUCTURE/METABOLISM
  or BIOC UN3300 BIOCHEMISTRY
- BIOL GU4512 MOLECULAR BIOLOGY

**Physics**
Select one of the following physics sequences:
- Sequence A:
  - PHYS UN1201 GENERAL PHYSICS I
  - PHYS UN1202 and GENERAL PHYSICS II
  - PHYS UN1401 INTRO TO MECHANICS # THERMO
  - PHYS UN1402 and INTRO ELEC/MAGNETSM # OPTCS
  - PHYS UN1403 and INTRO-CLASSCL # QUANTUM WAVES (PHYS UN1403 is recommended NOT required)

- Sequence B:
  - PHYS UN1601 PHYSICS I:MECHANICS/RELATIVITY
  - PHYS UN1602 and PHYSICS II: THERMO, ELEC # MAG
  - PHYS UN2601 and PHYSICS III:CLASS/QUANTUM WAVE (PHYS UN2601 is recommended but not required)

- Sequence C:
  - PHYS UN2801 ACCELERATED PHYSICS I
  - PHYS UN2802 and ACCELERATED PHYSICS II

- Sequence D:
  - MATH UN1101 CALCULUS I
  - MATH UN1102 and CALCULUS II
  - MATH UN1201 and CALCULUS III
  - MATH UN1202 and CALCULUS IV
  - MATH UN1207 HONORS MATHEMATICS A
  - MATH UN1208 and HONORS MATHEMATICS B

**Additional Courses**
Select two of the following upper level laboratory courses (one must be a Biology lab):
- BIOL UN2501 CONTEMPORARY BIOLOGY LAB
- BIOL UN2801 LAB IN MOLECULAR BIOLOGY (A 3 pt. Barnard lab course, with permission from Bio advisor)
- BIOL UN3052 PROJECT LAB-MOLECULAR GENETICS
- BIOL UN3058 PROJECT LAB IN MICROBIOLOGY
- BIOL UN3500 INDEP BIOLOGICAL RESEARCH
- CHEM UN3085 PHYSICL-ANALYTCL LABORATORY I
- CHEM UN3086 PHYSICL-ANALYTCL LABORATORY II
- CHEM UN3098 SUPERVISED INDEPENDENT RES
- CHEM UN3546 ADVANCED ORGANIC CHEMISTRY LAB

Select any three courses from the following:
- CHEM GU4071 INORGANIC CHEMISTRY
- CHEM GU4102 CHEMISTRY FOR THE BRAIN
- CHEM GU4103 ORGANOMETALLIC CHEMISTRY
- CHEM GU4147 ADVANCED ORGANIC CHEMISTRY I
- CHEM GU4312 CHEMICAL BIOLOGY
- CHEM GU4313 Peptide and Protein Chemistry
- BIOL GU4323 Biophysical Chemistry I
- BIOL GU4324 Biophysical Chemistry II
- MATH UN3027 ORDINARY DIFFERENTIAL EQUATIONS
  or MATH UN2030 ORDINARY DIFFERENTIAL EQUATIONS

One additional semester of calculus
One additional semester of honors math:
- MATH UN1207 HONORS MATHEMATICS A
  or MATH UN1208 HONORS MATHEMATICS B

Any biology course at the 3000/4000 level for 3 or more points. The following are recommended:
- BIOL UN3004 NEUROBIO I:CELLULAR # MOLECULR
Major in Chemical Physics

Select one of the tracks outlined above in Guidelines for all Chemistry Majors, Concentrators, and Interdepartmental Majors and complete the following lectures and labs.

Chemistry

Select one of the chemistry tracks outlined above.

CHEM UN3079 PHYSICAL CHEMISTRY I-LECTURES
CHEM UN3080 PHYSICAL CHEMISTRY II-LECTURES
CHEM UN3085 PHYSICL-ANALYTCL LABORATORY I
CHEM UN3086 PHYSICL-ANALYTCL LABORATORY II
CHEM GU4221 QUANTUM CHEMISTRY I
or PHYS GU4021 QUANTUM MECHANICS I

Physics

Select one of the physics sequences outlined above in Guidelines for all Chemistry Majors, Concentrators, and Interdepartmental Majors. For the chemical physics major, one lab MUST be completed for the sequence chosen.

Complete the following lectures:

PHYS UN3003 MECHANICS
PHYS UN3007 ELECTRICITY-MAGNETISM
PHYS UN3008 ELECTROMAGNETIC WAVES # OPTICS

Mathematics

Select one of the following sequences:

Four semesters of calculus:

MATH UN1101 CALCULUS I
- MATH UN1102 and CALCULUS II
- MATH UN1201 and CALCULUS III
- MATH UN1202 and CALCULUS IV

Two semesters of honors mathematics:

MATH UN1207 HONORS MATHEMATICS A
- MATH UN1208 and HONORS MATHEMATICS B
- MATH UN3027 and Ordinary Differential Equations

Two semesters of advanced calculus:

MATH UN1202 CALCULUS IV
- MATH UN3027 and Ordinary Differential Equations

Major in Environmental Chemistry

The requirements for this program were modified on February 1, 2016. Students who declared this program before this date should contact the director of undergraduate studies for the department in order to confirm their correct course of study.
Earth and Environmental Science:

EESC BC3017  ENVIRONMENTAL DATA ANALYSIS
EESC BC3025  HYDROLOGY
EESC GU4008  Introduction to Atmospheric Science
EESC GU4009  CHEMICAL GEOLOGY
EESC GU4040  CLIM THERMODYN/ENERGY TRANSFER
EESC GU4050  GLOBAL ASSMT-REMOTE SENSING
EESC GU4600  EARTH RESOURCES # SUSTAIN DEV
EESC GU4835  Wetlands and Climate Change
EESC GU4885  CHEMISTRY OF CONTINENTAL WATERS
EESC GU4888  Stable Isotope Geochemistry
EESC GU4924  INTRO TO ATMOSPHERIC CHEMISTRY
EESC GU4925  INTRO TO PHYSICAL OCEANOGRAPHY
EESC GU4926  INTRO TO CHEMICAL OCEANOGRAPHY

Earth and Environmental Engineering:

EAEE E4001  INDUST ECOLOGY-EARTH RESOURCES
EAEE E4003  AQUATIC CHEMISTRY

Mathematics:

One additional semester of calculus

For students who entered Columbia in or before the 2023-24 academic year

Concentration in Chemistry

No more than four points of CHEM UN3098 SUPERVISED INDEPENDENT RES may be counted toward the concentration.

Select one of the three chemistry tracks listed below.

PHYS UN1201  GENERAL PHYSICS I
- PHYS UN1202  and GENERAL PHYSICS II

Two semesters of calculus

Chemistry Tracks

Track 1

CHEM UN1403  GENERAL CHEMISTRY I-LECTURES
CHEM UN1404  GENERAL CHEMISTRY II-LECTURES
CHEM UN1500  GENERAL CHEMISTRY LABORATORY

Select 22 points of chemistry at the 2000-level or higher (excluding CHEM UN2408).

Track 2

CHEM UN1500  GENERAL CHEMISTRY LABORATORY
or CHEM UN1507  INTENSIVE GENERAL CHEMISTRY-LAB
CHEM UN1604  2ND TERM GEN CHEM (INTENSIVE)

Select 22 points of chemistry at the 2000-level or higher (excluding CHEM UN2408).

Track 3

CHEM UN1507  INTENSIVE GENERAL CHEMISTRY-LAB
CHEM UN2045  INTENSIVE ORGANIC CHEMISTRY
CHEM UN2046  INTENSIVE ORG CHEM-FOR 1ST YEAR

Select 18 points of chemistry at the 2000-level or higher (excluding CHEM UN2408).

CHEM UN0001 PREPARATION-COLLEGE CHEMISTRY. 0.00 points.

Not for credit toward the bachelor’s degree. Given on a Pass/Fail basis only.

Prerequisites: High school algebra or the instructor’s permission.
Recommended preparation: high school physics and chemistry.
Prerequisites: High school algebra or the instructor’s permission.
Recommended preparation: high school physics and chemistry. This course is preparation for Chemistry UN1403 or the equivalent, as well as for other science courses. It is intended for students who have not attended school for sometime or who do not have a firm grasp of high school chemistry. Topics include inorganic nomenclature, chemical reactions, chemical bonding and its relation to molecular structure, stoichiometry, periodic properties of elements, chemical equilibrium, gas laws, acids and bases, and electrochemistry.

Fall 2024

Please note that some lab fees have increased. You may consult the Directory of Classes for the most up to date fees.
CHEM UN1403 GENERAL CHEMISTRY I-LECTURES. 4.00 points.
CC/GS: Partial Fulfillment of Science Requirement

Corequisites: MATH UN1101
Corequisites: MATH UN1101 Preparation equivalent to one year of high school chemistry is assumed. Students lacking such preparation should plan independent study of chemistry over the summer or take CHEM UN0001 before taking CHEM UN1403. Topics include stoichiometry, states of matter, nuclear properties, electronic structures of atoms, periodic properties, chemical bonding, molecular geometry, introduction to quantum mechanics and atomic theory, introduction to organic and biological chemistry, solid state and materials science, polymer science and macromolecular structures and coordination chemistry. Although CHEM UN1403 and CHEM UN1404 are separate courses, students are expected to take both terms sequentially. The order of presentation of topics may differ from the order presented here, and from year to year. Students must ensure they register for the recitation that corresponds to the lecture section. When registering, please add your name to the wait list for the recitation corresponding to the lecture section (1405 for lecture sec 001, 1407 for lecture sec 002, 1409 for lecture sec 003, 1411 for lecture sec 004). Information about recitation registration will be sent out before classes begin. DO NOT EMAIL THE INSTRUCTOR. Please check the Directory of Classes for details.

Spring 2024: CHEM UN1403

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<th>Course Number</th>
<th>Section/Call Number</th>
<th>Times/Location</th>
<th>Instructor</th>
<th>Points</th>
<th>Enrollment</th>
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<tr>
<td>CHEM 1403</td>
<td>001/11152</td>
<td>T Th 6:10pm - 7:25pm</td>
<td>Ruben Savisky</td>
<td>4.00</td>
<td>95/120</td>
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<td>AU1/18946</td>
<td>T Th 6:10pm - 7:25pm</td>
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Fall 2024: CHEM UN1403

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<th>Times/Location</th>
<th>Instructor</th>
<th>Points</th>
<th>Enrollment</th>
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<tr>
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<td>001/11207</td>
<td>M W 10:10am - 11:25am</td>
<td>Gerard Parkin</td>
<td>4.00</td>
<td>38/220</td>
</tr>
<tr>
<td>CHEM 1403</td>
<td>002/11450</td>
<td>T Th 10:10am - 11:25am</td>
<td>Xavier Roy</td>
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<td>70/170</td>
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<tr>
<td>CHEM 1403</td>
<td>003/11140</td>
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<td>Ruben Savisky</td>
<td>4.00</td>
<td>13/170</td>
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<td>004/11141</td>
<td>M W 6:10pm - 7:25pm</td>
<td>Robert Beer</td>
<td>4.00</td>
<td>5/120</td>
</tr>
<tr>
<td>CHEM 1403</td>
<td>AU3/18836</td>
<td>T Th 6:10pm - 7:25pm</td>
<td>Ruben Savisky</td>
<td>4.00</td>
<td>8/10</td>
</tr>
<tr>
<td>CHEM 1403</td>
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<td>M W 6:10pm - 7:25pm</td>
<td>Robert Beer</td>
<td>4.00</td>
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</table>

CHEM UN1404 GENERAL CHEMISTRY II-LECTURES. 4.00 points.
CC/GS: Partial Fulfillment of Science Requirement

Prerequisites: CHEM UN1403
Prerequisites: CHEM UN1403 Although CHEM UN1403 and CHEM UN1404 are separate courses, students are expected to take both terms sequentially. Topics include gases, kinetic theory of gases, states of matter: liquids and solids, chemical equilibria, applications of equilibria, acids and bases, chemical thermodynamics, energy, enthalpy, entropy, free energy, periodic properties, chemical kinetics, and electrochemistry. The order of presentation of topics may differ from the order presented here, and from year to year. Students must ensure they register for the recitation that corresponds to the lecture section. Please check the Directory of Classes for details.

Spring 2024: CHEM UN1404

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<th>Course Number</th>
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<tbody>
<tr>
<td>CHEM 1404</td>
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<td>Christopher Eckdahl</td>
<td>4.00</td>
<td>200/190</td>
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<tr>
<td>CHEM 1404</td>
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<tr>
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<td>003/11176</td>
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<td>AU1/18947</td>
<td>M W 6:10pm - 7:25pm</td>
<td>Robert Beer</td>
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Fall 2024: CHEM UN1404

<table>
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<th>Course Number</th>
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<th>Instructor</th>
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<tr>
<td>CHEM 1404</td>
<td>001/11139</td>
<td>T Th 10:10am - 11:25am</td>
<td>Christopher Eckdahl</td>
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<td>CHEM 1404</td>
<td>AU1/18838</td>
<td>T Th 10:10am - 11:25am</td>
<td>Christopher Eckdahl</td>
<td>4.00</td>
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</tr>
</tbody>
</table>
CHEM UN1500 GENERAL CHEMISTRY LABORATORY. 3.00 points.
CC/GS: Partial Fulfillment of Science Requirement
Lab Fee: $140.

Corequisites: CHEM UN1403, CHEM UN1404
Corequisites: CHEM UN1403, CHEM UN1404

An introduction to basic
lab techniques of modern experimental chemistry, including quantitative
procedures and chemical analysis. Students must register for a Lab
Lecture section for this course (CHEM UN1501). Please check the
Directory of Classes for details. Please note that CHEM UN1500 is offered
in the fall and spring semesters. Mandatory lab check-in will be held
during the first week of classes in both the fall and spring semesters. You
may be asked to serve as research subjects in studies under direction of
the faculty while enrolled in this course (CHEM UN1500 Sec 1, 2, 5, 7 and
CHEM UN1501 Sec 1). Participation in voluntary

### Fall 2024: CHEM UN1500

<table>
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<th>Course Number</th>
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<th>Times/Location</th>
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<td></td>
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<td>302 Havemeyer Hall</td>
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<tr>
<td>CHEM 1500</td>
<td>002/11143</td>
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<td>Sarah Hansen</td>
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<td>29/46</td>
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<tr>
<td>CHEM 1500</td>
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<tr>
<td>CHEM 1500</td>
<td>004/11145</td>
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<td>Sarah Hansen</td>
<td>3.00</td>
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<td>CHEM 1500</td>
<td>005/11146</td>
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<td>Joseph</td>
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<td>CHEM 1500</td>
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### Spring 2024: CHEM UN1500

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<th>Section/Call Number</th>
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<tbody>
<tr>
<td>CHEM 1500</td>
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<td>M 1:00pm - 6:00pm</td>
<td>Luis Avila</td>
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<td>Luis Avila</td>
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<td>302 Havemeyer Hall</td>
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### Fall 2024: CHEM UN1507

CHEM UN1507 INTENSIVE GENERAL CHEMISTRY-LAB. 3.00 points.
CC/GS: Partial Fulfillment of Science Requirement
Lab Fee: $140.

Prerequisites: CHEM UN1604 or CHEM UN2045
Corequisites: CHEM UN2045
Prerequisites: CHEM UN1604 or CHEM UN2045
Corequisites: CHEM UN2045
A student-centered experimental course intended for students
who are taking or have completed CHEM UN1604 (Second Semester
General Chemistry Intensive Lecture offered in Fall), CHEM UN2045
(Intensive Organic Chemistry offered in Fall), or CHEM UN2046 (Intensive
Organic Chemistry Lecture offered in Spring). The course will provide an
introduction to theory and practice of modern experimental chemistry
in a contextual, student-centered collaborative learning environment.
This course differs from CHEM UN1500 in its pedagogy and its emphasis
on instrumentation and methods. Students must also attend the
compulsory Mentoring Session. Please check the Directory of Classes for
details. Please note that CHEM UN1507 is offered in the fall and spring
semesters

### Spring 2024: CHEM UN1507

<table>
<thead>
<tr>
<th>Course Number</th>
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<tr>
<td>CHEM 1507</td>
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### Fall 2024: CHEM UN1507

<table>
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<tr>
<td>CHEM 1507</td>
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### CHEM UN1604 2ND TERM GEN CHEM (INTENSIVE). 4.00 points.
CC/GS: Partial Fulfillment of Science Requirement

Prerequisites: Acceptable performance on the Department placement
exam during orientation week AND either a grade of "B" or better in CHEM
UN1403 or AP chemistry or the equivalent.
Corequisites: MATH UN1102
Prerequisites: Acceptable performance on the Department placement
exam during orientation week AND either a grade of "B" or better in
CHEM UN1403 or AP chemistry or the equivalent. Please contact Vesna
Gasperov (vg2231@columbia.edu) or your academic advisor at CSA
for further information. Corequisites: MATH UN1102 Topics include
chemical kinetics, thermodynamics and chemical bonding. Students
must register simultaneously for a corresponding recitation section.
Please check Courseworks or contact the instructor or departmental
adviser for additional details. When registering, be sure to add your name
to the wait list for the recitation corresponding to the lecture section
(CHEM UN1606). Information about registration for the required recitation
will be sent out before classes begin. Please expect to also be available
for review sessions on Fridays from 8:10am-9:55am

### Fall 2024: CHEM UN1604

<table>
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<th>Course Number</th>
<th>Section/Call Number</th>
<th>Times/Location</th>
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<tr>
<td>CHEM 1604</td>
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<td>Wei Min</td>
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<td>9/120</td>
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<td></td>
<td></td>
<td>209 Havemeyer Hall</td>
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</table>
CHEM UN2443 ORGANIC CHEMISTRY I-LECTURES. 4.00 points.
Prerequisites: (CHEM UN1403 and CHEM UN1404) or CHEM UN1604
Prerequisites: (CHEM UN1403 and CHEM UN1404) or CHEM UN1604
The principles of organic chemistry. The structure and reactivity of organic molecules are examined from the standpoint of modern theories of chemistry. Topics include stereochemistry, reactions of organic molecules, mechanisms of organic reactions, syntheses and degradations of organic molecules, and spectroscopic techniques of structure determination. Although CHEM UN2443 and CHEM UN2444 are separate courses, students are expected to take both terms sequentially. A recitation section is required. Please check the Directory of Classes for details and also speak with the TA for the course

Fall 2024: CHEM UN2443
<table>
<thead>
<tr>
<th>Course Number</th>
<th>Section/Call Number</th>
<th>Times/Location</th>
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<tr>
<td>CHEM 2443</td>
<td>001/12538</td>
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<td>James Leighton, Neel Shah</td>
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<tr>
<td>CHEM 2443</td>
<td>002/11239</td>
<td>T Th 1:10pm - 2:25pm 309 Havemeyer Hall</td>
<td>Charles Dobleady</td>
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<tr>
<td>CHEM 2443</td>
<td>003/11168</td>
<td>M W 6:10pm - 7:25pm 309 Havemeyer Hall</td>
<td>Charles Dobleady</td>
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<td>CHEM 2443</td>
<td>AU3/18839</td>
<td>M W 6:10pm - 7:25pm 0th Other</td>
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CHEM UN2493 ORGANIC CHEM. LAB I TECHNIQUES. 0.00 points.
Lab Fee: $63.00
Prerequisites: (CHEM UN1403 and CHEM UN1404) or (CHEM UN1604)
Prerequisites: (CHEM UN1403 and CHEM UN1404) or (CHEM UN1604)
Techniques of experimental organic chemistry, with emphasis on understanding fundamental principles underlying the experiments in methodology of solving laboratory problems involving organic molecules. Attendance at the first lab lecture and laboratory session is mandatory. Please note that CHEM UN2493 is the first part of a full year organic chemistry laboratory course. Students must register for the lab lecture section (CHEM UN2495) which corresponds to their lab section. Students must attend ONE lab lecture and ONE lab section every other week. Please contact your advisers for further information

Fall 2024: CHEM UN2493
<table>
<thead>
<tr>
<th>Course Number</th>
<th>Section/Call Number</th>
<th>Times/Location</th>
<th>Instructor</th>
<th>Points</th>
<th>Enrollment</th>
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<tbody>
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<td>CHEM 2493</td>
<td>001/11169</td>
<td>M 1:10pm - 4:50pm 202a Havemeyer Hall</td>
<td>Talha Siddiqui</td>
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<tr>
<td>CHEM 2493</td>
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<td>T 12:10pm - 3:50pm 202a Havemeyer Hall</td>
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<tr>
<td>CHEM 2493</td>
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<td>T 6:10pm - 9:50pm 202a Havemeyer Hall</td>
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<td>CHEM 2493</td>
<td>004/11172</td>
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<td>006/11180</td>
<td>F 11:10am - 2:50pm 202a Havemeyer Hall</td>
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<td>007/11181</td>
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<td>CHEM 2493</td>
<td>012/11186</td>
<td>F 11:10am - 2:50pm 202a Havemeyer Hall</td>
<td>Anna Ghurbanyan</td>
<td>0.00</td>
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CHEM UN2495 ORGANIC CHEM. LABORATORY I. 1.50 point.
Corequisites: CHEM UN2493
Corequisites: CHEM UN2493 The course is the lab lecture which accompanies the Organic Chemistry Laboratory I (Techniques) course

Fall 2024: CHEM UN2495
<table>
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<th>Course Number</th>
<th>Section/Call Number</th>
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<tr>
<td>CHEM 2495</td>
<td>002/11188</td>
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<td>Anna Ghurbanyan</td>
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<td>CHEM 2495</td>
<td>003/11189</td>
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<tr>
<td>CHEM 2495</td>
<td>004/11190</td>
<td>M 4:10pm - 5:50pm 309 Havemeyer Hall</td>
<td>Anna Ghurbanyan</td>
<td>1.50</td>
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</table>
CHEM UN2545 INTENSIVE ORGANIC CHEM LAB. 3.00 points.
Lab Fee: $125.

Prerequisites: (CHEM UN2045 and CHEM UN2046) and CHEM UN1507.

The lab is intended for students who have taken Intensive Organic Chemistry, CHEM UN2045 - CHEM UN2046 and who intend to major in Chemistry, Biochemistry, Chemical Physics, or Environmental Chemistry.

CHEM UN3079 PHYSICAL CHEMISTRY I-LECTURES. 4.00 points.
Prerequisites: (CHEM UN1403 and CHEM UN1404) or (CHEM UN1604) or (CHEM UN2045 and CHEM UN2046) and (MATH UN1101 and MATH UN102) or (MATH UN1207 and MATH UN1208) and (PHYS UN1401 and PHYS UN1402) PHYS UN1201 - PHYS UN1202 is acceptable; PHYS UN1401 - PHYS UN1402 or the equivalent is HIGHLY recommended.

Corequisites: CHEM UN3085.

CHEM UN3085 PHYSICL-ANALYTICL LABORATORY I. 4.00 points.
Lab Fee: $125 per term.

Corequisites: CHEM UN3079.

CHEM UN3098 SUPERVISED INDEPENDENT RES. 4.00 points.
Lab Fee: $105 per term.

Prerequisites: the instructor's permission for entrance, and the departmental representative's permission for aggregate points in excess of 12 or less than 4.

Prerequisites: the instructors permission for entrance, and the departmental representatives permission for aggregate points in excess of 12 or less than 4. This course may be repeated for credit (see major and concentration requirements). Individual research under the supervision of a member of the staff. Research areas include organic, physical, inorganic, analytical, and biological chemistry. Please note that CHEM UN3098 is offered in the fall and spring semesters.

BCHM UN3300 BIOCHEMISTRY. 3.00 points.
Prerequisites: one year each of Introductory Biology and General Chemistry. Corequisites: Organic Chemistry. Biochemistry is the study of the chemical processes within organisms that give rise to the immense complexity of life. This complexity emerges from a highly regulated and coordinated flow of chemical energy from one biomolecule to another. This course serves to familiarize students with the spectrum of biomolecules (carbohydrates, lipids, amino acids, nucleic acids, etc.) as well as the fundamental chemical processes (glycolysis, citric acid cycle, fatty acid metabolism, etc.) that allow life to happen. In particular, this course will employ active learning techniques and critical thinking problem-solving to engage students in answering the question: how is the complexity of life possible? NOTE: While Organic Chemistry is listed as a corequisite, it is highly recommended that you take Organic Chemistry beforehand.
In this course, we will study the chemistry of living systems. We will discuss how living systems harness energy from their environment, how living systems construct the molecules necessary for the functions of life, how these processes go awry in a variety of disease, including cancer, and how drugs can be discovered to treat such diseases. Using applications of such biochemical knowledge to mechanisms of disease (i.e. structure, electron counting, and elemental reaction types of transition metals) will depend on the final enrollment in this course. The basic knowledge of transition metal chemistry is recommended for the cross-coupling reactions (synthetic planning and the logic of organic assembly, classical and modern synthetic chemistry via the selected series of topics). The main purpose of the course is to introduce students to modern synthetic chemistry via the selected series of topics (synthetic planning and the logic of organic assembly, classical and new reactions/methods and their use in complex target synthesis). The course will be divided into modules, each with a specific focus. Each module will include lectures by Prof. Sames, who will introduce the key concepts and mechanisms of organic reactions, followed by discussions and problem-solving sessions. In addition to lectures by Prof. Sames, students will select and present relevant papers in the class (the number of student symposia will depend on the final enrollment in this course). The course will culminate in a final project where students will design and execute experiments to synthesize a complex organic molecule, and present relevant papers in the class (the number of student symposia will depend on the final enrollment in this course).
CHEM GU4312 CHEMICAL BIOLOGY. 4.00 points.
Prerequisites: (CHEM UN2443 and CHEM UN2444) and (CHEM UN3079 and CHEM UN3080) and (BIOC UN3501), or the equivalent.
Prerequisites: (CHEM UN2443 and CHEM UN2444) and (CHEM UN3079 and CHEM UN3080) and (BIOC UN3501), or the equivalent.

Development and application of chemical methods for understanding the molecular mechanisms of cellular processes. Review of the biosynthesis, chemical synthesis, and structure and function of proteins and nucleic acids. Application of chemical methods--including structural biology, enzymology, chemical genetics, and the synthesis of modified biological molecules--to the study of cellular processes--including transcription, translation, and signal transduction

Fall 2024: CHEM GU4312

<table>
<thead>
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<th>Section/Call</th>
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<tr>
<td>CHEM 4312</td>
<td>001/11256</td>
<td>M W 1:10pm - 2:25pm 320 Havemeyer Hall</td>
<td>Virginia Cornish</td>
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</table>

BIOC GU4323 Biophysical Chemistry I. 4 points.

This course provides a rigorous introduction to the theory underlying widely used biophysical methods, which will be illustrated by practical applications to contemporary biomedical research problems. The course has two equally important goals. The first goal is to explicate the fundamental approaches used by physical chemists to understand the behavior of molecules and to develop related analytical tools. The second goal is to prepare students to apply these methods themselves to their own research projects. The course will be divided into seven modules: (i) solution thermodynamics; (ii) hydrodynamic methods; (iii) statistical analysis of experimental data; (iv) basic quantum mechanics; (v) optical spectroscopy with an emphasis on fluorescence; (vi) nuclear magnetic resonance spectroscopy; and (vii) light-scattering and diffraction methods. The first three modules will be covered during the fall term. In each module, the underlying physical theories and models will be presented and used to derive the mathematical equations applied to the analysis of experimental data. Weekly recitations will emphasize the analysis of real experimental data and understanding the applications of biophysical experimentation in published research papers.

CHEM GR6168 MATERIALS CHEMISTRY IIA. 2.50 points.

Prerequisites: CHEM UN2443, or the equivalent.

The general topics will be based on the chemistry, self-assembly, and performance of block copolymers and conjugated polymers. Particular emphasis will be devoted to the demands required to drive materials from scientific curiosity to commercialization. At the fundamental level, the course will cover topics on polymerization techniques, electronic structure of organic semiconductors, characterization strategies, nanostructures and self-assembly

Spring 2025

Please note that some lab fees have increased. You may consult the Directory of Classes for the most up to date fees.

CHEM UN1403 GENERAL CHEMISTRY I-LECTURES. 4.00 points.

CC/GS: Partial Fulfillment of Science Requirement

Corequisites: MATH UN1101

Corequisites: MATH UN1101 Preparation equivalent to one year of high school chemistry is assumed. Students lacking such preparation should plan independent study of chemistry over the summer or take CHEM UN0001 before taking CHEM UN1403. Topics include stoichiometry, states of matter, nuclear properties, electronic structures of atoms, periodic properties, chemical bonding, molecular geometry, introduction to quantum mechanics and atomic theory, introduction to organic and biological chemistry, solid state and materials science, polymer science and macromolecular structures and coordination chemistry. Although CHEM UN1403 and CHEM UN1404 are separate courses, students are expected to take both terms sequentially. The order of presentation of topics may differ from the order presented here, and from year to year. Students must ensure they register for the recitation that corresponds to the lecture section. When registering, please add your name to the wait list for the recitation corresponding to the lecture section. (1405 for lecture sec 001; 1407 for lecture sec 002; 1409 for lecture sec 003; 1411 for lecture sec 004). Information about recitation registration will be sent out before classes begin. DO NOT EMAIL THE INSTRUCTOR. Please check the Directory of Classes for details

Spring 2024: CHEM UN1403

<table>
<thead>
<tr>
<th>Course Number</th>
<th>Section/Call</th>
<th>Times/Location</th>
<th>Instructor</th>
<th>Points</th>
<th>Enrollment</th>
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</thead>
<tbody>
<tr>
<td>CHEM 1403</td>
<td>001/11152</td>
<td>T Th 6:10pm - 7:25pm 309 Havemeyer Hall</td>
<td>Ruben Savizky</td>
<td>4.00</td>
<td>95/120</td>
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<tr>
<td>CHEM 1403</td>
<td>AU1/18946</td>
<td>T Th 6:10pm - 7:25pm Othr Other</td>
<td>Ruben Savizky</td>
<td>4.00</td>
<td>8/10</td>
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Fall 2024: CHEM UN1403

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<th>Course Number</th>
<th>Section/Call</th>
<th>Times/Location</th>
<th>Instructor</th>
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<th>Enrollment</th>
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<tr>
<td>CHEM 1403</td>
<td>001/11207</td>
<td>M W 10:10am - 11:25am 309 Havemeyer Hall</td>
<td>Gerard Parkin</td>
<td>4.00</td>
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<tr>
<td>CHEM 1403</td>
<td>002/11450</td>
<td>T Th 10:10am - 11:25am 309 Havemeyer Hall</td>
<td>Xavier Roy</td>
<td>4.00</td>
<td>70/170</td>
</tr>
<tr>
<td>CHEM 1403</td>
<td>003/11140</td>
<td>T Th 10:10am - 11:25am 309 Havemeyer Hall</td>
<td>Ruben Savizky</td>
<td>4.00</td>
<td>13/170</td>
</tr>
<tr>
<td>CHEM 1403</td>
<td>004/11141</td>
<td>M W 6:10pm - 7:25pm 312 Mathematics Building</td>
<td>Robert Beer</td>
<td>4.00</td>
<td>5/120</td>
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<tr>
<td>CHEM 1403</td>
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<tr>
<td>CHEM 1403</td>
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<td>4.00</td>
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CHEM UN1404 GENERAL CHEMISTRY II—LECTURES. 4.00 points.
CC/GS: Partial Fulfillment of Science Requirement

Prerequisites: CHEM UN1403
Prerequisites: CHEM UN1403 Although CHEM UN1403 and CHEM UN 1404 are separate courses, students are expected to take both terms sequentially. Topics include gases, kinetic theory of gases, states of matter: liquids and solids, chemical equilibria, applications of equilibria, acids and bases, chemical thermodynamics, energy, enthalpy, entropy, free energy, periodic properties, chemical kinetics, and electrochemistry. The order of presentation of topics may differ from the order presented here, and from year to year. Students must ensure they register for the recitation that corresponds to the lecture section. Please check the Directory of Classes for details.

<table>
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<tr>
<th>Spring 2024: CHEM UN1404</th>
<th>Course Number</th>
<th>Section/Call Number</th>
<th>Times/Location</th>
<th>Instructor</th>
<th>Points</th>
<th>Enrollment</th>
</tr>
</thead>
<tbody>
<tr>
<td>CHEM 1404</td>
<td>001/11174</td>
<td>T Th 10:10am - 11:25am</td>
<td>309 Havemeyer Hall</td>
<td>Christopher Eckdahl</td>
<td>4.00</td>
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<tr>
<td>CHEM 1404</td>
<td>002/11175</td>
<td>M W 8:40am - 9:55am</td>
<td>309 Havemeyer Hall</td>
<td>Angelo Cacciuto</td>
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<tr>
<td>CHEM 1404</td>
<td>003/11176</td>
<td>M W 6:10am - 7:25pm</td>
<td>428 Pupin Laboratories</td>
<td>Robert Beer</td>
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<tr>
<td>CHEM 1404</td>
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<td>Othr Other</td>
<td>Robert Beer</td>
<td>4.00</td>
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Fall 2024: CHEM 1404

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<th>Section/Call Number</th>
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<th>Points</th>
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<td>CHEM 1404</td>
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<td>401 Chandler</td>
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<td>CHEM 1404</td>
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CHEM UN1500 GENERAL CHEMISTRY LABORATORY. 3.00 points.
CC/GS: Partial Fulfillment of Science Requirement
Lab Fee: $140.

Corequisites: CHEM UN1403, CHEM UN1404
Corequisites: CHEM UN1403, CHEM UN1404 An introduction to basic lab techniques of modern experimental chemistry, including quantitative procedures and chemical analysis. Students must register for a Lab Lecture section for this course (CHEM UN1501). Please check the Directory of Classes for details. Please note that CHEM UN1500 is offered in the fall and spring semesters. Mandatory lab check-in will be held during the first week of classes in both the fall and spring semesters. You may be asked to serve as research subjects in studies under direction of the faculty while enrolled in this course (CHEM UN1500 Sec 1, 2, 5, 7 and CHEM UN1501 Sec 1). Participation in voluntary

<table>
<thead>
<tr>
<th>Spring 2024: CHEM UN1500</th>
<th>Course Number</th>
<th>Section/Call Number</th>
<th>Times/Location</th>
<th>Instructor</th>
<th>Points</th>
<th>Enrollment</th>
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<tr>
<td>CHEM 1500</td>
<td>001/11142</td>
<td>M 2:10pm - 5:50pm</td>
<td>302 Havemeyer Hall</td>
<td>Sarah Hansen</td>
<td>3.00</td>
<td>25/24</td>
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<tr>
<td>CHEM 1500</td>
<td>002/11143</td>
<td>T 1:10pm - 4:50pm</td>
<td>302 Havemeyer Hall</td>
<td>Sarah Hansen</td>
<td>3.00</td>
<td>29/46</td>
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<tr>
<td>CHEM 1500</td>
<td>003/11144</td>
<td>T 6:10pm - 9:50pm</td>
<td>302 Havemeyer Hall</td>
<td>Joseph Ulichny</td>
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<tr>
<td>CHEM 1500</td>
<td>004/11145</td>
<td>W 8:40am - 12:25pm</td>
<td>302 Havemeyer Hall</td>
<td>Sarah Hansen</td>
<td>3.00</td>
<td>23/46</td>
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<tr>
<td>CHEM 1500</td>
<td>005/11146</td>
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<td>CHEM 1500</td>
<td>006/11147</td>
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<td>302 Havemeyer Hall</td>
<td>Sarah Hansen</td>
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<td>CHEM 1500</td>
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<td>Th 6:10pm - 9:50pm</td>
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<td>CHEM 1500</td>
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<td>302 Havemeyer Hall</td>
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Fall 2024: CHEM 1500

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<th>Times/Location</th>
<th>Instructor</th>
<th>Points</th>
<th>Enrollment</th>
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<tr>
<td>CHEM 1500</td>
<td>001/11157</td>
<td>T 1:10pm - 4:50pm</td>
<td>302 Havemeyer Hall</td>
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<tr>
<td>CHEM 1500</td>
<td>002/11158</td>
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<td>302 Havemeyer Hall</td>
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<td>CHEM 1500</td>
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<td>302 Havemeyer Hall</td>
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<tr>
<td>CHEM 1500</td>
<td>004/11160</td>
<td>Th 1:10pm - 4:50pm</td>
<td>302 Havemeyer Hall</td>
<td>Sarah Hansen</td>
<td>3.00</td>
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</tbody>
</table>
CHEM UN1507 INTENSIVE GENERAL CHEMISTRY-LAB. 3.00 points.
CC/GS: Partial Fulfillment of Science Requirement
Lab Fee: $140.

Prerequisites: CHEM UN1604 or CHEM UN2045
Corequisites: CHEM UN2045

Spring 2024: CHEM UN1507
<table>
<thead>
<tr>
<th>Course Number</th>
<th>Section/Call Number</th>
<th>Times/Location</th>
<th>Instructor</th>
<th>Points</th>
<th>Enrollment</th>
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<tr>
<td>CHEM 1507</td>
<td>001/11150</td>
<td>M 1:00pm - 6:00pm</td>
<td>Luis Avila</td>
<td>3.00</td>
<td>3/18</td>
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<tr>
<td>CHEM 1507</td>
<td>002/11151</td>
<td>F 1:00pm - 6:00pm</td>
<td>Luis Avila</td>
<td>3.00</td>
<td>16/18</td>
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Fall 2024: CHEM UN1507
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<th>Course Number</th>
<th>Section/Call Number</th>
<th>Times/Location</th>
<th>Instructor</th>
<th>Points</th>
<th>Enrollment</th>
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<td>Luis Avila</td>
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<td>CHEM 1507</td>
<td>002/11166</td>
<td>F 1:00pm - 6:00pm</td>
<td>Luis Avila</td>
<td>3.00</td>
<td>8/18</td>
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CHEM UN2045 INTENSIVE ORGANIC CHEMISTRY. 4.00 points.
Prerequisites: A grade of 5 on the Chemistry Advanced Placement exam and an acceptable grade on the Department placement exam or an acceptable grade in CHEM UN1604.
Corequisites: CHEM UN1507

Spring 2024: CHEM UN2045
<table>
<thead>
<tr>
<th>Course Number</th>
<th>Section/Call Number</th>
<th>Times/Location</th>
<th>Instructor</th>
<th>Points</th>
<th>Enrollment</th>
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<tr>
<td>CHEM 2045</td>
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<td>Luis Campos</td>
<td>4.00</td>
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</table>

CHEM UN2408 1ST YEAR SEM IN CHEMICAL RES. 1.00 point.
Prerequisites: CHEM UN1403 or CHEM UN1604 or CHEM UN2045 or the instructor's permission.
Prerequisites: CHEM UN1403 or CHEM UN1604 or CHEM UN2045 or the instructors permission. A one-hour weekly lecture, discussion, and critical analysis of topics that reflect problems in modern chemistry, with emphasis on current areas of active chemical research

Spring 2024: CHEM UN2408
<table>
<thead>
<tr>
<th>Course Number</th>
<th>Section/Call Number</th>
<th>Times/Location</th>
<th>Instructor</th>
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<tr>
<td>CHEM 2408</td>
<td>001/11153</td>
<td>F 12:00pm - 12:50pm</td>
<td>Vesna</td>
<td>1.00</td>
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CHEM UN2444 ORGANIC CHEMISTRY II-LECTURES. 4.00 points.
Prerequisites: CHEM UN1404 or CHEM UN1604 and CHEM UN1500 and CHEM UN2443

Prerequisites: CHEM UN1404 or CHEM UN1604, CHEM UN1500 and CHEMUN2443. The principles of organic chemistry. The structure and reactivity of organic molecules are examined from the standpoint of modern theories of chemistry. Topics include stereochemistry, reactions of organic molecules, mechanisms of organic reactions, syntheses and degradations of organic molecules, and spectroscopic techniques of structure determination. Although CHEM UN2443 and CHEM UN2444 are separate courses, students are expected to take both terms sequentially. Students must ensure they register for the recitation which corresponds to the lecture section. Please check the Directory of Classes for details

Spring 2024: CHEM UN2444
<table>
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<tr>
<th>Course Number</th>
<th>Section/Call Number</th>
<th>Times/Location</th>
<th>Instructor</th>
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<td>Christopher</td>
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<td>Eckdahl</td>
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<td>CHEM 2444</td>
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<td>Charles</td>
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<td>James</td>
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<td></td>
<td></td>
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<td>Charles</td>
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<td></td>
<td>0th Other</td>
<td>Doubleday</td>
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</table>
CHEM UN2494 ORGANIC CHEM. LAB II SYNTHESIS. 0.00 points.
Lab Fee: $62.00
Prerequisites: (CHEM UN1403 and CHEM UN1404) and CHEM UN1500 and CHEM UN2493
Corequisites: CHEM UN2444
Prerequisites: CHEM W1403-CHEM W1404; CHEM W1500; CHEM W2493. Corequisites: CHEM W2444. Please note that you must complete CHEM W2493 before you register for CHEM W2494. This lab introduces students to experimental design and trains students in the execution and evaluation of scientific data. The technique experiments in the first half of the course (CHEM W2493) teach students to develop and master the required experimental skills to perform the challenging synthesis experiments in the second semester. The learning outcomes for this lab are the knowledge and experimental skills associated with the most important synthetic routes widely used in industrial and research environments. Attendance at the first lab lecture and laboratory session is mandatory. Please note that CHEM W2494 is the second part of a full year organic chemistry laboratory course. Students must register for the lab lecture section (CHEM W2496) which corresponds to their lab section. Students must attend ONE lab lecture and ONE lab section every other week. Please contact your advisors for further information.

CHEM UN3086 PHYSICAL CHEMISTRY II-LECTURES. 4.00 points.
Prerequisites: CHEM UN3079
Corequisites: CHEM UN3086
Prerequisites: CHEM UN3079 Corequisites: CHEM UN3086 CHEM UN3080 covers the quantum mechanisms of atoms and molecules, the quantum statistical mechanics of chemical systems, and the connection of statistical mechanics to thermodynamics. Although CHEM UN3079 and CHEM UN3080 are separate courses, students are expected to take both terms sequentially. A recitation section is required. Please check the Directory of Classes for details and also speak with the TA for the course.

CHEM UN3098 SUPERVISED INDEPENDENT RES. 4.00 points.
Lab Fee: $105 per term.
Prerequisites: CHEM UN3085, CHEM UN3098 is acceptable corequisite for CHEM UN3086.
Prerequisites: CHEM UN3085, CHEM UN3098 is acceptable corequisite for CHEM UN3086. A student-centered experimental course intended for students who are co-registered or have complete CHEM UN3079 and CHEM UN3080. The course emphasizes techniques of experimental physical chemistry and instrumental analysis, including vibrational, electronic, and laser spectroscopy; electroanalytical methods; calorimetry; reaction kinetics; hydrodynamic methods; scanning probe microscopy: applications of computers to reduce experimental data; and computational chemistry. Students must also attend the compulsory Mentoring Session. Please check the Directory of Classes for details.

CHEM UN2496 ORGANIC CHEM. LABORATORY II. 1.50 point.
Corequisites: CHEM UN2494
The course is the lab lecture which accompanies the Organic Chemistry Laboratory II (Synthesis) course.

CHEM UN3080 PHYSICAL CHEMISTRY II-LABORATORY II. 4.00 points.
Prerequisites: CHEM UN3079
Corequisites: CHEM UN3086
Prerequisites: CHEM UN3079 Corequisites: CHEM UN3086 CHEM UN3080 covers the quantum mechanisms of atoms and molecules, the quantum statistical mechanics of chemical systems, and the connection of statistical mechanics to thermodynamics. Although CHEM UN3079 and CHEM UN3080 are separate courses, students are expected to take both terms sequentially. A recitation section is required. Please check the Directory of Classes for details and also speak with the TA for the course.

CHEM UN3098 SUPERVISED INDEPENDENT RES. 4.00 points.
Lab Fee: $105 per term.
Prerequisites: the instructor’s permission for entrance, and the departmental representative’s permission for aggregate points in excess of 12 or less than 4.
Prerequisites: the instructors permission for entrance, and the departmental representatives permission for aggregate points in excess of 12 or less than 4. This course may be repeated for credit (see major and concentration requirements). Individual research under the supervision of a member of the staff. Research areas include organic, physical, inorganic, analytical, and biological chemistry. Please note that CHEM UN3098 is offered in the fall and spring semesters.
CHEM UN3546 ADVANCED ORGANIC CHEMISTRY LAB. 3.00 points.
Laboratory Fee: $125.
Prerequisites: CHEM UN2493 and CHEM UN2494, or the equivalent.
Prerequisites: CHEM UN2493 and CHEM UN2494, or the equivalent. A project laboratory with emphasis on complex synthesis and advanced techniques including qualitative organic analysis and instrumentation.

CHEM GU4102 CHEMISTRY FOR THE BRAIN. 4.50 points.
This course was upgraded from 2.5 to 4.5 and assigned a new number.
Prerequisites: Organic chemistry and biology courses, neuroscience or neurobiology recommended, but not required.
Prerequisites: Organic chemistry and biology courses, neuroscience or neurobiology recommended, but not required. The study of the brain is one of the most exciting frontiers in science and medicine today. Although neuroscience is by nature a multi-disciplinary effort, chemistry has played many critical roles in the development of modern neuroscience, neuropharmacology, and brain imaging. Chemistry, and the chemical probes it generates, such as molecular modulators, therapeutics, imaging agents, sensors, or actuators, will continue to impact neuroscience on both preclinical and clinical levels. In this course, two major themes will be discussed. In the first one, titled Imaging brain function with chemical tools, we will discuss molecular designs and functional parameters of widely used fluorescent sensors in neuroscience (calcium, voltage, and neurotransmitter sensors), their impact on neuroscience, pros and cons of genetically encoded sensors versus chemical probes, and translatability of these approaches to the human brain. In the second major theme, titled Perturbation of the brain function with chemical tools, we will examine psychoactive substances, the basics of medicinal chemistry, brain receptor activation mechanisms and coupled signaling pathways, and their effects on circuit and brain function. We will also discuss recent approaches, failures and successes in the treatment of neurodegenerative and psychiatric disorders. Recent advances in precise brain function perturbation by light (optogenetics and photopharmacology) will also be introduced. In the context of both themes we will discuss the current and future possibilities for the design of novel materials, drawing on the wide molecular structural space (small molecules, proteins, polymers, nanomaterials), aimed at monitoring, modulating, and repairing human brain function. This course is intended for students (undergraduate and graduate) from the science, engineering and medical departments.

CHEM GU4103 ORGANOMETALLIC CHEMISTRY. 4.50 points.
Prerequisites: (CHEM UN2443 and CHEM UN2444), or the equivalent. Some background in inorganic and physical chemistry is helpful but not required.
Main group and transition metal organometallic chemistry: bonding, structure, reactions, kinetics, and mechanisms.

CHEM GU4104 STRUCTURAL METHODS IN INORGANIC CHEMISTR. 2.50 points.
The determination of structures by diffraction methods, focusing on single crystal X-ray diffraction, is described. Emphasis is placed on a critical evaluation of published data.

CHEM GU4145 NMR SPECTROSCOPY. 1.00 point.
Prerequisites: elementary organic chemistry. Prerequisites: elementary organic chemistry. Introduction to theory and practice of NMR spectroscopy. Instrumental aspects, basic NMR theory, NOE, and a survey of 2D methods are covered.

CHEM GU4232 INTRO TO MOLECULAR MODELING. 4.50 points.
Prerequisites: physical chemistry sequence. Molecular modeling has become an integral part of research in many areas of chemistry, and in industry in drug discovery and materials design. Many experimental papers in the literature are routinely complemented by molecular modeling calculations. Experimental scientists working in industry have a significant advantage if they know how to optimally use modeling software. The course would consist of a normal lecture part plus a lab session every week in which the students learn to use modeling software by working on projects.

BIOC GU4512 MOLECULAR BIOLOGY. 3.00 points.
Prerequisites: one year of biology. Recommended but not required: BIOC UN3501 Prerequisites: one year of biology. This is a lecture course designed for advanced undergraduates and graduate students. The focus is on understanding at the molecular level how genetic information is stored within the cell and how it is regulated. Topics covered include genome organization, DNA replication, transcription, RNA processing, and translation. This course will also emphasize the critical analysis of the scientific literature and help students understand how to identify important biological problems and how to address them experimentally. SPS and TC students may register for this course, but they must first obtain the written permission of the instructor, by filling out a paper Registration Adjustment Form (Add/Drop form). The form can be downloaded at the URL below, but must be signed by the instructor and returned to the office of the registrar. http://registrar.columbia.edu/sites/default/files/content/reg-adjustment.pdf

CHEM GR6169 MATERIALS CHEMISTRY IIIIB. 2.50 points.
Prerequisites: CHEM UN2443, or the equivalent. Prerequisites: CHEM UN2443, or the equivalent.

CHEM GR6222 QUANTUM CHEMISTRY II. 2.50 points.
Prerequisites: CHEM GU4221 Prerequisites: CHEM GU4221 Atomic and molecular quantum mechanics: fundamentals of electronic structure, many-body wave functions and operators, Hartree-Fock and density functional theory, the Dirac equation.

CHEM GR8223 QUANTUM CHEMISTRY III. 2.50 points.
Not offered during 2023-2024 academic year.
Prerequisites: CHEM G6222.
Nonlinear spectroscopy: second harmonic and vibrational sum frequency generation; applications to surface and colloidal nano-microparticle interfaces; nonradiative molecular processes.
Courses Offered in Alternate Years

Please contact the Undergraduate Program Manager, Vesna Gasperov (vg2231@columbia.edu), for further information.

CHEM GU4103 ORGANOMETALLIC CHEMISTRY. 4.50 points.
Prerequisites: (CHEM UN2443 and CHEM UN2444), or the equivalent. Some background in inorganic and physical chemistry is helpful but not required.
Main group and transition metal organometallic chemistry: bonding, structure, reactions, kinetics, and mechanisms.

CHEM GU4104 STRUCTURAL METHODS IN INORGANIC CHEMISTRY. 2.50 points.
The determination of structures by diffraction methods, focusing on single crystal X-ray diffraction, is described. Emphasis is placed on a critical evaluation of published data.

CHEM GU4111 APPLICATIONS OF NMR SPECTROSCOPY TO INORGANIC CHEMISTRY. 2.50 points.
The use of multinuclear NMR spectroscopy in the determination of the structures of inorganic molecules and the use of dynamic NMR spectroscopy (variable temperature NMR and magnetization transfer techniques) to provide information concerned with reaction mechanisms.

Spring 2024: CHEM GU4111 Course Number Section/Call Number Times/Location Instructor Points Enrollment
CHEM 4111 001/11329 M W 8:40am - 9:55am 320 Havemeyer Hall Gerard Parkin 2.50 18/42

CHEM GU4154 Chemical Characterization for Synthetic Chemists. 3 points.
Prerequisites: Columbia University’s laboratory safety certification is required. One year each of (i) general chemistry lecture/lab; (ii) organic or inorganic chemistry lecture/lab; and (iii) research experience in a chemistry lab are recommended.
This course will teach synthetic chemists to use mass spectrometry, analytical chromatography, and single-crystal X-ray diffraction as tools for research in synthetic chemistry. The teaching approach will be practical with an emphasis on hands-on experience. Students will gain: (1) A user-level understanding of the theory of these analytical methods. (2) Hands-on proficiency with a variety of instruments available at Columbia. (3) An introduction to advanced instrument capabilities and an awareness of their applications. (4) Proficiency in processing and interpreting data.

CHEM GU4210 Writing Workshop for Chemists. 1 point.
Prerequisites: recommended for undergraduate students to have taken at least one semester of independent research.
This course offers undergraduate and graduate students an introduction to scientific writing and provides an opportunity for them to become more familiar with the skill and craft of communicating complex scientific research. This course will provide students with the basic grammatical, stylistic and practical skills required to write effective academic journal articles, theses, or research proposals. In addition, through an innovative partnership with Columbia University Libraries’ Digital Science Center, students will learn how to apply these basic skills to their writing through the use of state-of-the-art software and on-line resources. Regular opportunities to write, peer edit and revise throughout the semester will allow students to put what they are learning into immediate practice. It is recommended that undergraduates have taken at least one semester of research for credit before taking this course. Undergraduates should plan to take this course after taking the required Core course University Writing.

CHEM GR6168 MATERIALS CHEMISTRY IIA. 2.50 points.
Prerequisites: CHEM UN2443, or the equivalent. Prerequisites: CHEM UN2443, or the equivalent. This is an introductory course to the emerging field macromolecular materials chemistry. The general topics will be based on the chemistry, self-assembly, and performance of block copolymers and conjugated polymers. Particular emphasis will be devoted to the demands required to drive materials from scientific curiosity to commercialization. At the fundamental level, the course will cover topics on polymerization techniques, electronic structure of organic semiconductors, characterization strategies, nanostructures and self-assembly.

CHEM GR6169 MATERIALS CHEMISTRY IIB. 2.50 points.
Prerequisites: CHEM UN2443, or the equivalent.
Prerequisites: CHEM UN2443, or the equivalent

CHEM GR6222 QUANTUM CHEMISTRY II. 2.50 points.
Prerequisites: CHEM GU4221
Prerequisites: CHEM GU4221 Atomic and molecular quantum mechanics: fundamentals of electronic structure, many-body wave functions and operators, Hartree-Fock and density functional theory, the Dirac equation.

CHEM GR6231 INTERMEDIATE STATISTICAL MECH. 2.50 points.
Prerequisites: CHEM GU4221 and CHEM GU4230 Phase transitions and critical phenomena; renormalization group methods; classical theory of fluids.

CHEM GR8106 KINETICS. 2.50 points.
Not offered during 2023-2024 academic year.

Kinetics and mechanisms of inorganic reactions.
CHEM GR8120 Polymers in Nanotechnology. 2.5 points.
Polymeric materials have long been ubiquitous items and played
important roles in revolutionizing the way we live. Due to the advent
of modern polymerization fabrication strategies, polymers are rapidly
gaining interest for the development of next generation devices and
medical treatment. This course will focus on the chemistry polymers
and their use as nanostructured materials created by self-assembly and
top-down fabrication techniques. Specifically, the class will be divided
into two sections describing the uses of organic nanostructures on
a) surfaces and b) as particles. Patterned surfaces will be described
in terms of photo-, imprint-, and block copolymer lithography. The
preparation of nanoparticles through polymer synthesis, dendrimers, and
mechanical manipulation will be the second part.

CHEM GR8223 QUANTUM CHEMISTRY III. 2.50 points.
Not offered during 2023-2024 academic year.

Prerequisites: CHEM G6222.
Nonlinear spectroscopy: second harmonic and vibrational sum frequency
generation; applications to surface and colloidal nano-microparticle
interfaces; nonradiative molecular processes.

CHEM GR8232 ADV STATISTICAL MECHANICS. 2.50 points.
Prerequisites: CHEM GU4221 and CHEM GU4230, or their equivalents.
Stochastic processes; Brownian motion; Langevin equations and
fluctuation-dissipation theorems; reaction rate theory; time correlation
functions and linear response theory.

CHEM GR8349 Research Ethics & Philosophy. 2.5 points.
This lecture course aims to address philosophical and ethical questions
in scientific research. What are the most important traits of successful
scientists whose discoveries have greatly benefited humanity (and led
to Nobel Prizes)? What distinguishes great science from mediocre or
pathological "science"? What are the ethical standards of scientific
research? How do we identify scientific misconduct or fraud? Why are
ethical standards so critical to the integrity of the research enterprise?
The course requires extensive participation of students in the form of
discussions and debates. Grades will be based on participation, writing
assignments, and one oral presentation.