ENVIRONMENTAL CHEMISTRY

The Chemistry Department

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Interim Director of Undergraduate Studies: Dr. Vesna Gasperov, 319 Uris; 212-854-2017; vg2231@columbia.edu

The Study of Chemistry

Chemistry, the study of molecules, is a central science interesting for its own sake but also necessary as an intellectual link to the other sciences of biology, physics, and environmental science. Faculty find the various disciplines of chemistry fascinating because they establish intellectual bridges between the macroscopic or human-scale world that we see, smell, and touch, and the microscopic world that affects every aspect of our lives. The study of chemistry begins on the microscopic scale and extends to engage a variety of different macroscopic contexts.

Chemistry is currently making its largest impact on society at the nexus between chemistry and biology and the nexus between chemistry and engineering, particularly where new materials are being developed. A typical chemistry laboratory now has more computers than test tubes and no longer smells of rotten eggs.

The chemistry department majors are designed to help students focus on these new developments and to understand the factors influencing the nature of the discipline. Because the science is constantly changing, courses change as well, and while organic and physical chemistry remain the bedrock courses, they too differ greatly from the same courses 40 years ago. Many consider biochemistry to be a foundation course as well. Although different paths within the chemistry major take different trajectories, there is a core that provides the essential foundation students need regardless of the path they choose. Students should consider majoring in chemistry if they share or can develop a fascination with the explanatory power that comes with an advanced understanding of the nature and influence of the microscopic world of molecules.

Students who choose to major in chemistry may elect to continue graduate study in this field and obtain a Ph.D. which is a solid basis for a career in research, either in the industry or in a university. A major in chemistry also provides students with an astonishing range of career choices such as working in the chemical or pharmaceutical industries or in many other businesses where a technical background is highly desirable. Other options include becoming a financial analyst for a technical company, a science writer, a high school chemistry teacher, a patent attorney, an environmental consultant, or a hospital laboratory manager, among others. The choices are both numerous and various as well as intellectually exciting and personally fulfilling.

Student Advising

Consulting Advisers

Dr. Vesna Gasperov (vg2231@columbia.edu)

Enrolling in Classes

Dr. Vesna Gasperov (vg2231@columbia.edu)

Preparing 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.

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.

Other Important Information

Track Information

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-term intensive general chemistry laboratory course in the fall followed by a one-year course in organic chemistry for first-year students. The organic chemistry lecture sequence is taken spring-fall. In the second year, students may enroll in physical chemistry and the organic chemistry laboratory course.

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

Additional Courses

First-year students may also elect to take CHEM UN2408. This seminar focuses on topics in modern chemistry, and is offered to all students who have taken at least one semester of college chemistry and have an interest in chemical research.

Biochemistry (BIOC GU4501, BIOC GU4512) is recommended for students interested in the biomedical sciences.

Physical chemistry (CHEM UN3079-CHEM UN3080), a one-year program, requires prior preparation in mathematics and physics. The accompanying laboratory is CHEM UN3085-CHEM UN3086.

Also offered are a senior seminar (CHEM UN3920); advanced courses in biochemistry, inorganic, organic, and physical chemistry; and an introduction to research (CHEM UN3098).

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 CHEMSTRY 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	PHYSICL-ANALYTICL LABORATORY I
CHEM UN3086	PHYSICL-ANALYTCL LABORATORY II
CHEM UN3920	SENIOR SEMINAR
CHEM GU4071	INORGANIC CHEMISTRY

Advanced courses (4000-level or higher)

Track 2

First Year

CHEM UN1507	INTENSVE 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 CHEMSTRY 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	PHYSICL-ANALYTICL LABORATORY I
CHEM UN3086	PHYSICL-ANALYTCL LABORATORY II
CHEM UN3920	SENIOR SEMINAR
CHEM GU4071	INORGANIC CHEMISTRY

Advanced courses (4000- level or higher)

Track 3

First Year

CHEM UN1507	INTENSVE GENERAL CHEMISTRY-LAB
CHEM UN2045	INTENSVE ORGANIC CHEMISTRY
CHEM UN2408	1ST YEAR SEM IN CHEMICAL RES

Calculus and Physics as required.

Second Year

CHEM UN2046	INTENSVE ORG CHEM-FOR 1ST YEAR
CHEM UN3079	PHYSICAL CHEMISTRY I-LECTURES
CHEM UN3080	PHYSICAL CHEMISTRY II-LECTURES
CHEM UN2545	INTENSIVE ORGANIC CHEM LAB
CHEM UN3546	ADVANCED ORGANIC CHEMISTRY LAB

Calculus and physics as required.

Third Year

BIOC GU4501	BIOCHEM I-STRUCTURE/METABOLISM
CHEM UN3085	PHYSICL-ANALYTICL LABORATORY I
CHEM UN3086	PHYSICL-ANALYTCL LABORATORY II
CHEM UN3098	SUPERVISED INDEPENDENT RES
CHEM GU4071	INORGANIC CHEMISTRY

Fourth Year

CHEM UN3920	SENIOR SEMINAR

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

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

Track 3

CHEM UN1507	INTENSVE GENERAL CHEMISTRY-LAB
CHEM UN2045	INTENSVE ORGANIC CHEMISTRY
CHEM UN2046	INTENSVE 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 & PHYS UN2802	ACCELERATED PHYSICS I and ACCELERATED PHYSICS II
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-ANALYTICL LABORATORY I
CHEM UN3086	PHYSICL-ANALYTCL LABORATORY II
CHEM UN3546	ADVANCED ORGANIC CHEMISTRY LAB
CHEM UN3920	SENIOR SEMINAR
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 & MATH UN1102 & MATH UN1201 & MATH UN1202	CALCULUS I and CALCULUS II and CALCULUS III and CALCULUS IV
Two semesters of honors mathematics:	
MATH UN1207 & MATH UN1208	HONORS MATHEMATICS A 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
Biology	
BIOL UN1908	First Year Seminar in Biology (Recommended NOT required)
BIOL UN2005	INTRO BIO I: BIOCHEM,GEN,MOLEC
BIOL UN2006	INTRO BIO II:CELL BIO,DEV/PHYS
BIOC GU4501	BIOCHEM I-STRUCTURE/METABOLISM
or BIOC UN3300	BIOCHEMISTRY
BIOC GU4512	MOLECULAR BIOLOGY
Physics	
Select one of the following physics sequences:	
Sequence A:	
PHYS UN1201 & PHYS UN1202	GENERAL PHYSICS I and GENERAL PHYSICS II
Sequence B:	
PHYS UN1401 & PHYS UN1402 & PHYS UN1403	INTRO TO MECHANICS # THERMO and INTRO ELEC/MAGNETSM # OPTCS and INTRO-CLASSCL # QUANTUM WAVES (PHYS UN1403 is recommended NOT required)
Sequence C:	
PHYS UN1601 & PHYS UN1602 & PHYS UN2601	PHYSICS I:MECHANICS/RELATIVITY and PHYSICS II: THERMO, ELEC # MAG and PHYSICS III:CLASS/QUANTUM WAVE (PHYS UN2601 is recommended but not required)
Sequence D:	
PHYS UN2801 & PHYS UN2802	ACCELERATED PHYSICS I and ACCELERATED PHYSICS II
Mathematics	
Select one of the following sequences:	
Two semesters of calculus:	
MATH UN1101 & MATH UN1102 & MATH UN1201 & MATH UN1202	CALCULUS I and CALCULUS II and CALCULUS III and CALCULUS IV
Two semesters of honors mathematics:	
MATH UN1207 & MATH UN1208	HONORS MATHEMATICS A and HONORS MATHEMATICS B
AP credit and one term of calculus (Calculus II or higher)	
Additional Courses	
Select two of the following upper level laboratory courses (one must be a Biology lab):	
BIOL UN2501 & BIOL UN3040	CONTEMPORARY BIOLOGY LAB and 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-ANALYTICL 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
BIOC GU4323	Biophysical Chemistry I
BIOC 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
or BIOL UN3005	NEUROBIO II: DEVPT # SYSTEMS
BIOL UN3008	The Cellular Physiology of Disease
BIOL UN3022	DEVELOPMENTAL BIOLOGY

BIOL UN3034	Biotechnology
BIOL UN3041	CELL BIOLOGY
BIOL UN3073	CELLULAR/MOLECULAR IMMUNOLOGY
BIOL GU4065	Molecular Biology of Disease
BIOL GU4300	DRUGS AND DISEASE

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-ANALYTICL LABORATORY I
CHEM UN3086	PHYSICL-ANALYTCL LABORATORY II
CHEM UN3920	SENIOR SEMINAR
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 & MATH UN1102 & MATH UN1201 & MATH UN1202	CALCULUS I and CALCULUS II and CALCULUS III and CALCULUS IV
Two semesters of honors mathematics:	
MATH UN1207 & MATH UN1208 & MATH UN3027	HONORS MATHEMATICS A and HONORS MATHEMATICS B and Ordinary Differential Equations
Two semesters of advanced calculus:	
MATH UN1202 & MATH UN3027	CALCULUS IV and Ordinary Differential Equations

Major in Environmental 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. A second semester of Organic Chemistry lecture is recommended NOT required.	
CHEM UN3079	PHYSICAL CHEMISTRY I-LECTURES
CHEM GU4071	INORGANIC CHEMISTRY
The following courses are recommended NOT required:	
CHEM UN2408	1ST YEAR SEM IN CHEMICAL RES
CHEM UN3920	SENIOR SEMINAR
Earth and Environmental Science	
Select two of the following three courses:	
EESC UN2100	EARTH'S ENVIRO SYST: CLIM SYST
EESC UN2200	EARTH'S ENVIRONMENTAL SYSTEMS: THE SOLID EARTH
EESC UN2300	EARTH'S ENVIRO SYST: LIFE SYST
Additional course required:	
EESC UN3101	Geochemistry for a Habitable Planet
Select one of the following labs:	
EESC BC3016	ENVIRONMENTAL MEASURMENTS
CHEM UN3085	PHYSICL-ANALYTICL LABORATORY I
Select one option for Independent Research in Environmental Chemistry:	
EESC BC3800 & EESC BC3801	ENVIR SCIENCE SENIOR SEMINAR and ENVIR SCIENCE SENIOR SEM II
CHEM UN3098	SUPERVISED INDEPENDENT RES (It is strongly recommended to take CHEM UN3920 if taking CHEM UN3098)
Physics	
Select one of the following physics sequences:	
Sequence A:	
PHYS UN1201 & PHYS UN1202	GENERAL PHYSICS I and GENERAL PHYSICS II
Sequence B:	
PHYS UN1401 & PHYS UN1402 & PHYS UN1403	INTRO TO MECHANICS # THERMO and INTRO ELEC/MAGNETSM # OPTCS and INTRO-CLASSCL # QUANTUM WAVES (Recommended NOT required)
Sequence C:	
PHYS UN1601 & PHYS UN1602 & PHYS UN2601	PHYSICS I:MECHANICS/RELATIVITY and PHYSICS II: THERMO, ELEC # MAG and PHYSICS III:CLASS/QUANTUM WAVE (Recommended, not required)
Sequence D:	
PHYS UN2801 & PHYS UN2802	ACCELERATED PHYSICS I and ACCELERATED PHYSICS II
Mathematics	
Two semesters of calculus:	
MATH UN1101	CALCULUS I
MATH UN1102	CALCULUS II
MATH UN1201	CALCULUS III
MATH UN1202	CALCULUS IV
Additional Courses	
Select any two of the following:	
Chemistry:	
CHEM UN3080	PHYSICAL CHEMISTRY II-LECTURES
CHEM GU4103	ORGANOMETALLIC CHEMISTRY
CHEM GU4147	ADVANCED ORGANIC CHEMISTRY I
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 CONTINENTL 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 additonal semester of calculus	

Minor in Chemistry

Students should select 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

Track 2

CHEM UN1500	GENERAL CHEMISTRY LABORATORY
or CHEM UN1507	INTENSVE GENERAL CHEMISTRY-LAB
CHEM UN1604	2ND TERM GEN CHEM (INTENSIVE)
CHEM UN2443	ORGANIC CHEMISTRY I-LECTURES

Track 3

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

Select an additional two classes from the following options:

CHEM UN2444	ORGANIC CHEMSTRY II-LECTURES
CHEM UN3079	PHYSICAL CHEMISTRY I-LECTURES
CHEM UN3080	PHYSICAL CHEMISTRY II-LECTURES
CHEM GU4071	INORGANIC CHEMISTRY
BIOC GU4501	BIOCHEM I-STRUCTURE/METABOLISM

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 & PHYS UN1202	GENERAL PHYSICS I 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	INTENSVE 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	INTENSVE GENERAL CHEMISTRY-LAB
CHEM UN2045	INTENSVE ORGANIC CHEMISTRY
CHEM UN2046	INTENSVE 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 2025: CHEM UN0001

Course Number	Section/Call Number	Times/Location	Instructor	Points	Enrollment
CHEM 0001	001/10513	T Th 6:10pm - 7:25pm Room TBA	Christopher Eckdahl	0.00	0/50

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 2025: CHEM UN1403

Course Number	Section/Call Number	Times/Location	Instructor	Points	Enrollment
CHEM 1403	001/11152	T Th 6:10pm - 7:25pm 309 Havemeyer Hall	Ruben Savizky	4.00	110/130
CHEM 1403	AU1/18501	T Th 6:10pm - 7:25pm Othr Other	Ruben Savizky	4.00	7/10

Fall 2025: CHEM UN1403

Course Number	Section/Call Number	Times/Location	Instructor	Points	Enrollment
CHEM 1403	001/10514	M W 10:10am - 11:25am Room TBA	Gerard Parkin	4.00	0/220
CHEM 1403	002/11213	T Th 10:10am - 11:25am Room TBA	Xavier Roy	4.00	0/170
CHEM 1403	003/10515	T Th 6:10pm - 7:25pm Room TBA	Ruben Savizky	4.00	0/170
CHEM 1403	004/10516	M W 6:10pm - 7:25pm Room TBA	Robert Beer	4.00	0/120

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

Prerequisites: CHEM UN1403 *CHEM W1403*.
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

Spring 2025: CHEM UN1404

Course Number	Section/Call Number	Times/Location	Instructor	Points	Enrollment
CHEM 1404	001/11160	T Th 10:10am - 11:25am 309 Havemeyer Hall	Christopher Eckdahl	4.00	195/185
CHEM 1404	002/11336	M W 8:40am - 9:55am 309 Havemeyer Hall	Milan Delor	4.00	138/170
CHEM 1404	003/11194	M W 6:10pm - 7:25pm 209 Havemeyer Hall	Robert Beer	4.00	34/60
CHEM 1404	AU3/18502	M W 6:10pm - 7:25pm Othr Other	Robert Beer	4.00	3/10

Fall 2025: CHEM UN1404

Course Number	Section/Call Number	Times/Location	Instructor	Points	Enrollment
CHEM 1404	001/10517	T Th 10:10am - 11:25am Room TBA	Christopher Eckdahl	4.00	0/50

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, 4, 6 and CHEM UN1501 Sec 1). Participation in voluntary

Spring 2025: CHEM UN1500

Course Number	Section/Call Number	Times/Location	Instructor	Points	Enrollment
CHEM 1500	001/11161	M 2:10pm - 5:50pm 302 Havemeyer Hall	Sarah Hansen	3.00	26/24
CHEM 1500	002/11162	T 1:10pm - 4:50pm 302 Havemeyer Hall	Sarah Hansen	3.00	42/46
CHEM 1500	003/11163	T 6:10pm - 9:50pm 302 Havemeyer Hall	Joseph Ulichny	3.00	52/48
CHEM 1500	004/11164	W 8:40am - 12:25pm 302 Havemeyer Hall	Sarah Hansen	3.00	45/46
CHEM 1500	005/11165	W 1:10pm - 4:50pm 302 Havemeyer Hall	Joseph Ulichny	3.00	49/48
CHEM 1500	006/11166	Th 1:10pm - 4:50pm 302 Havemeyer Hall	Sarah Hansen	3.00	32/46
CHEM 1500	007/11167	Th 6:10pm - 9:50pm 302 Havemeyer Hall	Joseph Ulichny	3.00	51/48
CHEM 1500	008/11168	F 1:10pm - 4:50pm 302 Havemeyer Hall	Joseph Ulichny	3.00	30/27

Fall 2025: CHEM UN1500

Course Number	Section/Call Number	Times/Location	Instructor	Points	Enrollment
CHEM 1500	001/10482	T 1:10pm - 4:50pm 302 Havemeyer Hall	Sarah Hansen	3.00	0/46
CHEM 1500	002/10483	T 6:10pm - 9:50pm 302 Havemeyer Hall	Joseph Ulichny	3.00	0/46
CHEM 1500	003/10484	W 1:10pm - 4:50pm 302 Havemeyer Hall	Joseph Ulichny	3.00	0/46
CHEM 1500	004/10485	Th 1:10pm - 4:50pm 302 Havemeyer Hall	Sarah Hansen	3.00	0/46

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

Prerequisites: CHEM UN1604 or CHEM UN2045 *CHEM W1604* or *CHEM W2045*.
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 2025: CHEM UN1507

Course Number	Section/Call Number	Times/Location	Instructor	Points	Enrollment
CHEM 1507	001/11171	M 1:00pm - 6:00pm 302 Havemeyer Hall	Luis Avila	3.00	16/20
CHEM 1507	002/11172	F 1:00pm - 6:00pm 302 Havemeyer Hall	Luis Avila	3.00	19/20

Fall 2025: CHEM UN1507

Course Number	Section/Call Number	Times/Location	Instructor	Points	Enrollment
CHEM 1507	001/10488	M 1:10pm - 6:00pm 302 Havemeyer Hall	Luis Avila	3.00	0/18
CHEM 1507	002/10489	F 1:10pm - 6:00pm 302 Havemeyer Hall	Luis Avila	3.00	0/18

CHEM UN1604 2ND TERM GEN CHEM (INTENSIVE). *4.00 points*.
CC/GS: Partial Fulfillment of Science Requirement

Prerequisites: a grade of "B" or better in *CHEM W1403* OR acceptable performance on the Department placement exam.
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 2025: CHEM UN1604

Course Number	Section/Call Number	Times/Location	Instructor	Points	Enrollment
CHEM 1604	001/10544	T Th 11:40am - 12:55pm Room TBA	Wei Min	4.00	0/120

CHEM UN2046 INTENSVE ORG CHEM-FOR 1ST YEAR. *4.00 points*.
Prerequisites: CHEM UN2045 *CHEM W2045*
Prerequisites: CHEM UN2045 Premedical students may take CHEM UN2045, CHEM UN2046, and CHEM UN2545 to meet the minimum requirements for admission to medical school. This course covers the same material as CHEM UN2443 - CHEM UN2444, but is intended for students who have learned the principles of general chemistry in high school OR have completed CHEM UN1604 in their first year at Columbia. First year students enrolled in CHEM UN2045 - CHEM UN2046 are expected to enroll concurrently in CHEM UN1507. Although CHEM UN2045 and CHEM UN2046 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 2025: CHEM UN2046

Course Number	Section/Call Number	Times/Location	Instructor	Points	Enrollment
CHEM 2046	001/11449	T Th 11:40am - 12:55pm Room TBA	Colin Nuckolls	4.00	0/30

CHEM UN2443 ORGANIC CHEMISTRY I-LECTURES. *4.00 points*.
Prerequisites: (CHEM UN1403 and CHEM UN1404) or CHEM UN1604 *CHEM W1404* or *CHEM W1604* and *CHEM W1500*
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. Students must ensure they register for the recitation which corresponds to the lecture section. Please check the Directory of Classes for details

Fall 2025: CHEM UN2443

Course Number	Section/Call Number	Times/Location	Instructor	Points	Enrollment
CHEM 2443	001/10536	M W 11:40am - 12:55pm Room TBA	James Leighton	4.00	0/120
CHEM 2443	002/11432	T Th 11:40am - 12:55pm Room TBA	Virginia Cornish	4.00	0/120
CHEM 2443	003/10537	M W 6:10pm - 7:25pm Room TBA	Charles Doubleday	4.00	0/120

CHEM UN2493 ORGANIC CHEM. LAB I TECHNIQUES. *0.00 points*.
Lab Fee: $63.00

Prerequisites: (CHEM UN1403 and CHEM UN1404) or (CHEM UN1604) and (CHEM UN1500 or CHEM UN1507) *CHEM W2443*.
Corequisites: CHEM UN2443
Prerequisites: (CHEM UN1403 and CHEM UN1404) or (CHEM UN1604) and (CHEM UN1500 or CHEM UN1507) Corequisites: CHEM UN2443 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 2025: CHEM UN2493

Course Number	Section/Call Number	Times/Location	Instructor	Points	Enrollment
CHEM 2493	001/10490	M 1:10pm - 4:50pm 202a Havemeyer Hall	Talha Siddiqui	0.00	0/24
CHEM 2493	002/10491	T 1:10pm - 4:50pm 202a Havemeyer Hall	Talha Siddiqui	0.00	0/24
CHEM 2493	003/10492	T 6:10pm - 9:50pm 202a Havemeyer Hall	Talha Siddiqui	0.00	0/34
CHEM 2493	004/10493	W 1:10pm - 4:50pm 202a Havemeyer Hall	Anna Ghurbanyan	0.00	0/34
CHEM 2493	005/10494	Th 1:10pm - 4:50pm 202a Havemeyer Hall	Anna Ghurbanyan	0.00	0/34
CHEM 2493	006/10495	F 11:10am - 2:50pm 202a Havemeyer Hall	Anna Ghurbanyan	0.00	0/34
CHEM 2493	007/10496	M 1:10pm - 4:50pm 202a Havemeyer Hall	Talha Siddiqui	0.00	0/24
CHEM 2493	008/10497	T 1:10pm - 4:50pm 202a Havemeyer Hall	Talha Siddiqui	0.00	0/24
CHEM 2493	009/10498	T 6:10pm - 9:50pm 202a Havemeyer Hall	Talha Siddiqui	0.00	0/34
CHEM 2493	010/10499	W 1:10pm - 4:50pm 202a Havemeyer Hall	Anna Ghurbanyan	0.00	0/34
CHEM 2493	011/11453	Th 1:10pm - 4:50pm 202a Havemeyer Hall	Anna Ghurbanyan	0.00	0/34
CHEM 2493	012/10500	F 11:10am - 2:50pm 202a Havemeyer Hall	Anna Ghurbanyan	0.00	0/34

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 2025: CHEM UN2495

Course Number	Section/Call Number	Times/Location	Instructor	Points	Enrollment
CHEM 2495	001/10501	W 4:10pm - 5:25pm Room TBA	Talha Siddiqui	1.50	0/110
CHEM 2495	002/10502	M 4:10pm - 5:25pm Room TBA	Anna Ghurbanyan	1.50	0/110
CHEM 2495	003/10503	W 4:10pm - 5:25pm Room TBA	Talha Siddiqui	1.50	0/110
CHEM 2495	004/10504	M 4:10pm - 5:25pm Room TBA	Anna Ghurbanyan	1.50	0/110

CHEM UN2545 INTENSIVE ORGANIC CHEM LAB. *3.00 points*.
Lab Fee: $125.

Prerequisites: (CHEM UN2045 and CHEM UN2046) and CHEM UN1507 *CHEM W2045* and *CHEM W2046* and *CHEM W1507*.
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

Fall 2025: CHEM UN2545

Course Number	Section/Call Number	Times/Location	Instructor	Points	Enrollment
CHEM 2545	001/10505	M 1:10pm - 6:00pm 202b Havemeyer Hall	Fay Ng	3.00	0/10
CHEM 2545	002/10506	T 1:10pm - 6:00pm 202b Havemeyer Hall	Fay Ng	3.00	0/10

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 UN1102) or (MATH UN1207 and MATH UN1208) and (PHYS UN1401 and PHYS UN1402) *CHEM W1403* and *CHEM W1404*, or *CHEM W1604*, or *CHEM W3045* and *CHEM W3046*; *MATH V1101-V1102* or *V1207-V1208*; *PHYS V1201-V1202* is acceptable, *PHYS C1401-C1402* or the equivalent is recommended.
Corequisites: CHEM UN3085
Prerequisites: (CHEM UN1403 and CHEM UN1404) or (CHEM UN1604) or (CHEM UN2045 and CHEM UN2046) and (MATH UN1101 and MATH UN1102) 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 Elementary, but comprehensive, treatment of the fundamental laws governing the behavior of individual atoms and molecules and collections of them. CHEM UN3079 covers the thermodynamics of chemical systems at equilibrium and the chemical kinetics of nonequilibrium systems. 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

Fall 2025: CHEM UN3079

Course Number	Section/Call Number	Times/Location	Instructor	Points	Enrollment
CHEM 3079	001/11252	M W 10:10am - 11:25am Room TBA	Xiaoyang Zhu	4.00	0/60

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

Corequisites: CHEM UN3079
Corequisites: CHEM UN3079 A student-centered experimental course intended for students who are co-registered or have completed 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

Fall 2025: CHEM UN3085

Course Number	Section/Call Number	Times/Location	Instructor	Points	Enrollment
CHEM 3085	001/10507	T 12:00pm - 6:00pm 222 Havemeyer Hall	Luis Avila	4.00	0/15

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

Spring 2025: CHEM UN3098

Course Number	Section/Call Number	Times/Location	Instructor	Points	Enrollment
CHEM 3098	001/11155		Vesna Gasperov	4.00	8/25
CHEM 3098	002/20749		Vesna Gasperov	4.00	0/1

Fall 2025: CHEM UN3098

Course Number	Section/Call Number	Times/Location	Instructor	Points	Enrollment
CHEM 3098	001/10508		Vesna Gasperov	4.00	0/25

CHEM UN3920 SENIOR SEMINAR. *2.00 points*.
Pass/Fail credit only.

Open to senior chemistry, biochemistry, environmental chemistry, and chemical physics majors; senior chemistry concentrators; and students who have taken or are currently enrolled in CHEM UN3098. Senior seminar provides direct access to modern chemical research through selected studies by the students from active fields of chemical research. Topics to be presented and discussed draw from the current scientific literature and/or UN3098 research

Fall 2025: CHEM UN3920

Course Number	Section/Call Number	Times/Location	Instructor	Points	Enrollment
CHEM 3920	001/10509	F 2:10pm - 4:00pm Room TBA	Milan Delor	2.00	0/40

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

CHEM GU4071 INORGANIC CHEMISTRY. *4.50 points*.
CC/GS: Partial Fulfillment of Science Requirement

Prerequisites: (CHEM UN1403 and CHEM UN1404) or (CHEM UN1604) or (CHEM UN2045 and CHEM UN2046)
Prerequisites: (CHEM UN1403 and CHEM UN1404) or (CHEM UN1604) or (CHEM UN2045 and CHEM UN2046) , or the equivalent. Principles governing the structure and reactivity of inorganic compounds surveyed from experimental and theoretical viewpoints. Topics include inorganic solids, aqueous and nonaqueous solutions, the chemistry of selected main group elements, transition metal chemistry, metal clusters, metal carbonyls, and organometallic chemistry, bonding and resonance, symmetry and molecular orbitals, and spectroscopy

Fall 2025: CHEM GU4071

Course Number	Section/Call Number	Times/Location	Instructor	Points	Enrollment
CHEM 4071	001/11320	T Th 8:40am - 9:55am 320 Havemeyer Hall	Jonathan Owen	4.50	0/42

BIOC GU4501 BIOCHEM I-STRUCTURE/METABOLISM. *4.00 points*.
Undergraduates should register for *BIOC UN3501*.

Prerequisites: BIOL UN2005 and BIOL UN2006 and CHEM UN2443 and CHEM UN2444 one year of *BIOL C2005* and *BIOL C2006* and one year of organic chemistry.
In this course, we will study the chemistry of living systems. We will discuss how living systems convert environmental resources into energy, and how they use this energy and these materials to build the molecules required for the diverse functions of life. Finally, we will discuss the applications of such biochemical knowledge to mechanisms of disease and to drug discovery. At a high level, we expect that at the conclusion of the course, you should be able to explain the basic mechanisms by which 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 this knowledge, you will be able to diagram the major metabolic pathways and compare how these pathways are dysregulated in normal tissues in and disease states. In addition, you will learn which techniques are used to uncover this knowledge and how to design and interpret experiments that will address these questions. You will also collaborate with other students in the analysis and interpretation of biochemical data, and be able to communicate, defend and refute interpretations of data. In this course, we assume familiarity with basic concepts of modern biology, so having completed one year of college-level biology is required. In addition, we explore the reaction mechanisms governing a variety of transformations in metabolism. You must have completed one year of organic chemistry prior to taking this course.

CHEM GU4147 ADVANCED ORGANIC CHEMISTRY I. *4.50 points*.
Prerequisites: elementary organic and physical chemistry.
Prerequisites: elementary organic and physical chemistry. The mechanisms of organic reactions, structure of organic molecules, and theories of reactivity. How reactive intermediates are recognized and mechanisms are deduced using kinetics, stereochemistry, isotopes, and physical measurements

Fall 2025: CHEM GU4147

Course Number	Section/Call Number	Times/Location	Instructor	Points	Enrollment
CHEM 4147	001/11326	T Th 10:10am - 11:25am 320 Havemeyer Hall	Tomislav Rovis	4.50	0/42

CHEM GU4148 SYNTHETIC METHDS-ORGANC CHEM. *4.50 points*.
This course is intended for graduate students and advanced undergraduate students. 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). Mechanistic underpinning of the discussed reaction processes will also be briefly discussed. For each module (see the content below), specific examples of syntheses of natural products and/or synthetic materials will be provided. 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 basic knowledge of transition metal chemistry is recommended for the cross-coupling reactions (i.e. structure, electron counting, and elemental reaction types of transition metals)

Fall 2025: CHEM GU4148

Course Number	Section/Call Number	Times/Location	Instructor	Points	Enrollment
CHEM 4148	001/11258	M W 10:10am - 11:25am 320 Havemeyer Hall	Makeda Tekle-Smith	4.50	0/42

CHEM GU4221 QUANTUM CHEMISTRY I. *4.50 points*.
Prerequisites: elementary physical chemistry. Basic quantum mechanics: the Schrodinger equation and its interpretation, exact solutions in simple cases, methods or approximations including time-independent and time-dependent perturbation theory, spin and orbital angular momentum, spin-spin interactions, and an introduction to atomic and molecular structure

CHEM GU4230 STATISTICAL THERMODYNAMICS. *4.50 points*.
Prerequisites: elementary physical chemistry. Corequisites: CHEM G4221. Topics include the classical and quantum statistical mechanics of gases, liquids, and solids

Fall 2025: CHEM GU4230

Course Number	Section/Call Number	Times/Location	Instructor	Points	Enrollment
CHEM 4230	001/11323	T Th 11:40am - 12:55pm 320 Havemeyer Hall	Angelo Cacciuto, Timothy Berkelbach	4.50	0/42

CHEM GU4312 CHEMICAL BIOLOGY. *4.00 points*.
Prerequisites: (CHEM UN2443 and CHEM UN2444) and (CHEM UN3079 and CHEM UN3080) and (BIOC UN3501) elementary organic chemistry *CHEM W3443-CHEM W3444*. Recommended preparation: elementary physical chemistry *CHEM W3079-CHEM W3080* and biochemistry *BIOC C3501*.
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 2025: CHEM GU4312

Course Number	Section/Call Number	Times/Location	Instructor	Points	Enrollment
CHEM 4312	001/11248	M W 1:10pm - 2:25pm Room TBA	Virginia Cornish	4.00	0/42

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 with 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 *CHEM C3443* (or 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

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 2025: CHEM UN1403

Course Number	Section/Call Number	Times/Location	Instructor	Points	Enrollment
CHEM 1403	001/11152	T Th 6:10pm - 7:25pm 309 Havemeyer Hall	Ruben Savizky	4.00	110/130
CHEM 1403	AU1/18501	T Th 6:10pm - 7:25pm Othr Other	Ruben Savizky	4.00	7/10

Fall 2025: CHEM UN1403

Course Number	Section/Call Number	Times/Location	Instructor	Points	Enrollment
CHEM 1403	001/10514	M W 10:10am - 11:25am Room TBA	Gerard Parkin	4.00	0/220
CHEM 1403	002/11213	T Th 10:10am - 11:25am Room TBA	Xavier Roy	4.00	0/170
CHEM 1403	003/10515	T Th 6:10pm - 7:25pm Room TBA	Ruben Savizky	4.00	0/170
CHEM 1403	004/10516	M W 6:10pm - 7:25pm Room TBA	Robert Beer	4.00	0/120

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

Prerequisites: CHEM UN1403 *CHEM W1403*.
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

Spring 2025: CHEM UN1404

Course Number	Section/Call Number	Times/Location	Instructor	Points	Enrollment
CHEM 1404	001/11160	T Th 10:10am - 11:25am 309 Havemeyer Hall	Christopher Eckdahl	4.00	195/185
CHEM 1404	002/11336	M W 8:40am - 9:55am 309 Havemeyer Hall	Milan Delor	4.00	138/170
CHEM 1404	003/11194	M W 6:10pm - 7:25pm 209 Havemeyer Hall	Robert Beer	4.00	34/60
CHEM 1404	AU3/18502	M W 6:10pm - 7:25pm Othr Other	Robert Beer	4.00	3/10

Fall 2025: CHEM UN1404

Course Number	Section/Call Number	Times/Location	Instructor	Points	Enrollment
CHEM 1404	001/10517	T Th 10:10am - 11:25am Room TBA	Christopher Eckdahl	4.00	0/50

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, 4, 6 and CHEM UN1501 Sec 1). Participation in voluntary

Spring 2025: CHEM UN1500

Course Number	Section/Call Number	Times/Location	Instructor	Points	Enrollment
CHEM 1500	001/11161	M 2:10pm - 5:50pm 302 Havemeyer Hall	Sarah Hansen	3.00	26/24
CHEM 1500	002/11162	T 1:10pm - 4:50pm 302 Havemeyer Hall	Sarah Hansen	3.00	42/46
CHEM 1500	003/11163	T 6:10pm - 9:50pm 302 Havemeyer Hall	Joseph Ulichny	3.00	52/48
CHEM 1500	004/11164	W 8:40am - 12:25pm 302 Havemeyer Hall	Sarah Hansen	3.00	45/46
CHEM 1500	005/11165	W 1:10pm - 4:50pm 302 Havemeyer Hall	Joseph Ulichny	3.00	49/48
CHEM 1500	006/11166	Th 1:10pm - 4:50pm 302 Havemeyer Hall	Sarah Hansen	3.00	32/46
CHEM 1500	007/11167	Th 6:10pm - 9:50pm 302 Havemeyer Hall	Joseph Ulichny	3.00	51/48
CHEM 1500	008/11168	F 1:10pm - 4:50pm 302 Havemeyer Hall	Joseph Ulichny	3.00	30/27

Fall 2025: CHEM UN1500

Course Number	Section/Call Number	Times/Location	Instructor	Points	Enrollment
CHEM 1500	001/10482	T 1:10pm - 4:50pm 302 Havemeyer Hall	Sarah Hansen	3.00	0/46
CHEM 1500	002/10483	T 6:10pm - 9:50pm 302 Havemeyer Hall	Joseph Ulichny	3.00	0/46
CHEM 1500	003/10484	W 1:10pm - 4:50pm 302 Havemeyer Hall	Joseph Ulichny	3.00	0/46
CHEM 1500	004/10485	Th 1:10pm - 4:50pm 302 Havemeyer Hall	Sarah Hansen	3.00	0/46

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

Prerequisites: CHEM UN1604 or CHEM UN2045 *CHEM W1604* or *CHEM W2045*.
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 2025: CHEM UN1507

Course Number	Section/Call Number	Times/Location	Instructor	Points	Enrollment
CHEM 1507	001/11171	M 1:00pm - 6:00pm 302 Havemeyer Hall	Luis Avila	3.00	16/20
CHEM 1507	002/11172	F 1:00pm - 6:00pm 302 Havemeyer Hall	Luis Avila	3.00	19/20

Fall 2025: CHEM UN1507

Course Number	Section/Call Number	Times/Location	Instructor	Points	Enrollment
CHEM 1507	001/10488	M 1:10pm - 6:00pm 302 Havemeyer Hall	Luis Avila	3.00	0/18
CHEM 1507	002/10489	F 1:10pm - 6:00pm 302 Havemeyer Hall	Luis Avila	3.00	0/18

CHEM UN2045 INTENSVE 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 W1604*.
Corequisites: CHEM UN1507
Prerequisites: A grade of 5 on the Chemistry Advanced Placement exam and an acceptable grade on the Department placement exam. Corequisites: CHEM UN1507 Premedical students may take CHEM UN2045, CHEM UN2046, CHEM UN1507 and CHEM UN2545 to meet the minimum requirements for admission to medical school. This course covers the same material as CHEM UN2443-CHEM UN2444, but is intended for students who have learned the principles of general chemistry in high school OR have completed CHEM UN1604 in their first year at Columbia. First year students enrolled in CHEM UN2045-CHEM UN2046 are expected to enroll concurrently in CHEM UN1507. Although CHEM UN2045 and CHEM UN2046 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

Spring 2025: CHEM UN2045

Course Number	Section/Call Number	Times/Location	Instructor	Points	Enrollment
CHEM 2045	001/11156	T Th 1:10pm - 2:25pm 209 Havemeyer Hall	Luis Campos	4.00	36/60

CHEM UN2408 1ST YEAR SEM IN CHEMICAL RES. *1.00 point*.
Prerequisites: CHEM UN1403 or CHEM UN1604 or CHEM UN2045 *CHEM W1403*, *CHEM W1604*, *CHEM W3045*, 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 2025: CHEM UN2408

Course Number	Section/Call Number	Times/Location	Instructor	Points	Enrollment
CHEM 2408	001/11154	F 12:00pm - 12:50pm 209 Havemeyer Hall	Vesna Gasperov	1.00	21/80

CHEM UN2444 ORGANIC CHEMSTRY II-LECTURES. *4.00 points*.
Prerequisites: CHEM UN1404 or CHEM UN1604 and CHEM UN1500 and CHEM UN2443 *CHEM W1404* or *CHEM W1604* and *CHEM W1500*.
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 2025: CHEM UN2444

Course Number	Section/Call Number	Times/Location	Instructor	Points	Enrollment
CHEM 2444	001/11173	M W 11:40am - 12:55pm 309 Havemeyer Hall	Christopher Eckdahl	4.00	128/150
CHEM 2444	002/11174	T Th 11:40am - 12:55pm 309 Havemeyer Hall	James Leighton	4.00	107/110
CHEM 2444	003/11175	M W 6:10pm - 7:25pm 309 Havemeyer Hall	Charles Doubleday	4.00	50/65
CHEM 2444	AU3/18503	M W 6:10pm - 7:25pm Othr Other	Charles Doubleday	4.00	4/10

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 *CHEM W1403-CHEM W1404*; *CHEM W1500*; *CHEM W2493*.
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

Spring 2025: CHEM UN2494

Course Number	Section/Call Number	Times/Location	Instructor	Points	Enrollment
CHEM 2494	001/11240	M 1:10pm - 4:50pm 202a Havemeyer Hall	Talha Siddiqui	0.00	19/24
CHEM 2494	002/11241	T 12:10pm - 3:50pm 202a Havemeyer Hall	Talha Siddiqui	0.00	17/24
CHEM 2494	003/11253	T 6:10pm - 9:50pm 202a Havemeyer Hall	Talha Siddiqui	0.00	17/34
CHEM 2494	004/11242	W 1:10pm - 4:50pm 202a Havemeyer Hall	Anna Ghurbanyan	0.00	35/34
CHEM 2494	005/11243	Th 12:10pm - 3:50pm 202a Havemeyer Hall	Anna Ghurbanyan	0.00	13/34
CHEM 2494	006/11244	F 11:10am - 2:50pm 202a Havemeyer Hall	Anna Ghurbanyan	0.00	31/34
CHEM 2494	007/11276	M 1:10pm - 4:50pm 202a Havemeyer Hall	Talha Siddiqui	0.00	22/24
CHEM 2494	008/11275	T 12:10pm - 3:50pm 202a Havemeyer Hall	Talha Siddiqui	0.00	12/24
CHEM 2494	009/11245	T 6:10pm - 9:50pm 202a Havemeyer Hall	Talha Siddiqui	0.00	30/34
CHEM 2494	010/11246	W 1:10pm - 4:50pm 202a Havemeyer Hall	Anna Ghurbanyan	0.00	31/34
CHEM 2494	011/11277	Th 12:10pm - 3:50pm 202a Havemeyer Hall	Anna Ghurbanyan	0.00	5/34
CHEM 2494	012/11278	F 11:10am - 2:50pm 202a Havemeyer Hall	Anna Ghurbanyan	0.00	13/34

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.

Spring 2025: CHEM UN2496

Course Number	Section/Call Number	Times/Location	Instructor	Points	Enrollment
CHEM 2496	001/11247	W 4:10pm - 5:25pm 309 Havemeyer Hall	Talha Siddiqui	1.50	53/110
CHEM 2496	002/11248	M 4:10pm - 5:25pm 309 Havemeyer Hall	Anna Ghurbanyan	1.50	78/140
CHEM 2496	003/11249	W 4:10pm - 5:25pm 309 Havemeyer Hall	Talha Siddiqui	1.50	64/110
CHEM 2496	004/11250		Anna Ghurbanyan	1.50	49/140

CHEM UN3080 PHYSICAL CHEMISTRY II-LECTURES. *4.00 points*.
Prerequisites: CHEM UN3079 *CHEM W3079*
Corequisites: CHEM UN3086
Prerequisites: CHEM UN3079 Corequisites: CHEM UN3086 CHEM UN3080 covers the quantum mechanics 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

Spring 2025: CHEM UN3080

Course Number	Section/Call Number	Times/Location	Instructor	Points	Enrollment
CHEM 3080	001/11251	M W 10:10am - 11:25am 209 Havemeyer Hall	Xiaoyang Zhu	4.00	29/60

CHEM UN3086 PHYSICL-ANALYTCL LABORATORY II. *4.00 points*.
Lab Fee: $125 per term.

Prerequisites: CHEM UN3085 *CHEM W3085*
Prerequisites: CHEM UN3085 , CHEM UN3080 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

Spring 2025: CHEM UN3086

Course Number	Section/Call Number	Times/Location	Instructor	Points	Enrollment
CHEM 3086	001/11279	T 12:00pm - 6:00pm 222 Havemeyer Hall	Luis Avila	4.00	9/15

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

Spring 2025: CHEM UN3098

Course Number	Section/Call Number	Times/Location	Instructor	Points	Enrollment
CHEM 3098	001/11155		Vesna Gasperov	4.00	8/25
CHEM 3098	002/20749		Vesna Gasperov	4.00	0/1

Fall 2025: CHEM UN3098

Course Number	Section/Call Number	Times/Location	Instructor	Points	Enrollment
CHEM 3098	001/10508		Vesna Gasperov	4.00	0/25

CHEM UN3546 ADVANCED ORGANIC CHEMISTRY LAB. *3.00 points*.
Laboratory Fee: $125.

Prerequisites: CHEM UN2493 and CHEM UN2494 *CHEM W3543* or *CHEM W3545*.
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

Spring 2025: CHEM UN3546

Course Number	Section/Call Number	Times/Location	Instructor	Points	Enrollment
CHEM 3546	001/11176	M 1:00pm - 6:00pm 202b Havemeyer Hall	Fay Ng	3.00	5/10
CHEM 3546	002/11177	T 1:00pm - 6:00pm 202b Havemeyer Hall	Fay Ng	3.00	3/10

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

Spring 2025: CHEM GU4102

Course Number	Section/Call Number	Times/Location	Instructor	Points	Enrollment
CHEM 4102	001/15716	T Th 10:10am - 11:25am 320 Havemeyer Hall	Dalibor Sames	4.50	20/28

CHEM GU4103 ORGANOMETALLIC CHEMISTRY. *4.50 points*.
Prerequisites: (CHEM UN2443 and CHEM UN2444) elementary organic chemistry. (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.

Spring 2025: CHEM GU4103

Course Number	Section/Call Number	Times/Location	Instructor	Points	Enrollment
CHEM 4103	001/15717	T Th 11:40am - 12:55pm 320 Havemeyer Hall	Jack Norton	4.50	8/42

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.

Spring 2025: CHEM GU4104

Course Number	Section/Call Number	Times/Location	Instructor	Points	Enrollment
CHEM 4104	001/15719	M W 8:40am - 9:55am 320 Havemeyer Hall	Gerard Parkin	2.50	13/42

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

Spring 2025: CHEM GU4145

Course Number	Section/Call Number	Times/Location	Instructor	Points	Enrollment
CHEM 4145	001/15720	F 11:00am - 11:50am 320 Havemeyer Hall	John Decatur	1.00	19/42

CHEM GU4232 INTRO TO MOLECULAR MODELING. *4.50 points*.
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.

Spring 2025: CHEM GU4232

Course Number	Section/Call Number	Times/Location	Instructor	Points	Enrollment
CHEM 4232	001/15722	M W 1:10pm - 2:25pm 320 Havemeyer Hall	Richard Friesner	4.50	15/42

BIOC GU4512 MOLECULAR BIOLOGY. *3.00 points*.
Prerequisites: one year of biology. Recommended but not required: *BIOC C3501*.
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 IIB. *2.50 points*.
Prerequisites: CHEM UN2443 *CHEM C3443* (or equivalent).
Prerequisites: CHEM UN2443 , or the equivalent

CHEM GR6222 QUANTUM CHEMISTRY II. *2.50 points*.
Prerequisites: CHEM GU4221 Quantum Chemistry G4221.
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. *2.5 points*.
Prerequisites: *CHEM G6222*.
Nonlinear spectroscopy: second harmonic and vibrational sum frequency generation; applications to surface and colloidal nano-microparticle interfaces; nonradiative molecular processes.

CHEM GR8300 BIOPHOTONICS. *2.50 points*.

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) elementary organic chemistry. (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.

Spring 2025: CHEM GU4103

Course Number	Section/Call Number	Times/Location	Instructor	Points	Enrollment
CHEM 4103	001/15717	T Th 11:40am - 12:55pm 320 Havemeyer Hall	Jack Norton	4.50	8/42

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.

Spring 2025: CHEM GU4104

Course Number	Section/Call Number	Times/Location	Instructor	Points	Enrollment
CHEM 4104	001/15719	M W 8:40am - 9:55am 320 Havemeyer Hall	Gerard Parkin	2.50	13/42

CHEM GU4111 APPLICATIONS OF NMR SPECTROSCOPY TO INOR. *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

CHEM GU4154 Chemical Characterization for Synthetic Chemists. *3 points*.
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 *CHEM C3443* (or 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 *CHEM C3443* (or equivalent).
Prerequisites: CHEM UN2443 , or the equivalent

CHEM GR6222 QUANTUM CHEMISTRY II. *2.50 points*.
Prerequisites: CHEM GU4221 Quantum Chemistry G4221.
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 *CHEM G4221* and *CHEM G4230*.
Phase transitions and critical phenomena; renormalization group methods; classical theory of fluids.

CHEM GR8106 KINETICS. *2.5 points*.
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. *2.5 points*.
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 *CHEM G4221* and *CHEM G4230*, 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.