

CHEMISTRY AND PHYSICS

Department Description

The Department of Chemistry and Physics offers majors in chemistry, chemistry with a concentration in biochemistry, and physics. Minors in chemistry and physics are also offered. The courses of study are designed to meet the highest professional standards and are attuned to meet the needs of students with individual variations in preparation, interests, and career goals. Graduates of the chemistry and physics programs are well prepared to undertake careers in industry or teaching, graduate work in chemistry or physics, or advanced study in professional programs such as law or the health professions (including medicine, pharmacy, or dentistry). The majors in chemistry and physics also allow students to seamlessly participate in the Five-Year Dual-Degree Engineering Program with the University of Notre Dame.

Some courses in chemistry and physics are offered as a service to the other departments that require backgrounds in chemistry or physics for their students. Other courses are specifically designed to fulfill the Sophia Program requirements in the natural sciences for students who are not science majors but who seek to understand scientific concepts and processes that affect their daily lives in a technology-dependent world.

Certain course substitutions may be made with the consent of the department to meet the specialized needs of individual students. Students interested in attending graduate school in chemistry or biochemistry are strongly encouraged to participate in research and should consult the department chair about enrolling in additional chemistry, mathematics, and/or biology courses.

Study Abroad

Saint Mary's has a long history of providing quality international programs as an essential part of our educational mission—forming women leaders who will make a difference in the world. As this world becomes increasingly interdependent, the College offers an expanding range of semester, year, semester break, and summer study and service programs in a wide variety of countries, and encourages students to take advantage of them. Learn more about the various Study Abroad opportunities (<https://catalog.saintmarys.edu/undergraduate/academic-life/international-programs/>).

Programs

- Biochemistry Concentration, Chemistry Major, Bachelor of Science - BIOC (<https://catalog.saintmarys.edu/undergraduate/programs/chemistry-physics/biochemistry-concentration-bachelor-science/>)
- Chemistry, Bachelor of Science - CHEM (<https://catalog.saintmarys.edu/undergraduate/programs/chemistry-physics/chemistry-bachelor-science/>)
- Chemistry, Minor - CHEM (<https://catalog.saintmarys.edu/undergraduate/programs/chemistry-physics/chemistry-minor/>)
- Physics, Bachelor of Arts - PHYS (<https://catalog.saintmarys.edu/undergraduate/programs/chemistry-physics/physics-bachelor-arts/>)
- Physics, Bachelor of Science - PHYS (<https://catalog.saintmarys.edu/undergraduate/programs/chemistry-physics/physics-bachelor-science/>)
- Physics, Minor - PHYS (<https://catalog.saintmarys.edu/undergraduate/programs/chemistry-physics/physics-minor/>)

Department Chair

Christopher Dunlap
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Faculty

T. Barstis, I. Bentley, M. Drummond, C. Dunlap, J. Fishovitz, M. Gebran, E. Hinds, A. Houser, J. Mason

Physics Program Director

Marwan Gebrane

Faculty

I. Bentley, M. Gebrane

Chemistry Courses

CHEM 101 **Mystery, Mayhem, and Murder: Chemistry for the Citizen** (3,4)

A survey course for students majoring in disciplines other than the natural sciences. Application of fundamental chemical principles to selected inorganic, organic, and biological systems, with particular emphasis on topics of interest to citizens in a technological society. Offered in fall or spring semester for 4 credits (Three hours lecture and one two-hour laboratory) or summer session for 3 credits (Three hours lecture, no laboratory).

CHEM 101L **Mystery, Mayhem, and Murder: Chemistry for the Citizen Laboratory** (0)

One two-hour laboratory per week. Corequisite: CHEM 101.

CHEM 102 **Chemistry in Everyday Life** (3)

This course seeks to make the Saint Mary's College student aware of the chemicals that affect her directly as she lives her daily life. (Three lecture hours per week).

CHEM 104 **Pop Culture Chemistry** (3)

Through this course, you will be exposed to examples of chemistry in different popular culture mediums, including books, movies, television shows, the internet, and social media. Through investigation of the accuracy and validity of the science, you will learn principles of chemistry and biochemistry and will learn how to critique depictions of science in the media. In addition, this course will explore how real-world applications of chemistry influence pop culture and vice-versa. This course is for students majoring in non-science disciplines which fulfills the Natural Science (no lab) general education requirement.

CHEM 118 **Integrated General, Organic and Bio-Chemistry** (4)

An introduction to the fundamental concepts of general chemistry, organic chemistry and biochemistry with applications to the field of nursing. Laboratory experiments will closely correspond with the lecture material. (Four hours lecture and one two-hour laboratory) Prerequisite: One year high school chemistry and MATH 102 or concurrent enrollment in any higher level math course; or permission of the instructor.

CHEM 118L **Integrated General, Organic and Bio-Chemistry Laboratory** (0)

One two-hour laboratory per week. Corequisite: CHEM 118.

CHEM 121 Principles of Chemistry I (4)

This course is an introduction to chemical stoichiometry, atomic and molecular structure, and bonding. Laboratory will explore principles presented in lecture. (Three-hour lecture and one three-hour laboratory). Prerequisite: high school chemistry or permission of the instructor; students must be calculus-ready. For biology, chemistry, physics, and engineering intended majors. This course also satisfies the LO2 Critical Thinking Seminar.

CHEM 121L Principles of Chemistry I Laboratory (0)

One three-hour laboratory per week. Corequisite: CHEM 121.

CHEM 122 Principles of Chemistry II (4)

An introduction to chemical energetics, chemical equilibria, acid-base chemistry, and kinetics. Laboratory will explore principles presented in lecture. (Three hours lecture and one three-hour laboratory) Prerequisite: CHEM 121 or permission of instructor.

CHEM 122L Principles of Chemistry II Laboratory (0)

One three-hour laboratory per week. Corequisite: CHEM 122.

CHEM 221 Organic Chemistry I (3)

A treatment of the properties, structures, preparations and reactions of the important classes of compounds of carbon with emphasis on foundational concepts illustrated primarily through the chemistry of aliphatic hydrocarbons. (Three hours lecture) Prerequisite: CHEM 122.

CHEM 221L Organic Chemistry I Laboratory (1)

A course in a variety of organic laboratory skills, including separation and purification techniques. One three hour lab per week. Corequisite: CHEM 221.

CHEM 222 Organic Chemistry II (3)

A treatment of the properties, structures, preparations and reactions of the important classes of compounds of carbon. Aromatic chemistry is introduced and representative functional groups are covered. Three hours lecture. Prerequisite: CHEM 221 and CHEM 221L.

CHEM 222L Organic Chemistry II Laboratory (1)

A course in organic chemistry laboratory skills, including emphasizing qualitative analysis using chemical and instrumental methods. One three hour lab per week. Corequisite: CHEM 222.

CHEM 311 Thermodynamics (3)

A detailed study of thermodynamics, statistical mechanics, and kinetics. This calculus-based course integrates concepts of chemistry and physics. Three hours lecture. Prerequisites: CHEM 122, PHYS 122; Recommended: CHEM 221.

CHEM 312 Quantum Chemistry (3)

A detailed study of quantum chemistry, including techniques and applications of quantum theory, atomic and molecular structure, bonding, symmetry, group theory, and spectroscopy. (Three hours lecture) Prerequisites: CHEM 122, MATH 231, PHYS 122. Recommended: CHEM 221.

CHEM 324 Biochemistry (3)

A study of the chemical reactions of cells, the major metabolic pathways, and the interrelationship of these pathways. (Three hours lecture per week) Prerequisites: CHEM 222.

CHEM 332 Analytical Chemistry (3)

Quantitative methods of analysis are explored. The theory and application of wet chemical techniques and modern instrumental techniques (spectroscopy, chromatography and electrochemistry) are introduced with a focus on method selection and underlying chemical concepts. Analytical chemistry uses of statistics and equilibrium are also discussed. (Three hours lecture per week). Prerequisites: CHEM 221, PHYS 122.

CHEM 342 Bio-Inorganic Chemistry (3)

This course explores the properties and bonding of inorganic elements that are important to biological systems and biologically-inspired inorganic materials. Students will apply chemical principles in understanding the endogenous roles of metals in charge balance, catalysis, and structure. Students will learn how inorganic chemists design metal-based drugs and imaging agents to solve problems in human health, and how reverse-engineering of bio-inorganic systems have led to revolutionary inorganic solid state- and nano-materials. (Three hours lecture per week) Prerequisite: CHEM 222.

CHEM 361 Advanced Laboratory I (4)

Laboratory methods in chemistry are explored. Students will learn how to design and conduct experiments and gain hands-on experience with various laboratory techniques within the overall context of answering chemical questions. They will learn the basic chemical and physical principles upon which these varied techniques are based, plus they will demonstrate and apply their overall chemical knowledge from their first through third years of courses and laboratories. Students will also learn scientific presentation and writing skills. (Two 4-hour laboratories per week). Prerequisite: CHEM 222.

CHEM 362 Advanced Laboratory II (4)

A continuation of CHEM 361, students will explore more advanced laboratory techniques, building upon their experience of the previous course. Students will also build their scientific writing and presentation skills. (Two 4-hour laboratories per week). Prerequisite: CHEM 361.

CHEM 424 Advanced Biochemistry (3)

Advanced topics in the chemistry and chemical mechanisms involved in intermediary metabolism and developmental processes with consideration of the biochemistry current in the literature. (Three hours lecture per week). Prerequisites: CHEM 324, CHEM 311, or permission of instructor.

CHEM 431 Advanced Inorganic Chemistry (3)

A study of modern inorganic chemistry with emphasis on the principles, properties, and chemical trends of coordination compounds, This course will also explore the essentials of structure, bonding, symmetry, spectroscopy, and reactivity. (Three hours lecture per week). Prerequisite: CHEM 342. Concurrent or Prerequisite: CHEM 312.

CHEM 485 Research (1-3)

Participation in original experimental or theoretical investigation in collaboration with a member of the faculty. Prerequisite: Permission of the instructor. May be repeated.

CHEM 490 Topics in Chemistry (2,3)

Topics in Chemistry not covered in the regular department offerings and selected according to the interests of the students and instructor. Offered according to student demand. (Two or three lectures per week) Prerequisite: Permission of the instructor. May be repeated for credit with a different topic.

CHEM 497 Independent Study (1-2)

Topics in Chemistry not covered in the regular department offerings and selected according to the interests of the students and instructor. Offered according to student demand. (Two or three lectures per week) Prerequisite: Permission of the instructor. May be repeated for credit with a different topic.

CHEM 499 Chemistry Internship (1-4)

Experience in a chemistry internship. Graded S/U. May be repeated. Prerequisites: Permission of department required.

Physics Courses

PHYS 101 Intro Topics in Physics: Motion (4)

This course provides an introduction to the concepts and applications of physics through an exploration of everyday motion. This course will involve discussions of conceptual models to facilitate analyzing and viewing the natural world. The lab component of the course introduces fundamental principles in scientific investigation and will utilize the scientific method.

PHYS 101L Intro Topics PHYS: Motion-Lab (0)

One two-hour laboratory per week. Corequisite: PHYS 101.

PHYS 102 Introductory Topics in Physics: Energy (3)

An introduction to concepts, and applications of physics through the lens of energy. This course deals with the science of national and global energy concerns. The laboratory introduces fundamental principles of scientific investigation via experimental exploration. This course is intended for students not majoring in science. (Three hours lecture and a two-hour laboratory). Prerequisite: None.

PHYS 105 Astronomy (3)

A study of stars and galaxies within the Universe from our Earth based perspective. Scientific techniques and the history of scientific observation are included in addition to the properties of light and gravity. This course is intended for students not majoring in science or mathematics. (Three hours lecture). Prerequisite: None.

PHYS 107 Artificial Intelligence in Science and Everyday Life (3)

This course is an introduction to concepts and applications of Artificial Intelligence (AI) in Science and everyday life. It aims to give an understanding of the use and interpretation of available data and more particularly the STEM scientific data to recover accurate information using prediction techniques. This course will be based on the use of AI interactively with the students to solve real problems and predict solutions.

PHYS 111 College Physics I: Mechanics (4)

An introduction to mechanics. This is the first semester of a two-part algebra-based physics sequence designed primarily for students in life-sciences (biology, and neuroscience), communications sciences and disorders, and environmental studies. (Three hours of lecture and two hours laboratory.) Prerequisite: MATH 103.

PHYS 111L College Physics I Laboratory (0)

One two-hour laboratory per week. Corequisite: PHYS 111.

PHYS 112 College Physics II: Waves, Temperature, and Electricity (4)

An introduction to waves, thermodynamics, electricity, magnetism, and optics. This is the second semester of a two-part algebra-based physics sequence designed primarily for students in life-sciences (biology, and neuroscience), communications sciences and disorders, and environmental studies. (Three hours of lecture per week and a two-hour laboratory.) Prerequisite: PHYS 111.

PHYS 112L College Physics II Lab (0)

One two-hour laboratory per week. Corequisite: PHYS 112.

PHYS 121 General Physics I: Mechanics and Waves (4)

An introduction to mechanics, and waves. This is the first semester of a two-part calculus-based physics sequence designed for students in science, math, and engineering. (Three hours of lecture and two hours laboratory.) Prerequisite or corequisite: either MATH 131, MATH 132, or MATH 133. (High school physics strongly recommended)

PHYS 121L General Physics I Lab (0)

One two-hour laboratory per week. Corequisite: PHYS 121.

PHYS 122 General Physics II: Temperature, Electricity, and Light (4)

An introduction to thermodynamics, electricity, magnetism, and optics. This is the second semester of a two-part calculus-based physics sequence designed for students in science, math, and engineering. (Three hours of lecture per week and a two-hour laboratory.) Prerequisite: PHYS 121; and corequisite OR prerequisite either MATH 132 or MATH 133

PHYS 122L General Physics II Laboratory (0)

One two-hour laboratory per week. Corequisite: PHYS 122.

PHYS 205 Nuclear Science (3)

Nuclear science of the interplay between mathematics, science and ethics. This course contains a discussion of multiple facets of introductory nuclear science including applications such as nuclear power, nuclear weapons, nuclear medicine and food irradiation. Basic nuclear structure will be discussed as well as nuclear reactions and nucleosynthesis. Mathematical themes including algebra, statistics, probability and differential equations (exponential decay) will be introduced and used at various points in the course.

PHYS 253 General Physics III: Modern Physics (3)

An introduction to the conceptual and mathematical foundations of elementary quantum physics, and the historical framework and methodology of twentieth century physics, including contributions of women scientists. Special relativity and atomic physics are also discussed. (Three hours lecture). Prerequisite: PHYS 112 or PHYS 122; Corequisite MATH 231.

PHYS 272L Computational Physics Laboratory (1)

Computational methods in physics are explored. This course covers computational topics in physics, primarily in astrophysics, biophysics, and quantum mechanics. Offered in the fall on a three-year rotation. (Three hours laboratory). Prerequisite: PHYS 122.

PHYS 282L Modern Experimental Laboratory (1)

Experimental methods in modern physics are explored. This course covers experimental topics primarily from modern physics and materials science. Offered in the fall on a three-year rotation. (Three hours laboratory). Prerequisite: PHYS 122.

PHYS 292L Wave Mechanics Laboratory (1)

Laboratory methods in physics are explored. This course covers experimental and computational topics related to wave mechanics in both mechanical phenomenon and circuit analysis. Offered in the fall on a three-year rotation. (Three hours laboratory). Prerequisite: PHYS 122.

PHYS 321 Lagrangian Mechanics (1)

This course will cover topics in classical mechanics including wave motion. The primary focus is the Lagrange formalism which is used to setup simple differential equations and solve for equations of motion. This course covers the same material as PHYS 323 but only lasts for the first third of the semester. This course is intended for students who are also required to take additional courses in mechanics. Typically offered fall of even-numbered years. (Three hours lecture). Prerequisite: PHYS 122 and Corequisite: MATH 231

PHYS 323 Classical Mechanics (3)

A detailed study of classical mechanics including Newton's laws, and conservation laws. Equations of motion are derived based on the Lagrange and Hamiltonian formalisms. Typically offered fall of even-numbered years. (Three hours lecture). Prerequisite: PHYS 122 and Corequisite: MATH 231.

PHYS 341 Statistical Mechanics (1)

This course will cover topics in thermodynamics from a statistical mechanics viewpoint. Systems containing large numbers of particles will be analyzed using Boltzmann statistics. This course covers the same material as PHYS 343 but only lasts for the first third of the semester. This course is intended for students who are also required to take additional courses in Thermodynamics. Typically offered fall of odd-numbered years. (Three hours lecture). Prerequisite: PHYS 122 and Corequisite: MATH 231.

PHYS 343 Thermodynamics (3)

A detailed study of statistical mechanics and thermodynamics. Systems containing large numbers of particles will be analyzed using Boltzmann statistics. The laws of thermodynamics will be introduced. Cyclic processes and other thermodynamic concepts will be developed. Typically offered fall of even-numbered years. (Three hours lecture). Prerequisite: PHYS 122 and Corequisite: MATH 231.

PHYS 373 Fundamentals of Astrophysics (3)

The course will include an introduction to astrophysics. The night sky and coordinate systems, Kepler's law, observational astrophysics, magnitudes, and telescope types will all be discussed. The course will also introduce students to stellar physics and the evolution of stars.

PHYS 424 Quantum Mechanics (3)

A detailed physical and mathematical study of quantum mechanics including wave mechanics. Physical applications of quantum mechanics are also discussed. Typically offered spring of odd-numbered years. (Three hours lecture). Prerequisites: PHYS 253 and MATH 326.

PHYS 444 Electricity and Magnetism (3)

A detailed physical and mathematical study of electricity and magnetism focusing on applications from vector calculus. Interactions between electric and magnetic fields are explored including the use of Maxwell's equations. Typically offered spring of even-numbered years. (Three hours lecture). Prerequisites: PHYS 122 and MATH 426.

PHYS 485 Research (1-3)

Participation in original experimental or theoretical investigation in collaboration with a member of the faculty. Prerequisite: Permission of the department chair. May be repeated.

PHYS 490 Special Topics in Physics (1-5)

Topics in Physics not covered in the regular department offerings and selected according to the interests of the students and the instructor. Offered according to student demand. (Two or three lectures per week) Prerequisite: Permission of the instructor. May be repeated for credit with a different topic.

PHYS 497 Independent Study (1-3)

Enables properly qualified students to carry out independent study under the guidance of an instructor. Content dependent on student need and interest. Elective with permission of the department chair. Generally graded S/U; may be letter graded. May be repeated with a different topic.

Four Year Plan for Chemistry and Physics Programs

- Chemistry (p. 4)
- Biochemistry (p. 5)
- Physics (p. 6)

Bachelor of Science in Chemistry

The major in Chemistry requires 11 courses in chemistry with flexibility at the upper level. The 4 year schedule below is a model, but students often spread their Chemistry Core and Chemistry Advanced courses out over the junior and senior year. The Advanced Writing Proficiency is usually completed in the fall semester of the senior year, while the Senior Comprehensive is completed in the spring semester of the senior year.

ACS CERTIFICATION: Students who wish to take a more rigorous program can opt for the American Chemical Society certified degree.

This program requires 2 more advanced courses as well as two semesters (or a semester and a summer) of research. If interested, students should consult with their adviser or the chair of the department.

STUDY ABROAD: The chemistry program will allow students under normal circumstances to study abroad for a semester, usually in the spring of their junior year. This takes advanced planning in order to make sure all classes will be available for a student, and so students considering this should discuss this with their adviser as soon as possible.

| Course | Title | Credits |
|--|---|-----------|
| First Year | | |
| First Semester | | |
| Sophia Language I | | 4 |
| CHEM 121 & 121L | Principles of Chemistry I and Principles of Chemistry I Laboratory (Sophia NS, CTS) | 4 |
| SPLL 101 | | 1 |
| MATH 131 or MATH 132 or MATH 133 or MATH 231 | Calculus I (Sophia Mathematical Arts (Math depends on placement scores)) or Calculus II or Theory and Application of Calculus or Calculus III | 4 |
| PHYS 121 & 121L | General Physics I: Mechanics and Waves and General Physics I Lab | 4 |
| Credits | | 17 |
| Second Semester | | |
| Sophia Language II | | 4 |
| CHEM 122 & 122L | Principles of Chemistry II and Principles of Chemistry II Laboratory (Sophia NS) | 4 |
| PHYS 122 & 122L | General Physics II: Temperature, Electricity, and Light and General Physics II Laboratory | 4 |
| MATH 132 or MATH 231 | Calculus II (Math beyond 132 is not required except in specific cases.) or Calculus III | 4 |
| Credits | | 16 |

Second Year**First Semester**

| | | |
|-----------------|--|-----------|
| CHEM 221 & 221L | Organic Chemistry I and Organic Chemistry I Laboratory | 4 |
| Sophia W Course | | 4 |
| Sophia | | 3 |
| Sophia | | 3 |
| Math or Sophia | | 3 |
| Credits | | 17 |

Second Semester

| | | |
|-----------------|--|-----------|
| CHEM 222 & 222L | Organic Chemistry II and Organic Chemistry II Laboratory | 4 |
| CHEM 332 | Analytical Chemistry | 3 |
| Sophia | | 3 |
| Sophia | | 3 |
| Sophia | | 3 |
| Credits | | 16 |

Third Year**First Semester**

| | | |
|--|---|-----------|
| CHEM 361 | Advanced Laboratory I | 4 |
| CHEM 311 or CHEM 312 or CHEM 342 | Thermodynamics (CHEM Core I: Chemistry Core classes depend on offerings that semester.) or Quantum Chemistry or Bio-Inorganic Chemistry | 3 |
| Chemistry Core II: Chemistry Core: Chemistry 311, 312 classes depend on offerings that semester. | | 3 |
| CHEM 342 | Bio-Inorganic Chemistry | 3 |
| Sophia | | 3 |
| Credits | | 16 |

Second Semester

| | | |
|--|--|-----------|
| CHEM 362 | Advanced Laboratory II | 4 |
| CHEM 424 or CHEM 490 or CHEM 311 or CHEM 312 | Advanced Biochemistry (Advanced Classes depend on offerings that semester. May be taken senior year as well. These classes often have chemistry or other prerequisites, so be aware of that.) or Topics in Chemistry or Thermodynamics or Quantum Chemistry | 3 |
| Chemistry Core III: Chemistry Core: Chemistry 311, 312, 342 classes depend on offerings that semester. | | 3 |
| Elective or Research | | 3 |
| Sophia | | 3 |
| Credits | | 16 |

Fourth Year**First Semester**

| | | |
|---|--|-----------|
| Independent study for work on Advanced Writing paper. | | 1 |
| Sophia | | 3 |
| Sophia | | 3 |
| Elective courses | | 9 |
| Credits | | 16 |

Second Semester

| | |
|----------------------|------------|
| Electives | 15 |
| Credits | 15 |
| Total Credits | 129 |

Bachelor of Science in Chemistry, Biochemistry Concentration

The major in Chemistry with a Biochemistry Concentration includes courses in chemistry and Biology with flexibility at the upper level. The 4 year schedule below is a model, but students often spread their Chemistry Core and Chemistry Advanced courses out over the junior and senior year. The Advanced Writing Proficiency is usually completed in the fall semester of the senior year, while the Senior Comprehensive is completed in the spring semester of the senior year.

ACS CERTIFICATION: Students who wish to take a more rigorous program can opt for the American Chemical Society certified degree.

This program requires 2 more advanced courses as well as two semesters (or a semester and a summer) of research. If interested, students should consult with their adviser or the chair of the department.

STUDY ABROAD: The chemistry program will allow students under normal circumstances to study abroad for a semester, usually in the spring of their junior year. This takes advanced planning in order to make sure all classes will be available for a student, and so students considering this should discuss this with their adviser as soon as possible.

| Course | Title | Credits |
|--|--|-----------|
| First Year | | |
| First Semester | | |
| Sophia Language I | | 4 |
| CHEM 121 & 121L | Principles of Chemistry I and Principles of Chemistry I Laboratory (Sophia NS, CTS) | 4 |
| MATH 131 or MATH 132 or MATH 133 or MATH 231 | Calculus I (Sophia Math. Math depends on placement.) or Calculus II or Theory and Application of Calculus or Calculus III | 4 |
| BIO 155 | Foundations of Molecular Biology | 2 |
| SPLL 101 | | 1 |
| Credits | | 15 |
| Second Semester | | |
| Sophia Language II | | 4 |
| CHEM 122 & 122L | Principles of Chemistry II and Principles of Chemistry II Laboratory (Sophia NS) | 4 |
| MATH 132 or MATH 231 | Calculus II (Math beyond 132 is not required except in specific cases.) or Calculus III | 4 |
| BIO 157 | Foundations of Cellular Biology | 2 |
| Credits | | 14 |

Second Year**First Semester**

| | | |
|-----------------|--|---|
| CHEM 221 & 221L | Organic Chemistry I and Organic Chemistry I Laboratory | 4 |
|-----------------|--|---|

| | | |
|---------------------------|--|------------|
| Sophia W Course | | 4 |
| PHYS 121 & 121L | General Physics I: Mechanics and Waves and General Physics I Lab | 4 |
| Sophia | | 3 |
| Sophia | | 3 |
| Credits | | 18 |
| Second Semester | | |
| CHEM 222 & 222L | Organic Chemistry II and Organic Chemistry II Laboratory | 4 |
| CHEM 332 | Analytical Chemistry | 3 |
| PHYS 122 & 122L | General Physics II: Temperature, Electricity, and Light and General Physics II Laboratory | 4 |
| Sophia | | 3 |
| Sophia | | 3 |
| Credits | | 17 |
| Third Year | | |
| First Semester | | |
| CHEM 361 | Advanced Laboratory I (Sophia Prof Arts) | 4 |
| CHEM 324 | Biochemistry | 3 |
| CHEM 342 | Bio-Inorganic Chemistry | 3 |
| Biology Required Elective | can be taken any time in junior or senior year. Courses allowed are Biology 221/221L, 317/317L or 328/328L | 4 |
| Sophia | | 3 |
| Credits | | 17 |
| Second Semester | | |
| CHEM 362 | Advanced Laboratory II | 4 |
| CHEM 311 | Thermodynamics | 3 |
| CHEM 424 | Advanced Biochemistry | 3 |
| Sophia | | 3 |
| Sophia | | 3 |
| Credits | | 16 |
| Fourth Year | | |
| First Semester | | |
| CHEM 497 | Independent study for work on Advanced Writing paper. | 1 |
| Sophia | | 3 |
| Sophia | | 3 |
| Electives | | 9 |
| Credits | | 16 |
| Second Semester | | |
| Electives | | 12 |
| Sophia | | 3 |
| Credits | | 15 |
| Total Credits | | 128 |

Bachelor of Science in Physics

PHYS 121 in Odd Fall

| Course | Title | Credits |
|-------------------------------------|---|-----------|
| First Year | | |
| First Semester | | |
| CHEM 121 | Principles of Chemistry I | 4 |
| MATH 131 | Calculus I | 4 |
| PHYS 121 | General Physics I: Mechanics and Waves | 4 |
| Modern Language I | | 4 |
| Credits | | 16 |
| Second Semester | | |
| CHEM 122 | Principles of Chemistry II | 4 |
| MATH 132 | Calculus II | 4 |
| PHYS 122 | General Physics II: Temperature, Electricity, and Light | 4 |
| Modern Language II | | 4 |
| Credits | | 16 |
| Second Year | | |
| First Semester | | |
| CPSC 207 | Computer Programming | 3 |
| MATH 231 | Calculus III | 4 |
| PHYS 253 | General Physics III: Modern Physics | 3 |
| PHYS 323 | Classical Mechanics | 3 |
| PHYS 272L or PHYS 282L or PHYS 292L | Computational Physics Laboratory or Modern Experimental Laboratory or Wave Mechanics Laboratory | 1 |
| Philosophy | | 3 |
| Credits | | 17 |
| Second Semester | | |
| MATH 326 | Linear Algebra and Differential Equations | 4 |
| PHYS 424 | Quantum Mechanics | 3 |
| Technical Elective | | 3 |
| Literature | | 4 |
| Creative Arts | | 3 |
| Credits | | 17 |
| Third Year | | |
| First Semester | | |
| PHYS 343 | Thermodynamics | 3 |
| PHYS 272L or PHYS 282L or PHYS 292L | Computational Physics Laboratory or Modern Experimental Laboratory or Wave Mechanics Laboratory | 1 |
| Social Science | | 3 |
| Religious Traditions I | | 3 |
| Free Electives | | 6 |
| Credits | | 16 |
| Second Semester | | |
| PHYS 444 | Electricity and Magnetism | 3 |
| Technical Elective | | 3 |
| Social Science II | | 3 |
| Religious Traditions II | | 3 |
| Free Electives | | 3 |
| Credits | | 15 |

Fourth Year**First Semester**

| | |
|--------------------|-----------|
| History | 3 |
| Technical Elective | 3 |
| Free Electives | 9 |
| Credits | 15 |

Second Semester

| | |
|----------------------|------------|
| Free Electives | 16 |
| Credits | 16 |
| Total Credits | 128 |

PHYS 121 in Even Fall

| Course | Title | Credits |
|--------|-------|---------|
|--------|-------|---------|

First Year**First Semester**

| | | |
|-------------------|--|-----------|
| CHEM 121 | Principles of Chemistry I | 4 |
| MATH 131 | Calculus I | 4 |
| PHYS 121 | General Physics I: Mechanics and Waves | 4 |
| Modern Language I | | 4 |
| Credits | | 16 |

Second Semester

| | | |
|--------------------|---|-----------|
| CHEM 122 | Principles of Chemistry II | 4 |
| MATH 132 | Calculus II | 4 |
| PHYS 122 | General Physics II: Temperature, Electricity, and Light | 4 |
| Modern Language II | | 4 |
| Credits | | 16 |

Second Year**First Semester**

| | | |
|---|---|-----------|
| CPSC 207 | Computer Programming | 3 |
| MATH 231 | Calculus III | 4 |
| PHYS 343 | Thermodynamics | 3 |
| PHYS 272L or PHYS 282L or PHYS 292L | Computational Physics Laboratory or Modern Experimental Laboratory or Wave Mechanics Laboratory | 1 |
| Social Science | | 3 |
| Philosophy | | 3 |
| Credits | | 17 |

Second Semester

| | | |
|--------------------|---|-----------|
| MATH 326 | Linear Algebra and Differential Equations | 4 |
| PHYS 444 | Electricity and Magnetism | 3 |
| Technical Elective | | 3 |
| Literature | | 4 |
| Creative Arts | | 3 |
| Credits | | 17 |

Third Year**First Semester**

| | | |
|---|---|---|
| PHYS 253 | General Physics III: Modern Physics | 3 |
| PHYS 323 | Classical Mechanics | 3 |
| PHYS 272L or PHYS 282L or PHYS 292L | Computational Physics Laboratory or Modern Experimental Laboratory or Wave Mechanics Laboratory | 1 |
| Religious Traditions I | | 3 |

| | |
|----------------|-----------|
| Free Electives | 6 |
| Credits | 16 |

Second Semester

| | | |
|-------------------------|-------------------|-----------|
| PHYS 424 | Quantum Mechanics | 3 |
| Technical Elective | | 3 |
| Social Science II | | 3 |
| Religious Traditions II | | 3 |
| Free Electives | | 3 |
| Credits | | 15 |

Fourth Year**First Semester**

| | |
|--------------------|-----------|
| History | 3 |
| Technical Elective | 3 |
| Free Electives | 9 |
| Credits | 15 |

Second Semester

| | |
|----------------------|------------|
| Free Electives | 16 |
| Credits | 16 |
| Total Credits | 128 |

PHYS 121 in Odd Spring

| Course | Title | Credits |
|--------|-------|---------|
|--------|-------|---------|

First Year**First Semester**

| | | |
|-------------------|---------------------------|-----------|
| CHEM 121 | Principles of Chemistry I | 4 |
| MATH 131 | Calculus I | 4 |
| Literature | | 4 |
| Modern Language I | | 4 |
| Credits | | 16 |

Second Semester

| | | |
|--------------------|--|-----------|
| CHEM 122 | Principles of Chemistry II | 4 |
| MATH 132 | Calculus II | 4 |
| PHYS 121 | General Physics I: Mechanics and Waves | 4 |
| Modern Language II | | 4 |
| Credits | | 16 |

Second Year**First Semester**

| | | |
|----------------|---|-----------|
| CPSC 207 | Computer Programming | 3 |
| MATH 231 | Calculus III | 4 |
| PHYS 122 | General Physics II: Temperature, Electricity, and Light | 4 |
| Social Science | | 3 |
| Philosophy | | 3 |
| Credits | | 17 |

Second Semester

| | | |
|--------------------|---|-----------|
| MATH 326 | Linear Algebra and Differential Equations | 4 |
| Technical Elective | | 6 |
| Creative Arts | | 3 |
| History | | 3 |
| Credits | | 16 |

Third Year**First Semester**

| | | |
|---|---|-----------|
| PHYS 253 | General Physics III: Modern Physics | 3 |
| PHYS 323 | Classical Mechanics | 3 |
| PHYS 272L or PHYS 282L or PHYS 292L | Computational Physics Laboratory or Modern Experimental Laboratory or Wave Mechanics Laboratory | 1 |
| Religious Traditions I | | 3 |
| Free Electives | | 6 |
| Credits | | 16 |

Second Semester

| | | |
|-------------------------|-------------------|-----------|
| PHYS 424 | Quantum Mechanics | 3 |
| Technical Elective | | 3 |
| Social Science II | | 3 |
| Religious Traditions II | | 3 |
| Credits | | 12 |

Fourth Year**First Semester**

| | | |
|---|---|-----------|
| PHYS 343 | Thermodynamics | 3 |
| PHYS 272L or PHYS 282L or PHYS 292L | Computational Physics Laboratory or Modern Experimental Laboratory or Wave Mechanics Laboratory | 1 |
| Free Electives | | 12 |
| Credits | | 16 |

Second Semester

| | | |
|----------------------|---------------------------|------------|
| PHYS 444 | Electricity and Magnetism | 3 |
| Free Electives | | 13 |
| Credits | | 16 |
| Total Credits | | 125 |

PHYS 121 in Even Spring

| Course | Title | Credits |
|------------------------|--|-----------|
| First Year | | |
| First Semester | | |
| CHEM 121 | Principles of Chemistry I | 4 |
| MATH 131 | Calculus I | 4 |
| Literature | | 4 |
| Modern Language I | | 4 |
| Credits | | 16 |
| Second Semester | | |
| CHEM 122 | Principles of Chemistry II | 4 |
| MATH 132 | Calculus II | 4 |
| PHYS 121 | General Physics I: Mechanics and Waves | 4 |
| Modern Language II | | 4 |
| Credits | | 16 |
| Second Year | | |
| First Semester | | |
| CPSC 207 | Computer Programming | 3 |
| MATH 231 | Calculus III | 4 |
| PHYS 122 | General Physics II: Temperature, Electricity, and Light | 4 |
| Social Science | | 3 |

| | | |
|----------------|--|-----------|
| Philosophy | | 3 |
| Credits | | 17 |

Second Semester

| | | |
|--------------------|---|-----------|
| MATH 326 | Linear Algebra and Differential Equations | 4 |
| Technical Elective | | 6 |
| Creative Arts | | 3 |
| History | | 3 |
| Credits | | 16 |

Third Year**First Semester**

| | | |
|---|---|-----------|
| PHYS 343 | Thermodynamics | 3 |
| PHYS 272L or PHYS 282L or PHYS 292L | Computational Physics Laboratory or Modern Experimental Laboratory or Wave Mechanics Laboratory | 1 |
| Religious Traditions I | | 3 |
| Free Electives | | 9 |
| Credits | | 16 |

Second Semester

| | | |
|-------------------------|---------------------------|-----------|
| PHYS 444 | Electricity and Magnetism | 3 |
| Technical Elective | | 3 |
| Social Science II | | 3 |
| Religious Traditions II | | 3 |
| Free Electives | | 3 |
| Credits | | 15 |

Fourth Year**First Semester**

| | | |
|---|---|-----------|
| PHYS 253 | General Physics III: Modern Physics | 3 |
| PHYS 323 | Classical Mechanics | 3 |
| PHYS 272L or PHYS 282L or PHYS 292L | Computational Physics Laboratory or Modern Experimental Laboratory or Wave Mechanics Laboratory | 1 |
| Free Electives | | 9 |
| Credits | | 16 |

Second Semester

| | | |
|----------------------|-------------------|------------|
| PHYS 424 | Quantum Mechanics | 3 |
| Free Electives | | 13 |
| Credits | | 16 |
| Total Credits | | 128 |