PHYSICS

Description

The Department of Physics and Astronomy offers programs leading to the bachelor of arts and bachelor of science degrees. Students preparing for either graduate study or a professional career in physics should pursue a bachelor of science degree with a professional option. For students who have special interests, the department offers options in optics and lasers, materials physics, and computational physics.

The courses required for the bachelor of arts degree in physics offer a broader program in science and the liberal arts suitable for a variety of pre-professional curricula and for interdisciplinary studies in areas including biophysics, chemical physics, and geophysics.

College Admission

The entrance requirements for the College of Arts and Sciences (CAS), including any of the majors or minors offered through the college, are the same as the University of Nebraska–Lincoln General Admission Requirements. In addition to these requirements, the College of Arts and Sciences strongly recommends a third and fourth year of one foreign language in high school. Four years of high school coursework in the same language will fulfill the College of Arts and Sciences' language requirement. It will also allow students to continue language study at a more advanced level at the University of Nebraska–Lincoln and provide more opportunity to study abroad.

Academic and Career Advising

Academic and Career Advising Center

Not sure where to go or who to ask? The Advising Center team in 107 Oldfather Hall can help. The Academic and Career Advising Center is the undergraduate hub for CAS students in all majors. Centrally located and easily accessed, students encounter friendly, knowledgeable people who are eager to help or connect students to partner resources. Students also visit the Advising Center in 107 Oldfather Hall to:

- Choose or change their major, minor, or degree program.
- Check on policies, procedures, and deadlines.
- Get a college approval signature from the Dean's representatives.

CAS Career Coaches are available by appointment (in-person or zoom) and located in the CAS Academic and Career Advising Center, 107 Oldfather Hall. They help students explore majors and minors, gain experience, and develop a plan for life after graduation.

Assigned Academic Advisors

Academic advisors are critical resources dedicated to students' academic, personal, and professional success. Every CAS student is assigned an academic advisor based on their primary major. Since most CAS students have more than just a single major, it is important to get to know the advisor for any minors or additional majors. Academic advisors work closely with the faculty to provide the best overall support and the discipline specific expertise. They are available for appointments (in-person or zoom) and through weekly virtual drop-ins. Assigned advisors are listed in MyRED (https://its.unl.edu/myunl/) and their offices may be located in or near the department of the major for which they advise.

Students who have declared a pre-health or pre-law area of interest will also work with advisors in the Exploratory and Pre-Professional Advising Center (Explore Center) in 127 Love South, who are specially trained to guide students preparing to enter a professional school.

For complete and current information on advisors for majors, minors, or pre-professional areas, visit https://cas.unl.edu/major-advisors (https://cas.unl.edu/major-advisors/), or connect with the Arts and Sciences Academic and Career Advising Center, 107 Oldfather Hall, 402-472-4190, casadvising@unl.edu.

Career Coaching

The College believes that **Academics + Experience = Opportunities** and encourages students to complement their academic preparation with real-world experience, including internships, research, education abroad, service, and leadership. Arts and sciences students have access to a powerful network of faculty, staff, and advisors dedicated to providing information and support for their goals of meaningful employment or advanced education. Arts and sciences graduates have unlimited career possibilities and carry with them important career competencies—communication, critical thinking, creativity, context, and collaboration. They have the skills and adaptability that employers universally value. Graduates are prepared to effectively contribute professionally and personally with a solid foundation to excel in an increasingly global, technological, and interdisciplinary world.

Students should contact the career coaches in the Arts and Sciences Academic and Career Advising Center in 107 Oldfather Hall, or their assigned advisor, for more information. The CAS career coaches help students explore career options, identify ways to build experience and prepare to apply for internships, jobs, or graduate school, including help with resumes, applications, and interviewing.

ACE Requirements

Students must complete one course for each of the ACE Student Learning Outcomes below. Certified course choices are published in the degree audit, or visit the ACE website (http://ace.unl.edu) for the most current list of certified courses.

ACE Student Learning Outcomes
ACE 1: Write texts, in various forms, with an identified purpose, that respond to specific audience needs, integrate research or existing knowledge, and use applicable documentation and appropriate conventions of format and structure.
ACE 2: Demonstrate competence in communication skills.
ACE 3: Use mathematical, computational, statistical, logical, or other formal reasoning to solve problems, draw inferences, justify conclusions, and determine reasonableness.
ACE 4: Use scientific methods and knowledge to pose questions, frame hypotheses, interpret data, and evaluate whether conclusions about the natural and physical world are reasonable.
ACE 5: Use knowledge, historical perspectives, analysis, interpretation, critical evaluation, and the standards of evidence appropriate to the humanities to address problems and issues.
ACE 6: Use knowledge, theories, and research perspectives such as statistical methods or observational accounts appropriate to the social sciences to understand and evaluate social systems or human behaviors.

ACE 7: Use knowledge, theories, or methods appropriate to the arts to understand their context and significance.	
ACE 8: Use knowledge, theories, and analysis to explain ethical principles and their importance in society.	
ACE 9: Exhibit global awareness or knowledge of human diversity through analysis of an issue.	
ACE 10: Generate a creative or scholarly product that requires broad knowledge, appropriate technical proficiency, information collection, synthesis, interpretation, presentation, and reflection.	

College Degree Requirements

College Distribution Requirements – BA and BS

The College of Arts and Sciences distribution requirements are common to both the bachelor of arts and bachelor of science degrees and are designed to ensure a range of courses. By engaging in study in several different areas within the College, students develop the ability to learn in a variety of ways and apply their knowledge from a variety of perspectives. All requirements are in addition to University ACE requirements, and no course can be used to fulfill both an ACE outcome and a College Distribution Requirement.

- A student may not use a single course to satisfy more than one College Distribution Requirement, with the exception of CDR Diversity. Courses used to meet CDR Diversity may also meet CDR Writing, CDR Humanities, or CDR Social Science.
- Independent study or reading courses and internships cannot be used to satisfy distribution requirements.
- Courses from interdisciplinary programs will be applied in the same area as courses from the home/cross-listed department.

College Distribution Requirements	
CDR: Written Communication	*3*
Select from courses approved for ACE outcome 1.	
CDR: Natural, Physical, and Mathematical Sciences with Lab	*4*
Select from biochemistry, biological sciences, chemistry, computer science, geology, meteorology, mathematics, and physics. Must include one lab in the natural or physical sciences. Lab courses may be selected from biochemistry, biological sciences, chemistry, geology, meteorology, and physics.	
Some courses from geography and anthropology may also be used to satisfy the lab requirement above. [1]	
CDR: Humanities	*3*
Select from classics, English, film studies, history, modern languages and literatures, philosophy, and religious studies. [2]	
CDR: Social Science	*3*
Select from anthropology, communication studies, geography, national security studies, political science, psychology, or sociology. [3]	
CDR: Human Diversity in U.S. Communities	*0-3*
Select from a set of approved courses as listed in the degree audit.	
CDR: Language	*0-16*
Fulfilled by the completion of the 6-credit-hour second-year sequence in a single foreign language in one of the following departments: Classics and religious studies or modern languages and literatures. Instruction is currently available in Arabic, Chinese, Czech, French, German, Greek, Japanese, Latin, Russian, and Spanish.	
A student who has completed the fourth-year level of one foreign language in high school is exempt from the languages requirement, but encouraged to continue on in their language study.	
Credit Hours Subtotal:	13-32

[1] *See Degree Audit or a College of Arts and Sciences advisor for approved geography and anthropology courses that apply as natural science.*

[2] *Language courses numbered 220 and below do not fulfill the CDR Humanities.*

[3] *See Degree Audit or College of Arts and Sciences advisor for list of natural/physical science courses in anthropology, geography, and psychology that do not apply as social science.*

Language Requirement

The University of Nebraska–Lincoln and the College of Arts and Sciences place great value on academic exposure and proficiency in a second language. The University of Nebraska–Lincoln entrance requirement of two years of the same foreign language or the College's language distribution requirement (CDR: Language) will rarely be waived and only with relevant documentation. See the main College of Arts and Sciences page for more details.

Experiential Learning Requirement

All undergraduates in the College of Arts and Sciences must complete an Experiential Learning (EL) designated course. This may include 0-credit courses designed to document co-curricular activities recognized as Experiential Learning.

Scientific Base - BS Only

The bachelor of science degree requires students to complete 60 hours in mathematical, physical, and natural sciences. Approved courses for scientific-based credit come from the following College of Arts and Sciences disciplines: actuarial science, anthropology (selected courses), astronomy, biochemistry (excluding BIOC 101), biological sciences (excluding BIOS 100 or BIOS 203), chemistry (excluding CHEM 101), geography (selected courses), geology, life sciences, mathematics (excluding courses below MATH 104), meteorology, microbiology (excluding MBIO 101), and physics (excluding PHYS 201.)

See your Degree Audit or your assigned academic advisor for a complete list, including individual classes that fall outside of the disciplines listed above. Up to 12 hours of scientific and technical courses offered by other colleges may be accepted toward this requirement with approval of the College of Arts and Sciences. See your assigned academic advisor to start the approval process.

Minimum Hours Required for Graduation

A minimum of 120 semester hours of credit is required for graduation from the College of Arts and Sciences. A cumulative grade point average of at least 2.0 is required.

Grade Rules

Restrictions on C- and D Grades

The College will accept no more than 15 semester hours of C- and D grades from other domestic institutions except for UNO and UNK. All courses taken at UNO and UNK impact the UNL transcript. No transfer of C- and D grades can be applied toward requirements in a major or a minor. No University of Nebraska–Lincoln C- and D grades can be applied toward requirements in a major or a minor. International coursework (including education abroad) with a final grade equivalent to a C- or lower will not be validated by the College of Arts and Sciences departments to be degree applicable.

Pass/No Pass Privilege

The College of Arts and Sciences adheres to the University regulations for the Pass/No Pass (P/N) privilege with the following additional regulations:

- Pass/No Pass hours can count toward fulfillment of University ACE requirements and college distribution requirements up to the 24-hour maximum.
- Most arts and sciences departments and programs do not allow courses graded Pass/No Pass to apply to the major or minor. Students should refer to the department's or program's section of the catalog for clarification. By college rule, departments can allow up to 6 hours of Pass/No Pass in the major or minor.
- Departments may specify that certain courses of theirs can be taken only on a P/N basis.
- The college will permit no more than a total of 24 semester hours of P/N grades to be applied toward degree requirements. This total includes all Pass grades earned at the University of Nebraska–Lincoln and other U.S. schools. **NOTE:** This 24-hour limit is more restrictive than the University regulation.

Grading Appeals

A student who feels that he/she has been unfairly graded must ordinarily take the following sequential steps in a timely manner, usually by initiating the appeal in the semester following the awarding of the grade:

1. Talk with the instructor concerned. Most problems are resolved at this point.
2. Talk to the instructor's department chairperson.
3. Take the case to the Grading Appeal Committee of the department concerned. The Committee should be contacted through the department chairperson.
4. Take the case to the College Grading Appeals Committee by contacting the Dean's Office, 1223 Oldfather Hall.

Course Level Requirements

Courses Numbered at the 300 or 400 Level

Thirty (30) of the 120 semester hours of credit must be in courses numbered at the 300 or 400 level. Of those 30 hours, 15 hours (1/2) must be completed in residence at the University of Nebraska–Lincoln.

Residency Requirement

Students must complete at least 30 of the 120 total hours for their degree at the University of Nebraska–Lincoln. Students must complete at least 1/2 of their major coursework, including 6 hours at the 300 or 400 level in their major and 15 of the 30 hours required at the 300 or 400 level, in residence. Credit earned during education abroad may be used toward the residency requirement only if students register through the University of Nebraska–Lincoln.

Catalog to Use

Students must fulfill the requirements stated in the catalog for the academic year in which they are first admitted to and enrolled as a degree-seeking student at the University of Nebraska–Lincoln. In consultation with advisors, a student may choose to follow a subsequent catalog for any academic year in which they are admitted to and enrolled as a degree-seeking student at the University of Nebraska–Lincoln in the College of Arts and Sciences. Students must complete all degree requirements from a single catalog year. Beginning in 1990-1991, the catalog which a student follows for degree requirements may not be more than 10 years old at the time of graduation.

Transfer Students: Students who have transferred from a community college may be eligible to fulfill the requirements as stated in the catalog for an academic year in which they were enrolled at the community college prior to attending the University of Nebraska-Lincoln. This decision should be made in consultation with academic advisors, provided the student a) was enrolled in a community college during the catalog year they are utilizing, b) maintained continuous enrollment at the previous institution for 1 academic year or more, and c) continued enrollment at the University of Nebraska-Lincoln within 1 calendar year from their last term at the previous institution. Students must complete all degree requirements from a single catalog year and within the time frame allowable for that catalog year.

Learning Outcomes

Graduates with a major in physics will:

1. Demonstrate a conceptual understanding of the fundamental principles and concepts of physics, including those in the areas of mechanics, electromagnetism, thermodynamics, and quantum mechanics.
2. Apply mathematical tools to analyze and solve problems.
3. Critically evaluate and interpret data.
4. Communicate concepts and approaches effectively, both orally and in writing.

Major Requirements

Bachelor of Science

Complete the core requirements plus one of the following options: Professional, Optics and Lasers, Materials Physics, or Computational Physics.

Core Requirements

Physics		
PHYS 201	Modern Topics in Physics and Astronomy	1
PHYS 211 & PHYS 221	General Physics I and General Physics Laboratory I	5
PHYS 212 & PHYS 222	General Physics II and General Physics Laboratory II	5
PHYS 213 & PHYS 223	General Physics III and General Physics Laboratory III	5
PHYS 231	Electrical and Electronic Circuits	3
PHYS 311	Mechanics	3
PHYS 431	Thermal Physics	3
PHYS 451	Electromagnetic Theory	3

PHYS 461	Quantum Mechanics	3
Credit Hours Subtotal:		31
Mathematics		
MATH 106	Calculus I	5
MATH 107	Calculus II	4
MATH 208	Calculus III	4
MATH 221	Differential Equations	3
Chemistry [1]		**4**
CHEM 109A & CHEM 109L	General Chemistry I and General Chemistry I Laboratory	
Or		
CHEM 113A & CHEM 113L	Fundamental Chemistry I and Fundamental Chemistry I Laboratory	
Credit Hours Subtotal:		20
Option Courses		
Complete one of the following options described below.		17-20
Credit Hours Subtotal:		17-20
Total Credit Hours		**68-71**

[1] CHEM 113A & CHEM 113L *are required for students declaring the Materials Physics Option.*

Professional Option

The Professional Option is designed for students intending to pursue graduate study or employment in physics or a related scientific or engineering discipline.

Professional Option Required Courses		
PHYS 441	Experimental Physics I	3
PHYS 442	Experimental Physics II	3
PHYS 452	Optics and Electromagnetic Waves	3
PHYS 462	Atoms, Nuclei, and Elementary Particles	3
Select at least 6 hours of the following: [2]		6
ASTR 403	Galactic and Extragalactic Astronomy	
ASTR 404	Stellar Astrophysics	
ASTR 405	Physics of the Solar System	
ASTR 407	Physics of the Interstellar Medium	
MATH 314	Linear Algebra	
or MATH 424	Introduction to Partial Differential Equations	
PHYS 343	Physics of Lasers and Modern Optics	
PHYS 361	Concepts of Modern Physics	
PHYS 401	Computational Physics	
PHYS 422 / ECEN 422	Introduction to Physics and Chemistry of Solids	
PHYS 443	Experimental Physics III	
PHYS 480 / ECEN 480	Introduction to Lasers and Laser Applications	
Credit Hours Subtotal:		18
Total Credit Hours		**18**

[2] *Up to 3 hours of* PHYS 398 *may be counted toward these 6 hours by substitution, provided that the research project is approved by the advisor.*

Optics and Lasers Option

The Optics and Lasers Option is designed for students intending to pursue graduate study or employment in optical or laser physics or in related engineering disciplines.

Optics and Lasers Option Required courses		
PHYS 343	Physics of Lasers and Modern Optics	3
PHYS 441	Experimental Physics I	3
PHYS 452	Optics and Electromagnetic Waves	3
PHYS 480 / ECEN 480	Introduction to Lasers and Laser Applications	3
Select at least 6 hours of the following: [2]		6
MATH 314	Linear Algebra	
or MATH 424	Introduction to Partial Differential Equations	
PHYS 361	Concepts of Modern Physics	
PHYS 401	Computational Physics	
PHYS 422 / ECEN 422	Introduction to Physics and Chemistry of Solids	
PHYS 442	Experimental Physics II	
PHYS 462	Atoms, Nuclei, and Elementary Particles	
Credit Hours Subtotal:		18
Total Credit Hours		**18**

[2] *Up to 3 hours of* PHYS 398 *may be counted toward these 6 hours by substitution, provided that the research project is approved by the advisor.*

Materials Physics Option

The Materials Physics Option is designed for students intending to pursue graduate study or employment in materials physics or in related disciplines.

Materials Physics Option Required courses		
CHEM 114	Fundamental Chemistry II	3
CHEM 221A & CHEM 221L	Elementary Quantitative Analysis and Elementary Quantitative Analysis Laboratory	5
MATL 360	Elements of Materials Science	4
MATL 462	X-ray Diffraction	3
or MATL 471	Electron Microscopy of Materials	
PHYS 422 / ECEN 422	Introduction to Physics and Chemistry of Solids	3
Select at least 3 hours of the following: [2]		3
CHEM 261	Organic Chemistry	
CHEM 481	Physical Chemistry I	
ECEN 216	Electronics and Circuits II	
PHYS 343	Physics of Lasers and Modern Optics	
PHYS 401	Computational Physics	
PHYS 441	Experimental Physics I	
Credit Hours Subtotal:		21
Total Credit Hours		**21**

[2] *Up to 3 hours of* PHYS 398 *may be counted toward these 3 hours by substitution, provided that the research project is approved by the advisor.*

Computational Physics Option

The Computational Physics Option is designed for students intending to pursue graduate study or employment in computational physics or in related disciplines.

Computational Physics Option Required courses		
CSCE 155N	Computer Science I: Engineering and Science Focus	3
CSCE 156	Computer Science II	4
CSCE 251	Unix Programming Environment	1
PHYS 401	Computational Physics	3
Select at least 6 hours of the following: [2]		6
CSCE 235	Introduction to Discrete Structures	
CSCE 310	Data Structures and Algorithms	
CSCE 440 / MATH 440	Numerical Analysis I	
CSCE 456	Parallel Programming	
PHYS 343	Physics of Lasers and Modern Optics	
PHYS 441	Experimental Physics I	
Credit Hours Subtotal:		17
Total Credit Hours		**17**

[2] *Up to 3 hours of* PHYS 398 *may be counted toward these 6 hours by substitution, provided that the research project is approved by the advisor.*

Bachelor of Arts

Core Requirements

The BA course requirements are designed for students pursuing careers for which the knowledge and methodology of physics are essential.

Required Physics Courses		
PHYS 201	Modern Topics in Physics and Astronomy	1
Select one sequence:		*15*
PHYS 141 & PHYS 142 & PHYS 213 & PHYS 223	Elementary General Physics I and Elementary General Physics II and General Physics III and General Physics Laboratory III	
or PHYS 211	General Physics I and General Physics Laboratory I	
& PHYS 221	and General Physics II and General Physics Laboratory II	
& PHYS 212	and General Physics III and General Physics Laboratory III	
& PHYS 222		
& PHYS 213		
& PHYS 223		
PHYS 231	Electrical and Electronic Circuits	3
PHYS 311	Mechanics	3
PHYS 441	Experimental Physics I	3
Credit Hours Subtotal:		25
Mathematics		
MATH 106	Calculus I	5
MATH 107	Calculus II	4
MATH 208	Calculus III	4
MATH 221	Differential Equations	3
Credit Hours Subtotal:		16
Chemistry		
Select one sequence:		*4*
CHEM 109A & CHEM 109L	General Chemistry I and General Chemistry I Laboratory	
or CHEM 113A & CHEM 113L	Fundamental Chemistry I and Fundamental Chemistry I Laboratory	
Credit Hours Subtotal:		4
Total Credit Hours		**45**

Specific Major Requirements

Additional Physics Courses		
Select 9 hours of the following: [2]		9
PHYS 343	Physics of Lasers and Modern Optics	
PHYS 361	Concepts of Modern Physics	
PHYS 451	Electromagnetic Theory	
PHYS 461	Quantum Mechanics	
PHYS 431	Thermal Physics	
PHYS 480 / ECEN 480	Introduction to Lasers and Laser Applications	
Credit Hours Subtotal:		9
Additional Related Courses		
Select 6 hours of math, statistics, engineering or science courses at the 300 or 400 level		6
Credit Hours Subtotal:		6
Total Credit Hours		**15**

[2] *Up to 3 hours of* PHYS 398 *may be counted toward these 6 hours by substitution, provided that the research project is approved by the advisor.*

Additional Major Requirements

Grade Rules

C- and D Grades

A grade of C or above is required for all courses in the major and minor.

Pass/No Pass

No course taken Pass/No Pass will be counted toward the major or minor.

Requirements for Minor Offered by Department

Plan A Minor (19 hours)

PHYS 201	Modern Topics in Physics and Astronomy	1
Select one sequence from the following:		10
PHYS 211 & PHYS 221 & PHYS 212 & PHYS 222	General Physics I and General Physics Laboratory I and General Physics II and General Physics Laboratory II	
PHYS 141 & PHYS 142	Elementary General Physics I and Elementary General Physics II	
PHYS 213	General Physics III	4
PHYS 223	General Physics Laboratory III	1

Select one of the following:		3-4
Three (3) additional hours chosen from physics courses listed as requirements for the major in physics		
ASTR 204 & ASTR 224	Introduction to Astronomy and Astrophysics and Astronomy and Astrophysics Laboratory	
Total Credit Hours		**19**

Plan B Minor (15 hours)

PHYS 201	Modern Topics in Physics and Astronomy	1
Select one sequence from the following:		10
PHYS 211 & PHYS 221 & PHYS 212 & PHYS 222	General Physics I and General Physics Laboratory I and General Physics II and General Physics Laboratory II	
PHYS 141 & PHYS 142	Elementary General Physics I and Elementary General Physics II	
PHYS 213	General Physics III	4
Total Credit Hours		**15**

Grade Rules

C- and D Grades

A grade of C or above is required for all courses in the major and minor.

Pass/No Pass

No course taken Pass/No Pass will be counted toward the major or minor.

ASTR 103 Descriptive Astronomy
Description: Approach is essentially nonmathematical. Survey of the nature and motions of the planets, the sun, the stars, and their lives, galaxies, and the structure of the universe. Black holes, pulsars, quasars, and other objects of special interest included.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Grading Option: Graded with Option
Prerequisite for: ASTR 113; ASTR 203
ACE: ACE 4 Science
Course and Laboratory Fee: $25

ASTR 103H Honors: Descriptive Astronomy
Prerequisites: Good standing in the University Honors Program or by invitation
Notes: Broad look at astronomy for non-science majors.
Description: Approach is essentially non-mathematical, but simple algebra is employed where appropriate. Sun and solar system, the stars, galaxies, and cosmology. Black holes, pulsars, quasars, and other objects of special interest included. Emphasis on both "what is out there" and "how we know it".
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Grading Option: Graded
Prerequisite for: ASTR 113; ASTR 203
ACE: ACE 4 Science
Course and Laboratory Fee: $25

ASTR 113 Selected Topics in Astronomy
Prerequisites: ASTR 103 or permission.
Description: A non-mathematical continuation and extension of ASTR 103, designed for students who would like a more detailed look at specific areas in astronomy. Possible topics: astronomy and relativity; life in the universe; pulsars, quasars, and black holes; evolution of galaxies, origin of the universe.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Grading Option: Graded with Option
ACE: ACE 4 Science

ASTR 117 Life in the Universe
Description: Survey of what modern science tells us about the possibilities of life elsewhere in the universe. Topics include how the Earth formed and became suitable for life, how life arose on the Earth, the conditions under which life can thrive, places in the solar system that might support life, the existence of other solar systems that might provide suitable habitats, and attempts to find evidence of life on other planets.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Grading Option: Graded with Option
ACE: ACE 4 Science

ASTR 203 Introduction to Observational Astronomy
Prerequisites: ASTR 103/ASTR 103H or equivalent
Notes: The course consists of 2 lecture hours and three evening laboratory hours per week.
Description: Exploration of equipment and techniques needed to observe and investigate the motions and objects in the night sky.
Credit Hours: 4
Max credits per semester: 4
Max credits per degree: 4
Grading Option: Graded with Option
Course and Laboratory Fee: $25

ASTR 204 Introduction to Astronomy and Astrophysics
Prerequisites: PHYS 211/211H; MATH 107/107H; parallel ASTR 224
Notes: Survey of the sun, the solar system, stellar properties, stellar systems, interstellar matter, galaxies, and cosmology.
Description: Survey of the sun, the solar system, stellar properties, stellar systems, interstellar matter, galaxies, and cosmology.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Grading Option: Graded with Option
Prerequisite for: ASTR 224
ACE: ACE 4 Science

ASTR 224 Astronomy and Astrophysics Laboratory
Prerequisites: Parallel ASTR 204.
Description: Telescopic observations and laboratory experiments relating to observational astronomy. Obtaining digital astronomical images, the analysis of the resulting data and its astrophysical interpretation.
Credit Hours: 1
Max credits per semester: 1
Max credits per degree: 1
Grading Option: Graded with Option
Course and Laboratory Fee: $55

ASTR 403 Galactic and Extragalactic Astronomy
Crosslisted with: ASTR 803
Prerequisites: ASTR 204 and PHYS 213, and permission.
Description: Introduction to the techniques for determining constituents and dynamics of our galaxy, including interstellar matter and theories of spiral arm formation. Extragalactic topics include basic characteristics of galaxies, active galaxies, quasars, evolution, and the cosmological distance scale.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Grading Option: Graded with Option

ASTR 404 Stellar Astrophysics
Crosslisted with: ASTR 804
Prerequisites: ASTR 204; PHYS 213; and permission.
Description: Stellar atmospheres, interiors, and evolution. Theoretical and observational aspects of stellar astronomy. The relation between observed parameters and theoretical parameters, star formation, stellar energy generation, and degenerate stars.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Grading Option: Graded with Option

ASTR 405 Physics of the Solar System
Crosslisted with: ASTR 805
Prerequisites: ASTR 204; MATH 107/107H; PHYS 142/142H or PHYS 212/212H.
Description: Celestial mechanics; tidal effects; planetary interiors; atmospheres and surfaces; comets; asteroids; and the origin of the solar system. Applying physics to the solution of solar system problems.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Grading Option: Graded with Option

ASTR 407 Physics of the Interstellar Medium
Crosslisted with: ASTR 807
Prerequisites: ASTR 204 and PHYS 213.
Description: Gaseous nebulae, interstellar dust, interstellar clouds and star forming regions. Theoretical and observational aspects of the various components of the interstellar medium. Includes the physics of emission nebulae, the properties of the interstellar dust, interstellar molecules and the properties of clouds in which star formation occurs.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Grading Option: Graded with Option

ASTR 492 Special Topics in Astronomy
Crosslisted with: ASTR 892
Prerequisites: ASTR 204 and permission.
Description: Topic varies.
Credit Hours: 1-6
Min credits per semester: 1
Max credits per semester: 6
Max credits per degree: 6
Grading Option: Graded with Option

PHYS 115 Descriptive Physics
Description: Qualitative approach to physics for the non-science major that emphasizes concepts and how they are used to understand the everyday physical world. Newton's description of motion and forces, the atomic view of matter, kinds and transformations of energy, the nature of electricity and magnetism, sound and light waves, and subatomic particles. Some topics selected according to student interest. Recommended for all students wanting a nonmathematical look at basic discoveries of physics.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Grading Option: Graded with Option
ACE: ACE 4 Science

PHYS 141 Elementary General Physics I
Prerequisites: MATH 102 or higher; or qualifying score on Math Placement Exam for MATH 106 or higher.
Notes: Credit toward the degree may be earned in only one of: PHYS 141, 141H and 151. Lab fee required.
Description: Mechanics, heat, waves and sound.
Credit Hours: 5
Max credits per semester: 5
Max credits per degree: 5
Grading Option: Graded with Option
Prerequisite for: AGST 232; AGST 245; AGST 262; AGST 342; AGST 354, SOIL 354, WATS 354; AGST 364; AGST 452, AGST 852, WATS 452, PLAS 452; ARCH 333, CNST 305; FDST 363, AGST 363; GEOL 400; PHYS 142; PHYS 142H; PLAS 458, AGRO 858, NRES 458, NRES 858, SOIL 458
ACE: ACE 4 Science
Course and Laboratory Fee: $55

PHYS 141H Honors: Elementary General Physics I
Prerequisites: Good standing with the University Honors Program; MATH 102 or higher; or qualifying score on Math Placement Exam for MATH 106 or higher.
Notes: Credit toward the degree may be earned in only one of: PHYS 141, 141H and 151. Lab fee required.
Description: For course description, see PHYS 141.
Credit Hours: 5
Max credits per semester: 5
Max credits per degree: 5
Grading Option: Graded
Prerequisite for: AGST 245; AGST 262; AGST 342; AGST 354, SOIL 354, WATS 354; AGST 364; AGST 452, AGST 852, WATS 452, PLAS 452; FDST 363, AGST 363; GEOL 400; PHYS 142; PHYS 142H; PLAS 458, AGRO 858, NRES 458, NRES 858, SOIL 458
ACE: ACE 4 Science
Course and Laboratory Fee: $55

PHYS 142 Elementary General Physics II
Prerequisites: PHYS 141 or 141H.
Description: Continuation of PHYS 141. Electricity, magnetism, optics, relativity, atomic and nuclear physics.
Credit Hours: 5
Max credits per semester: 5
Max credits per degree: 5
Grading Option: Graded with Option
Prerequisite for: BIOC 440; PHYS 343; PHYS 361
Course and Laboratory Fee: $55

PHYS 142H Honors: Elementary General Physics II
Prerequisites: Good standing in the University Honors program or by invitation; PHYS 141 or 141H.
Notes: Lab fee required.
Description: For course description, see PHYS 142.
Credit Hours: 5
Max credits per semester: 5
Max credits per degree: 5
Grading Option: Graded
Prerequisite for: BIOC 440; PHYS 343; PHYS 361
Course and Laboratory Fee: $55

PHYS 151 Elements of Physics
Prerequisites: MATH 102 or higher; or qualifying score on Math Placement Exam for MATH 106 or higher.
Notes: Credit toward the degree may be earned in only one of: PHYS 141, 141H and 151.
Description: Short course, without laboratory, for those who need one semester of elementary general physics. Emphasis on understanding our physical environment through application of principles of mechanics, heat, sound, electricity, and light.
Credit Hours: 4
Max credits per semester: 4
Max credits per degree: 4
Grading Option: Graded with Option
Prerequisite for: AGST 109L; AGST 232; AGST 245; AGST 262; AGST 342; AGST 354, SOIL 354, WATS 354; AGST 364; AGST 452, AGST 852, WATS 452, PLAS 452; ARCH 333, CNST 305; CNST 306; FDST 363, AGST 363; PHYS 153
ACE: ACE 4 Science

PHYS 153 Elements of Physics Laboratory
Prerequisites: PHYS 151 or parallel.
Notes: Optional lab to accompany PHYS 151.
Description: Laboratory experiments in mechanics, heat, and wave motion.
Credit Hours: 1
Max credits per semester: 1
Max credits per degree: 1
Grading Option: Graded with Option
Course and Laboratory Fee: $55

PHYS 192 Special Topics in Physics
Description: Topic varies.
Credit Hours: 1-6
Min credits per semester: 1
Max credits per semester: 6
Max credits per degree: 6
Grading Option: Graded with Option

PHYS 201 Modern Topics in Physics and Astronomy
Prerequisites: Must be a PHYS major or minor with freshman or sophomore status.
Description: Seminar/workshop that introduces students to topics in modern physics research in basic and applied areas. Students given an understanding of how their studies relate to current progress in physics and astronomy and to prepare for careers in physics-related disciplines.
Credit Hours: 1
Max credits per semester: 1
Max credits per degree: 1
Grading Option: Graded with Option

PHYS 211 General Physics I
Prerequisites: MATH 106 or parallel
Notes: One year of either high school physics or algebra-based college physics is expected.
Description: Calculus-based course intended for students in engineering and the physical sciences. Mechanics, fluids, wave motion, and heat.
Credit Hours: 4
Max credits per semester: 4
Max credits per degree: 4
Grading Option: Graded with Option
Prerequisite for: AGST 232; AGST 245; AGST 262; AGST 342; AGST 354, SOIL 354, WATS 354; AGST 364; AGST 452, AGST 852, WATS 452, PLAS 452; ARCH 333, CNST 305; AREN 211; ASTR 204; BSEN 244; BSEN 317; BSEN 410; ECEN 211; GEOL 400; MECH 223; MECH 223H; MECH 250; METR 205; METR 311; METR 323; PHYS 142; PHYS 212; PHYS 212H; PHYS 221
ACE: ACE 4 Science

PHYS 211H Honors: General Physics I
Prerequisites: Physics major or good standing with the University Honors Program; MATH 106 or parallel.
Notes: Ambitious students who are not in the Honors Program are encouraged to request permission to enroll.
Description: For course description, see PHYS 211.
Credit Hours: 4
Max credits per semester: 4
Max credits per degree: 4
Grading Option: Graded
Prerequisite for: AGST 232; AGST 262; AGST 342; AGST 354, SOIL 354, WATS 354; AGST 364; AGST 452, AGST 852, WATS 452, PLAS 452; AREN 211; ASTR 204; BSEN 244; BSEN 317; ECEN 211; GEOL 400; MECH 223; MECH 223H; MECH 250; METR 205; METR 311; METR 323; PHYS 142; PHYS 212; PHYS 212H; PHYS 221
ACE: ACE 4 Science

PHYS 212 General Physics II
Prerequisites: PHYS 211 or 211H; MATH 107 or 107H or parallel.
Description: Continuation of PHYS 211. Electricity, magnetism, and optics.
Credit Hours: 4
Max credits per semester: 4
Max credits per degree: 4
Grading Option: Graded with Option
Prerequisite for: AGEN 325, BSEN 325; BIOC 440; BSEN 244; ECEN 306; MATL 260; MATL 360; MECH 200H; MECH 421, MECH 821, ENGR 421; PHYS 213; PHYS 213H; PHYS 222; PHYS 231; PHYS 311; PHYS 343; PHYS 361
ACE: ACE 4 Science

PHYS 212H Honors: General Physics II
Prerequisites: Physics major or good standing with the University Honors Program; PHYS 211 or 211H; MATH 107 or 107H or parallel.
Notes: Ambitious students who are not in the Honors Program are encouraged to request permission to enroll.
Description: For course description, see PHYS 212.
Credit Hours: 4
Max credits per semester: 4
Max credits per degree: 4
Grading Option: Graded
Prerequisite for: AGEN 325, BSEN 325; BIOC 440; BSEN 244; ECEN 306; MATL 260; MATL 360; MECH 200H; MECH 421, MECH 821, ENGR 421; PHYS 213; PHYS 213H; PHYS 222; PHYS 231; PHYS 311; PHYS 343; PHYS 361
ACE: ACE 4 Science

PHYS 213 General Physics III
Prerequisites: PHYS 212 or 212H; MATH 208 or 208H or parallel.
Description: Continuation of PHYS 212. Relativity, quantum mechanics, atoms, and nuclei.
Credit Hours: 4
Max credits per semester: 4
Max credits per degree: 4
Grading Option: Graded with Option
Prerequisite for: PHYS 223

PHYS 213H Honors: General Physics III
Prerequisites: Physics major or good standing with the University Honors program; PHYS 212 or 212H; MATH 208 or 208H, or parallel.
Notes: Ambitious students who are not in the Honors Program are encouraged to request permission to enroll.
Description: For course description, see PHYS 213.
Credit Hours: 4
Max credits per semester: 4
Max credits per degree: 4
Grading Option: Graded
Prerequisite for: PHYS 223

PHYS 221 General Physics Laboratory I
Prerequisites: PHYS 211 or 211H or parallel.
Notes: Optional lab to accompany PHYS 211.
Description: Experiments in mechanics, heat and wave motion.
Credit Hours: 1
Max credits per semester: 1
Max credits per degree: 1
Grading Option: Graded with Option
Course and Laboratory Fee: $55

PHYS 222 General Physics Laboratory II
Prerequisites: PHYS 212 or 212H or parallel.
Notes: Optional lab to accompany PHYS 212.
Description: Laboratory experiments in electromagnetism and optics.
Credit Hours: 1
Max credits per semester: 1
Max credits per degree: 1
Grading Option: Graded with Option
Prerequisite for: PHYS 231
Course and Laboratory Fee: $55

PHYS 223 General Physics Laboratory III
Prerequisites: PHYS 213 or 213H or parallel.
Notes: Optional lab to accompany PHYS 213.
Description: Experiments in atomic and nuclear physics.
Credit Hours: 1
Max credits per semester: 1
Max credits per degree: 1
Grading Option: Graded with Option
Course and Laboratory Fee: $55

PHYS 231 Electrical and Electronic Circuits
Prerequisites: PHYS 212 and 222.
Description: Diode, transistor, and operational amplifier circuits and analog applications; gates, flip-flops, and elementary digital electronics.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Grading Option: Graded with Option
Course and Laboratory Fee: $55

PHYS 292 Special Topics in Physics
Description: Topic varies.
Credit Hours: 1-6
Min credits per semester: 1
Max credits per semester: 6
Max credits per degree: 6
Grading Option: Graded with Option

PHYS 311 Mechanics
Prerequisites: PHYS 212 or 212H or parallel, MATH 221 or 221H or parallel.
Description: Review of vector operations and of the kinematics and dynamics of a particle. Dynamics of a system of particles, motion of rigid bodies, central force problems, collisions, Lagrangian techniques, oscillations, and coupled oscillators.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Grading Option: Graded with Option

PHYS 343 Physics of Lasers and Modern Optics
Prerequisites: PHYS 142 or 142H or 212 or 212H.
Description: Physical principles and techniques of lasers and modern optics. Emphasis on practical experience with state-of-the-art techniques and applications.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Grading Option: Graded with Option
ACE: ACE 10 Integrated Product
Course and Laboratory Fee: $55

PHYS 361 Concepts of Modern Physics
Prerequisites: PHYS 142 or 212 with a grade of C+ or better.
Description: Some of the concepts and ideas underlying modern areas of physics through readings from non-technical works by noted physicists and science writers. Includes quantum mechanics, relativity, cosmology, chaos, and examples of modern technology.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Grading Option: Graded with Option

PHYS 398 Undergraduate Research
Prerequisites: Permission.
Description: Research participation.
Credit Hours: 1-6
Min credits per semester: 1
Max credits per semester: 6
Max credits per degree: 12
Grading Option: Graded with Option

PHYS 401 Computational Physics
Crosslisted with: PHYS 801
Prerequisites: A grade of P, C or better in PHYS 311.
Description: Re-formulation of physics problems for solution on a computer, control of errors in numerical work, and programming.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Grading Option: Graded with Option

PHYS 422 Introduction to Physics and Chemistry of Solids
Crosslisted with: PHYS 822, ECEN 422, ECEN 822
Prerequisites: PHYS 213 or CHEM 481/881, MATH 221/821.
Description: Introduction to structural, thermal, electrical, and magnetic properties of solids, based on concepts of atomic structure, chemical bonding in molecules, and electron states in solids. Principles underlying molecular design of materials and solid-state devices.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Grading Option: Graded with Option

PHYS 431 Thermal Physics
Crosslisted with: PHYS 831
Prerequisites: PHYS 213
Description: Thermal phenomena from the point of view of thermodynamics, kinetic theory, and statistical mechanics.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Grading Option: Graded with Option

PHYS 441 Experimental Physics I
Crosslisted with: PHYS 841
Prerequisites: PHYS 213, 223 and 231
Notes: Lab fee required.
Description: Methods and techniques of modern experimental physics.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Grading Option: Graded with Option
Prerequisite for: PHYS 442, PHYS 842
ACE: ACE 10 Integrated Product
Course and Laboratory Fee: $55

PHYS 442 Experimental Physics II
Crosslisted with: PHYS 842
Prerequisites: PHYS 441/841 or permission
Notes: Lab fee required.
Description: Continuation of PHYS 441/841.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Grading Option: Graded with Option
Prerequisite for: PHYS 443, PHYS 843
Course and Laboratory Fee: $55

PHYS 443 Experimental Physics III
Crosslisted with: PHYS 843
Prerequisites: PHYS 442/842 or permission.
Description: Continuation of PHYS 442/842.
Credit Hours: 1-3
Min credits per semester: 1
Max credits per semester: 3
Max credits per degree: 3
Grading Option: Graded with Option
Course and Laboratory Fee: $55

PHYS 451 Electromagnetic Theory
Crosslisted with: PHYS 851
Prerequisites: PHYS 213; MATH 221/821.
Description: Theory of electric and magnetic fields and their interaction with charges and currents, Maxwell's equations, electric and magnetic properties of matter.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Grading Option: Graded with Option

PHYS 452 Optics and Electromagnetic Waves
Crosslisted with: PHYS 852
Prerequisites: A grade of P, C or better in PHYS 451/851
Description: Production of electromagnetic waves, wave guides and cavities, properties of waves, plane waves, reflection and refraction, interference and coherence phenomena, polarization. Optical properties of matter.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Grading Option: Graded with Option

PHYS 461 Quantum Mechanics
Crosslisted with: PHYS 861
Prerequisites: A grade of P, C or better in PHYS 213 and 311.
Description: Basic concepts and formalism of quantum mechanics with applications to simple systems.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Grading Option: Graded with Option

PHYS 462 Atoms, Nuclei, and Elementary Particles
Crosslisted with: PHYS 862
Prerequisites: A grade of P, C or better in PHYS 461
Description: Basic concepts and experimental foundation for an understanding of the physics of atoms, nuclei, and elementary particles.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Grading Option: Graded with Option

PHYS 480 Introduction to Lasers and Laser Applications
Crosslisted with: ECEN 480, ECEN 880, PHYS 880
Prerequisites: PHYS 213/(UNO) PHYS 2130.
Description: Physics of electronic transition production stimulated emission of radiation. Threshold conditions for laser oscillation. Types of lasers and their applications in engineering.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Grading Option: Graded with Option

PHYS 492 Special Topics in Physics
Crosslisted with: PHYS 892
Prerequisites: PHYS 213 and permission.
Description: Topics vary.
Credit Hours: 1-6
Min credits per semester: 1
Max credits per semester: 6
Max credits per degree: 6
Grading Option: Graded with Option

PHYS 499 Undergraduate Thesis
Prerequisites: Permission.
Description: Independent research leading to a thesis.
Credit Hours: 1-3
Min credits per semester: 1
Max credits per semester: 3
Max credits per degree: 6
Grading Option: Graded with Option

PHYS 499H Honors Undergraduate Thesis
Prerequisites: Permission.
Description: Independent research leading to a thesis.
Credit Hours: 1-3
Min credits per semester: 1
Max credits per semester: 3
Max credits per degree: 6
Grading Option: Graded with Option

PLEASE NOTE
This document represents a sample 4-year plan for degree completion with this major. Actual course selection and sequence may vary and should be discussed individually with your college or department academic advisor. Advisors also can help you plan other experiences to enrich your undergraduate education such as internships, education abroad, undergraduate research, learning communities, and service learning and community-based learning.

Physics (B.A.)

Physics - Professional (B.S.)

Career Information

The following represents a sample of the internships, jobs and graduate school programs that current students and recent graduates have reported.

Transferable Skills

- Make predictions using mathematical, statistical, and scientific modeling methods
- Conduct and present research to large and small groups
- Apply mathematical and scientific skills to solve real-world problems
- Analyze and explain data
- Collaborate with a team to develop solutions
- Compose convincing arguments and present logical information
- Comprehend and critically evaluate complex information
- Define problems and identifying causes
- Design and implement research experiments
- Develop and defend evidence based arguments
- Communicate results of scientific experiments to scientific and non-scientific audiences
- Provide a creative, inquisitive approach to problem-solving
- Read, understand, and critically review scientific information
- Understand and practice proper laboratory safety procedures
- Understand and use proper laboratory and technical skills and instruments

Jobs of Recent Graduates

- Battery Technician, Duncan Aviation – Lincoln, NE
- Data Analyst, Changing the Present – Middlesex, NY
- Lab Assistant, Neogen – Lincoln, NE
- Plant Operator, Nebraska Public Power District – Brownville, NE
- Software Engineer, HydroGreen – Sioux Falls, SD
- Technical Engineer, Northrop Grumman – Los Angeles, CA
- Science Teacher, Lincoln Public Schools – Lincoln, NE
- Process Engineer I, Garmin – Olathe, KS
- Systems Programmer, Bryan Health – Lincoln, NE
- Technician, JA Woollam – Lincoln, NE

Internships

- Intern, UNL Holland Computing - Lincoln NE

Graduate & Professional Schools

- Master's Degree, Mathematics, University of Nebraska - Lincoln – Lincoln, NE
- Master's Degree, Mechanical Engineering, University of Texas - Dallas – Richardson, TX
- Master's Degree, Science Teaching, University of Nebraska - Lincoln – Lincoln, NE
- Doctoral Degree, Condensed Matter Physics, Rutgers University – New Brunswick, NJ
- Doctoral Degree, Physics, University of Nebraska - Lincoln – Lincoln, NE
- Doctoral Degree, Physics, University of Colorado - Boulder – Boulder, CO
- Doctoral Degree, Physics, Brown University – Providence, RI
- Doctoral Degree, Space Science Instrumentation, University of Michigan – Ann Arbor, MI
- Doctoral Degree, Geophysics, California Institute of Technology – Pasadena, CA
- Doctoral Degree, Astronomy, University of California - Berkeley – Berkley CA