Department of Physics

(College of Humanities, Arts and Sciences)

www.physics.uni.edu

The Department of Physics offers the following programs:

Undergraduate Major (B.S.)

- Physics (p. 1)

Undergraduate Major (B.A.)

- Physics (p. 1)
- Physics-Teaching (p. 3)

Minors

- Data Science (p. 4) (also listed in Department of Computer Science and Department of Mathematics)
- Materials Science and Technology (p. 5) (also listed in Department of Chemistry and Biochemistry and Department of Applied Engineering)
- Nanoscience and Nanotechnology (p. 5)
- Physics (p. 5)

Program Certificate

- Physics Teaching (p. 6)

The Department of Physics offers major programs in two baccalaureate areas: the Bachelor of Science and the Bachelor of Arts. The B.S. Physics major is recommended for students who wish to prepare for graduate study in physics, engineering, or other sciences such as geophysics, astronomy, biophysics, or medical physics. The B.A. Physics major is ideal for a student with interdisciplinary interests who wishes to combine physics with courses from another area. The B.A. Physics-Teaching program provides students with the best qualification to teach physics in high school.

The dual-degree program in physics and engineering in cooperation with Iowa State University (ISU) is also offered. The first three years of coursework in liberal arts and physics B.S. are completed at UNI. During the fourth and fifth years, engineering courses are completed at ISU. When finished, a student will have a bachelor's degree in Physics from UNI and bachelor's degree in Engineering from ISU.

Bachelor of Science Degree Program

Emphasis-B.S. Physics Major Honors Research

Students who complete a sustained research project in physics may be invited to do Honors Research. Students must first complete 4 credit hours of PHYSICS 3000 Undergraduate Research in Physics and then 1 credit hour of PHYSICS 4990 Senior Thesis.

Physics Major

The B.S. Physics major requires a minimum of 120 total hours to graduate. This total includes UNIFI/General Education requirements and the following specified major requirements, plus electives to complete the minimum of 120 hours.

Note: To graduate with a B.S. degree in Physics, a student must earn an overall grade point average of at least 2.50 in all courses applied toward the major.

Required		
Mathematics:		
MATH 1420	Calculus I	4
MATH 1421	Calculus II	4
MATH 2422	Calculus III	4
Physics:		
PHYSICS 1100	First-Year Projects in Physics	1
PHYSICS 1701	Physics I for Science and Engineering	4
PHYSICS 1702	Physics II for Science and Engineering	4
PHYSICS 2300	Physics III: Theory and Simulation	3
PHYSICS 2700	Mathematical Methods of Physics & Engineering	3
PHYSICS 3000	Undergraduate Research in Physics @	2
or PHYSICS 3500	Internship in Applied Physics	
PHYSICS 3700	Physics Seminar	1
PHYSICS 4100/5100	Modern Physics	4
PHYSICS 4110/5110	Modern Physics Laboratory	2
PHYSICS 4300/5300	Introduction to Electronics	4
PHYSICS 4600/5600	Classical Mechanics	4
PHYSICS 4700/5700	Electrodynamics	4
PHYSICS 4860/5860	Computational Physics	3
PHYSICS 4900/5900	Thermodynamics and Statistical Mechanics	4
Electives		
Physics, Natural Science, or Math Electives *		4
Total Hours		**59**

* Electives must be mathematics or science courses that count toward a major of the department offering the course. Electives should be selected with the advice of an academic adviser in Physics.

@This course meets the Bachelor of Science degree undergraduate research requirement.

Bachelor of Arts Degree Program

Physics Major

The B.A. Physics Major is suitable for students who are interested in physics but are looking for a more interdisciplinary experience

than the B.S. Physics Major. Potential careers include, for example, computer science, data science, medicine, business, or law. The B.A. Physics Major requires a minimum of 120 total hours for graduation. This includes the major requirements and electives specified below, as well as UNIFI/General Education requirements.

The B.A. Physics major has four emphases: Custom Emphasis, Data Science Emphasis, Physical Chemistry Emphasis, and Computer Science and Data Science. Students should choose one emphasis. Each emphasis requires completion of a common physics core, a common mathematics core and electives. The Data Science Emphasis has an additional core of data science-related courses and a required project.

Custom Emphasis

The Custom Emphasis is designed to combine a core understanding of physics with additional course work from other disciplines. The flexibility of this major makes it ideal for students interested in dual majors or one or more minors. The rigor of the program allows students to better prepare themselves for careers in any field, especially those related to science or technology. Students work with an advisor to create an individualized emphasis to best meet their needs.

Required Physics Core:		
PHYSICS 1100	First-Year Projects in Physics	1
PHYSICS 1701	Physics I for Science and Engineering	4
PHYSICS 1702	Physics II for Science and Engineering	4
PHYSICS 2300	Physics III: Theory and Simulation	3
PHYSICS 4100/5100	Modern Physics	4
PHYSICS 4110/5110	Modern Physics Laboratory	2
Required Mathematics Core:		
MATH 1420	Calculus I	4
MATH 1421	Calculus II	4
Electives:		
Physics:		7
3000-level and above		
No more than 2 hours of PHYSICS 3000 Undergraduate Research		
Natural Sciences or Other Disciplines		9
Elective courses must count toward a major in the department that offers the course.		
Mathematics courses must be higher level than MATH 1421.		
Total Hours		**42**

Data Science Emphasis

The Data Science Emphasis integrates significant course work in physics, statistics and business analytics with electives from other areas such as Geographic Information Systems and computer programming. The goal is for students to develop broad-based skills in the analysis of data and the extraction of gainful information about a variety of systems.

Required Physics Core		
PHYSICS 1100	First-Year Projects in Physics	1
PHYSICS 1701	Physics I for Science and Engineering	4
PHYSICS 1702	Physics II for Science and Engineering	4
PHYSICS 2300	Physics III: Theory and Simulation	3
PHYSICS 4100/5100	Modern Physics	4
PHYSICS 4110/5110	Modern Physics Laboratory	2
Required Mathematics Core		
MATH 1420	Calculus I	4
MATH 1421	Calculus II	4
Required Data Science Core		
STAT 1772	Introduction to Statistical Methods	3
STAT 4772/5772	Statistical Computing I	3
ECON 1011	Statistics for Business Analytics	3
ECON 2090	Decision Analytics	3
Required Data Science Project		
PHYSICS 3000	Undergraduate Research in Physics	1
or PHYSICS 3500	Internship in Applied Physics	
Electives		3-4
Elective requirements should be chosen from the following: (Other choices will need departmental approval)		
CS 1510	Introduction to Computing	
GEOG 2410	Geographic Information Systems I	
ACT SCI 3780/5780	Mathematics of Finance	
STAT 3752/5752	Introduction to Probability	
STAT 3771/5771	Applied Statistical Methods for Research	
Total Hours		**42-43**

Physical Chemistry Emphasis

The Physical Chemistry Emphasis is intended to facilitate deeper study of physics by chemistry or biochemistry majors. The study of more-advanced physics topics will enhance problem-solving skills and promote greater understanding of chemistry and biochemistry though connections with quantum mechanics, electricity & magnetism, and classical mechanics studied in physics.

Required Physics Core:		
PHYSICS 1100	First-Year Projects in Physics	1
PHYSICS 1701	Physics I for Science and Engineering	4
PHYSICS 1702	Physics II for Science and Engineering	4
PHYSICS 2300	Physics III: Theory and Simulation	3
PHYSICS 4100/5100	Modern Physics	4
Required Chemistry Core:		
CHEM 1110 & CHEM 1120	General Chemistry I and General Chemistry II	5-8
or CHEM 1130	General Chemistry I-II	

CHEM 4420/5420	Physical Chemistry I	3
CHEM 4430/5430	Physical Chemistry II	3
Required Mathematics Core:		
MATH 1420	Calculus I	4
MATH 1421	Calculus II	4
Advanced Laboratory:		**2**
Choose one of the following		
PHYSICS 4110/5110	Modern Physics Laboratory	
CHEM 4440/5440	Physical Chemistry Laboratory *	
Applied Physics:		**3-4**
PHYSICS 4750/5750	Physics of Modern Materials *	
or PHYSICS 4500/5500	Biological Physics	
or PHYSICS 4300/5300	Introduction to Electronics	
Electives:		**2-3**
3000-level Physics or above (no more than 1 hour of PHYSICS 3000 Undergraduate Research in Physics); or 3000-level Chemistry/Biochemistry or above (no more than 1 hour of CHEM 3600 Undergraduate Research in Chemistry)		
Total Hours		**42-47**

* CHEM 4440/5440 has CHEM 2320 and CHEM 2330 and CHEM 4420/5420 and junior standing as prerequisites
PHYSICS 4750/5750 has PHYSICS 1701 and PHYSICS 1702 and MATH 2422 and junior standing as prerequisites.

Computer Science and Data Science Emphasis

The Computer Science and Data Science Emphasis is suitable for students majoring in computer science who are seeking a deeper background in physics and data science. It may also function as a standalone major. It is especially appropriate for students who intend to pursue careers in software engineering related to data science or science and technology.

Physics Core		
PHYSICS 1100	First-Year Projects in Physics	1
PHYSICS 1701	Physics I for Science and Engineering	4
or PHYSICS 1511	General Physics I	
PHYSICS 1702	Physics II for Science and Engineering	4
PHYSICS 2300	Physics III: Theory and Simulation	3
PHYSICS 3100	Introduction to Quantum Computing	3
PHYSICS 4100/5100	Modern Physics	4
PHYSICS 4160/5160	Data Visualization, Modeling and Simulation	3
Computer Science and Data Science		
CS 1510	Introduction to Computing	4
CS 2150	Computing for Data Science	3-7
OR		
CS 1520 & CS 1800	Data Structures and Discrete Structures	
CS 3140/5140	Database Systems	3
STAT 4784/5784	Introduction to Machine Learning	3
Mathematics and Statistics		
MATH 1420	Calculus I	4
MATH 1421	Calculus II	4
STAT 1772	Introduction to Statistical Methods	3
Total Hours		**46-50**

Emphasis-B.A. Physics Major-Teaching Honors Research

Students who complete a sustained research project in physics education may be invited to do Honors Research. Students must first complete 4 credit hours of PHYSICS 3000 Undergraduate Research in Physics and then 1 credit hour of PHYSICS 4990 Senior Thesis.

Physics Major-Teaching

The B.A. Physics major in teaching requires a minimum of 120 total hours to graduate. This total includes UNIFI/General Education requirements, the Professional Experiences requirements, Educator Essentials requirements, and the following specified major requirements, to complete the minimum of 120 hours.

This major leads to endorsement #156: 5-12 Physics.

Required		
Mathematics:		
MATH 1420	Calculus I	4
MATH 1421	Calculus II	4
Physics:		
PHYSICS 1100	First-Year Projects in Physics	1
PHYSICS 1701	Physics I for Science and Engineering	4
PHYSICS 1702	Physics II for Science and Engineering	4
PHYSICS 2300	Physics III: Theory and Simulation	3
PHYSICS 4080/5080	Resources for Teaching Physics	2
PHYSICS 4100/5100	Modern Physics	4
PHYSICS 4110/5110	Modern Physics Laboratory	2
Electives		
Physics: all 3000+ level courses		6
Mathematics or non-physics science courses from the College of Humanities, Arts and Sciences *		4
Total Hours		**38**

* Excluding all 820:xxx and mathematics below *MATH 1420*.

Professional Experiences

Required:		
EDUC 2385	Teaching Methods I: Secondary Science *, **	3
EDUC 2485	Teaching Internship I: Secondary Science	3

EDUC 3585/5585	Teaching Methods ll: Secondary Science *	3
EDUC 3685/5685	Teaching Internship ll: Secondary Science	3
EDUC 4138	Secondary School Teaching	12
Total Hours		**24**

* A grade of C (2.00) or higher is required for all Methods courses.

**Physics Teaching majors can count EDUC 2385 Teaching Methods l: Secondary Science for category 5 of Educator Essentials.

It is recommended that sufficient work including current curricula should be taken for licensure approval in a second area. Common teaching combinations are physics-chemistry or physics-mathematics.

Educator Essentials

Required: *

Select one of the following in each category:		
Category 1: The Learner		**3**
EDPSYCH 1500	Reflections on Learning	
EDPSYCH 2068	Development and Learning in Sociocultural Contexts	
EDPSYCH 2100	Creativity and Higher Order Thinking in the Classroom	
SOCFOUND 2243	Rethinking the Learning Society: Education and Its Future(s)	
Category 2: Social Contexts of Learning		**3**
SOCFOUND 2119	Social & Cultural Foundations of Education	
SOCFOUND 2134	A Modern History of Education in the United States	
SOCFOUND 2334	Education Policy and Politics of Education	
TESOL 2015	Language Today	
Category 3: Education for All		**3**
KINES 4152	Adapted Physical Education	
SOCFOUND 3334	Education, Power, and Change	
SOCFOUND 3434	Social Movements and Education	
SPIE 3140	Interdisciplinary and Intersectional Study of Education for All	
SPIE 3150	Meeting the Needs of Diverse Learners in Classrooms	
TESOL 3710	Content Area Strategies for English Language Learners	
Category 4: The Classroom Environment		**3**
EDPSYCH 3200	Deeper Motivation and the Highly Engaged Classroom	
EDPSYCH 3300	Level Up: Gamified Learning Environments	
ELEMECML 4151	Early Childhood Curriculum Development and Organization	
RTNL 3360	Playful Learning and Project-Based Experiences: Techniques for Ed and Recreational Environments	
SOCFOUND 3219	Critical Perspectives on Technology and Education	
Category 5: Effective Pedagogy		**3**
ARTED 4600	Expressive Learning Assessment	
LRNTECH 3600	Technology, Pedagogy, and Learning in the Digital Age	
MEASRES 3510	Assessment for Learning	
TEACHING 3500	Effective Teaching through Differentiation, Technology and Assessment	
Category 6: The Professional Educator		**3**
ELEMECML 3149	Child, Family, School and Community Relationships	
SOCFOUND 3519	Teacher Leadership & Educational Change	
TEACHING 3177	Collaborative Partnerships for Educators	
Total Hours		**18**

* A grade of C (2.00) or higher is required in each Educator Essentials course.

Minors

Data Science Minor

The Data Science minor is an interdisciplinary program that integrates computer programming, machine learning, statistics, predictive modeling and visualization to provide students with broad based skills for extracting gainful information from data that originate from a variety of sources. A final project (ideally with corporate or non-profit partnerships) will ensure that students employ their skills to solve a real-world problem.

Statistics:		
STAT 1772	Introduction to Statistical Methods	3
STAT 4784/5784	Introduction to Machine Learning	3
Computer Science:		
CS 1510	Introduction to Computing	4
CS 2150	Computing for Data Science	3-7
or		
CS 1520 & CS 1800	Data Structures and Discrete Structures	
CS 3140/5140	Database Systems	3
Physics:		
PHYSICS 4160/5160	Data Visualization, Modeling and Simulation	3
Required Data Science Project		2-3
CS 4800	Undergraduate Research in Computer Science	

or MATH 4990	Undergraduate Research in Mathematics	
or PHYSICS 3000	Undergraduate Research in Physics	
Total Hours		**21-26**

Materials Science and Technology Minor

This is an interdisciplinary minor that is jointly offered by the Departments of Chemistry and Biochemistry, Physics, and Applied Engineering.

Materials science and the use of materials in technology requires the use of concepts from multiple disciplines. This interdisciplinary minor gives students the broad foundation they need to learn about the science of materials and an introduction to how these scientific principles are used in the development and application of materials in new technology. This minor is complementary preparation to a major in Chemistry and Biochemistry, Physics or Manufacturing Engineering Technology for students who are interested in working in industry or going on to advanced study in materials science.

Required:

Choose one of the following three options: [+]		**5-8**
Option 1 Chemistry (8 hours)		
CHEM 1110	General Chemistry I	
CHEM 1120	General Chemistry II	
OR		
Option 2 Chemistry (5 hours)		
CHEM 1130	General Chemistry I-II	
OR		
Option 3 Chemistry/Technology (7 hours)		
CHEM 1020	Chemical Technology [&]	
TECH 3127	Applied Thermodynamics [&]	
Additional requirements (all three options)		
Choose one of the following sets of Physics courses:		8
PHYSICS 1511 & PHYSICS 1512	General Physics I and General Physics II	
OR		
PHYSICS 1701 & PHYSICS 1702	Physics I for Science and Engineering and Physics II for Science and Engineering	
Additional required (all three options)		
CHEM 4200/5200	Nanoscience [*]	3
or PHYSICS 4200/5200	Nanoscience	
TECH 2072	Engineering Materials	3
Electives (all three options) - choose one of the following:		**3-4**
Note: in order to earn the Materials Science and Technology minor, the elective course students take for the minor cannot be a required course for their primary major.		
CHEM 2110	Descriptive Inorganic Chemistry [*]	
CHEM 2320	Chemical Analysis [#]	
CHEM 4210/5210	Nanotechnology [*]	
or PHYSICS 4210/5210	Nanotechnology	
PHYSICS 4750/5750	Physics of Modern Materials [#]	
TECH 3132/5132	Metallurgy and Phase Transformation	
Total Hours		**22-26**

[+] **There are additional prerequisite courses that must be taken along with the required courses in some options – choose the option that aligns with the courses for your major.**
Prerequisites for TECH 3127: TECH 1024; MATH 1150 or MATH 1420.
Prerequisite or corequisites for PHYSICS 1701: MATH 1420.
Prerequisite or corequisites for PHYSICS 1702: MATH 1421.

[*] Students who have declared a Materials Science and Technology Minor may take these courses after completing CHEM 1020 Chemical Technology and TECH 3127 Applied Thermodynamics in place of the usual CHEM 1120 General Chemistry II prerequisite.

[&] These courses are taken by students in the Manufacturing Engineering Technology major.

[#] Prerequisite for CHEM 2320: CHEM 1120 or CHEM 1130.
Prerequisite for PHYSICS 4750/5750: PHYSICS 4100/5100 and PHYSICS 4110/5110.

Nanoscience and Nanotechnology Minor

Required

Chemistry and Biochemistry:		5-8
Select one of the following:		
CHEM 1110 & CHEM 1120	General Chemistry I and General Chemistry II	
CHEM 1130	General Chemistry I-II	
Physics:		
PHYSICS 1511	General Physics I	4
or PHYSICS 1701	Physics I for Science and Engineering	
PHYSICS 1512	General Physics II	4
or PHYSICS 1702	Physics II for Science and Engineering	
PHYSICS 4200/5200	Nanoscience	3
or CHEM 4200/5200	Nanoscience	
PHYSICS 4210/5210	Nanotechnology	3
or CHEM 4210/5210	Nanotechnology	
Total Hours		**19-22**

Physics Minor

Required

Physics:		
Select one of the following:		8
PHYSICS 1511 & PHYSICS 1512	General Physics I and General Physics II (required)	
PHYSICS 1701 & PHYSICS 1702	Physics I for Science and Engineering and Physics II for Science and Engineering (required)	
Electives:		**12**

Physics:		
3000-level electives in Physics, with no more than 3 hours earned in the following: *		
PHYSICS 3000	Undergraduate Research in Physics (and/or)	
PHYSICS 4450/5450	Laboratory Projects	
Total Hours		**20**

* See course descriptions to reference 4-digit numbers associated with these 3000-level courses.

Program Certificate

The University of Northern Iowa makes available, in addition to traditional programs, the opportunity for students to earn program certificates. Program certificates provide an alternative to programs leading to a degree, a major, or a minor; they certify that an individual has completed a program approved by the university. For information on the following certificates, contact the Department of Physics or the Office of the Registrar, which serves as the centralized registry.

Physics Teaching Certificate

The Physics Teaching Certificate provides for second endorsement approval by the Iowa Board of Educational Examiners and requires first endorsement approval (major) in another grades 5-12 science discipline, basic science, or all science.

First endorsement approval (major) may also be grades 5-12 mathematics upon completion of a secondary science methods course.

This certificate leads to endorsement #156 physics (5-12). Students must also complete all requirements for a Secondary Science or Mathematics Teaching major, including student teaching.

Required:		
Physics:		
PHYSICS 1511	General Physics I	4
or PHYSICS 1701	Physics I for Science and Engineering	
PHYSICS 1512	General Physics II	4
or PHYSICS 1702	Physics II for Science and Engineering	
PHYSICS 4080/5080	Resources for Teaching Physics	2
Science Education (choose one of the following):		3
EDUC 2385	Teaching Methods l: Secondary Science	
EDUC 3585/5585	Teaching Methods ll: Secondary Science	
Electives chosen from the following:		3-5
Elective hours vary by major program. Mathematics Teaching majors and Chemistry Teaching majors must select three hours from the following; other secondary science teaching majors including Comprehensive Secondary Science Teaching, Middle Level Science Teaching Dual, Biology Teaching, and Earth Science Teaching must select five hours from the following:		
PHYSICS 1100	First-Year Projects in Physics	
PHYSICS 2300	Physics III: Theory and Simulation	
PHYSICS 3000	Undergraduate Research in Physics *	
PHYSICS 3030	Robotics and Sensors	
PHYSICS 3100	Introduction to Quantum Computing	
PHYSICS 4050/5050	Optical Science	
PHYSICS 4100/5100	Modern Physics	
PHYSICS 4110/5110	Modern Physics Laboratory	
PHYSICS 4200/5200	Nanoscience	
PHYSICS 4210/5210	Nanotechnology	
PHYSICS 4290/5290	Project Lead The Way: Digital Electronics	
PHYSICS 4300/5300	Introduction to Electronics	
Total Hours		**16-18**

* A maximum of 2 hours are allowed.