Nebraska Wesleyan University

Physics, Astronomy, and Computer Science

Catalog

2013-2014

About the Program

The Bachelor of Arts degree is designed for those students who want a solid physics education with a broad liberal arts background and will be pursuing further education or employment in fields other than physics or engineering. The Bachelor of Science degree is designed for those students pursuing employment or further education in physics or engineering.

Physics Education major

See the Education Department on interdisciplinary majors in physical sciences and physics, natural sciences education, and applicable endorsements.

Dual-Degree Engineering Program

The Dual-Degree Program is a cooperative academic program between Nebraska Wesleyan University and The Fu Foundation School of Engineering and Applied Science at Columbia University in New York; The School of Engineering and Applied Science at Washington University in St. Louis; and the College of Engineering and Technology at the University of Nebraska. The Dual-Degree Program enables a student to devote three years to the study of sciences and liberal arts at Nebraska Wesleyan before transferring to one of these schools for two years of engineering studies. This program leads to a Bachelor of Science degree from Nebraska Wesleyan and the appropriate engineering bachelor's degree from Columbia University, Washington University, or the University of Nebraska.

The Dual-Degree Program is designed to give the student the best of both liberal arts and engineering and to provide the practicing engineer with a background in the humanities and social sciences. The program encourages engineers to be aware of the changing values and priorities of society, and to be concerned about the effects of science and technology upon the environment and the quality of life.

Engineering fields of study include the following:

Columbia University

- Applied Mathematics
- Applied Physics
- Computer Engineering
- Computer Science
- Earth and Environmental Engineering
- Electrical Engineering
- Engineering Management Systems
- Engineering Mechanics
- Financial Engineering
- Industrial Engineering
- Materials Science and Engineering
- Mechanical Engineering
- Operations Research

Washington University

- Biomedical Engineering
- Chemical Engineering
- Computer Engineering
- Computer Science
- Electrical Engineering

- Mechanical Engineering
- System Science and Engineering

University of Nebraska

- Agricultural Engineering
- Architectural Engineering
- Biological Systems Engineering
- Chemical and Biomolecular Engineering
- Civil Engineering
- Computer Engineering
- Construction Engineering
- Construction Management
- Electrical Engineering
- Electronics Engineering
- Industrial Engineering
- Mechanical Engineering

Other information

In addition to the regular course offerings, the department provides opportunities to participate in research projects on an individual basis. These projects may be of a theoretical or experimental nature. The department is especially well equipped in digital electronics, atomic bean collisions, x-ray fluorescence spectroscopy, nuclear spectroscopy, health physics, and radiation protection.

Courses numbered below 100 are suitable for students who are not natural science majors. They may not be counted toward a major or minor in physics.

Courses

CMPSC 010 Microcomputer Applications

2 hours

A hands-on introduction to word processing, spreadsheets, databases, and presentation graphics.

(Normally offered each semester.)

CMPSC 030 Introduction to Computational Problem Solving

3 hours

An introduction to computational problem-solving using a programming language. Students learn the syntax and semantics of a language and apply these to the solution of mathematical problems. Students review mathematical concepts and use them as the basis of algorithmic solution during a hands-on lab. The course is recommended for all who wish to explore computer science.

Prerequisite(s): Appropriate placement score.

CMPSC 040 Program Design

4 hours

A disciplined approach to the development of programs to solve problems on a computer. Topics include data types, control structures, abstraction, and software development. A lab component introduces a high-level programming language and software tools.

Corequisite(s): CMPSC 030 Introduction to Computational Problem Solving or permission of the instructor.

(Normally offered each semester.)

CMPSC 100 Discrete Mathematics

3 hours

An introduction to fundamental concepts of discrete mathematics with application to computer science. Topics include sets, relations, functions, sequences, Boolean algebra, difference equations, combinatorics, and graph theory.

Prerequisite(s): Placement into MATH 105 Calculus I or grade of "C" or better in MATH 050 Pre-Calculus.

(Normally offered each year.)

CMPSC 110 Unix

1 hours

Introduction to the Unix operating system, Unix file system, Unix tools and utilities, and shell programming. A laboratory course.

(Normally offered each year.)

CMPSC 120 Imperative Problem-Solving

2 hours

Students solve algorithmically complex problems using an imperative language and will have the opportunity to represent NWU in the ACM Programming Contest. A laboratory course. May be repeated.

Prerequisite(s): CMPSC 040 Program Design with a grade of "C" or better.

(Normally offered each year.)

CMPSC 130 Computer Architecture and Interfacing

4 hours

See PHYS 130 Computer Architecture and Interfacing.

CMPSC 140 Data Structures

4 hours

A natural continuation of Computer Science 40 concentrating on the motivation, design, implementation, and utilization of abstract data types. Topics include linked lists, stacks, queues, trees, and recursion. A lab component is incorporated.

Prerequisite(s): Grade of "C" or better in CMPSC 040 Program Design.

(Normally offered each spring semester.)

CMPSC 190 Selected Topics

1-3 hours

An intermediate-level course designed to treat subject matter not covered in other computer science courses. The title, content, and credit hours will be determined by current mutual interests of students and faculty and availability of resources.

Prerequisite(s): Permission of the instructor and the department chair.

CMPSC 200 Formal Languages and Automata

3 hours

An overview of formal models of computation and complexity classes. Topics include formal languages (finite automata, regular expressions, push-down automata, context-free grammars, and Turing machines), Church's thesis, computability, non-determinism, and NP-completeness. Same as MATH 200 Formal Languages and Automata.

Prerequisite(s): Grade of "C" or better in either CMPSC 100 Discrete Mathematics or MATH 111 Introduction to Higher Mathematics and junior standing.

(Normally offered alternate years.)

CMPSC 205 Database Systems

3 hours

An introduction to the design, implementation, and management of database systems. Topics include entity-relation, relational, and object-oriented databases. A client-server database project is assigned.

Prerequisite(s): Grade of "C" or better in CMPSC 140 Data Structures.

(Normally offered alternative years.)

CMPSC 210 Operating Systems

3 hours

A study of the fundamental concepts of operating systems and distributed systems. Topics include process and storage management, protection and security, and the organization and coordination of systems having interacting processors. The material is illustrated by case studies.

Prerequisite(s): Grade of "C" or better in CMPSC 140 Data Structures.

(Normally offered alternate years.)

CMPSC 230 Software Engineering I

3 hours

Topics include design objectives, life-cycle model, reliability and risk assessment, maintenance, specification and design tools, implementation issues and strategies, and verification and validation.

Prerequisite(s): Grade of "C" or better in CMPSC 140 Data Structures.

(Normally offered alternate years.)

CMPSC 235 Computer Networks

4 hours

This course focuses on the communications protocols used in computer networks: their functionality, specification, verification, implementation, and performance. The course also considers the use of network architectures and protocol hierarchies to provide more complex services. Existing protocols and architectures will be used as the basis of discussion and study. Includes formal laboratory work.

Prerequisite(s): Grade of "C" or better in CMPSC 140 Data Structures.

(Normally offered alternate years.)

CMPSC 240 Compiler Construction

3 hours

A capstone course in which students design and implement a compiler as an application of the principles of software engineering, formal language theory, algorithms and data structures. Topics include lexical analysis, parsing, symbol table management, code generation and optimization and use of compiler tools.

Prerequisite(s): Grades of "C" or better in CMPSC 140 Data Structures and CMPSC 200 Formal Languages and Automata.

(Normally offered alternate years.)

CMPSC 255 Algorithms

3 hours

A systematic study of the analysis and design of algorithms, particularly those used for complex data structures and non-numeric processes. Topics include analysis of complexity, complexity classes, dynamic programming, automata-based algorithms, backtracking, and parallel algorithms.

Prerequisite(s): Grades of "C" or better in CMPSC 100 Discrete Mathematics and CMPSC 140 Data Structures.

(Normally offered alternate years.)

CMPSC 260 Programming Languages

3 hours

A survey of the principles and paradigms of programming languages. Topics include data types, scope and run-time storage, control structures, syntax, semantics, translation, and implementation. Paradigms discussed include: procedural, functional, logic, and object-oriented programming.

Prerequisite(s): Grade of "C" or better in CMPSC 140 Data Structures.

(Normally offered alternate years.)

CMPSC 265 Artificial Intelligence

3 hours

A study of the techniques and theory of artificial intelligence. Topics include the history and philosophy of AI, knowledge representation, state space search, logic programming, AI languages, expert systems, natural language understanding, machine learning, and neural networks.

Prerequisite(s): Grade of "C" or better in CMPSC 260 Programming Languages.

CMPSC 290 Selected Topics

1-3 hours

An upper-level course designed to treat subject matter not covered in other computer science courses. The title, content, and credit hours will be determined by current mutual interests of students and faculty and availability of resources.

Prerequisite(s): Permission of the instructor and department chair.

CMPSC 295 Independent Study

1-12 hours

Individual study of a specific computer science topic under the supervision of a faculty member. Independent study may not duplicate courses described in the catalog.

Prerequisite(s): Permission of the instructor and the department chair.

CMPSC 297 Internship

1 hours

The student secures a firm to sponsor on-the-job training satisfactory to the sponsor, the department, and the student. The student submits a written report and the sponsor supplies a statement regarding the satisfactory completion of the internship.

Pass/Fail only.

Prerequisite(s): 17 hours in computer science and permission of the department chair.

CMPSC 299 Software Engineering II

3 hours

A capstone course in which student teams undertake a large software project using contemporary software engineering techniques.

Prerequisite(s): CMPSC 230 Software Engineering I with a grade of "C" or better and junior standing.

(Normally offered alternate years.)

NATSC 030 Introduction to Environmental Science

4 hours

An introduction to environmental science that provides an interconnected grounding in the natural sciences. Topics include energy, ecosystems, photosynthesis, biodiversity, population dynamics, air pollution, water pollution, radon/radioactivity, and hazardous waste. Laboratory activities, computer exercises, guest speakers, and multimedia presentations will also be a part of the course. When possible, the course will be team taught by faculty from at least two of the three natural science departments: Biology, Chemistry, and Physics.

Three lectures per week.

One 3-hour lab per week.

PHYS 010 Astronomy

4 hours

An introductory course on the solar system, stars and galaxies.

Three lectures per week.

One laboratory/observation per week.

Prerequisite(s): One year of high school algebra or permission of instructor.

(Normally offered each semester.)

PHYS 020 Introduction to Meteorology

4 hours

A survey of and explanation of weather and climate phenomena in terms of the physical characteristics and processes of the atmosphere.

Three lectures per week.

One laboratory per week.

Prerequisite(s): One year of high school algebra or permission of instructor.

PHYS 053 Earth Science

4 hours

A survey of geology and geophysics. Topics include characteristics of minerals and rocks, plate tectonics, Earth's interior, Earth history and time scales, surface processes, and ocean processes.

Three lectures per week.

One laboratory per week.

PHYS 054 Energy and the Global Environment

3 hours

A course covering some of the most critical problems facing the world today - those relating to the production, distribution, and use of energy. Text material may be supplemented with films, video tapes, and guest speakers.

Three lectures per week.

(Normally offered each spring semester.)

PHYS 055 Energy and the Global Environment Lab

1 hours

Laboratory experiments associated with PHYS 054 Energy and the Global Environment.
One laboratory per week.

Corequisite(s): PHYS 054 Energy and the Global Environment.

PHYS 100 Physics in Modern Society

1 hours

Applications of physics and technology and their impact on the individual, society, and the environment.

One hour of discussion/recitation per week.

Corequisite(s): PHYS 101 Principles of Physics I or PHYS 102 Principles of Physics II.

PHYS 101 Principles of Physics I

4 hours

The principles of classical mechanics, energy and motion designed for majors in the natural sciences. Algebra and trigonometry will be used in descriptions and problems.

Three 2-hour workshop sessions per week.

Corequisite(s): MATH 050 Pre-Calculus or permission of the instructor.

(Normally offered each fall semester.)

PHYS 102 Principles of Physics II

4 hours

A continuation of PHYS 101 Principles of Physics I with emphasis on waves, sound, electricity, magnetism, and electronics.

Three 2-hour workshop sessions per week.

Prerequisite(s): MATH 050 Pre-Calculus or permission of the instructor.

(Normally offered each spring semester.)

PHYS 111 General Physics I

4 hours

An introduction to classical mechanics, energy and motion designed for majors in the natural sciences. Elements of calculus will be used in descriptions and problems.

Three 2-hour workshop sessions per week.

Corequisite(s): MATH 060 Calculus for Management, Biological, and Social Sciences or MATH 105 Calculus I or permission of the instructor.

PHYS 112 General Physics II

4 hours

A continuation of PHYS 111 General Physics I with emphasis on waves, sound, electricity, magnetism, and electronics.

Three 2-hour workshop sessions per week.

Prerequisite(s): MATH 060 Calculus for Management, Biological, and Social Sciences or MATH 105 Calculus I; or permission of the instructor.

PHYS 121 Electronic Measurements

4 hours

An integrated treatment of analog and digital circuits and measurements using the techniques of solid state electronics and integrated circuits. Emphasis is placed on laboratory techniques.

Three lectures per week.

One or two laboratories per week.

Prerequisite(s): PHYS 102 Principles of Physics II or PHYS 112 General Physics II, and MATH 105 Calculus I.

(Normally offered each fall semester.)

PHYS 130 Computer Architecture and Interfacing

4 hours

A first course in the levels of architecture of a modern computer, from digital logic, through circuits and register level components, to programming. Topics include data representation, memory organization, input/output control, interfacing, and communication.

Three lectures per week.

One laboratory per week.

Prerequisite(s): PHYS 121 Electronic Measurements or CMPSC 040 Program Design or permission of the instructor.

PHYS 140 Introduction to Health Physics

4 hours

An introduction to health physics with emphasis on the practical aspects of radiation detection, protection, and regulation. Basic interaction of radiation with matter, biological effects of radiation, radiation dosimetry, and radiation protection regulations will be covered. Laboratory experience includes radiation spectroscopy, radiation dosimetry, environmental radiation monitoring, and radiation protection program design.

Three lectures per week.

One laboratory per week.

Prerequisite(s): PHYS 101 Principles of Physics I or PHYS 111 General Physics I or permission of the instructor.

PHYS 162 Introduction to Modern Physics

4-5 hours

An introduction to modern physics with emphasis on atomic and nuclear physics. Both analytical and experimental techniques will be used. Basic principles of physics and wave mechanics will be applied to atomic and nuclear models. The practical aspects of atomic and nuclear models. The practical aspects of atomic and nuclear radiation detection and safety will also be covered.

Three lectures per week.

One or two laboratories per week.

Prerequisite(s): PHYS 102 Principles of Physics II or PHYS 112 General Physics II, and MATH 106 Calculus II or permission of the instructor.

(Normally offered each spring semester.)

PHYS 190 Selected Topics

1-5 hours

A course designed to treat subject matter not covered in other departmental courses. The title, content, and credit hours will be determined by current mutual interests of faculty and students. This course may be offered to meet a requirement for a major only by approval of the department chair.

Prerequisite(s): To be determined by the instructor.

PHYS 201 Classical Mechanics

4 hours

An in-depth theoretical treatment of classical mechanics of particles and systems of particles with emphasis on the conservation laws of energy, momentum, angular momentum, and oscillations. Particular topics include Newtonian, Lagrangian, and Hamiltonian formalisms, non-inertial reference frames.

Four lecture/recitation periods per week.

Prerequisite(s): PHYS 101 Principles of Physics I or PHYS 111 General Physics I, MATH 106 Calculus II, and computer programming skills or permission of the instructor. Corequisite(s): MATH 204 Calculus III or MATH 224 Differential Equations or permission of the instructor.

PHYS 204 Quantum and Atomic Physics

4 hours

An introduction to quantum theory, statistical physics, and atomic spectra and properties, phenomena in atomic, molecular, nuclear, solid-state, and high-energy physics as application of the principles of microscopic physics.
Three lectures per week. One recitation per week.

Prerequisites; PHYS 162 Introduction to Modern Physics and MATH 204 Calculus III or MATH 224 Differential Equations, computer programming skills or permission of the instructor.

PHYS 281 Advanced Laboratory

1 hours

An advanced laboratory in which students extend and amplify the work of other courses. Work may be chosen in electrical measurements, physical optics, modern physics, or other areas of mutual interest.

Prerequisite(s): Permission of the instructor and approval of the department chair.

(Normally offered each semester.)

PHYS 290 Selected Topics

1-4 hours

A course designed to treat subject matter not covered in other departmental courses. The title, content, and credit hours will be determined by current mutual interests of faculty and students.

Prerequisite(s): Permission of the instructor and approval of the department chair.

PHYS 295 Independent Study

1 hours

Individual projects of a creative nature for qualified physics students. Projects may be of a theoretical or experimental nature. Independent study may not duplicate courses described in the catalog.

Prerequisite(s): Permission of the instructor and approval of the department chair.

PHYS 297 Physics Internship

1-8 hours

On-the-job training for physics majors in situations that satisfy the mutual interests of the student, the supervisor, and the instructor. The student will arrange for the position in accordance with the guidelines established by the department.

Pass/Fail only.

Prerequisite(s): Permission of the instructor and approval of the department chair.