

# Physics and Astrophysics (Phys)

B.S. with Major in Physics (<http://und-public.courseleaf.com/undergraduateacademicinformation/departmentalcoursesprograms/physicsandastrophysics/phys-bs>)

B.S./M.S. with Major in Physics (<http://und-public.courseleaf.com/undergraduateacademicinformation/departmentalcoursesprograms/physicsandastrophysics/phys-bsms-5yr>)

Minor in Physics (<http://und-public.courseleaf.com/undergraduateacademicinformation/departmentalcoursesprograms/physicsandastrophysics/phys-minor>)

Minor in Astrophysics (<http://und-public.courseleaf.com/undergraduateacademicinformation/departmentalcoursesprograms/physicsandastrophysics/phys-minor-astro>)

## Courses

### PHYS 101. Survey of Physics & Astrophysics. 1 Credit.

A survey of a broad range of topics in physics ranging from nanoscience to astrophysics and physics-related educational and career opportunities. Intended to help physics majors and students interested in majoring in physics make informed academic decisions early in their college life. S/U grading. F.

### PHYS 110. Introductory Astronomy. 3 Credits.

An introductory study of the universe: The solar system, stars, stellar evolution, galaxies, black holes, big bang cosmology, and the accelerating universe. The astronomy laboratory 110L is optional for 1 credit. F,S.

### PHYS 110L. Introductory Astronomy Lab. 1 Credit.

An introductory study of the universe: The solar system, stars, stellar evolution, galaxies, black holes, big bang cosmology, and the accelerating universe. The astronomy laboratory 110L is optional. F,S.

### PHYS 130. Natural Science-Physics. 4 Credits.

For non-science majors, this is a hands-on, inquiry-based course on the workings of science. Emphasis is on critical thinking and the use of the scientific method. Topics will include: electricity, force, motion, and energy. The laboratory is a component of this course. S.

### PHYS 140. Physics for Poets. 3 Credits.

An introduction to the fundamental concepts of physics, especially those developed in the twentieth century. A knowledge of elementary algebra is recommended, but the course is designed for students with a limited mathematical background. No laboratory. On demand.

### PHYS 150. Physics for Aerospace Sciences. 5 Credits.

An introduction to the principles and concepts of physics as they apply to the study of aerospace sciences. Topics: Newtonian mechanics, gravitation, work, energy, fluids, electricity, magnetism. F,S.

### PHYS 161. Introductory College Physics I. 4 Credits.

An introduction to the principles and concepts of physics with the application of minimal mathematics, sufficient to show the logical progression from one topic to the next. General physics for those who do not plan to take an advanced course in science. Topics: Newtonian mechanics and gravitation, work and energy, solids and fluids, vibrations and waves, electricity and magnetism, light and optics. The laboratory is a component of this course. No mathematical prerequisite is required, but knowledge of elementary algebra is recommended. F.

### PHYS 162. Introductory College Physics II. 4 Credits.

An introduction to the principles and concepts of physics with the application of minimal mathematics, sufficient to show the logical progression from one topic to the next. General physics for those who do not plan to take an advanced course in science. Topics: Newtonian mechanics and gravitation, work and energy, solids and fluids, vibrations and waves, electricity and magnetism, light and optics. The laboratory is a component of this course. Prerequisite: PHYS 161. S.

### PHYS 211. College Physics I. 4 Credits.

This non-calculus general physics course is recommended for pre-medical or pre-professional students. Topics: Newtonian mechanics and gravitation, work and energy, solids and fluids, heat and thermodynamics. The laboratory is a component of this course. A student may not receive credit for PHYS 211 and PHYS 212, and also PHYS 161 and PHYS 162. Prerequisite: MATH 103. F.

### PHYS 211C. College Physics I. 3 Credits.

This non-calculus general physics course is recommended for pre-medical or pre-professional students. Topics: Newtonian mechanics and gravitation, work and energy, solids and fluids, heat and thermodynamics. Students requiring a laboratory must take PHYS 211CL. Prerequisite: MATH 103. F.

### PHYS 211CL. College Physics I Laboratory. 1 Credit.

The laboratory part of Physics 211C. Prerequisite: PHYS 211C or consent of instructor. S/U grading. SS.

### PHYS 212. College Physics II. 4 Credits.

The non-calculus general physics course sequence recommended for pre-medical or preprofessional students. Topics: vibrations and waves, electricity and magnetism, light and optics, and an introduction to modern physics. The laboratory is a corequisite for this course. The laboratory is a component of this course. A student may not receive credit for PHYS 211 and PHYS 212, and also PHYS 161 and PHYS 162. Prerequisite: PHYS 211. S.

### PHYS 212C. College Physics II. 3 Credits.

The non-calculus general physics course sequence recommended for pre-medical or preprofessional students. Topics: vibrations and waves, electricity and magnetism, light and optics, and an introduction to modern physics. Students requiring a laboratory with this course must take PHYS 212CL. Prerequisite: PHYS 211C or PHYS 211. S.

### PHYS 212CL. College Physics II Laboratory. 1 Credit.

The laboratory part of Physics 212C. Prerequisite: PHYS 212C or consent of instructor. S/U grading. SS.

### PHYS 213. College Physics III. 4 Credits.

A survey of modern physics covering physical optics, special theory of relativity, quantum theory, atomic physics, molecular and solid state physics, nuclear physics and radioactivity, particle physics, and astrophysics. The laboratory is a component of this course. Prerequisite: PHYS 212. F.

### PHYS 251. University Physics I. 4 Credits.

The university physics sequence is for students majoring in science and engineering. Topics normally covered in PHYS 251 include Newtonian mechanics and gravitation, work and energy, rotational dynamics, vibrations and waves, mechanics of solids and fluids, basic kinetic theory, equations of state and the first and second laws of thermodynamics. The laboratory is a component of this course. Prerequisite: MATH 165. F,S.

### PHYS 252. University Physics II. 4 Credits.

Topics normally covered include electricity, magnetism, electromagnetic waves, light and geometrical optics. The laboratory is a component of this course. Prerequisites: MATH 166 and PHYS 251. F,S.

### PHYS 253. University Physics III. 4 Credits.

Modern physics, a survey covering physics of the 20th and 21st centuries. Topics normally covered include theory of relativity, discovery of quantum phenomena, basic quantum mechanics, overview of atomic, nuclear and solid state physics, statistical physics, quantum fluids and superconductivity, fundamental forces and the physics of elementary particles. This course is a prerequisite for most courses in advanced physics. The laboratory is a component of this course. Prerequisites: MATH 265 and PHYS 252. S.

### PHYS 294. Selected Topics. 1-4 Credits.

Prerequisite: 8 hours of college physics or consent of instructor. Repeatable to 4 credits. On demand.

### PHYS 317. Mechanics I. 3 Credits.

Motion of a single particle, central forces and simple oscillatory systems. Prerequisites: PHYS 251 and MATH 266, or approval of department. F.

### PHYS 318. Mechanics II. 3 Credits.

Rigid body motion, Lagrangian and Hamiltonian dynamics, relativity, continuum mechanics. Prerequisite: PHYS 317 or approval of instructor. S.

### PHYS 320. Introduction to Materials Science. 3 Credits.

An introduction to solid state physics with emphasis on applications. Prerequisite: PHYS 253 or approval of department. F, even years.

### PHYS 324. Thermal Physics. 3 Credits.

Thermodynamics with an introduction to statistical physics. Prerequisite: PHYS 253 or approval of instructor. S, even years.

**PHYS 325. Optics. 3 Credits.**

Geometrical and physical optics with an emphasis on physical optics. Prerequisite: PHYS 253 or approval of department. S, odd years.

**PHYS 325L. Optics Laboratory. 1 Credit.**

Laboratory to accompany Physics 325. Corequisite: PHYS 325. S, odd years.

**PHYS 327. Electricity and Magnetism I. 3 Credits.**

A quantitative treatment of electromagnetic theory with an introduction to Maxwell's equations. Prerequisite: PHYS 253 or approval of instructor. F, odd years.

**PHYS 328. Electricity and Magnetism II. 3 Credits.**

Maxwell's equations. The scalar potential as a solution of a boundary value problem. The vector potential and its application. A quantitative treatment of dielectrics, magnetic materials and electromagnetic radiation. Prerequisite: PHYS 327. Corequisite: MATH 352 or approval of instructor. S, even years.

**PHYS 402. Computers in Physics. 3 Credits.**

Computer applications in physics, that may include data analysis, numerical simulation, symbolic and algebraic programming, parallel computing, computer interfacing and/or experimental physics applications. Prerequisites: PHYS 252 and knowledge of a higher-level computer programming language, or consent of instructor. On demand.

**PHYS 415. Undergrad Research Experience. 3 Credits.**

The students will engage in research activities of a UND physics faculty member or may take part in a physics department approved external research program such as an NSF-funded REU program. Prerequisite: PHYS 253 or advisor's consent.

**PHYS 420. Advanced Topics in Materials Science. 3 Credits.**

The application of physics to design, synthesis and characterization of materials of current interest. Prerequisite: PHYS 320. S, odd years.

**PHYS 428. Advanced Physics Laboratory. 2 Credits.**

Advanced undergraduate experiments in physics, using modern techniques and instrumentation. Classic experiments leading to the current understanding of physical theory. Prerequisite: PHYS 253 or approval of instructor. F, odd years.

**PHYS 431. Quantum Mechanics I. 3 Credits.**

An introduction to quantum mechanics with applications to atomic structure. Prerequisite: PHYS 253. Prerequisite or Corequisite: PHYS 317 or approval of department. F, even years.

**PHYS 432. Quantum Mechanics II. 3 Credits.**

Further development of basic quantum theory with application to atomic, molecular, solid state and nuclear physics. Prerequisite or Corequisite: PHYS 431 or consent of instructor. S, odd years.

**PHYS 434. Nuclear Physics. 3 Credits.**

Introduction to the theory of atomic nuclei, fundamental forces and sub-atomic particles. Prerequisite: PHYS 253 or approval of instructor. F, odd years.

**PHYS 437. Introductory Solid State Physics. 3 Credits.**

A general introduction to solid state phenomena. Prerequisite: PHYS 253 or approval of instructor. F, even years.

**PHYS 460. Introduction to Astrophysics. 3 Credits.**

Nature of stars. Topics include celestial mechanics, relativity, optics, stellar birth, stellar interiors and evolution, nucleosynthesis, stellar death, compact objects, black holes, neutron stars, white dwarfs, binaries and variable stars. Some topics include the use of computer tools to solve problems. Prerequisite: PHYS 253 or approval of instructor. F, even years.

**PHYS 461. Introduction to Astrophysics II. 3 Credits.**

Galaxies and the universe. Topics include structure and evolution of galaxies, the Milky Way, stellar populations, globular clusters, interstellar medium, big bang, Hubble and the distance scale, radio galaxies, quasars, jets, blazars, clusters and superclusters of galaxies and cosmology. Some topics include the use of computer tools to solve problems. Prerequisite: PHYS 460 or approval of instructor. S, odd years.

**PHYS 489. Senior Honors Thesis. 1-15 Credits.**

**PHYS 492. Special Problems. 1-3 Credits.**

Selected problems in physics or astrophysics. Prerequisite: Approval of the department. Repeatable to 9 credits. On demand.