Applied Physics majors may complete their degree at Carroll University, the University of Wisconsin – Platteville, or the University of Wisconsin – Milwaukee in accordance with the pre-engineering program. For details on this program see a member of the Physics or Mathematics faculty. In either case, the Applied Physics major provides a strong foundation for further studies in physics, engineering, computers, law and medicine. Applied Physics majors can find jobs immediately after graduation in a variety of technologically demanding careers.

Physics minors are encouraged to select additional supporting courses in the other sciences. The minor provides excellent preparation for a career in many fields including mathematics, chemistry, biology, medicine and physical therapy.

A certification program to teach physics at the secondary level, with a minor in physics, is available. Details of this program can be obtained from either the physics or the education faculty.

**Learning Outcomes for the Applied Physics**

Upon completion of the major and degree requirements the successful graduate will have:

1. a robust understanding of classical physics theories, including Newtonian mechanics, classical electrodynamics, thermodynamics, and 20th century physics, as well as some current topics in physics and engineering;
2. the ability to work independently to describe a problem within a physical system and create a plan to solve that problem;
3. the ability to apply physical theories to practical problems using both analytical and numerical techniques;
4. an understanding and appreciation of the interdisciplinary nature of physics, particularly in relation to chemistry and mathematics;
5. an understanding and appreciation of the historical development of physics and the role of physics in modern technology.
6. an understanding and appreciation of the basic physical principles underlying the universe.

**Fees**

Specific courses that require use of equipment and disposable supplies are assigned a course fee.
Applied Physics Major

Core
Physics 203 & 204, General Physics (recommended) or
   Physics 101 & 102, Introductory Physics
Physics 301, Electricity and Magnetism
Physics 303, Modern Physics
Physics 304, Classical Mechanics
Physics 320, Thermodynamics
Physics 450, Advanced Physics Lab
Mathematics 160, 161, 207, Calculus I, II, III
General Engineering 100, 101, Engineering Seminar I, II
Capstone: Mathematics 450

Required Support Courses
Mathematics 309, Differential Equations
Chemistry 109, Principles of Inorganic Chemistry
Chemistry 110, Principles of Analytical Chemistry
Computer Science 110, Problem Solving through Programming
12 hours of electives in the Mathematics and Physics programs

Physics Minor
Physics 203, 204, General Physics (Recommended) or
   Physics 101,102, Introductory Physics
Physics 303, Modern Physics
Physics 304, Mechanics

PHY 101. Introductory Physics I 4 credits
The first course of a non-calculus based two-course sequence in the basic principles of
physics covering the general areas of mechanics, thermal physics and fluids. The mathematical proficiency expected for this course is algebra and introductory trigonometry. This course satisfies the physics requirement for some majors, and pre-health professional requirements. Four hours of lecture/discussion and two hours of laboratory per week. (Credit cannot be received for both 101 and 203.) (Required course fee) (Sp, Su)
Prerequisite: MAT 101 or higher.

PHY 102. Introductory Physics II 4 credits
The second course of a non-calculus based two-course sequence in the basic principles of
physics covering the general areas of wave motion (oscillations, waves and sound),
light and optics, and electromagnetism. The mathematical proficiency expected for this course is algebra and introductory trigonometry. This course satisfies the physics requirement for some majors, and pre-health professional requirements. Four hours of lecture/discussion and two hours of laboratory per week. (Credit cannot be received for both 102 and 204.) (Required course fee) (Fa, Su) Prerequisite: PHY 101. Instructor consent is necessary for enrollment in 102 without completion of 101.
PHY 105. Astronomy N1 4 credits
The course includes the study of the motions and structures of the earth, the moon, the sun, planets, stars and galaxies, and consideration of cosmological theories. The laboratory includes telescopic observational astronomy. Labs are scheduled for twice a week but only meet once a week on average for three hours. (Required course fee) (Fa, Sp, Su)
Prerequisites: Satisfaction of the mathematics competency requirement for graduation.

PHY 203. General Physics I 4 credits
The first course of a calculus level two-course sequence in the basic principles of physics covering the general areas of mechanics, fluids and wave motion. This course satisfies the physics requirement for some majors, and pre-health professional requirements. Four hours of lecture/discussion and three hours of laboratory per week. (Credit cannot be received for both 101 and 203.) (Required course fee) (Sp)
Prerequisites: MAT 160.

PHY 204. General Physics II 4 credits
The second course of a calculus level two-course sequence in the basic principles of physics covering the general areas of heat, light, electricity and circuits, and magnetism. This course satisfies the physics requirement for some majors, and pre-health professional requirements. Four hours of lecture/discussion and three hours of laboratory per week. (Credit cannot be received for both 102 and 204.) (Required course fee) (Fa)
Prerequisites: MAT 160 and 161. Instructor consent is necessary for enrollment in 204 without the successful completion of 203.

PHY 301. Electricity and Magnetism 4 credits
Physical principles underlying modeling of charges and currents, including circuit elements and fundamentals of analog electrical circuits are explored through lecture and laboratory. Topics will include the following: Maxwell's equations, electric and magnetic fields in vacuum and in matter, potentials and the uniqueness theorem, current and voltage sources, resistors, Ohm's Law, Kirchhoff's Laws, Thevenin and Norton theorems. Four hours of lecture/discussion and three hours of laboratory per week. (Required course fee) (Sp, even years) Prerequisites: PHY 204, MAT 207.

PHY 303. Modern Physics 4 credits
A course in the basic principles of modern physics treating the general subjects of atomic and nuclear physics, relativity, cosmology and quantum physics. Four hours of lecture/discussion and three hours of laboratory per week. (Required course fee) (Sp, odd years) Prerequisites: PHY 204 or 102 and MAT 160 and 161.

PHY 304. Classical Mechanics 4 credits
An intermediate course in mechanics including vector calculus, conservation laws of mechanics, and dynamics of a particle and of a rigid body. Four hours of lecture/discussion and three hours of laboratory per week. (Required course fee) (Sp, odd years) Prerequisites: PHY 204 or 102 and MAT 160 and 161.
PHY 320. Thermodynamics 4 credits
An introduction to the basic concepts of thermodynamics, including temperature, thermal expansion, heat flow, calorimetry, the First and Second Laws of Thermodynamics, statistical mechanics and fundamental theories of phase transitions, topics on gas, vapor, combined power cycles, refrigeration cycles, gas mixtures, and gas-vapor mixtures. Engineering applications will be emphasized alongside theoretical fundamentals. (Sp, even years) Prerequisites: PHY 204, MAT 207.

PHY 380/480. Work-Oriented Experience 4 credits
A work-oriented experience in applied physics. This is to be planned in advance with a physics faculty member. It does not count toward a minor in physics. S/U graded.

PHY 396/496. Special Problems and Research 4 credits
Prerequisite: Approval of the divisional dean and consent of instructor. (Required course fee)

PHY 398. Independent Studies in Physics 1-4 credits
Prerequisites: Junior standing, approval of divisional dean and consent of the instructor.

PHY 450. Advanced Physics Lab 4 credits
In this advanced physics lab course, students design and complete a research project, discuss general physics topics and physics research, as well as attend seminars by physics and engineering professionals. Preparation for employment and professional skills development are emphasized. The course meets for 5 hours per week. (Required course fee.) (Fa) Prerequisites: PHY 301 and PHY 303.