PHYSICS

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www.mcla.edu/phys (http://www.mcla.edu/phys/)
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Physics Major

The Department of Physics offers a four-year program leading to a Bachelor of Arts or Science in physics. Students study basic physical laws of nature, apply these laws in the laboratory, and explore practical applications found in society. Opportunities are available for advanced study in electronics, optics, computational methods, and elementary particle physics. Upon graduation, students are prepared to enter graduate school in physics or related scientific and engineering fields or to enter directly into the scientific or technological community. An undergraduate degree in physics is an excellent foundation for graduate work in a host of other fields. Graduates are also well-prepared to pursue careers as high school physics teachers—a profession that offers strong job security and the opportunity to make a meaningful impact through science education.

Students graduating with a major in Physics will be able to:

- Understand the basic principles in the various fields of physics.
- Make connections between various fields of physics.
- Solve problems using mathematical and physical reasoning.
- Use modern computational methods to analyze and present data.
- Design and conduct experiments to evaluate ideas and verify theories.
- Evaluate the validity of experimental evidence.
- Effectively communicate information gained by written and oral means.

Physics Programs

- Physics Minor (PHYS) (https://catalog.mcla.edu/undergraduate/academic-programs-study/physics/physics-minor/)
- Physics, B.A. (PHYS) (https://catalog.mcla.edu/undergraduate/academic-programs-study/physics/physics-ba/)
- Physics, B.S. (PHYS) (https://catalog.mcla.edu/undergraduate/academic-programs-study/physics/physics-bs/)

Physics Courses

PHYS 120 Introduction to Engineering **4 cr**
Introduces students to basic scientific methodology, current problems and fundamental principles of engineering design. Intended for nonscience majors and potential engineering students. Required laboratory introduces fundamental science and engineering principles through collaborative projects such as robotics.
Corequisite: PHYS 120L
Attributes: Core Science & Tech w/lab (CSTL)

PHYS 131 General Physics I **4 cr**
This is the first of a two-semester sequence, designed primarily for students in the biological and health sciences and others who desire a rigorous but non-calculus-based course that presents a complete introduction to physics. Covers vectors, one and two dimensional motion, Newton's laws, and rotational motion, conservation of energy and momentum, gravitation, wave motion, sound, heat and thermodynamics.
Corequisite: PHYS 131L
Attributes: Core Science & Tech w/lab (CSTL)

PHYS 132 General Physics II **4 cr**
This is the second of a two-semester sequence, designed primarily for students in the biological and health sciences and others who desire a rigorous but non-calculus-based course that presents a complete introduction to physics. Covers geometrical optics, electricity and magnetism, electronics, modern physics, relativity.
Prerequisite: PHYS 131
Corequisite: PHYS 132L
Attributes: Core Science & Tech w/lab (CSTL)

PHYS 140 Astronomy **3 cr**
Looks at historical and modern aspects of astronomy. Topics covered will include: the Earth-Moon system, our solar system, galaxies, the observable universe, as well as current research in astronomy, including quasars, pulsars, black holes, other planetary systems and the search for extraterrestrial life.
Attributes: Core Science & Tech w/o lab (CST)

PHYS 151 Introduction to Mechanics **4 cr**
First course in a three-course introductory physics sequence which utilizes a calculus-based approach to study the natural world. This course focuses on kinematics, dynamics, conservation of energy and momentum, and rotational motion.
Prerequisite: MATH 150 or MATH 220 or concurrent enrollment in MATH 220
Corequisite: PHYS 151L
Attributes: Core Science & Tech w/lab (CSTL)

PHYS 153 Introduction to Thermodynamics, Waves, and Optics **4 cr**
Second course in a three-course introductory physics sequence which utilizes a calculus-based approach to study the natural world. The course focuses on thermodynamics, waves, and optics. Required Laboratory.
Prerequisite: MATH 220, PHYS 151
Corequisite: MATH 320, PHYS 153L

PHYS 200 Seminar for Physics Majors **1 cr**
Explores the discipline of physics in order to support majors in their academic work and help them understand their career options. Explores the diversity of fields within physics through presentations, reading and writing activities and interactions with peers and mentors. This seminar is required for all MCLA physics majors.

PHYS 251 Introduction to Electricity & Magnetism **4 cr**
Third course in a three-course introductory physics sequence which utilizes a calculus-based approach to study the natural world. This course focuses on electricity and magnetism, including Maxwell's Laws. Required Laboratory.
Prerequisite: PHYS 151, MATH 220
Corequisite: PHYS 251L, MATH 320

PHYS 301 Classical Mechanics **3 cr**
Studies particle motion in two- and three-dimensions, systems of particles, rigid bodies, moving coordinates systems, and Lagrange's equations.
Prerequisite: MATH 330, PHYS 251

PHYS 303 Electricity and Magnetism **3 cr**
Studies electrostatics, magnetostatics, electrodynamics, Maxwell's equations and its applications. Applications include electromagnetic properties of matter, wave propagation, radiating systems and special relativity.
Prerequisite: PHYS 251, MATH 330

PHYS 305 Electronics **3 cr**
Provides experience in building and analyzing analog and digital circuits and becoming familiar with the standard electronics lab equipment, such as oscilloscopes, power supplies, function generators, and multimeters. Students will build circuit containing resistors, capacitors, inductors, transistors, and logic gates and analyze these circuits, which entails calculating the theoretical output (voltage, current, signal shape) and comparing these predictions to the experimental output.
Prerequisite: PHYS 351

PHYS 351 Modern Physics **4 cr**
Studies the discovery of various physical phenomena which led to the development of quantum mechanics and introductory quantum mechanics.
Prerequisite: PHYS 251
Corequisite: PHYS 351L

PHYS 361 Mathematical Methods of Physics **4 cr**
Explores the foundational mathematical methods essential for solving physical problems. The course introduces students to a diverse array of mathematical tools and techniques necessary for problem-solving and modeling in the physical sciences. Topics covered include vector calculus, linear algebra, Fourier analysis, and differential equations. Required Laboratory.
Prerequisite: MATH 320
Corequisite: PHYS 361L

PHYS 371 Computational Methods of Physics **4 cr**
Introduces students to the fundamental principles, techniques, and tools of computational physics using the python programming language. In the modern era, computational methods are indispensable for modeling, simulating, and analyzing complex physical systems that are often beyond the reach of analytical solutions. Topics include programming, data visualization and interpretation, numerical integration and differentiation, ordinary and partial differential equations.
Prerequisite: MATH 320
Corequisite: PHYS 371L

PHYS 401 Advanced Physics Laboratory I **3 cr**
Studies laboratory techniques to supplement senior physics courses or work on special projects with departmental approval. Use of current computer technology is integral.
Prerequisite: PHYS 251

PHYS 402 Advanced Physics Laboratory II **3 cr**
Continues Physics 401. Use of current computer technology is integral.
Prerequisite: Grade of C or better in PHYS 401

PHYS 403 Introduction to Particle Physics **3 cr**
Introduces the concepts necessary to understand the structure of matter at the most fundamental level. Considers matter in terms of its most elementary constituents, and discusses the properties, classifications, and forces which act on these particles. Discusses the relationship between conservation laws and symmetries. The experimental study of elementary particles is discussed throughout the course. Concludes with a discussion of outstanding questions in the field.
Prerequisite: PHYS 351

PHYS 405 Optics **3 cr**
Studies the principles of physical optics. Topics include reflection, refraction, interference, diffraction, polarization, and Fresnel's equations for transmittance and reflectance at plane dielectric interfaces. Additional topics will include optical instruments and modern applications of optics.
Prerequisite: PHYS 351

PHYS 460 Statistical Thermodynamics **3 cr**
Studies statistical techniques applied to physical phenomena. Topics include kinetic theory of gasses, classical thermodynamics and quantum statistical physics.
Prerequisite: PHYS 251

PHYS 471 Quantum Mechanics **3 cr**
Studies inadequacies of classical mechanics and explores ways of describing nature at the atomic level. Topics include the Schrödinger equation and its solutions for various simple systems, expectation values, operator formalism and matrix representation.
Prerequisite: PHYS 351

PHYS 499 Teaching Assistantship in Physics **1-3 cr**
Provides the opportunity for a student to assist in the preparation and/or implementation of a physics course.
Prerequisite: Department approval
Repeatable: Maximum of 6 credits

PHYS 500 Directed Independent Study **1-3 cr**
Open to juniors and seniors who wish to read in a given area or to study a topic in depth. Written reports and frequent conferences with the advisor are required.
Prerequisite: Junior status, department approval
Repeatable: Maximum of 12 credits

PHYS 510 Independent Research **1-3 cr**
Participation in research in physics under the direction of a member of the physics faculty in a specific area.
Prerequisite: Department approval
Repeatable: Maximum of 12 credits

PHYS 540 Physics Internship **3-15 cr**
Offers the upper-level physics major an opportunity to practice physics in an appropriate professional situation. The student will work with a faculty sponsor and an off-campus supervisor in gaining experience significant to the major.
Prerequisite: Junior status, department approval
Repeatable: Maximum of 15 credits

PHYS 580 Special Topics in Physics **1-4 cr**
Studies concepts, problems, issues, topics or themes that are important in the field of physics. Special topic seminars may explore a variety of topics including but not limited to: physics for educators, solid state physics, robotics and engineering applications. Lab may be required depending on topic.
Prerequisite: Department approval
Repeatable: Unlimited Credits

PHYSICS: TEACHER LICENSURE

Students majoring in physics may opt to pursue initial teacher licensure as an early childhood teacher or elementary teacher. Also, physics majors may pursue initial licensure as a teacher of physics for the middle school or secondary levels. Students seeking any of these licenses must complete a physics major, and a licensure program in education.