

# PHYSICS

Science Building, Room 110  
201-200-3448

The Physics Department (<https://www.njcu.edu/academics/schools-colleges/william-j-maxwell-college-arts-sciences/departments/physics/>) offers a comprehensive education that links theoretical concepts and hands-on activities to real-world applications. We are preparing the next generation of innovators for careers in physics, engineering or science education, as well as for graduate study in the discipline.

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Various discipline-specific concentrations that will prepare students for multiple fields of employment or areas of additional undergraduate/graduate study are noted below. Course requirements for each concentration are explained in detail. The requirements for graduation, in addition to completion of the major area, are listed on "Undergraduate Degree Requirements (<https://catalog.njcu.edu/undergraduate/undergraduate-degree-requirements/>)."

- Applied Physics, B.A.
- Applied Physics, B.S.
- Applied Physics—Physical Science Teacher Certification Secondary Education (K-12), B.A.
- Applied Physics—Pre-Engineering (Two-Year Program for Transfer to an Engineering B.S. program)
- Applied Physics, B.S. (NJCU) and Civil Engineering, B.S. (NJIT), Dual Degree (3 + 2) Program (<https://catalog.njcu.edu/undergraduate/arts-sciences/physics/applied-physics-civil-engineering-dual/>)
- Applied Physics, B.S. (NJCU) and Electrical Engineering, B.S. (NJIT), Dual Degree (3 + 2) Program
- Applied Physics, B.S. (NJCU) and Mechanical Engineering, B.S. (NJIT), Dual Degree (3 + 2) Program (<https://catalog.njcu.edu/undergraduate/arts-sciences/physics/applied-physics-mechanical-engineering-dual/>)
- Applied Physics, Minor
- Astronomy, Minor

## Physics (PHYS)

**PHYS 1XX Physics Transfer Credit (0 Credits)**

**PHYS 2XX Physics Transfer Credit (0 Credits)**

**PHYS 100 Preparation for Physics (3 Credits)**

Measurement, trigonometry, vectors, problem solving, graphing and basic physical concepts are discussed. This lecture course is required before taking PHYS 130 or PHYS 140. Credits are not included as part of major or minor.

**Pre-Requisite:** or Co-Requisite: MATH 175

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**PHYS 101 Basic Concepts of Physics (3 Credits)**

This is a one-semester course, which gives an overview of the basic principles of physics including mechanics, heat, electricity and magnetism, light and sound, and modern physics.

**PHYS 103 Physical Principles of Telecommunications (3 Credits)**

This course explores the integration of the basic physical principles and their applications to the dynamic field of telecommunications. It gives an understanding of the contemporary explosion in communications technologies—computers, satellites, tape, disk, fiber optics and new radio and telephone services. The central role of the computer is examined.

**PHYS 104 The Science of Telecommunications (3 Credits)**

This course explores how the scientific method is used to understand the principles that make telecommunications possible. It also studies the technology developed to create networks. The class provides a basis for understanding the contemporary explosion in communication technologies computers, fiber optics networks and cellular telephone services.

**PHYS 107 Physics of Art and Media (3 Credits)**

The course is designed especially for students who have an interest in art, music, and media. Its purpose is to establish connections and relationships between human esthetic expression and experience in these endeavors, and the existing important underlying physical bases. Scientific inquiry and demonstrations are used to explore color, sound, light, the ear, the eye, the role of symmetry and chaos, and electromagnetic communications, along with the interaction between technology and society.

**PHYS 108 The Physics of Sports (3 Credits)**

This course is a one-semester conceptual physics and biomechanical course, examining general principles of physics in the context of sporting events and activities. Students will learn fundamental principles of classical mechanics and fluid dynamics. At the conclusion of the course, students will demonstrate their understanding of the course material in a final project based on a sports physics topic of their choosing at the end of the semester. The final project will consist of a research paper and an oral presentation.

**PHYS 111 Introduction to Energy and the Environment (3 Credits)**

This is a thematic course that focuses on human activities such as the exploitation of energy resources, energy conversion methods, and energy utilization and their impact on the global environment. The Kyoto protocol, together with possible solutions to crucial worldwide problems, and methods of abatement will be studied using a case study approach. Alternative sources of clean, safe sustainable sources of energy and improved methods of energy conversion will be investigated.

**PHYS 113 Introduction to Astronomy (3 Credits)**

Early astronomical thought and the role of astronomy in the development of modern science are introduced in this course. This involves a study of motion within the Solar System along with the classification, structure, and types of stars. An introduction to stellar evolution and cosmology is also included.

**PHYS 114 Why Things Move: Thinking Science through Motion (3 Credits)**

This course introduces students to basic scientific reasoning. Starting out from real-life situations, experiments and demonstrations, students collect and analyze data to deduce general physical principles. Starting with common sense observations, they develop methods to build scientific theories to describe nature.

**PHYS 130 College Physics I (Lecture) (3 Credits)**

Fundamental concepts and laws of mechanics, including statics, dynamics, energy-momentum conservation, and gravitation are examined in this course. Additional areas of study include behavior of fluids, vibrations, and wave motion. Instruction includes four hours of lecture, demonstration, discussion, and problem solving per week.

**Pre-Requisite(s):** MATH 175 Enhanced Precalculus or MATH 165 Pre Calculus and Co-Requisite(s): PHYS 1130 Physics I Recitation & Laboratory

**Co-Requisite(s):** PHYS 1130 Physics I Recitation & Laboratory

**PHYS 131 Physics II (Lecture) (3 Credits)**

The students are shown that physics, as the most fundamental of all sciences, is a highly creative and satisfying activity which has made major contributions to our culture affecting every aspect of our lives, including our thought about the nature and origin of the Universe. Fundamental concepts and laws of thermodynamics, wave mechanics, and electricity and magnetism are examined in this course. Instruction includes 4 hours of lecture, demonstration/discussion and problem solving, and 3 hours of laboratory work per week. To accommodate student schedules, the lecture and laboratory/recitation sections are offered as two different courses, each a co-requisite of the other.

**Pre-requisite:** PHYS 130 College Physics I Lecture Co-requisite: PHYS 1131 College Physics I Recitation & Laboratory

**Co-requisite:** PHYS 1131 College Physics I Recitation & Laboratory

**PHYS 140 Principles of Physics I - Lecture (3 Credits)**

This course develops the concepts and laws of mechanics, especially conservation laws, and includes scalar and vector quantities: rectilinear and circular motion; equilibrium; work energy and momentum; elements of fluid statics and dynamics; heat and thermodynamics. Instruction includes 4 hours of lecture, demonstration/discussion and problem solving per week with emphasis on applications.

**Co-requisite:** MATH 192 Calculus and Analytic Geometry I AND PHYS 1140 Principles of Physics I - Laboratory and recitation

**PHYS 141 Principles of Physics II - Lecture (3 Credits)**

This course is a continuation of Physics 140 and develops a conceptual, quantitative and applied understanding of electric field and electrostatics; DC circuits; magnetic fields and properties of matter; AC circuits electromagnetic waves; geometric and wave optics. Instruction includes 4 hours lecture, demonstration/discussion and problem solving per week with emphasis on applications.

**Pre-requisite:** PHYS 140 Physics for Engineering I Lecture, Co-requisite PHYS 1141 Principles of Physics II - Laboratory and Recitation

**PHYS 204 Digital Electronics and Applications (3 Credits)**

This course deals with logical design and optimization of digital computers devices. It offers an introduction to number systems, Boolean algebra and machine language. The course explores electronics and solid-state components- gates, flip-flops, shift registers, counters- arithmetic circuits, memory and the 8085 microprocessor.

**PHYS 226 Experimental Astronomy (2 Credits)**

This course focuses on basic research and field experiences in astronomy.

**Pre-requisite:** GEOS 113 Introduction to Astronomy

**PHYS 230 Physics III (Lecture) (3 Credits)**

Electromagnetic waves – theory, production, propagation, and detection; applied optical techniques; modern physics, relativity and its implications; the Bohr atom; elements of atomic and nuclear structure; radiation and its measurement – are examined. Instruction includes 4 hours of lecture, demonstration/ discussion and problem solving per week with emphasis on applications.

**Pre-Requisite(s):** PHYS 141 Physics for Engineering II Lecture or PHYS 131 College Physics II Lecture

**PHYS 240 Digital Techniques and Applications (3 Credits)**

This course deals with logical design and optimization of digital computers and digital devices. Introduction to number systems, codes and Boolean algebra. Electronics and solid state components-gates, flip flops, shift registers, docks, counters, adders, and other arithmetic circuits, and memory devices are explored. Experiments include design of logic circuits, using discrete and integrated circuit components.

**PHYS 241 Microprocessors (3 Credits)**

This course is a sequel to the Digital Techniques and Applications course (PHYS 240). The purpose of this course is to use the fundamental principles of digital circuits from PHYS 240 to understand the basic principles of the microprocessor. This course will cover the basic design and applications of the microprocessor.

**PHYS 260 Observational Astronomy (3 Credits)**

This course teaches students how to use high quality amateur telescopes including optics, the use of setting circles, mounting, and astrophotography. Celestial coordinate systems (equatorial) are also taught.

**Pre-Requisite(s):** PHYS 113 Intro To Astronomy

**PHYS 270 Statics and Dynamics (4 Credits)**

Classification and systems of forces, their resultants, geometric and analytical conditions for equilibrium, frames, trusses, moments of inertia, rotation of a rigid body, principles of work, energy and impulse and momentum are studied in this course. Instruction includes 4 hours of lecture, demonstration/discussion and problem solving per week with emphasis on computer simulations and applications.

**Pre-requisites:** PHYS 141 Physics for Engineering II Lecture or PHYS 131 College Physics II Lecture and MATH 192 Calculus and Analytical Geometry I

**PHYS 271 Statics and Dynamics II (2 Credits)**

The kinetics of rigid bodies detailing the effects of forces, work, energy, impulse and momentum, including mechanical vibrations are explored, in this course. Instruction includes 2 hours of lecture, demonstration/ discussion and problem solving per week with emphasis on computer simulations and applications.

**Pre-Requisite(s):** PHYS 270 Statics and Dynamics I

**PHYS 290 Computational Techniques for the Natural Sciences (4 Credits)**

This course reviews areas of mathematics that are regularly used in the natural sciences, including important areas from complex variables, Fourier analysis and partial differential equations. A current standard symbolic manipulation program will be introduced and its appropriate use in theoretical analyses as well as in data manipulation will be taught.

**Pre-Requisite(s):** PHYS 230 and MATH 292 or Permission from the Instructor

**PHYS 301 Thermodynamics and Kinetic Theory (3 Credits)**

The operational definitions of heat, internal energy, entropy, absolute temperature are developed along with the theory of specific heats. Thermodynamics functions and relations are applied to heat engines and other physical systems and the kinetic theory of gases, viscosity, and conductivity are included.

**Pre-Requisite(s):** PHYS 141 Physics for Engineering II Lecture or PHYS 131 College Physics II Lecture

**PHYS 307 Principles of Electronics Lecture (3 Credits)**

Circuit theory, techniques of electrical measurements, principles and operation of solid devices, such as junction diodes, bipolar transistors, FET's and MOSFET's, rectification and filtering, feedback, amplifiers, nonlinear circuits are examined. The Course provides an understanding of the electronics applied to various fields. Instruction includes 4 hours of lecture, demonstration/discussion and problem solving per week with emphasis on application.

**Pre-Requisite(s):** PHYS 141 Physics for Engineering II Lecture or PHYS 131 College Physics II Lecture

**PHYS 310 Virtual Instrumentation for Scientists and Engineers (3 Credits)**

This course covers the basics principles of virtual instrumentation including use of IEEE GPIB, RS232 interfaces, and data acquisition boards. It is an introduction to the use of computer interfacing for data collection and instrument manipulation in laboratory experiments using state-of-the-art software such as LabVIEWTM.

**Pre-Requisite(s):** PHYS 230 or Permission of the Instructor.

**PHYS 321 Theory and Applications of Electricity and Magnetism (3 Credits)**

This course examines electrostatic fields in vacuum and material media, magneto-statics fields, electromagnetic induction, magnetic fields in matter, Maxwell's equations, propagation of electromagnetic waves, in free space and matter, reflection, and radiation, guided waves.

**Pre-Requisite(s):** PHYS 141 Physics for Engineering II Lecture or PHYS 131 College Physics II Lecture

**Co-Requisite(s):** MATH 311 Differential Equations for Engineers

**PHYS 330 Physics Seminar I (2 Credits)**

This course provides students with the opportunity to present the results of original research appropriate to a junior student and to attend talks given by professionals in physics related fields. The students will learn how to communicate with colleagues and the general public.

**Pre-Requisite(s):** PHYS 230, PHYS 321, Permission of the Instructor, and Junior Status

**PHYS 401 Principles and Application of Modern Optics (3 Credits)**

Four different areas of optics are studied in this course: wave optics (polarization, diffraction, and interference), geometric optics (lenses, mirrors, and optical instruments), and quantum, and coherent optics (lasers and fiber optics). Instruction includes four hours of lecture, demonstration, discussion, and problem-solving per week with emphasis on applications.

**Pre-Requisite(s):** PHYS 230 Physics III Lecture

**PHYS 404 Nuclear Radiation: Theory and Applications (3 Credits)**

This course considers the discovery and nature of radioactivity, nuclear decay process, determination of half-life, interaction with various forms of matter, instrumentation and detection principles, radioactive dating and tracing procedures, sources of environmental exposure, and effects on the human body and materials.

**Pre-Requisite(s):** PHYS 230 Physics III Lecture

**PHYS 405 Introduction to Quantum Mechanics (3 Credits)**

This course is designed to give upper level physics students a basic understanding of quantum physics, including black body radiation, the photoelectric effect, the uncertainty principle, one-dimensional Schroedinger equation, the quantum mechanical oscillator, the hydrogen atom, and other selected topics. Discussion of theory and applications, including problems and demonstrations, are conducted.

**Pre-Requisite(s):** PHYS 230 Physics III Lecture and MATH 311 Differential Equations for Engineers

**PHYS 410 Classical Mechanics (4 Credits)**

This course covers the theoretical foundations of Newtonian mechanics of particles and systems. It includes various mathematical tools of theoretical physics to understand Lagrange's and Hamilton's approaches to the study of mechanical systems. Topics covered include the theory of small oscillations and mechanical waves, rigid bodies, stability, linearization methods, forced vibrators and perturbation theory, fluids and mechanics of continuous media.

**Pre-Requisite(s):** PHYS 230 and MATH 311

**PHYS 420 Physics in Medicine (3 Credits)**

This course is designed for students who wish to pursue a career in health professions or who have an interest in applied physics problems. A variety of applied physics techniques in medicine are covered including, medical imaging, (X-ray,CAT scans, MRI, PET, and ultrasound imaging), fiber optics, medical lasers, nuclear medicine, and other applications.

**Pre-Requisite(s):** PHYS 230 Physics III Lecture

**PHYS 430 Physics Seminar II (2 Credits)**

A capstone course where students present in oral and written form the results of original advanced or literature research of special topics conducted in the last year of the program. Students should provide evidence that they can perform at a level required by industry standards or graduate programs.

**Pre-Requisite(s):** PHYS 330, Permission of the Instructor, and Senior Status.

**PHYS 448 Stellar Astronomy (3 Credits)**

This course presents an introduction to the physical characteristics, structure and evolution of the stars, nuclear processes, and the formation of elements in the stellar interiors. Stellar remnants such as white dwarfs, neutron stars and black holes are also discussed.

**Pre-Requisite(s):** PHYS 113

**PHYS 449 Solar System Astronomy (3 Credits)**

This course covers the physical characteristics of the Sun and the planets. Newton's and Kepler's Laws, orbital theory applied to planetary systems. This course discusses the information and evolution of terrestrial and Jovian planets. This course also investigates and compares the atmospheres and interiors of planets. Minor bodies such as dwarf planets, moons, asteroids, comets and meteorites are discussed.

**Pre-Requisite(s):** PHYS 113 Introduction To Astronomy

**PHYS 480 Physics Research (3 Credits)**

This is a course individually designed to provide undergraduate students with training in Physics research. A project is undertaken under the guidance and supervision of a faculty member. Written reports and a final paper are required.

**Pre-Requisite(s):** Permission of Instructor, Approval from the Chair, and Junior or Senior Status

**PHYS 1130 Physics I Recitation & Laboratory (1 Credit)**

Correlated student laboratory experiments for most areas cited in Physics 130 College Physics I (Lecture) are presented in this course. Instruction includes structured and open-ended lab experiments with recitation.

**Pre/Co-Requisite(s):** MATH 175 Enhanced Pre Calculus or MATH 165 Pre Calculus and PHYS 130 Physics I Lecture

**PHYS 1131 Physics II Recitation & Laboratory (1 Credit)**

Correlated student laboratory experiments for most areas cited in Physics 131 are presented in this course. Instruction includes structured and open-ended lab. Experiments with recitation are performed to verify or discover the principles of physics. Co-requisite: PHYS 131 College Physics II, Lecture.

**Co-Requisite(s):** PHYS 131 Physics II Lecture

**PHYS 1140 Principles of Physics I - Laboratory and recitation (1 Credit)**

Correlated student laboratory experiments for most areas cited in PHYS 140 are performed to verify or discover the principles of physics. Instruction includes structured and open-ended laboratory experiments with recitation.

**Co-Requisite(s):** PHYS 140 Principles of Physics I - Lecture

**PHYS 1141 Principles of Physics II - Laboratory and Recitation (1 Credit)**

Correlated student laboratory experiments for most areas cited in PHYS 141 are performed to verify or discover the principles of physics. Instruction includes structured and open-ended laboratory experiments with recitation.

**Co-Requisite(s):** PHYS 141 Principles of Physics II - Lecture

**PHYS 1230 Physics III Recitation & Laboratory (1 Credit)**

Correlated student laboratory experiments for most areas cited in Physics 230 are performed to verify or discover the principles of physics. Instruction includes structured and open-ended lab. Experiments with recitation.

**Co-requisites:** PHYS 131 Physics II (Lecture) or PHYS 141 Principles of Physics II - Lecture Co-requisite: PHYS 230 Physics III Lecture

**PHYS 1307 Principles of Electronics, Recitation (1 Credit)**

Correlated student laboratory experiments for most areas cited in PHYS 307 are performed to verify or discover the principles of physics. Instruction includes structured and open-ended laboratory experiments with recitation. Computer software packages to simulate and analyze complex circuits are used.

**Pre-Requisite(s):** PHYS 307 Principles of Electronics Lecture

**PHYS 1401 Optics Recitation/Laboratory (1 Credit)**

Correlated student laboratory experiments for most areas cited in PHYS 401 are performed in this course. Introduction includes structured and open-ended laboratory experiments with recitation to verify or discover the principles of optics. Students use computer software packages to simulate and analyze complex optical systems.

**Pre-Requisite(s):** PHYS 230 Physics III Lecture

**Co-Requisite(s):** MATH 311 Differential Equations for Engineers and PHYS 401