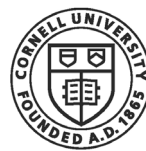


# Undergraduate Physics Major Core Requirements



The Department of  
**Physics**

- All physics majors must complete the Core requirements, as well as a Concentration
- Substitutions of Core classes are not allowed

## INTRODUCTORY SEQUENCE

### MECHANICS I: **PHYS 1116 (honors) or 1112** Offered: **FA SP**

Students with strong high school preparation (AP Calculus BC and physics) intending to major in physics are encouraged to take 1116. **PHYS 1116 is more mathematically rigorous than PHYS 1112 and includes special relativity. Students who do not take PHYS 1116 must complete PHYS 2216: Introduction to Special Relativity (1 cr)**

**Prereqs:**  
Calculus II or AP  
Calc. BC credit

### ELECTRICITY & MAGNETISM I: **PHYS 2217 (honors) or 2213** Offered: **FA SP**

Electrostatics, magnetic fields, circuits, magnetic fields, Maxwell's equations, and electromagnetic waves. PHYS 2217 employs more advanced vector calculus. Students transferring in from biological sciences may substitute PHYS 2207 and 2208, with permission.

**Prereqs:**  
PHYS 1112 or 1116  
Vector Calculus

### WAVES: **PHYS 2218 (honors) or 2214** Offered: **FA SP**

Waves and oscillations, resonance, sound waves, electromagnetic waves and polarization, and optics. PHYS 2218 also covers thermodynamics and statistical mechanics. Prior exposure to differential equations (e.g. MATH 2930) strongly recommended.

**Prereqs:**  
PHYS 2213 or 2217  
Diff. Eqs  
recommended

## QUANTUM MECHANICS SEQUENCE

### **PHYS 3316** Offered: **FA SP**

#### **BASICS OF QUANTUM MECHANICS**

Breakdown of classical physics : photoelectric effect, atomic spectra. Schrodinger equation and solutions for the square well, harmonic oscillator, and hydrogen atom. Scattering in 1 dimension and two-level systems.

**Prereqs:**  
Intro sequence  
Diff. Eqs

**Coreqs:**  
Linear Algebra

### **PHYS 3317** Offered: **FA**

#### **APPLICATIONS OF QUANTUM MECHANICS**

Multi-electron atoms (many-body wave functions, quantum statistics), molecules and chemical bonding, concepts in solid-state physics, quantum numbers and symmetries, addition of angular momentum, variational principle, basics of high-energy physics.

**Prereqs:**  
PHYS 3316  
Linear Algebra

## INTERMEDIATE MECHANICS & ELECTRICITY AND MAGNETISM

### **PHYS 3314 or 3318** Offered: **SP**

#### **INTERMEDIATE CLASSICAL MECHANICS**

Follow up to PHYS 1112/1116 covering Lagrangian and Hamiltonian formulations of mechanics, conservation laws from symmetries, planetary motion, motion in non-inertial reference frames, rigid body motion. PHYS 3318 is more advanced than 3314.

**Prereqs:**  
Intro sequence  
Linear Algebra

### **PHYS 3323 or 3327** Offered: **FA**

#### **INTERMEDIATE ELECTRICITY AND MAGNETISM**

Follow up to PHYS 2213/2217 covering vector and scalar potentials, solutions to Laplace's equation, boundary value problems, wave guides, and relativistic electrodynamics. PHYS 3327 is more advanced than 3323.

**Prereqs:**  
Intro sequence  
Diff. Eqs

## One LABORATORY CLASS selected from:

**PHYS 3310** Intermediate Experimental Physics **SP**

**PHYS 3360** Electronic Circuits **FA SP**

**PHYS 3330** Modern Optics **FA**

**PHYS 4410\*** Advanced Experimental Lab **FA SP**

ASTRO 4410 (Experimental Astronomy), AEP 2640 (Interfacing Digital with Analog World), and BEE 4500 (Bioinstrumentation) may also be used for the Core lab  
\*PHYS 4410 is more advanced than other 3000-level labs; inside concentrators must also complete 4410 **in addition** to their Core lab class

## MATH REQUIREMENTS FOR THE CORE

Math requirements satisfied by **completion of 4 math classes** covering the following topics:

<b>INTEGRAL CALCULUS (CALC II)</b>	AP Calculus BC credit (4,5); MATH 1910, MATH 1120, MATH 1220	* math honors sequence, 2230 must be taken before 2240. Classes are more profs based and are intended for math majors
<b>VECTOR CALCULUS</b>	<b>MATH 1920</b> , MATH 2220, MATH 2240*	
<b>DIFFERENTIAL EQUATIONS</b>	<b>MATH 2930</b> , MATH 3230	
<b>LINEAR ALGEBRA</b>	<b>MATH 2940</b> , MATH 2210, MATH 2230*	

Classes in red are recommended options.

# Physics Major Concentration Requirements :



The Department of  
**Physics**

In addition to the Core, all physics majors must complete EITHER an Inside Concentration OR an Outside Concentration. The breakdown between Inside and Outside Concentrators is approximately 50/50.

## INSIDE CONCENTRATION

The Inside Concentration is comprised of additional physics and math classes at the 3000+ level, and is geared primarily towards students preparing for graduate school in physics or related disciplines. Inside Concentrators must complete PHYS 4410 and PHYS 4230 as well as 7 additional units of 3000+ level classes in the physics department. Inside Concentrators must also complete two additional math classes at the 3000+ level. Unlike the Outside Concentration, there is only one type of Inside Concentration; students do not need to declare a sub-field (e.g. solid-state physics or high-energy physics)

### Required Classes

**PHYS 4410** : Advanced Experimental Physics    Offered: **FA** **SP**  
**PHYS 4230** : Statistical Thermodynamics                    **FA**

**7 additional credits of 3000+ level physics classes.** Typical classes include:

Classes marked in red are recommended

**PHYS 4443** : Intermediate Quantum Mechanics                    **SP**  
**PHYS 4454** : Introduction to Solid State Physics                    **FA**  
**PHYS 4443** : Introduction to General Relativity                    **FA**  
**PHYS 4444** : Introduction to Particle Physics                    **SP**

- **ASTRO 3302**, **ASTRO 4431**, and **AEP 4340** may be also used towards the 11 additional credits of 3000+ level physics classes

**2 additional 3000+ level math classes**

Typical classes include:

**AEP 4210 & 4220** (Mathematical Physics I & II)  
**MATH 4420** : Complex Analysis  
**MATH 4200** : Diff. Equations & Dynamical Systems

- No more than 4 credits of S/U classes or Independent Study (**PHYS 4490**) may be used towards the inside concentration
- **PHYS 4484-4487** may not be used towards the inside concentration

## OUTSIDE CONCENTRATION

The Outside Concentration allows physics majors the flexibility to explore academic interests outside the Physics Department. Students are given the freedom to design, in conjunction with their Major Advisor, an Outside Concentration which reflects their own interests and future goals. An Outside Concentration can be interdisciplinary and need not be limited within a specific department or even College. There is no official distinction (i.e. student's transcript or diploma) between majors graduating with an Inside or Outside Concentration.

### Requirements

**15 credits in an internally coherent concentration outside of physics. At least 8 of the 15 credits must be for 3000+ level classes.**

- The outside concentration is designed in coordination with your major advisor, and classes must be agreed upon by your advisor
- No more than 4 credits of S/U classes or independent study may be used
- Classes from the physics department should not be used towards the outside concentration
- Classes used for your outside concentration cannot also be counted towards another major
- An outside concentration cannot be in a subfield of physics (e.g. atomic physics)
- Classes used for the outside concentration can span different departments or Colleges

**Recent Outside Concentrations Include** : Astronomy, Acoustics, Biological Sciences, Business, Chemistry, Computer Science, Economics, Education, Electrical Engineering, Geology, Law, Mathematics, Meteorology, Philosophy, Planetary Science, Public Policy, Sustainable Energy, Science Technology and Society, Science Writing.

**Future paths for Outside Concentrators have included**: Engineering; Medical school; Computer programming; Teaching; Graduate School in Astronomy, Astrophysics, Biophysics, Geophysics, Quantitative finance; Law school; Business school; Management consulting.