

Bachelor of Science with a Major in Physics

Science undergraduates may choose from two different majors within the Department of Physics: **Physics** and **Physics in Medicine**. The course sequences in these two programs are designed to accommodate the academic and professional interests of the majority of physics majors.

The basic physics major is a particularly flexible option for students, and is the one that will be chosen by the majority of undergraduates majoring in the Department. The schedule of physics courses is designed to allow the physics major the option of studying abroad for the Spring semester of the Junior year.

Students following the physics major program will gain a basic broad understanding of the concepts of physics. Depth is gained through the optional addition of one or more **concentration programs** offered through the department. Two of these concentration programs, **Advanced Physics** and **Astrophysics**, help to prepare the student for graduate work in physics, astronomy, or astrophysics. The **Applied Physics** concentration allows the student to combine the physics major with a sequence of courses in a particular engineering discipline. Completion of these concentrations is indicated on the student's final transcript.

Students with interests in other areas have time to explore second major, minor, or concentration options offered through departments in the Colleges of Science or Arts & Letters. Students with interests in alternative advanced Physics courses should discuss these with the Director of Undergraduate Studies.

While no supplemental concentration is *required* of **Physics** majors, interested students are allowed and encouraged to add as many concentrations as their schedules and interests allow. Students following the **Physics in Medicine** major are *not* allowed to add concentrations; the major program is already designed to accommodate the special interests of those students intending careers in medicine.

Physics as a Second Major is an option for students in the Colleges of Engineering, Arts & Letters, or Business.

The following pages describe the Physics (PHYS) degree program. The Physics in Medicine (PHIM) program is described in a separate handout.

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Science Requirements for the Core Physics Major (PHYS)

Total Science Credits: 60

Total Physics Credits: 41.5

Freshman

	Physics Courses	Other Science Courses
Fall	General Physics A-M/Lab PHYS 10411/11411 ¹ 4 credits	Intro Chemical Principles/ Lab CHEM 10171/11171 ² 4 credits
		Calculus I & Tutorial MATH 10550/12550 4 credits
Spring	General Physics C-M/Lab PHYS 20435/21435 4 credits	Biol Chemistry for Engineers CHEM 10122 ³ 3 credits
		Calculus II/ Tutorial MATH 10560/12560 ⁴ 4 credits

¹PHYS 10310 and 10320 may substitute for PHYS 10411 and 20435 respectively.

²CHEM 10181 may substitute for CHEM 10171.

³CHEM 10172 or 10182 (Organic Chemistry) may substitute for CHEM 10122.

⁴Honors Calculus I – IV (MATH 10850, 10860, 20850, 20860) may substitute for Calculus I through III.

⁵MATH 20750 may substitute for PHYS 20451.

⁶PHYS 40602, 50501 or 50701 may substitute for PHYS 30465.

Sophomore

Fall	General Physics B-M PHYS 10424 3 credits	Calculus III/ Tutorial MATH 20550/22550 3.5 credits
	Intro to Circuitry & Electronics PHYS 10430 1.5 credits	
	Math Methods in Phys I/Tutorial PHYS 20451/22451 ⁵ 3.5 credits	
	Sophomore Seminar PHYS 23411 1 credit	
Spring	Math Methods in Phys II/Tutorial PHYS 20452/22452 3.5 credits	
	Intermediate Mechanics PHYS 20454 3 credits	
	Modern Physics I PHYS 20464 3 credits	

Science Requirements

Not all science courses will count toward degree credit or science elective credit for science majors. The survey science courses offered as options for non-science majors for their University science requirement will not count as a science elective or toward the minimum science credit hour requirement.

All College of Science courses offered by a major program must be taken at the University of Notre Dame. If a student wants to take a course outside Notre Dame for credit toward the Notre Dame degree, prior approval of the dean's office must be obtained. This does not apply to the courses taken by a transfer student prior to attending Notre Dame.

Language Requirements

The College of Science requires language proficiency through intermediate level in one of the following languages: Arabic, Chinese, French, German, Greek, Irish, Italian, Japanese, Korean, Latin, Portuguese, Russian and Spanish. Students may complete the language requirement by either completing a course taught at intermediate level or by demonstrating proficiency through placement examination.

Study Abroad

The Spring semester of the Junior year is the preferred time for a semester abroad or for taking Literature and Fine Arts electives.

Junior

Fall	Thermal Physics PHYS 30461 3 credits
	Electricity & Magnetism PHYS 30471 3 credits
	Quantum Mechanics I PHYS 40453 3 credits

Senior

Fall	Topics in Modern Physics II ⁶ PHYS 30465 3 credits
	Modern Phys Lab I Lecture/Lab PHYS 40441/41441 3 credits

Honors Track in Physics

The goal of this honors track is to give our most talented students an exceptional background in Physics research. Participation in this program will increase their level of commitment and productivity while preparing them for successful postgraduate work.

Students who have identified their research advisor in the Physics Department and have already completed one semester of undergraduate research can apply in the Spring of their Sophomore year. Acceptance will be based on a research statement and transcript. At acceptance into the program a formal agreement will be set up between the student and the advisor.

For track requirements and additional information, see the Director of Undergraduate Studies and <http://physics.nd.edu/undergraduate-program/concentrations/>

Concentration Programs

Physics majors may add as many concentrations as their interests and schedules allow. Completion of these concentrations is indicated on the student's final transcript.

The Advanced Physics Concentration (APHY)

Requirements: 14 credits

Junior Seminar PHYS 33411 1 credit (Fall)	Electromagnetic Waves PHYS 30472 3 credits (Spring)
Senior Seminar PHYS 43411 1 credit (Fall)	Quantum Mechanics II PHYS 40454 3 credits (Spring)
Physics Elective ¹ 3 credits	Modern Physics Lab II Lecture/Lab PHYS 40442/41442 (Spring) or MATH/ACMS elective at 40000-level

¹Electives include:

PHYS 20420	Computational Methods in Physics (every other Spring)
PHYS 20481	Intro to Astronomy and Astrophysics (Fall)
PHYS 30432	Lasers and Modern Optics (every other Spring)
PHYS 30481	Modern Observational Techniques (every other Fall)
PHYS 40602	Particles and Cosmology (Spring)
PHYS 48480 ²	Undergraduate Research (Fall and Spring)
PHYS 50201	Advanced Astrophysics (Fall)
PHYS 50472	Relativity: Special and General (Spring)
PHYS 50501	Intro to Solid State Physics (Fall)
PHYS 50701	Intro to Nuclear Physics (Spring)
MATH 40480	Complex Variables (Spring)

²Research must be performed under the supervision of one advisor and taken for 3 credits distributed over at least two semesters. Research in other departments may be substituted with departmental permission. Physics electives cannot be double-counted with requirements for the Astrophysics Concentration.

The Astrophysics Concentration (ASTR)

Requirements: 14 credits

Junior Seminar PHYS 33411 1 credit (Fall)	Relativity: Special & General PHYS 50472 3 credits (Spring)
Intro Astronomy & Astrophysics PHYS 20481 3 credits (Fall)	
Mod Observational Techniques PHYS 30481 ¹ 3 credits (Fall)	
Senior Seminar PHYS 43411 1 credit (Fall)	
Advanced Astrophysics PHYS 50201 3 credits (Fall)	

¹PHYS 30481 is offered in the Fall of odd years.

The Applied Physics Concentration (PHAP)

Students complete at least 15 credits hours of courses in the College of Engineering, chosen with the aid of the Director of Undergraduate Studies. As shown in the examples below, the student is expected to complete a five-course sequence with two of the courses at the 20000 level and remaining three courses (9 credits) at the 30000/40000 level. At least six of these nine credit hours must be engineering credits. Three of the credit hours may come from a 30000/40000 level physics course appropriate in the selected course of study. Specific curricula can be generated to meet the student's particular interests.

Aeronautics Sequence (AME)

16 credits

Mechanics I AME 20221 3 credits (Fall)	Thermodynamics AME 20231 3 credits (Spring)
Fluid Mechanics AME 30331 3 credits (Fall)	Theory/Experimental Aerodynamics AME 30333 4 credits (Spring)
Gas Turbines & Propulsion AME 40431 3 credits (Fall)	Other sequences in AME such as design and energy are available.

Computer Science Sequence (CSE)

17 credits

Fundamentals of Computing I CSE 20211 4 credits (Fall)	Fundamentals of Computing II CSE 20212 4 credits (Spring)
Data Structures CSE 30331 3 credits (Fall)	
Computer Science Courses 30000 or 40000 level 6 credits	

Computer Engineering Sequence (CSE)

17 credits

Fundamentals of Computing I CSE 20211 4 credits (Fall)	Fundamentals of Computing II CSE 20212 4 credits (Spring)
Data Structures CSE 30331 3 credits (Fall)	Computer Engineering Elective 30000 or 40000 level 3 credits
Database Concepts CSE 30246 3 credits (Fall)	