PHYSICS MAJOR

Physicists study the properties and behavior of matter and energy in a wide variety of contexts, ranging from the sub-microscopic particles from which all ordinary matter is made (particle physics) to the behavior of the Universe as a whole (cosmology). Physics primarily is the science that deals with exploring the Rules of Nature. The fundamental understanding of nature that comes from the study of physics is central to all of the natural sciences, applied sciences and technology; and, thus, profoundly affects the life of every human along with their environment.

The Department of Physics of Saint Joseph's University offers students a comprehensive and flexible curriculum in the discipline of physics. The program offers several advisory tracks (**Materials Science and Nanotechnology, Astrophysics, Biophysics, Computational Physics and Engineering, Medical Physics, Physics Education**) which will allow students to specialize in variety of areas and prepare for a range of careers. The program begins with a core grouping of three introductory physics courses (freshman and sophomore years) in the foundations of classical Newtonian mechanics and Maxwellian electricity and magnetism, geometrical optics, thermodynamics and fluids along with a one-semester program in nonclassical (modern) physics: this course, based on developments in physics that occurred in the first quarter of the twentieth century, introduce students to quantum theory and special relativity. Each of the introductory physics courses is accompanied by a laboratory , which not only complements the didactic material but also trains the student in the methodology of doing experimental physics. During this time, students master the language of physics, i.e., mathematics. Students take three semesters of calculus, Differential Equations and Introduction to Linear Algebra. In addition, they are exposed to modern computational techniques in Numerical Analysis. These physics and mathematics courses provide the foundation to explore a vast array of upper division courses, including physics electives in particular areas of interest. The upper-level courses include the study of classical mechanics, statistical mechanics , electricity and magnetism, quantum mechanics, and experimental methods of physics. Elective topics include solid state physics, biophysics, nuclear and particle physics, computational physics, astrophysics, physics of fluids, quantum materials,network science, biophysics of the brain, chaos and complex systems and more.

The Department of Physics at Saint Joseph's University has developed a research-oriented culture for both its faculty and students. Undergraduates participate in research in three different ways. First, they may decide to take research for academic credit. Within the major, students take three physics electives and one or more of these may be used to perform scientific research under the guidance of our physics faculty. Second, students may opt to do research as a Summer Scholar. Saint Joseph's University is well known for its 10 week Summer Scholars Research Program. Historically, the Physics Department, through the generosity of its alumni, Dean and Provost, has been able to provide stipends for all physics students who have wanted to do summer research. Students selected to participate in the Summer Scholars Program not only receive a stipend but also are provided low-cost housing by the University. Lastly, students may opt to volunteer in a laboratory at SJU or elsewhere.

Learning Goals and Outcomes

Goal 1: The student will have a deep conceptual and working understanding of the laws of physical phenomena and pursue a mastery of the foundations of Physics.

> **Outcome 1.1:** Students will be able to interpret and analyze a variety of physical phenomena by applying a fundamental and working knowledge of Newtonian Mechanics, Electricity and Magnetism, Optics, Quantum Mechanics, and Statistical Thermodynamics.
>
> **Outcome 1.2:** The students will be able to solve problems in Newtonian Mechanics, Electricity and Magnetism, Optics, Quantum Mechanics and Statistical Thermodynamics

Goal 2: The student will be able to analyze phenomena quantitatively, be able to build scientific models, and use the scientific method to test those models theoretically and experimentally.

> **Outcome 2:** Students will be able to develop models of physical phenomena by applying experimental, computational, theoretical, and critical reasoning skills.

Goal 3: Student will be able to conduct scientific research in physics and understand the central themes of physical thought as they apply to other areas of natural and applied sciences, technology, and engineering.

> **Outcome 3:** Students will be able to describe, explain, and/or perform and present research activities by applying what they have learned in interdisciplinary activities and education, to various areas of sciences, technology and engineering.

Requirements

Cornerstone Core Curriculum Requirements

Consist of 14 core and 2 overlay requirements. See below for additional detailed information on each of these requirements.

Code	Title	Hours
First Year Course Requirements		
ENG 101	Craft of Language	3
World History Course Area		3
Philosophy Requirements		
Either Level One or Level Two (but not both) -- must be Ethics designated. If approved, philosophy courses may count for a student's Writing Intensive overlay. Students may not double-count the same course as Philosophy Level Two and as a Mission Overlay course.		
Philosophy Level One		3
Philosophy Level Two		3
Theology & Religious Studies Requirements		
If approved, Theology & Religious Studies courses may count for a student's Writing Intensive overlay. Students may not double-count the same course as CCC Theology and as a Mission Overlay course.		
Theology		3
Religious Studies		3
Diversity & INT 151 Requirements		

A student's Diversity course may not count for any other CCC course area requirement or as their Mission Overlay course. If approved, Diversity courses may count for a student's Writing Intensive Overlay requirement. INT 151 may not count for any other CCC requirements. This course must be taken in the first two years		
Diversity		3
INT 151	Inequality in American Society	1
Math & Natural Science Requirements		
If approved, Math & Natural Science Requirements may count toward overlay requirements.		
Mathematics		3-4
Natural Science		4
Social Science Requirement		**3**
If approved, such Social Science Requirement may count toward a student's overlay requirements.		
Non-Native Language Requirement		**3-4**
A single Non-Native Language course may not count as an overlay course but a second language course fulfills a student's Mission Overlay requirement.		
Literature Requirement		**3**
If approved, Literature courses may count toward a student's overlay requirements.		
Fine and Performing Arts, Creativity, and Design Requirement		**3**
If approved, Fine and Performing Arts, Creativity, and Design courses may count toward a student's overlay requirements.		
Overlay Requirements		
Writing-Intensive		3
If approved, Writing-Intensive courses may double count as major courses, minor courses, electives, or as any CCC course area requirement except for the first-year courses (World History and Rhetoric and Composition).		
Mission-Overlay		3
Mission Overlay courses may double count as major courses, minor courses, elective courses, or any of the following CCC course areas: Fine and Performing Arts, Creativity, and Design, Literature, Mathematics, Natural Science, or Social Science.		
Total Hours		**47-49**

Recommended CCC Courses

Code	Title	Hours
Mission-Overlay		
Second Semester of Non-Native Language		

Major Requirements

Code	Title	Hours
MAT 161	Calculus I (will count for CCC: Mathematics)	4
MAT 162	Calculus II	4
MAT 213	Calculus III	4
MAT 226	Introduction to Linear Algebra	3
MAT 238	Differential Equations	3
MAT 311	Numerical Analysis	3
PHY 105	University Physics I (will count for CCC: Natural Science)	3
PHY 105L	University Physics Lab I (will count for CCC: Natural Science)	1
PHY 106	University Physics II	3
PHY 106L	University Physics Lab II	1
PHY 213	Physics III	3
PHY 213L	Intro. Physics III Laboratory	1
PHY 251	Modern Physics I	3
PHY 301	Classical Mechanics	3
PHY 307	Electricity and Magnetism	3
PHY 308	Waves and Optics	3
PHY 312	Experimental Methods in Phy II	3
PHY 380	Engineering Circuit Analysis	3
PHY 380L	Engineer Circuit Analysis Lab	1
PHY 321	Quantum Mechanics I	3
PHY 409	Statistical Mechanics	3
CHM 120	General Chemistry I	3
CHM 120L	General Chemistry Lab I	1
CHM 125	General Chemistry II	3
CHM 125L	General Chemistry Lab II	1
PHY 313	Comp Methods for Sci and Eng	3
PHY 482	Math Meth Physics & Engineer	3
PHY 390	Physics Seminar	0
Two PHY 3-credit electives, which must be at the 300- level or higher		6
Total Hours		**78**

Free Electives

Three free electives are required. Graduation requires 120 credits. Any credits necessary to reach that number outside of the CCC and major requirements are considered free electives.

Typical Course Sequence

Course	Title	Hours
First Year		
Fall		
PHY 105	University Physics I	3
PHY 105L	University Physics Lab I	1
MAT 161	Calculus I	4
Non-Native Language		3-4
ENG 101	Craft of Language	3
PHY 390	Physics Seminar	0
	Hours	**14-15**
Spring		
PHY 106	University Physics II	3
PHY 106L	University Physics Lab II	1
MAT 162	Calculus II	4
Non-Native Language (Overlay Mission Specific)		3
World History		3
Diversity		3
PHY 390	Physics Seminar	0
	Hours	**17**
Sophomore		
Fall		
PHY 213	Physics III	3
PHY 213L	Intro. Physics III Laboratory	1
MAT 238	Differential Equations	3
MAT 213	Calculus III	4

CHM 120	General Chemistry I	3
CHM 120L	General Chemistry Lab I	1
PHY 390	Physics Seminar	0
	Hours	**15**
Spring		
PHY 251	Modern Physics I	3
MAT 226	Introduction to Linear Algebra	3
CHM 125	General Chemistry II	3
CHM 125L	General Chemistry Lab II	1
INT 151	Inequality in American Society	1
PHY 390	Physics Seminar	0
Philosophy Level One		3
Religious Studies		3
	Hours	**17**
Junior		
Fall		
PHY 321 or PHY 301	Quantum Mechanics I or Classical Mechanics	3
PHY 313 or PHY 482	Comp Methods for Sci and Eng or Math Meth Physics & Engineer	3
PHY 312	Experimental Methods in Phy II	3
PHY 390	Physics Seminar	0
Theology		3
Philosophy Level Two		3
Overlay or Free Elective (Writing Intensive)		3
	Hours	**18**
Spring		
PHY 409 or PHY 307	Statistical Mechanics or Electricity and Magnetism	3
PHY 308 or MAT 311	Waves and Optics or Numerical Analysis	3
Physics Elective #1 (300-level and above)		3
Fine & Performing Arts, Design, & Creativit		3
PHY 390	Physics Seminar	0
Free Elective		3
	Hours	**15**
Senior		
Fall		
PHY 321 or PHY 301	Quantum Mechanics I or Classical Mechanics	3
PHY 313 or PHY 482	Comp Methods for Sci and Eng or Math Meth Physics & Engineer	3
Literature		3
PHY 380	Engineering Circuit Analysis	3
PHY 380L	Engineer Circuit Analysis Lab	1
Free Elective		3
PHY 390	Physics Seminar	0
	Hours	**16**
Spring		
PHY 409 or PHY 307	Statistical Mechanics or Electricity and Magnetism	3
PHY 308 or MAT 311	Waves and Optics or Numerical Analysis	3
Physics Elective #2 (300-level and above)		3
Social Science		3
Free Elective		3
PHY 390	Physics Seminar	0
	Hours	**15**
	Total Hours	**127-128**

Physics/Secondary Education

Students majoring in Physics who are interested in teaching grades 7-12 can dual major in Physics/Secondary Education (7-12). Upon successful completion of the dual major, SJU degree requirements, and required certification exams, teacher candidates may apply to obtain an Instructional I Secondary Education (7-12) Teaching Certificate from the State of Pennsylvania. Students must also maintain an overall GPA of 3.0 or higher to obtain teacher certification upon graduation.

In addition to their Physics advisor, Physics/Secondary Education(7-12) dual majors will also be assigned an advisor from the Education Department who will guide them through their required Education courses. The Education advisor will also assist students seeking teacher certification in formally applying for the SJU Educator Preparation Program, usually in the spring semester of their sophomore year. Students must have an overall GPA of 3.0 or higher to enroll in EDU 491 (https://academiccatalog.sju.edu/search/?P=EDU%20491) Secondary Student Teaching in their senior year.

Pennsylvania's Secondary Education (referred to as "secondary" or "7-12") preparation program guidelines require a professional core of courses, early and varied field experiences, and student teaching. In addition to the subject-specific content requirements for secondary programs that are met by the student's major, candidates for the 7-12 teaching certificate in Pennsylvania must complete a prescribed sequence of coursework, which includes the specific requirements for Accommodations and Adaptations for Diverse Learners in Inclusive Settings and Meeting the Needs of English Language Learners under §49.13(4)(i)).

Please see Secondary Education 7-12 for secondary major requirements. (https://academiccatalog.sju.edu/education-humandev/education/teacher-edu/seed-major/)

Code	Title	Hours
MAT 162	Calculus II	4
MAT 238	Differential Equations	3
PHY 106 & 106L	University Physics II and University Physics Lab II	4
PHY 213 & 213L	Physics III and Intro. Physics III Laboratory	4
PHY 251	Modern Physics I	3
PHY 301	Classical Mechanics	3
PHY 307 or PHY 308	Electricity and Magnetism Waves and Optics	3
PHY 311	Experimental Methods of Phy I	3
PHY 312	Experimental Methods in Phy II	3
Three 300/400 Level Physics Electives		9
CHM 120 & 120L	General Chemistry I and General Chemistry Lab I	4
CHM 125 & 125L	General Chemistry II and General Chemistry Lab II	4
Total Hours		**47**