

THEORETICAL PHYSICS AND APPLIED MATHEMATICS (BS)

The laws and theories of modern physics are formulated in the language of modern mathematics. In the past, students wishing to study the basic physical laws governing our universe might have gotten away with proficiency in multivariable calculus; but no longer. Since the advent of statistical mechanics, quantum mechanics, and the like, a solid foundation in analysis, abstract algebra, and statistics is also essential. Students pursuing a B.S. in Theoretical Physics and Applied Mathematics will gain exposure to these modern physical theories and to the abstract mathematics underpinning them. Graduating students will be well-prepared for advanced degrees in applied mathematics, physics, or engineering.

Curriculum

AP Credit Policies (<https://catalog.luc.edu/undergraduate/arts-sciences/mathematics-statistics/#policiestext>)

| Code | Title | Hours |
|--|--|-----------|
| Mathematics Course Requirements | | |
| MATH 161 | Calculus I | 4 |
| MATH 162 | Calculus II | 4 |
| MATH 201 | Introduction to Discrete Mathematics & Number Theory | 3 |
| MATH 212 | Linear Algebra | 3 |
| MATH 263 | Multivariable Calculus | 4 |
| MATH 264 | Ordinary Differential Equations | 3 |
| MATH 313 | Abstract Algebra | 3 |
| MATH 351 | Introduction to Real Analysis I | 3 |
| MATH 353 | Introductory Complex Analysis | 3 |
| PHYS 130 | Introduction to Computational Physics | 3 |
| or MATH 215 | Object-Oriented Programming with Mathematics | |
| Physics Course Requirements | | |
| PHYS 121 | College Physics I Lec/Dis | 3 |
| PHYS 111L | College Physics Laboratory I | 1 |
| PHYS 122 | College Physics II Lec/Dis | 3 |
| PHYS 112L | College Physics Lab II | 1 |
| PHYS 126F | Freshman Projects | 1 |
| PHYS 235 | Modern Physics | 3 |
| PHYS 235L | Modern Physics Laboratory | 1 |
| PHYS 301 | Mathematical Methods in Physics | 3 |
| PHYS 314 | Theoretical Mechanics I | 3 |
| PHYS 351 | Electricity and Magnetism I | 3 |
| PHYS 328 | Thermal Physical & Statistical Mechanics | 3 |
| PHYS 338 | Advanced Physics Laboratory | 2 |
| PHYS 361 | Quantum Mechanics I | 3 |
| Total Hours | | 63 |

Suggested Sequence of Courses

The below sequence of courses is meant to be used as a suggested path for completing coursework. An individual student's completion of requirements depends on course offerings in a given term as well as the

start term for a major or graduate study. Students should consult their advisor for assistance with course selection.

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| Course | Title | Hours |
|---------------------------------------|--|-----------|
| First Year | | |
| Fall | | |
| PHYS 121 | College Physics I Lec/Dis | 3 |
| PHYS 111L | College Physics Laboratory I | 1 |
| MATH 161 | Calculus I | 4 |
| UCWR 110 | Writing Responsibly | 3 |
| Core | | 3 |
| Hours | | 14 |
| Spring | | |
| PHYS 122 | College Physics II Lec/Dis | 3 |
| PHYS 112L | College Physics Lab II | 1 |
| PHYS 126F | Freshman Projects | 1 |
| MATH 162 | Calculus II | 4 |
| COMP 215 / MATH 215 or PHYS 130 | Object Oriented Programming with Mathematics or Introduction to Computational Physics | 3 |
| Core | | 3 |
| Hours | | 15 |
| Second Year | | |
| Fall | | |
| PHYS 235 | Modern Physics | 3 |
| PHYS 235L | Modern Physics Laboratory | 1 |
| MATH 263 | Multivariable Calculus | 4 |
| MATH 264 | Ordinary Differential Equations | 3 |
| Core | | 3 |
| Hours | | 14 |
| Spring | | |
| MATH 201 | Introduction to Discrete Mathematics & Number Theory | 3 |
| MATH 212 | Linear Algebra | 3 |
| PHYS 314 | Theoretical Mechanics I | 3 |
| PHYS 301 | Mathematical Methods in Physics | 3 |
| Core | | 3 |
| Hours | | 15 |
| Third Year | | |
| Fall | | |
| PHYS 351 | Electricity and Magnetism I | 3 |
| MATH 313 | Abstract Algebra | 3 |
| MATH 351 | Introduction to Real Analysis I | 3 |
| Core | | 3 |
| General Elective | | 3 |
| Hours | | 15 |

| | | |
|--------------------|--|------------|
| Spring | | |
| PHYS 361 | Quantum Mechanics I | 3 |
| Core | | 3 |
| Core | | 3 |
| Core | | 3 |
| General Elective | | 3 |
| Hours | | 15 |
| Fourth Year | | |
| Fall | | |
| MATH 353 | Introductory Complex Analysis | 3 |
| PHYS 328 | Thermal Physical & Statistical Mechanics | 3 |
| Core | | 3 |
| Core | | 3 |
| Core | | 3 |
| Hours | | 15 |
| Spring | | |
| PHYS 338 | Advanced Physics Laboratory | 2 |
| Core | | 3 |
| Core | | 3 |
| General Elective | | 3 |
| General Elective | | 3 |
| General Elective | | 3 |
| Hours | | 17 |
| Total Hours | | 120 |

or in high-tech industries. Recent majors have gone on to world class graduate programs in fields ranging from physics to neuroscience, and programming jobs at major tech companies.

The course of study for the Theoretical Physics / Applied Mathematics major covers the core classes in the Physics major, provides laboratory experience, and adds a comprehensive mathematics component. Upon completion of this program, students will:

- Exhibit foundational knowledge in both physics and mathematics.
- Be able to develop and interpret mathematical models that provide both quantitative and qualitative understanding of physical systems.
- Possess intermediate level laboratory skills that will serve as a foundation for more advanced training in graduate or professional school.
- Recognize how careful data collection and analysis helps develop or falsify scientific theories.
- Demonstrate effective and ethical decision-making abilities in issues related to the sciences.

College of Arts and Sciences Graduation Requirements

All Undergraduate students in the College of Arts and Sciences are required to take two Writing Intensive courses (6 credit hours) as well as complete a foreign language requirement at 102-level or higher (3 credit hours) or a language competency test. More information can be found here (<https://www.luc.edu/cas/college-requirements/>).

Additional Undergraduate Graduation Requirements

All Undergraduate students are required to complete the University Core, at least one Engaged Learning course, and UNIV 101. SCPS students are not required to take UNIV 101. Nursing students in the Accelerated BSN program are not required to take core or UNIV 101. You can find more information in the University Requirements (<https://catalog.luc.edu/undergraduate/university-requirements/>) area.

Learning Outcomes

Loyola University Chicago's major in Theoretical Physics / Applied Mathematics is an interdisciplinary program that provides extensive training in both physics and mathematics. It prepares students for graduate study in physics, mathematics, or applied mathematics; careers in fields such as engineering or computer science that value quantitative reasoning and mathematical modeling; or technical training in professions like medicine, dentistry, or law.

Students majoring in Theoretical Physics / Applied Mathematics possess a versatile set of skills that are well-suited to data science, numerical modeling, and quantitative analysis. They may pursue careers in higher education, at research institutes or government labs,