University of Massachusetts Lowell

College of Sciences
Department of Physics and Applied Physics

UNDERGRADUATE PHYSICS PROGRAM

Student Information for

Bachelor of Science Degree

in Physics

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www.uml.edu/physics

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The Bachelor of Science in Physics

Physics is the study of all natural phenomena. As such, almost all science and engineering fields, from archaeology and astronomy to metallurgy and medicine, draw upon physics for their basic understanding.

The employer for a present-day physics graduate may be an educational institution, a small business, an industrial firm, a government laboratory or a non-profit research center. The University of Massachusetts Lowell physics program is designed to introduce the student to both fundamental and applied aspects of physics leading to a wide range of career options after graduation. Some of our graduates seek employment after receiving the Baccalaureate degree, while others continue on to graduate study aiming for a research career.

Students who complete the undergraduate program in physics may receive complete support for graduate study. In the past, graduating seniors have received awards of complete tuition for graduate study and additional stipends from graduate schools such as Harvard University, Yale University, the University of Chicago, Brown University, the University of Illinois, Johns Hopkins University, Brandeis University, Purdue University, the State University of New York at Stony Brook, Boston University, the University of Maryland, University of Rochester, University of Arizona and Rensselaer Polytechnic Institute.

Physics majors at the University of Massachusetts Lowell have the opportunity to become involved and discover first-hand what scientific research is all about. Research projects can be undertaken both during the regular academic year, as well as during the summer months and other semester breaks. In most cases, the student earns a stipend during the process, and benefit from working with physics faculty who are regularly engaged in a variety of research programs in subatomic physics, astrophysics, nanoscience, photonics, terahertz technology, radiological and medical physics.

Upon entering the program, incoming students are assigned a faculty advisor, who guides the student throughout his or her undergraduate career at the University. The advisor is available at any time to discuss the academic concerns of the student, and helps the student plan a program of study. Available programs of study include the Standard program and Radiological Health Physics option, as well as programs meant to prepare the student for graduate studies or a teaching career.

STANDARD COURSE OF STUDY

The standard course of study superimposes technical elective courses chosen by the student and his/her academic advisor on a general physics foundation of the Kernel courses. The special non-physics electives may be in any of the engineering fields, computer science, mathematics, biology or chemistry. A student pursuing this course of study develops a solid foundation in physics and concurrently acquires a background in a specialized field, thereby obtaining the necessary practical knowledge to solve applied problems competently. This combination of the general and the specialization prepares the student for immediate employment after graduation.

RADIOLOGICAL HEALTH PHYSICS OPTION

Radiological health physics involves the study of the effects of radiation and radioactivity on life processes. It also can be called radiation protection science and is particularly involved with the effects of radiation on the human body and the control of such radiation. A graduate of this curriculum would enter the profession of health physics, which is devoted to the protection of man and the environment from the harmful effects of radiation, while at the same time making it possible for our advancing civilization to enjoy all of the benefits resulting from uses of radiation.

PREPARATION FOR GRADUATE STUDIES IN PHYSICS

The course sequence in this program of study is intended for students who plan to continue towards an M.S. or Ph.D. program in physics. It provides the student with a stronger foundation of physics courses in preparation for graduate work. These include some of the advanced physics courses that are suggested as electives in the standard course of study, such as Quantum Mechanics II, Electricity and Magnetism II and Statistical Thermodynamics. The material in these courses are also appropriate for preparing the student for the Graduate Record Examination in Physics, which is a requirement for admission to a number of graduate physics programs in the country. In addition to the undergraduate courses listed in this sequence, particularly well-prepared students who complete the prerequisites may also take graduate level courses offered in the department.

B.S. PHYSICS WITH UTEACH MINOR

This course of study is designed for a student interested in teaching at the K-12 level after graduation. The UTeach program integrated with the B.S. Physics courses requires a significant commitment in terms of time and effort and culminates in a semester-long practicum at a local school. Two introductory courses referred to as Step 1 and Step 2 in the program of study allow an interested student to sample this degree pathway without full commitment.

FIVE-YEAR B.S./M.S. PROGRAM IN PHYSICS

To encourage outstanding undergraduate students to continue their studies toward an advanced degree, the Department of Physics and Applied Physics has instituted a program of accelerated study which leads to a combined bachelor’s and master’s degree. Every full-time student with a grade point average of 3.0 or above at the end of the junior year is eligible to be admitted to this program. Admission to the combined bachelor’s and master’s degree program is an honor conferred on the student that carries with it distinct benefits, for example, Graduate Record Examination (GRE) scores are not required for admittance into the graduate program. The student may or may not decide to take advantage of the honor conferred, and can graduate with a bachelor’s degree in exactly the same way as a student not admitted to the accelerated program. For more information on this program, contact the Undergraduate Coordinator.

KERNEL

The courses listed below constitute the **Kernel.** Programs of study specify how these courses are integrated with **Core Curriculum** and **Electives** to make a four-year degree program.

I. LOWER DIVISION COURSES

Physics

PHYS 1120	Freshman Physics Seminar (1)
PHYS 1610/1640/2690	Physics I/II/III (4,4,4) (H)
PHYS 1610L/1640L	Physics I/II Lab (2,2) (H)
PHYS 2100	Intro Modern Physics (3)
PHYS 2610	Physics of Materials/Devices (3)
PHYS 2620	Principles of Lab Automation (3)

Non-Physics

ENGL 1010/1020	College Writing I/II (3,3)
CHEM 1210/1220	Chemistry I/II (3,3)
CHEM.1230/1240	Chemistry I/II Lab (1,1)
MATH 1310/1320/2310	Calculus I/II/III (4,4,4)
MATH 2340	Differential Equations (3)

II. UPPER DIVISION COURSES

Physics

PHYS 3380	Physical Optics and Waves (3)
PHYS 3530	Electricity and Magnetism I (3)
PHYS 3930L/3940L	Advanced Experimental Physics I/II (2,2)
PHYS 4130	Mechanics (3)
PHYS 4350	Introduction to Quantum Mechanics I (3)
PHYS 4540	Physics Capstone (3)

Math Physics

PHYS/MATH 3810	Math Physics I (3)
PHYS 3820	Math Physics II (3)

Advanced lab options

The advanced lab courses below may be substituted for Advanced Experimental Physics II.

PHYS 4060	Nuclear Instrumentation (3)
PHYS 4450	Characterization of Matter (2)

Any waivers or substitutions for these requirements must be approved by the Undergraduate Coordinator.

CORE CURRICULUM (GENERAL EDUCATION)

Part 1 – Breadth of Knowledge

Students will be required to fulfill the following Breadth-of-Knowledge requirements from courses outside of their major department, with **no more than two courses from a single discipline applied to the same criterion**. The Breadth of Knowledge requirement is designed to familiarize the student with different perspectives on knowledge.

- 3 Social Sciences courses (9 credits) SS
- 3 Arts and Humanities courses (9 credits) AH
- 2 Science courses with lab (6 credits minimum)* SCL
- 1 STEM course (3 credits)* STEM
- College writing I and II (6 credits)* CW
- Math course (3 credits minimum)* MATH

*met by the required Kernel courses

Part 2 – Essential Learning Outcomes

Students will be required to master each of seven Essential Learning Outcomes (ELOs) listed below.

- Diversity and Cultural Awareness (DCA)
- Information Literacy (IL)
- Social Responsibility and Ethics (SRE)
- Written and Oral Communication (emphasizing Writing in the Discipline) (WOC)
- Critical Thinking and Problem Solving (CTPS)
- Applied and Integrative Learning (AIL)
- Quantitative Literacy (QL)

These ELOs are met within the Physics major and through Breadth-of-Knowledge courses as follows.

DCA	AH breadth-of-knowledge course
IL	PHYS 4540 Physics Capstone or PHYS 4530 Health Physics Capstone
SRE	SS breadth-of-knowledge course
WOC	PHYS 4540 Physics Capstone or PHYS 4530 Health Physics Capstone
CTPS	PHYS 3930L Advanced Experimental Physics or PHYS 4060 Nuclear Instrumentation
AIL	PHYS 4540 Physics Capstone or PHYS 4530 Health Physics Capstone
QL	PHYS 3930L Advanced Experimental Physics or PHYS 4060 Nuclear Instrumentation

ELECTIVES

PHYSICS ELECTIVES – UPPER DIVISION

1. General Physics

PHYS 3540*	Electricity and Magnetism II	(3)
PHYS 4060**	Nuclear Instrumentation	(4)
PHYS 4210*	Statistical Thermodynamics	(3)
PHYS 4360*	Intro to Quantum Mechanics II	(3)
PHYS 4450**	Characterization of Matter	(2)
PHYS 4610	Nuclear Physics I	(3)
PHYS 4390	Electro-optics	(3)
PHYS 4720	Solid State Physics	(3)
PHYS 4770	SS Elec. and Optoelec. Devices	(3)
PHYS 4970/80	Senior Thesis	(3,3)

* Courses strongly recommended for students intending to pursue a graduate degree in physics.

2. Astronomy/Astrophysics

PHYS 3830	Astrophysics	(3)
PHYS 4060**	Nuclear Instrumentation	(3)
PHYS 4560	Radiative Processes in Astrophysics	(3)
PHYS 4640	Particle Astrophysics	(3)

3. Radiological Health Physics electives (required for Radiological Health Physics option)

PHYS 4060**	Nuclear Instrumentation	(4)
PHYS 2040	Intro to Rad Sciences	(3)
PHYS 4010/4020L	Rad Safety & Control I/II	(4,4)
PHYS 4620	Radiation Biology	(3)
PHYS 4810	Math Methods of Rad Sci	(3)
PHYS 4820	Numerical Methods in Rad Sci	(3)

** Acceptable alternatives to Advanced Experimental Physics II if approved by the student's faculty advisor.

ELECTIVES (definitions)

Core Curriculum Elective	see the Core Curriculum requirements for details
Physics Elective	an upper division course offered by the Physics Department
Special Elective	a technical course NOT given by the Physics Department
Free Elective	any course NOT given by the Physics Department