3460 Physics

Programs Offered:

Bachelor of Science in Physics
  Standard Program in Physics
  Concentration in Applied Physics
  Concentration in Astronomy
  Concentration in Pre-Medicine
  Concentration in Biophysics
  Concentration in Geology
  Concentration in Computer Science

BS in Physics / MAT in Science Education

Minor in Physics

Department of Physics and Astronomy
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H. Richard Miller, Chair
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All degree programs described below are built on a core of 21 semester hours of physics numbered 3300 or above and 3 semester hours of mathematics at the 3000 level. The standard program is designed to prepare the student for graduate school or immediate employment upon graduation. Students selecting the standard program must complete 21 semester hours of physics, astronomy and mathematics beyond the core set of physics and mathematics courses listed below. As an alternative to the standard program, courses in one of several specific areas of concentration may be chosen as described below. The available areas of concentration are applied physics, astronomy, pre-medicine, biophysics, geology, and computer science.

In partnership with the Department of Middle-Secondary Education and Instructional Technology (MSIT) in the College of Education, the Department of Physics and Astronomy also offers the BS Physics / MAT Science Education option. This program, described more fully below, allows completion of both degrees and teacher certification requirements in approximately 5 years.

A central objective of Georgia State University is that all graduates from its programs will be proficient in writing, critical and analytical thinking, and use of information resources. In support of this objective, the Department of Physics and Astronomy explicitly incorporates activities to develop these skills as appropriate in each course.

To schedule an effective program of study, it is very important that all students intending to major in physics consult with the physics faculty adviser as soon as possible. Physics majors should pay special attention to the early completion of the mathematical requirements if they are to complete their physics requirements during the usual four-year span. The first calculus course should be taken during the freshman year, and the second and third calculus courses should be completed during the sophomore year. The department recommends that General Chemistry I and II be taken during the freshman year. The beginning physics sequence (Physics 2211K-2212K) should be completed before the end of the sophomore year. Students who enter the physics major after completing a non-calculus level elementary physics sequence should consult with their departmental adviser on the best method of preparing for more advanced courses in physics.

The degree programs described below do not require a foreign language. However, the department recommends that students continue their high school experience to a level of competency equivalent to Georgia State’s 1002 level or higher.

Program Degree Requirements

In addition to the Program Degree Requirements, students must fulfill the College of Arts and Sciences Degree Requirements (see section 3030) and the University Degree Requirements (see section 1400).
Program Financial Information

Effective summer 2009, lab fees will be assessed automatically for students who register for certain courses. As a result, students will no longer be required to purchase lab fee cards. For more information, please feel free to contact the department. For a complete list of courses and their respective fees, go to General Registration Information at http://www.gsu.edu/es/20272.html.

B.S. in Physics

Areas A-E: Core Curriculum Recommendations

1. Required course:
   Math 1113 Precalculus (3) (or a higher-level mathematics course)

2. Required course:
   Math 2211 Calculus of One Variable I (4) (or a higher-level mathematics course)

3. Recommended courses:
   Chem 1211K Principles of Chemistry I (4)
   Chem 1212K Principles of Chemistry II (4)

Area F: Courses Appropriate to the Major (18)*

1. Required Course
   Phys 1000 Gateway to Physics

2. Required Courses (Unless used to satisfy Area D requirements)
   Phys 2211K Principles of Physics I (4)
   Phys 2212K Principles of Physics II (4)
   Chem 1211K Principles of Chemistry I (4)
   Chem 1212K Principles of Chemistry II (4)
   Math 2212 Calculus of One Variable II (4)
   Math 2215 Multivariate Calculus (4)*

3. To complete 18 semester hours in Area F, select additional courses from the following list that were not used to satisfy the Area A or D requirements.*
   Biol 1103K Introductory Biology I (4)
   Biol 1104K Introductory Biology II (4)
   Biol 2107K Principles of Biology I (4)
   Biol 2108K Principles of Biology II (4)
   CSc 2010 Introduction to Computer Science (3)
   CSc 2310 Principles of Computer Programming (3)
   CSc 2510 Theoretical Foundations of Computer Science (3)
   Geol 1121K Introductory Geosciences I (4)
   Geol 1122K Introductory Geosciences II (4)

*Required Lower Division Courses

All students majoring in physics must complete the following set of courses: Phys 2211K, 2212K, Chem 1211K, 1212K, Math 2212, and 2215. Any semester hours exceeding 18 earned to complete the lower division and Area F requirements will count toward elective hours.

Area G: Major Courses

A grade of C or higher is required in all major courses. The Department of Physics and Astronomy offers several concentrations within the B.S. degree program for the physics major. The standard program is recommended for those who plan to pursue graduate study in physics, or who plan to seek immediate employment upon graduation. Other options include concentrations in applied physics, astronomy, pre-medicine, biophysics, geology, and computer science. Course requirements listed below for each of the options are in addition to the courses listed under Area F and the required lower division courses listed above. The
standard program and all concentrations are centered on the 21-hour core of physics courses and the three-hour core of mathematics courses listed below.

**Physics and Mathematics Core (24)**

1. Required Courses to Fulfill CTW Requirement (6)
   - Phys 3300  Advanced Physics Laboratory (3)
   - Phys 4900  Research Project (3)

2. Additional Physics Requirements (15)
   - Phys 3401  Modern Physics I (4)
   - Phys 3850  Statistical and Thermal Physics (3)
   - Phys 4600  Classical Mechanics (4)
   - Phys 4700  Electricity and Magnetism (4)

3. Mathematics Requirements (3)
   - Math 3260  Differential Equations (3)

**Standard Program in Physics (21)**

To meet the requirements for the degree with the standard program, the core set of physics and mathematics courses must be completed along with additional physics and mathematics courses as described below:

1. Required course (9)
   - Phys 3402  Modern Physics II (3)
   - Math 4258  Vector Calculus (3)
   - Math 4265  Partial Differential Equations (3)

2. Physics and Astronomy Courses. Select nine hours from the following (9):
   - Phys 3500  Electronics (3)
   - Phys 3800  Optics (3)
   - Phys 4110  Introduction to Embedded Systems Laboratory (4)
   - Phys 4410  Nuclear and Particle Physics (3)
   - Phys 4810  Quantum Mechanics (3)
   - Phys 4910  Solid State Physics (3)
   - Phys 4950  Senior Research (1-3)
   - Astr 3500  Quantitative Astronomy (4)
   - Astr 4000  Fundamentals of Astrophysics (3)
   - Astr 4100  Astronomical Techniques and Instrumentation (3)

3. Mathematics and Computer Science Courses: Select one course. (3)
   - CSc 4610  Numerical Analysis I (3)
   - Math 3435  Introductory Linear Algebra (3)
   - Math 4250  Complex Analysis (3)
   - Math 4391  Introduction to Differential Geometry and Its Applications (3)

**Applied Physics Concentration (21)**

In addition to the core courses in physics and mathematics, the applied physics concentration allows courses from other sciences and engineering to complete the program in physics-related areas. Engineering courses are available through cross registration at the Georgia Institute of Technology. At least 18 semester hours must be completed at the 3000 level or above, and at least nine semester hours must be selected from science and/or engineering courses offered by other departments. The overall program must be developed in consultation with a faculty adviser within the Department of Physics and Astronomy.

**Astronomy Concentration (21)**

In addition to the core set of physics and mathematics courses, the astronomy concentration consists of 10 semester hours in astronomy courses (Astr 3500, 4000, 4010, and 4100), and others from the list below, to
complete the requirements for the degree. (Although not a requirement, the department recommends that students take Astr 1010 and/or Astr 1020 before the junior year.)

1. Required courses (10)
   
   Astr 3500    Quantitative Astronomy (4)
   Astr 4000    Fundamentals of Astrophysics (3)
   Astr 4100    Astronomical Techniques and Instrumentation (3)

2. Physics, Mathematics, and Computer Science Courses. Select eleven hours from the following: (11)
   
   Phys 3402    Modern Physics II (3)
   Phys 3500    Electronics (3)
   Phys 3800    Optics (3)
   Phys 4110    Introduction to Embedded Systems Laboratory (4)
   Phys 4410    Nuclear and Particle Physics (3)
   Phys 4810    Quantum Mechanics (3)
   Phys 4910    Solid State Physics (3)
   Phys 4950    Senior Research (1-3)
   CSc 4610    Numerical Analysis I (3)
   Math 3435    Introductory Linear Algebra (3)
   Math 4250    Complex Analysis (3)
   Math 4258    Vector Calculus (3)
   Math 4265    Partial Differential Equations (3)
   Math 4391    Introduction to Differential Geometry and Its Applications (3)

Pre-Medicine Concentration (21)

In addition to the core set of physics and mathematics courses, the pre-medicine concentration allows courses from biology and chemistry to complete the requirements for the degree. The concentration also provides the set of physics, chemistry, and biology courses required for admission to most medical schools. Note that Biol 2107K and 2108K are prerequisites for Biol 3800 and other upper-division biology courses.

1. Required Chemistry courses (12)
   
   Chem 2400    Organic Chemistry I (4)
   Chem 3410    Organic Chemistry II (4)
   Chem 3100    Organic Chemistry Laboratory I (2)
   Chem 3110    Organic Chemistry Laboratory II (2)

2. Required Biology courses. Select one of the following (3):
   
   Biol 3240    Human Physiology (3)
   Biol 3800    Molecular Cell Biology (3)

3. Electives. Select six hours from the following (6):
   
   Biol 3240    Human Physiology (3) (unless used above)
   Biol 3250    Human Physiology Laboratory (1)
   Biol 3800    Molecular Cell Biology (3) (unless used above)
   Biol 3810    Molecular Cell Biology Laboratory (3)
   Biol 3880    Microbiology (3)
   Biol 3890    Microbiology Laboratory (1)
   Biol 3900    Genetics (3)
   Biol 3910    Genetics Laboratory (1)
   Chem 4600    Biochemistry I (5)
   Math 4258    Vector Calculus (3)
   Math 4265    Partial Differential Equations (3)
**Biophysics Concentration (21)**

In addition to the core set of physics and mathematics courses, the biophysics concentration allows biology and chemistry courses to complete the requirements for the degree. The courses should be chosen from the list below and provide background in several areas including biochemical, biomolecular, and neural sciences. This concentration provides excellent preparation for advanced study in biological physics and for admission to M.D./Ph.D. programs. Note that Biol 2107K and 2108K are prerequisites for Biol 3800 and other upper-division biology courses.

1. **Required courses (7)**
   - Biol 3800 Molecular Cell Biology (3)
   - Chem 2400 Organic Chemistry I (4)

2. **Select 14 hours from the following:** (Chem 3410, Organic Chemistry II, is a prerequisite for many other courses listed.) (14)
   - Chem 3100 Organic Chemistry Laboratory I (2)
   - Chem 3110 Organic Chemistry Laboratory II (2)
   - Chem 3410 Organic Chemistry II (4)
   - Chem 4000 Fundamentals of Chemical Analysis (3)
   - Chem 4110 Physical Chemistry I (3)
   - Chem 4600 Biochemistry I (5)
   - Biol 3810 Molecular Cell Biology Laboratory (3)
   - Biol 3840 Animal Biology (3)
   - Biol 3850 Animal Biology Laboratory (1)
   - Biol 3880 Microbiology (3)
   - Biol 3890 Microbiology Laboratory (1)
   - Biol 3900 Genetics (3)
   - Biol 3910 Genetics Laboratory (1)
   - Biol 4102 Neurobiology (4)
   - Biol 4180 Neurobiology Laboratory (4)
   - Phys 3402 Modern Physics II (3)
   - Phys 3500 Electronics (3)
   - Math 4258 Vector Calculus (3)
   - Math 4265 Partial Differential Equations (3)

**Geology Concentration (22)**

In addition to the core set of physics and mathematics courses, this concentration allows geology courses to complete the requirements for the degree. The courses should be chosen from the list below. Note that Geol 1121K and 1122K are prerequisites for upper-division geology courses.

1. **Required courses (4)**
   - Geol 3002 Introduction to Earth Minerals (4)

2. **Electives: Select 12 hours from the following:** (or other approved 3000-4000 geology courses) (12)
   - Geol 4007 Hydrogeology (4)
   - Geol 4013 Structural Geology (4)
   - Geol 4015 Crystallography and Optical Mineralogy (4)
   - Geol 4017 Environmental Geology (4)

3. **Electives. Select at least five hours from the following:** (5):
   - Phys 3402 Modern Physics II (3)
   - Phys 3500 Electronics (3)
   - Phys 3800 Optics (3)
   - Phys 4110 Introduction to Embedded Systems Laboratory (4)
   - Phys 4410 Nuclear and Particle Physics (3)
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**Computer Science Concentration (21)**

In addition to the core set of physics and mathematics courses, this option allows courses in computer science and related areas to complete the requirements for the degree. The courses should be chosen from the list below. Note that CSc 2010, 2310 and 2510 are prerequisites for upper-division computer science courses.

1. **Required Physics course (3)**
   
   *Phys 3500*  
   Electronics (3)

2. **Electives: Select 12 hours of courses from the following (or other approved computer science courses) (12)**

   - CSc 3210 Computer Organization and Programming (3)
   - CSc 3320 System Level Programming (3)
   - CSc 3330 C++ Programming (3)
   - CSc 3410 Data Structures (3)
   - CSc 3610 MATLAB Programming (3)
   - CSc 4210 Computer Architecture (4)
   - CSc 4220 Computer Networks (3)
   - CSc 4230 VLSI Design (4)
   - CSc 4310 Parallel and Distributed Computing (4)
   - CSc 4330 Programming Language Concepts (3)
   - CSc 4350 Software Engineering (4)
   - CSc 4520 Design and Analysis of Algorithms (4)
   - CSc 4610 Numerical Analysis I (3)
   - CSc 4620 Numerical Analysis II (3)
   - CSc 4730 Scientific Visualization (4)
   - CSc 4820 Computer Graphics Algorithms (4)

3. **Electives. Select six hours from the following (6):**

   - Phys3402 Modern Physics II (3)
   - Phys3500 Electronics (3)
   - Phys3800 Optics (3)
   - Phys4110 Introduction to Embedded Systems Laboratory (4)
   - Phys4410 Nuclear and Particle Physics (3)
   - Phys4810 Quantum Mechanics (3)
   - Phys4910 Solid State Physics (3)
   - Phys4950 Senior Research (1-3)
   - Math 3030 Mathematical Models for Computer Science (3)
   - Math3435 Introductory Linear Algebra (3)
   - Math4250 Complex Analysis (3)
   - Math4258 Vector Calculus (3)
   - Math4265 Partial Differential Equations (3)
Area H: Minor and/or Additional Courses
1. Students earning a B.S. through the Department of Physics and Astronomy are not required to take a minor.
2. Additional courses must be taken as electives to complete a minimum of 120 semester hours, exclusive of 1000/2000 physical education, health, or military science courses. Although not a requirement, the department recommends that physics majors take these elective courses at the 2000 level or above in mathematics, computer science, chemistry, biology, geology, physics, or astronomy. (Consult with the departmental academic adviser.)

BS Physics / MAT Science Education Program
This program, allowing completion of both degrees and teacher certification requirements in approximately 5 years, is available to undergraduates majoring in physics who have completed at least 30 hours of academic credit (excluding AP or transfer credits) and who have earned a minimum cumulative GPA of 3.5. Students may apply to the option at any time after completing 30 hours but prior to completing 90 hours of undergraduate coursework. Applicants are applying for early acceptance into the College of Education’s MAT program and therefore must submit the following documentation in addition to meeting the GPA requirement:
- Complete the BS/MAT application form. This will be kept on file in the Office of Academic Assistance in the College of Education, in the Department of Physics & Astronomy, and in the Office of Academic Assistance in the College of Arts & Sciences.
- 2-3 letters of recommendation: (a) one academic or professional letter; (b) one letter from someone who can evaluate the applicant’s personal qualifications, experience, and background in light of potential to work successfully with adolescents; (c) one letter from a current work supervisor, if applicable
- Documentation of previous work experience (résumé or curriculum vitae)
- Personal statement of goals and/or reasons for teaching
- Successful interview with appropriate program faculty in the College of Education

Final acceptance into the MAT portion of the program will be contingent upon the following:
- Maintaining a cumulative GPA of 3.0 or higher;
- Completion of the BS degree in physics
- Submission of acceptable GRE scores;
- Filing an application to the MAT program by the appropriate deadline.

Students in this program will select one of the concentrations listed above. The curriculum allows students to satisfy the content requirement of the MAT program by enrolling in the 7000-level counterparts of the core physics courses (Phys 7850 for 3850, Phys 7460 for 3401, Phys 7600 for 4600, and Phys 7700 for 4700). In addition, to meet the MAT and teacher certification requirements, students will enroll in EXC 4020 and 6 hours of graduate-level courses required for the MAT to satisfy 9 hours of elective credits towards the BS in physics.

For more information on this program’s curriculum, please contact the department. The MAT requirements for Science Education are described more fully in the College of Education section of the Graduate Catalog.

Minor in Physics
Students who wish to minor in physics must take at least 15 semester hours in physics and/or astronomy courses, including at least nine semester hours at the 3000 level or above. Students taking more than 15 semester hours in these courses may count the additional hours toward their electives or may consider completing a double major. A grade of C or higher is required in all courses counting toward the minor.