Applied Physics, B.S.

Learning Outcomes

Applied physics majors will be able to:

• demonstrate competency in applying the basic laws of physics in a focused area of physics and a related applied field;
• solve complex, real-world problems using the principles of physics; and
• demonstrate competency in using theoretical tools, basic instrumentation, and in analyzing the data obtained.

Requirements

The Bachelor of Science with a major in applied physics requires a minimum of 120 s.h., including at least 59-87 s.h. of work for the major. Total credit required for the major depends on a student’s choice of concentration. Students must maintain a g.p.a. of at least 2.00 in all courses for the major and in all UI courses for the major. They also must complete the College of Liberal Arts and Sciences GE CLAS Core.

The major in applied physics is intended primarily for students interested in a broad program of study in physics combined with a significant concentration of courses in a field that has immediate application to high-technology industry. The degree provides a foundation for a wide range of employment opportunities in high-technology industries, including research and development, product design and testing, sales, and quality control. It also is designed to include exposure to physics sufficient to allow students to continue with graduate studies in either physics or astronomy.

An essential component of each concentration is successful completion of a related one-semester internship or practicum experience in a research laboratory (an applied physics research report is required for the latter option). Well-prepared students will be able to complete the degree in four years. Students should work closely with their advisors on a graduation plan.

All applied physics students complete a common set of courses that includes calculus, linear algebra, physics, and an experiential learning course. They also complete the courses required for their chosen concentration. The department encourages students to take additional coursework; advisors can suggest electives that will enrich programs and help students prepare for graduate work.

Students who want to earn a double major in applied physics and astronomy must choose their coursework carefully; see “Double Major in Applied Physics and Astronomy” below.

Students who earn a B.S. in applied physics may not earn a B.A. or B.S. in physics.

The B.S. with a major in applied physics requires the following courses. Many upper-level physics courses have prerequisites; students should consult their advisors when choosing courses numbered 3000 or above.

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Common Requirements</td>
<td>37-41</td>
</tr>
<tr>
<td></td>
<td>Concentration Area Courses</td>
<td>22-46</td>
</tr>
<tr>
<td></td>
<td><strong>Total Hours</strong></td>
<td><strong>59-87</strong></td>
</tr>
</tbody>
</table>

Common Requirements

Students in all concentrations must successfully complete the following courses or their equivalents.

Mathematics

<table>
<thead>
<tr>
<th>Code</th>
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<th>Hours</th>
</tr>
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<tbody>
<tr>
<td>All of these:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>MATH:1850 &amp; MATH:1860</td>
<td>Calculus I-II</td>
<td>8</td>
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<tr>
<td>MATH:2700</td>
<td>Introduction to Linear Algebra</td>
<td>4</td>
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<tr>
<td>MATH:2850</td>
<td>Calculus III</td>
<td>4</td>
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Physics

<table>
<thead>
<tr>
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</thead>
<tbody>
<tr>
<td>One of these sequences:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>PHYS:1611- PHYS:1612</td>
<td>Introductory Physics I-II</td>
<td>8</td>
</tr>
<tr>
<td>PHYS:1701 &amp; PHYS:1702 &amp; PHYS:2703</td>
<td>Physics I-II - Physics III (strongly preferred)</td>
<td>12</td>
</tr>
<tr>
<td>All of these:</td>
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<td></td>
</tr>
<tr>
<td>PHYS:2704</td>
<td>Physics IV</td>
<td>4</td>
</tr>
<tr>
<td>PHYS:3710</td>
<td>Intermediate Mechanics</td>
<td>3</td>
</tr>
<tr>
<td>PHYS:3741</td>
<td>Introduction to Quantum Mechanics I</td>
<td>3</td>
</tr>
<tr>
<td>PHYS:3811</td>
<td>Electricity and Magnetism I</td>
<td>3</td>
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</tbody>
</table>

Experiential Learning

<table>
<thead>
<tr>
<th>Code</th>
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<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>One of these:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>A one-semester industrial internship (requires a research report)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>A one-semester practicum in a research laboratory (requires a research report)</td>
<td></td>
<td></td>
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</table>

Concentrations

Students select one of the four concentration areas below.

Computer Science Concentration

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>One of these:</td>
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<td></td>
</tr>
<tr>
<td>PHYS:3730</td>
<td>Statistical Physics</td>
<td>3</td>
</tr>
<tr>
<td>PHYS:3756</td>
<td>Intermediate Laboratory</td>
<td>3</td>
</tr>
<tr>
<td>PHYS:3812</td>
<td>Electricity and Magnetism II</td>
<td>3</td>
</tr>
<tr>
<td>PHYS:3850</td>
<td>Electronics</td>
<td>4</td>
</tr>
<tr>
<td>CS:1210</td>
<td>Computer Science I: Fundamentals</td>
<td>4</td>
</tr>
<tr>
<td>CS:2210</td>
<td>Discrete Structures</td>
<td>3</td>
</tr>
<tr>
<td>CS:2230</td>
<td>Computer Science II: Data Structures</td>
<td>4</td>
</tr>
<tr>
<td>One additional computer science course numbered 3000 or above</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Two of these:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CS:2630</td>
<td>Computer Organization</td>
<td>4</td>
</tr>
<tr>
<td>CS:2820</td>
<td>Introduction to Software Development</td>
<td>4</td>
</tr>
<tr>
<td>CS:3330</td>
<td>Algorithms</td>
<td>3</td>
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</tbody>
</table>
**Optics Concentration**

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Hours</th>
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<tbody>
<tr>
<td>All of these:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>PHYS:3730</td>
<td>Statistical Physics</td>
<td>3</td>
</tr>
<tr>
<td>PHYS:3756</td>
<td>Intermediate Laboratory</td>
<td>3</td>
</tr>
<tr>
<td>PHYS:3812</td>
<td>Electricity and Magnetism II</td>
<td>3</td>
</tr>
<tr>
<td>PHYS:3850</td>
<td>Electronics</td>
<td>4</td>
</tr>
<tr>
<td>PHYS:4720</td>
<td>Introductory Optics</td>
<td>3</td>
</tr>
<tr>
<td>Two of these:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>PHYS:4726</td>
<td>Introductory Optics</td>
<td>3</td>
</tr>
<tr>
<td>PHYS:4728</td>
<td>Introductory Solid State Physics</td>
<td>3</td>
</tr>
<tr>
<td>PHYS:4820</td>
<td>Optical Signal Processing</td>
<td>3</td>
</tr>
</tbody>
</table>

**Solid-State Electronics Concentration**

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>All of these:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>PHYS:3730</td>
<td>Statistical Physics</td>
<td>3</td>
</tr>
<tr>
<td>PHYS:4728</td>
<td>Introductory Solid State Physics</td>
<td>3</td>
</tr>
<tr>
<td>ECE:2400</td>
<td>Linear Systems I</td>
<td>3</td>
</tr>
<tr>
<td>ECE:2410</td>
<td>Principles of Electronic Instrumentation</td>
<td>4</td>
</tr>
<tr>
<td>ECE:3320</td>
<td>Introduction to Digital Design</td>
<td>3</td>
</tr>
<tr>
<td>ECE:3410</td>
<td>Electronic Circuits</td>
<td>4</td>
</tr>
<tr>
<td>ENGR:1300</td>
<td>Introduction to Engineering Computing</td>
<td>3</td>
</tr>
<tr>
<td>ENGR:2120</td>
<td>Electrical Circuits</td>
<td>3</td>
</tr>
<tr>
<td>ENGR:2730</td>
<td>Computers in Engineering</td>
<td>3</td>
</tr>
<tr>
<td>One of these:</td>
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<td></td>
</tr>
<tr>
<td>PHYS:3742</td>
<td>Introduction to Quantum Mechanics II</td>
<td>3</td>
</tr>
<tr>
<td>PHYS:3812</td>
<td>Electricity and Magnetism II</td>
<td>3</td>
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</table>

**Medical Physics Concentration**

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>All of these:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>PHYS:3756</td>
<td>Intermediate Laboratory</td>
<td>3</td>
</tr>
<tr>
<td>PHYS:3850</td>
<td>Electronics</td>
<td>4</td>
</tr>
<tr>
<td>BIOL:1411 &amp; BIOL:1412</td>
<td>Foundations of Biology - Diversity of Form and Function</td>
<td>8</td>
</tr>
<tr>
<td>CHEM:1110 &amp; CHEM:1120</td>
<td>Principles of Chemistry I-II</td>
<td>8</td>
</tr>
<tr>
<td>CHEM:2210 &amp; CHEM:2220</td>
<td>Organic Chemistry I-II</td>
<td>6</td>
</tr>
<tr>
<td>CHEM:2410</td>
<td>Organic Chemistry Laboratory</td>
<td>3</td>
</tr>
<tr>
<td>Two additional biology courses numbered 2000 or above</td>
<td>6-8</td>
<td></td>
</tr>
<tr>
<td>One of these:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>BIOS:4120</td>
<td>Introduction to Biostatistics</td>
<td>3</td>
</tr>
<tr>
<td>STAT:3510</td>
<td>Biostatistics</td>
<td>3</td>
</tr>
<tr>
<td>One of these:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>PHYS:3730</td>
<td>Statistical Physics</td>
<td>3</td>
</tr>
<tr>
<td>PHYS:3742</td>
<td>Introduction to Quantum Mechanics II</td>
<td>3</td>
</tr>
</tbody>
</table>

Undergraduate majors who plan to pursue graduate study are advised to go as far as they can beyond the minimum requirements listed above, including further work in mathematics. In planning this work, they should be guided by the College of Liberal Arts and Sciences maximum hours rule: Students earning a B.S. may apply a maximum of 56 s.h. earned in one department to the minimum 120 s.h. required for graduation, whether or not the coursework is accepted toward requirements for the major. Students who earn more than 56 s.h. from one department may use the additional semester hours to satisfy requirements for the major (if the department accepts them), and the grades they earn become part of their grade-point average, but they cannot apply the additional semester hours to the minimum 120 s.h. required for graduation.

**Double Major in Applied Physics and Astronomy**

Students working toward a Bachelor of Science with a double major in applied physics and in astronomy must complete all requirements for both majors and must earn a minimum of 56 s.h. outside the Department of Physics and Astronomy in order to graduate. Students interested in earning a double major should consult with their advisors. See Requirements for a Bachelor’s Degree on the College of Liberal Arts and Sciences website.

**Combined Programs**

### B.S./M.S. in Business Analytics

(Career Subprogram)

Students majoring in applied physics who are interested in earning a master’s degree in business analytics with a career subprogram may apply to the combined B.S./M.S. program offered by the College of Liberal Arts and Sciences and the Tippie College of Business. The program enables students to begin the study of business analytics before they complete their bachelor’s degree. Students are able to complete both degrees in five years rather than six.

Separate application to each degree program is required. Applicants must be admitted to both programs before they may be admitted to the combined degree program. For information about the business analytics program, see the M.S. in business analytics (career) in the Tippie College of Business section of the Catalog.

### B.S./M.S. in Finance

Students majoring in applied physics who are interested in earning a master’s degree in finance may apply to the combined B.S./M.S. program offered by the College of Liberal Arts and Sciences and the Tippie College of Business. The program enables students to begin the study of finance before they complete their bachelor’s degree. Students are able to complete both degrees in five years rather than six.

Separate application to each degree program is required. Applicants must be admitted to both programs before they may be admitted to the combined degree program. For
information about the finance program, see the M.S. in finance (Tippie College of Business) section of the Catalog.

Honors

Honors in the Major

Students majoring in applied physics have the opportunity to graduate with honors in their major. Departmental honors students must maintain a University of Iowa g.p.a. of at least 3.33. To graduate with honors in the major, they must earn 6-8 s.h. in PHYS:4999 Undergraduate Research during their junior and senior years and conduct an investigation under the guidance of a faculty member. They must present a written report of their research (honors thesis) and describe their research results at a departmental seminar.

University of Honors Program

In addition to honors in the major, students have opportunities for honors study and activities through membership in the University of Iowa Honors Program. Visit Honors at Iowa to learn about the University's honors program. Membership in the UI Honors Program is not required to earn honors in the applied physics major.

Career Advancement

Applied physics graduates have mastered skills that are readily transferable to a number of fields. They might choose to work in research, engineering, software development, teaching, finance, biomedical research, or consulting.

About 70 percent of physics and astronomy graduates go on to graduate school. With help from the department’s in-house recruiting office, they win acceptance to some of the best graduate programs in the country.

The Pomerantz Career Center offers multiple resources to help students find internships and jobs.

Academic Plans

Four-Year Graduation Plan

The following checkpoints list the minimum requirements students must complete by certain semesters in order to stay on the University’s Four-Year Graduation Plan. Courses in the major are those required to complete the major; they may be offered by departments other than the major department.

Before the third semester begins: calculus II and physics II.

Before the fifth semester begins: physics III-IV, introduction to linear algebra, calculus III, one more course in the major, and up to four courses in another science or engineering department.

Before the seventh semester begins: two to four more courses in the major, up to three other science or engineering courses, and at least 90 s.h. earned toward the degree.

Before the eighth semester begins: two or three more courses in the major or other science or engineering courses and all or part of an academic year research experience or a summer research experience or internship as approved by the applied physics coordinator.

During the eighth semester: enrollment in all remaining coursework in the major, all remaining CLAS Core courses, and a sufficient number of semester hours to graduate.

Sample Plan of Study

Sample plans represent one way to complete a program of study. Actual course selection and sequence will vary and should be discussed with an academic advisor. For additional sample plans, see MyUI.

Applied Physics, B.S.

Medical Physics Concentration

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>PHYS:1701</td>
<td>Physics I ¹</td>
<td>4</td>
</tr>
<tr>
<td>CHEM:1110</td>
<td>Principles of Chemistry I ¹, b</td>
<td>4</td>
</tr>
<tr>
<td>MATH:1850</td>
<td>Calculus I ¹, c</td>
<td>4</td>
</tr>
<tr>
<td>ENGL:1200</td>
<td>The Interpretation of Literature or Rhetoric</td>
<td>3 - 4</td>
</tr>
<tr>
<td>or RHET:1030</td>
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<td></td>
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<tr>
<td>CSI:1600</td>
<td>Success at Iowa</td>
<td>2</td>
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<tr>
<td></td>
<td></td>
<td>17-18</td>
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<tr>
<td>PHYS:1702</td>
<td>Physics II</td>
<td>4</td>
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<tr>
<td>CHEM:1120</td>
<td>Principles of Chemistry II</td>
<td>4</td>
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<td>MATH:1860</td>
<td>Calculus II</td>
<td>4</td>
</tr>
<tr>
<td>RHET:1030</td>
<td>Rhetoric or The Interpretation of Literature</td>
<td>3 - 4</td>
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<tr>
<td>or ENGL:1200</td>
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<tr>
<td></td>
<td></td>
<td>15-16</td>
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<tr>
<td>PHYS:2703</td>
<td>Physics III</td>
<td>4</td>
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<tr>
<td>BIOL:1411</td>
<td>Foundations of Biology</td>
<td>4</td>
</tr>
<tr>
<td>MATH:2700</td>
<td>Introduction to Linear Algebra</td>
<td>4</td>
</tr>
<tr>
<td>GE CLAS Core: World Languages First Level</td>
<td>Proficiency or elective course ²</td>
<td>4 - 5</td>
</tr>
<tr>
<td></td>
<td></td>
<td>16-17</td>
</tr>
<tr>
<td>PHYS:2704</td>
<td>Physics IV</td>
<td>3 - 4</td>
</tr>
<tr>
<td>BIOL:1412</td>
<td>Diversity of Form and Function</td>
<td>4</td>
</tr>
<tr>
<td>MATH:2850</td>
<td>Calculus III</td>
<td>4</td>
</tr>
<tr>
<td>GE CLAS Core: World Languages Second Level</td>
<td>Proficiency or elective course ²</td>
<td>4 - 5</td>
</tr>
<tr>
<td></td>
<td></td>
<td>15-17</td>
</tr>
<tr>
<td>PHYS:3741</td>
<td>Introduction to Quantum Mechanics I</td>
<td>3</td>
</tr>
<tr>
<td>PHYS:3811</td>
<td>Electricity and Magnetism I</td>
<td>3</td>
</tr>
<tr>
<td>CHEM:2210</td>
<td>Organic Chemistry I</td>
<td>3</td>
</tr>
<tr>
<td>GE CLAS Core: Values and Culture ³</td>
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<td>3</td>
</tr>
<tr>
<td>GE CLAS Core: World Languages Second Level</td>
<td>Proficiency or elective course ³</td>
<td>4 - 5</td>
</tr>
<tr>
<td></td>
<td></td>
<td>16-17</td>
</tr>
<tr>
<td>PHYS:3710</td>
<td>Intermediate Mechanics</td>
<td>3</td>
</tr>
<tr>
<td>PHYS:3850</td>
<td>Electronics</td>
<td>4</td>
</tr>
<tr>
<td>Course Code</td>
<td>Course Name</td>
<td>Hours</td>
</tr>
<tr>
<td>-------------</td>
<td>-------------------------------------------------------</td>
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</tr>
<tr>
<td>CHEM:2220</td>
<td>Organic Chemistry II</td>
<td>3</td>
</tr>
<tr>
<td>GE CLAS Core: Diversity and Inclusion</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>GE CLAS Core: World Languages Fourth Level</td>
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<tr>
<td>Proficiency  d</td>
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<td></td>
</tr>
<tr>
<td><strong>Hours</strong></td>
<td><strong>17-18</strong></td>
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**Summer**

Internship: industrial internship or research practicum

<table>
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<tr>
<th>Hours</th>
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</table>

**Fourth Year**

**Fall**

<table>
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<th>Course Name</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>PHYS:3756</td>
<td>Intermediate Laboratory</td>
<td>3</td>
</tr>
<tr>
<td>Major: biology course numbered 2000 or above f</td>
<td>3 - 4</td>
<td></td>
</tr>
<tr>
<td>CHEM:2410</td>
<td>Organic Chemistry Laboratory</td>
<td>3</td>
</tr>
<tr>
<td>GE CLAS Core: Literary, Visual, and Performing Arts</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>GE CLAS Core: Historical Perspectives</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td><strong>Hours</strong></td>
<td><strong>15-16</strong></td>
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</table>

**Spring**

<table>
<thead>
<tr>
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<th>Course Name</th>
<th>Hours</th>
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</thead>
<tbody>
<tr>
<td>Major: biology course numbered 2000 or above f</td>
<td>3 - 4</td>
<td></td>
</tr>
<tr>
<td>GE CLAS Core: Social Sciences e</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>STAT:3510</td>
<td>Biostatistics or Introduction to Biostatistics</td>
<td>3</td>
</tr>
<tr>
<td>GE CLAS Core: International and Global Issues</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>Major: medical concentration select one course</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>Degree Application: apply on MyUI before deadline</td>
<td></td>
<td></td>
</tr>
<tr>
<td>(typically in February for spring, September for fall)</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Hours</strong></td>
<td><strong>15-16</strong></td>
<td></td>
</tr>
</tbody>
</table>

| Total Hours | 129-138 |

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a Fulfills a major requirement and may fulfill a GE requirement.
b Enrollment in chemistry courses requires completion of a placement exam.
c Enrollment in math courses requires completion of a placement exam.
d Students who have completed four years of a single language in high school have satisfied the GE CLAS Core World Languages requirement. Enrollment in world languages courses requires a placement exam, unless enrolling in a first-semester-level course.
e GE CLAS Core courses may be completed in any order unless used as a prerequisite for another course. Students should consult with an advisor about the best sequencing of courses.
f Students in this concentration are required to complete two biology courses (BIOL) numbered 2000 or above (6-8 s.h.)
g Choose from PHYS:3730, PHYS:3742, PHYS:3812, PHYS:4750, or PHYS:4905.
h Please see Academic Calendar, Office of the Registrar website for current degree application deadlines. Students should apply for a degree for the session in which all requirements will be met. For any questions on appropriate timing, contact your academic advisor or Graduation Services.