DOCTOR OF PHILOSOPHY (PHD) DEGREE IN THE FIELD OF APPLIED PHYSICS

Program Learning Outcomes for the MS and PhD Degrees in the field of Applied Physics

Upon completing the MS and PhD degrees in the field of Applied Physics, students will be able to:

1. Acquire and demonstrate advanced knowledge in the foundational applications of physics including familiarity with past and current scientific literature in their chosen specialization.
2. Develop the ability to conduct independent applied physics research including the aptitude to identify, formulate, and overcome challenging scientific and engineering problems in this endeavor.
3. Make an original and significant technical contribution in their chosen specialization area.

Requirements for the MS and PhD Degrees in the field of Applied Physics

The Applied Physics Program (APP) offers a PhD degree. For general university requirements, please see Doctoral Degrees (ga.rice.edu/graduate-students/academic-policies-procedures/regulations-procedures-doctoral-degrees). The MS degree is a thesis master's degree. For general university requirements, please see Thesis Master's Degrees (ga.rice.edu/graduate-students/academic-policies-procedures/regulations-procedures-thesis-masters-degrees). For additional requirements, regulations, and procedures for all graduate programs, please see All Graduate Students (ga.rice.edu/graduate-students/academic-policies-procedures/regulations-procedures-thesis-masters-degrees).

The program does not offer a stand-alone thesis MS degree, although students admitted to the program are required to earn the MS within the program before proceeding to the PhD. For each degree, the student must fulfill the university requirements set forth in the General Announcements under which he/she entered. The semester hour requirements may be fulfilled both by classroom hours and research hours. A total of nine one-semester, 3-credit hour per course minimum, graduate level courses is required for the master's degree in applied physics, ordinarily a requirement for advancement to candidacy in the PhD program. Four of these are core courses required of all students, and five are elective courses chosen according to individual research goals. The Applied Physics Curriculum and Admissions Committee (APCAC) may waive some course requirements for students who demonstrate a thorough knowledge of material in one or more core/elective course(s). Full requirements are available online at https://appliedphysics.rice.edu/.

By the end of the third year in the program, all APP students should have completed the university requirements for the master's degree, fulfilled the course requirements of the APP, and defended a master's thesis in a public oral examination by a committee approved by the APCAC. The examination covers the work reported in the thesis as well as the entire field in which the student intends to work toward their PhD. The examining committee votes separately on awarding the master's degree and on admission to candidacy for the PhD. The student may be required to fulfill teaching/grading requirements set by the host department. Fulfillment of all university degree requirements and successful defense of a PhD thesis in a public examination by an APCAC-approved committee is necessary for the PhD.

Summary

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Credit Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Total Credit Hours Required for the PhD in the field of Applied Physics</td>
<td>90</td>
</tr>
</tbody>
</table>

Degree Requirements

<table>
<thead>
<tr>
<th>Core Requirements</th>
<th>Title</th>
<th>Credit Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>Select 4 courses from the following, depending on area of research (see Areas of Specialization below)</td>
<td>12</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Credit Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>BIOE 502 / SSPB 501</td>
<td>PHYSICAL BIOLOGY</td>
<td>12</td>
</tr>
<tr>
<td>CHBE 501</td>
<td>FLUID MECHANICS AND TRANSPORT PROCESSES</td>
<td>3</td>
</tr>
<tr>
<td>PHYS 515</td>
<td>CLASSICAL DYNAMICS</td>
<td>3</td>
</tr>
<tr>
<td>PHYS 516</td>
<td>MATHEMATICAL METHODS</td>
<td>3</td>
</tr>
<tr>
<td>PHYS 521</td>
<td>QUANTUM MECHANICS I</td>
<td>3</td>
</tr>
<tr>
<td>or CHEM 530</td>
<td>QUANTUM CHEMISTRY</td>
<td>3</td>
</tr>
<tr>
<td>PHYS 522</td>
<td>QUANTUM MECHANICS II</td>
<td>3</td>
</tr>
<tr>
<td>or CHEM 531</td>
<td>ADVANCED QUANTUM CHEMISTRY</td>
<td>3</td>
</tr>
<tr>
<td>PHYS 526</td>
<td>STATISTICAL PHYSICS</td>
<td>3</td>
</tr>
<tr>
<td>or CHEM 520</td>
<td>CLASSICAL AND STATISTICAL THERMODYNAMICS</td>
<td>3</td>
</tr>
<tr>
<td>PHYS 532</td>
<td>CLASSICAL ELECTRODYNAMICS</td>
<td>3</td>
</tr>
<tr>
<td>PHYS 563 / ELEC 563</td>
<td>INTRODUCTION TO SOLID STATE PHYSICS</td>
<td>3</td>
</tr>
<tr>
<td>CHBE 602</td>
<td>PHYSICO-CHEMICAL HYDRODYNAMICS</td>
<td>3</td>
</tr>
<tr>
<td>CHBE 611</td>
<td>ADVANCED TOPICS-THERMODYNAMICS</td>
<td>3</td>
</tr>
</tbody>
</table>

Elective Requirements

Select 5 elective courses (See Areas of Specialization suggested courses below) | 15 |

Additional Requirements as Defined by Department | 63 |

Total Credit Hours | 90 |

Footnotes and Additional Information

1 Any course taken beyond the four-course requirement for the Applied Physics Core Requirements can be applied towards the Applied Physics Electives requirement.

2 It is assumed that the student has an adequate background in classical mechanics, electrostatics, and statistical and thermal physics. This background is determined from interviews or exams given to entering students by the APCAC or the host department.

3 A full list of elective courses can be found on the Applied Physics website (http://rqi.rice.edu/curriculum). No courses may be used for both core and elective courses. Due to overlap of curricula, only one from each of the pairs PHYS 521/CHEM 530, and PHYS 526/CHEM 520 may be used for the nine required courses.
Course Lists to Satisfy Requirements
Areas of Specialization
Some examples of areas of specialization that students may choose are listed below. The lists are only suggested lists and are by no means a full list of possible courses for the area of specialization.

### Applied Biological and Soft Matter Physics

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Credit Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>BIOE 502 / SSPB 501</td>
<td>PHYSICAL BIOLOGY</td>
<td>3</td>
</tr>
<tr>
<td>CHBE 501</td>
<td>FLUID MECHANICS AND TRANSPORT PROCESSES</td>
<td>3</td>
</tr>
<tr>
<td>PHYS 515</td>
<td>CLASSICAL DYNAMICS</td>
<td>3</td>
</tr>
</tbody>
</table>

**Suggested Core Courses**

**Suggested Elective Courses**

### Applied Chemical Physics

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Credit Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>CHBE 501</td>
<td>FLUID MECHANICS AND TRANSPORT PROCESSES</td>
<td>3</td>
</tr>
<tr>
<td>CHEM 530</td>
<td>QUANTUM CHEMISTRY</td>
<td>3</td>
</tr>
<tr>
<td>PHYS 526</td>
<td>STATISTICAL PHYSICS</td>
<td>3</td>
</tr>
<tr>
<td>PHYS 563 / ELEC 563</td>
<td>INTRODUCTION TO SOLID STATE PHYSICS</td>
<td>3</td>
</tr>
</tbody>
</table>

**Suggested Core Courses**

**Suggested Elective Courses**

### Applied Mechanics

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Credit Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>CHBE 501</td>
<td>FLUID MECHANICS AND TRANSPORT PROCESSES</td>
<td>3</td>
</tr>
<tr>
<td>PHYS 515</td>
<td>CLASSICAL DYNAMICS</td>
<td>3</td>
</tr>
<tr>
<td>PHYS 516</td>
<td>MATHEMATICAL METHODS</td>
<td>3</td>
</tr>
</tbody>
</table>

**Suggested Core Courses**

**Suggested Elective Courses**

### Applied Optics and Photonics

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Credit Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>PHYS 521</td>
<td>QUANTUM MECHANICS I</td>
<td>3</td>
</tr>
<tr>
<td>PHYS 526</td>
<td>STATISTICAL PHYSICS</td>
<td>3</td>
</tr>
</tbody>
</table>

**Suggested Core Courses**
### Suggested Elective Courses

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Credit Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>BIOE 587</td>
<td>OPTICAL IMAGING AND NANOBIOPHOTONICS</td>
<td>3</td>
</tr>
<tr>
<td>ELEC 562</td>
<td>OPTOELECTRONIC DEVICES</td>
<td>3</td>
</tr>
<tr>
<td>ELEC 568</td>
<td>LASER SPECTROSCOPY</td>
<td>3</td>
</tr>
<tr>
<td>ELEC 569 / PHYS 569</td>
<td>ULTRAFAST OPTICAL PHENOMENA</td>
<td>3</td>
</tr>
<tr>
<td>ELEC 571</td>
<td>IMAGING AT THE NANOSCALE</td>
<td>3</td>
</tr>
<tr>
<td>ELEC 603</td>
<td>TOPICS IN NANOPHOTONICS</td>
<td>2</td>
</tr>
<tr>
<td>PHYS 571</td>
<td>MODERN ATOMIC PHYSICS</td>
<td>3</td>
</tr>
</tbody>
</table>

### Applied Physical Electronics

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Credit Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>PHYS 516</td>
<td>MATHEMATICAL METHODS</td>
<td>3</td>
</tr>
<tr>
<td>PHYS 521</td>
<td>QUANTUM MECHANICS I</td>
<td>3</td>
</tr>
<tr>
<td>PHYS 532</td>
<td>CLASSICAL ELECTRODYNAMICS</td>
<td>3</td>
</tr>
<tr>
<td>PHYS 563 / ELEC 563 I</td>
<td>INTRODUCTION TO SOLID STATE PHYSICS</td>
<td>3</td>
</tr>
</tbody>
</table>

### Suggested Elective Courses

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Credit Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>CHEM 511</td>
<td>SPECTRAL METHODS IN ORGANIC CHEMISTRY</td>
<td>3</td>
</tr>
<tr>
<td>ELEC 562</td>
<td>OPTOELECTRONIC DEVICES</td>
<td>3</td>
</tr>
<tr>
<td>ELEC 680 / BIOE 680</td>
<td>NANO-NEUROTECHNOLOGY</td>
<td>3</td>
</tr>
<tr>
<td>PHYS 522</td>
<td>QUANTUM MECHANICS II</td>
<td>3</td>
</tr>
<tr>
<td>PHYS 539</td>
<td>CHARACTERIZATION AND FABRICATION AT THE NANOSCALE</td>
<td>3</td>
</tr>
<tr>
<td>PHYS 567</td>
<td>QUANTUM MATERIALS</td>
<td>3</td>
</tr>
<tr>
<td>PHYS 663</td>
<td>CONDENSED MATTER THEORY: APPLICATIONS</td>
<td>3</td>
</tr>
</tbody>
</table>

### Policies for the PhD Degree in the field of Applied Physics

**Applied Physics Graduate Program Handbook**

The General Announcements (GA) is the official Rice curriculum. As an additional resource for students, Applied Physics publishes a graduate program handbook, which can be found here: [https://gradhandbooks.rice.edu/2019_20/Applied_Physics_Graduate_Handbook.pdf](https://gradhandbooks.rice.edu/2019_20/Applied_Physics_Graduate_Handbook.pdf)

### Additional Information

For additional information, please see the Applied Physics website: [https://appliedphysics.rice.edu/](https://appliedphysics.rice.edu/)

### Opportunities for the PhD Degree in the field of Applied Physics

Students who have completed the PhD program in Applied Physics establish careers in industry, government laboratories, and academia.