Applied Physics Graduate Program

The Rice Quantum Institute

Director of Applied Physics Graduate Program
D. Natelson

Participating Faculty

This program is open to faculty from physics and astronomy, chemistry, mechanical engineering and materials science, electrical and computer engineering, bioengineering, computational and applied mathematics, civil and environmental engineering, and chemical and biomolecular engineering.

Degrees offered: MS, PhD

A joint effort of both the natural sciences and the engineering divisions at Rice and overseen by the Rice Quantum Institute (RQI), the Applied Physics Program (APP) is administered by a committee composed of members from the participating departments mentioned above. The objective is to provide an interdisciplinary graduate education in the basic science that underlies important technology. The faculty believes that the experience obtained by performing research at the intellectually stimulating interface of physical science and engineering is particularly effective in producing graduates who succeed in careers based on new and emerging technologies.

Due to the interdisciplinary nature of the program, students can access virtually any of the research facilities in either the natural sciences or engineering schools of Rice University. The Applied Physics Committee (APC) urges prospective students to contact individual departments or RQI for detailed descriptions of research facilities and ongoing research projects. Within RQI alone, there are more than 100 separate projects, and there are numerous other research opportunities.

Degree requirements

The Applied Physics Program (APP) offers master's and PhD degrees. For each degree, the student must fulfill the university requirements set forth in the catalog under which he/she entered. The semester hour requirements may be fulfilled both by classroom hours and research hours. A total of 9 one-semester 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 5 are elective courses chosen according to individual research goals. The Applied Physics Committee (APC) may waive some course requirements for students who demonstrate a thorough knowledge of material in 1 or more core/elective course(s). Full requirements are available on line at rqi.rice.edu/academics/graduate/APPRequirements.pdf.

By the end of the 3rd year in the program, all APP students should have completed the university requirements for a 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 APC. The examination covers the work reported in the thesis as well as the entire field in which the student intends to work toward the PhD. The examining committee votes separately on awarding the master's degree and on admission to candidacy for the PhD. The student also must fulfill the teaching requirements set by the host department to achieve candidacy. Fulfillment of all university degree requirements and successful defense of a PhD thesis in a public examination by an APC-approved committee is necessary for the PhD.

Core courses

Quantum Mechanics I (PHYS 521 or CHEM 530)

Quantum Mechanics II or *Statistical Physics* (PHYS 522 or PHYS 526 or CHEM 531 or CHEM 520)

Classical Electrodynamics (PHYS 532)

Introduction to Solid State Physics I (PHYS 563/ELEC 563)

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 APC or the host department.

Elective courses (5 required)

BIOE 584 *Lasers in Medicine and Bioengineering*

BIOE 589/BIOS 589 *Computational Molecular Biophysics*

BIOE 610/PHYS 600 *Methods of Molecular Simulation/Advanced Topics in Physics*

CENG 630 *Chemical Engineering of Nanostructured Materials*

CHEM 495 *Transition Metal Chemistry*

CHEM 515 *Chemical Kinetics & Dynamics*

CHEM 520 *Classical and Statistical Thermodynamics*

CHEM 530 *Quantum Mechanics I/Quantum Chemistry*

CHEM 531 *Quantum Mechanics II/Quantum Chemistry*

CHEM 533 *Nanostructure & Nanotechnology*

CHEM 547 *Supramolecular Chemistry*

CHEM 611 *High Temperature and High Pressure Chemistry*

CHEM 630 *Molecular Spectroscopy and Group Theory*

ELEC 462 *Semiconductor Devices*

ELEC 463 *Lasers and Photonics*

ELEC 465 *Physical Electronics Practicum*

ELEC 560 *Linear/Nonlinear Fiber Optics*

ELEC 561 *Topics in Semiconductor Manufacturing*

ELEC 562 *Submicrometer & Nanometer Device Technology*

ELEC 564/PHYS 564 *Introduction to Solid State Physics II*

ELEC 565 *Topics in Quantum Semiconductor Nanostructures*

ELEC 567 *Applied Quantum Mechanics*

ELEC 568 *Laser Spectroscopy*

ELEC 569 *Ultrafast Optics*

ELEC 591 *Optics*

ELEC 592 *Topics in Quantum Optics (Nonlinear Optics)*

ELEC 603 *Topics in Micro- and Nanophotonics*

ELEC 691 *Seminar Topics in Nanotechnology*

MECH 679 *Applied Monte Carlo Analysis*

MECH 682 *Convective Heat Transfer*

MECH 683 *Radiative Heat Transfer I*

MECH 684 *Radiative Heat Transfer II*

MSCI 402 *Mechanical Properties of Materials*

MSCI 523 *Properties, Synthesis, and Design of Composite Materials*

MSCI 535 *Crystallography and Diffraction*

MSCI 597 *Polymer Synthesis, Soft Materials, and Nanocomposites*

MSCI 610 *Crystal Thermodynamics*

MSCI 614 *Principles of Nanoscale Mechanics*

MSCI 615 *Thin Film Failure Analysis, Measurement, and Reliability*

MSCI 623 *Analytical Spectroscopies*

MSCI 634 *Thermodynamics of Alloys*

MSCI 635 T*ransformation of Alloys*

MSCI 645/ELEC 645 *Thin Films*

MSCI 666 *Conduction Phenomena in Solids*

PHYS 480 *Introduction to Plasma Physics*

PHYS 512 *Ionospheric Physics*

PHYS 515 *Classical Dynamics*

PHYS 516 *Mathematical Methods*

PHYS 521 *Quantum Mechanics I*

PHYS 522 *Quantum Mechanics II*

PHYS 526 *Statistical Physics*

PHYS 533/534 *Nanostructures and Nanotechnology I/II*

PHYS 537/538 *Methods of Experimental Physics I/II*

PHYS 539 *Characterization and Fabrication at the Nanoscale*

PHYS 552 *Molecular Biophysics*

PHYS 564/ELEC 564 *Introduction to Solid State Physics II*

PHYS 566 *Surface Physics*

PHYS 568 *Quantum Phase Transitions*

PHYS 571 *Modern Atomic Physics and Quantum Optics*

PHYS 572 *Fundamentals of Quantum Optics*

PHYS/ELEC 605 *Computational Electrodynamics and Nanophotonics*

PHYS 663 *Condensed Matter Theory: Applications*

PHYS 664 *Condensed Matter Theory: Many-Body Formalism*

No courses may be used for both core and elective courses. Due to overlap of curricula, only 1 from each of the pairs PHYS 521/CHEM 530, PHYS 522/CHEM 531, and PHYS 526/CHEM 520 may be used for the 9 required courses.