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, 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 Transformation 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.